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Exchange Rate and Manufacturing Output in Nigeria: An Autoregressive Distributed Lag (ARDL) Model Approach

by

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Abstract

This study examined the effects of exchange rate on manufacturing output in Nigeria, using annual data covering the period of 1985-2022. Specifically, it ascertained the existence of short and long run relationship between exchange rate and manufacturing output growth in Nigeria; and determines the causal relations between exchange rate and manufacturing output growth in Nigeria. It employed Autoregressive Distributed Lag (ARDL) model to examine the long run relationship existing among the variables. The key findings of this study are: exchange rate has a positive and statistically significant relationship with manufacturing output in Nigeria both in the short and long run. The ARDL model long run bounds test shows the existence of a long run association among the variables under investigation, while the granger causality test indicates the existence of a unidirectional causality between exchange rate and manufacturing output in Nigeria with causality running from exchange rate to manufacturing output. The study recommends that there is need for relevant authorities to prioritize the design and implementation of a robust exchange rate management framework that not only guarantees exchange rate stability but also creates an enabling environment for the advancement of manufacturing activities. This will include and not limited to synergy among the central banks, manufacturing stakeholders and policy authorities, with a strong emphasis on instituting supportive measures that enhance manufacturing capabilities, boost productivity, and foster sustainable growth in agricultural output. Finally, regular monitoring and adaptive policy adjustments are imperatives to achieving the objectives of exchange rate stability and the promotion of a thriving manufacturing sector in Nigeria.

Key words: exchange rate, manufacturing output, ARDL model, error correction, co-integration, granger causality.

1. Introduction

The exchange rate is crucial to global economics, profoundly affecting national stability and growth. In Nigeria, with its evolving manufacturing sector and reliance on imports and exports, the exchange rate shapes economic development. Despite recent

growth, Nigerian manufacturing faces sustainability challenges, prominently including exchange rate fluctuations driven by global conditions, oil prices, and domestic policies. These fluctuations impact the cost of crucial imports and export competitiveness, creating a complex web of consequences for cost structures, production volumes, and overall economic performance (Bakare, 2011).

The Nigerian manufacturing sector significantly contributes to economic growth, employment, and GDP. However, it faces challenges, notably exchange rate instability, which causes substantial cost variations for imported raw materials, intermediate goods, and machinery. This volatility complicates budgeting, planning, and pricing for manufacturers and affects the competitiveness of Nigerian goods in international markets. A depreciating naira makes exports cheaper but raises import costs, while an appreciating naira lowers import costs but reduces export competitiveness, creating a dilemma for manufacturers aiming to expand globally. Furthermore, exchange rate instability significantly impacts the cost structures of Nigerian manufacturing firms, raising the cost of imported inputs and foreign debt servicing during naira depreciation and affecting profitability. This limits investment in technology, innovation, and expansion, hindering long-term growth. Such instability creates uncertainty, affecting investment decisions, production planning, and supply chain management, thus undermining the sector's contribution to economic growth and job creation. These challenges highlight the need to investigate the effects of exchange rates on the performance of Nigeria's manufacturing sector.

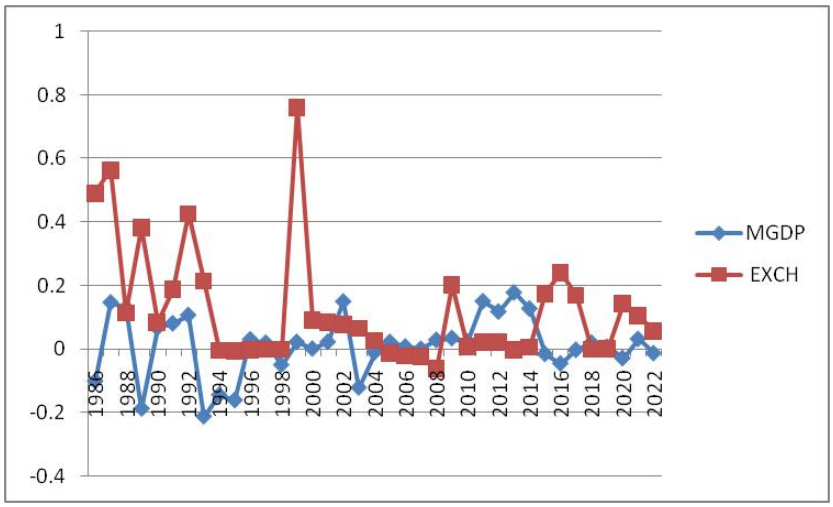

Figure 1: Trends of Exchange rate and Manufacturing Output in Nigeria
Source: World Bank, (2022)

Available data on the Nigerian economy revealed that exchange rate and manufacturing output fluctuated actively over the period of 1985 to 2022. Specifically, as seen in figure 1, exchange rate fluctuated actively over the period attending an all-time high peak point of 76% in 1999. Similarly, the growth rate of manufacturing output fluctuated actively and was negative as at 2023. It is interesting to note that while

exchange rates fluctuated actively, the growth rate of manufacturing output was negative for most of the year under review. This makes it difficult to understand the actual relationship between both variables. What is the relationship between exchange rate and manufacturing output in Nigeria? Is there any correlation between both variables in Nigeria? Specifically, the study seeks to: ascertain the existence of short and long run relationship between exchange rate and manufacturing output growth in Nigeria; and determine the causal relations between exchange rate and manufacturing output growth in Nigeria.

This study is crucial for policymakers, industry players, and the broader economy. It provides policymakers with insights into how exchange rates impact the manufacturing sector, guiding decisions on exchange rate policies, trade regulations, and industrial support programs. By analyzing the link between exchange rates and manufacturing output growth, the study aids in developing policies that promote sector growth, job creation, and economic stability in Nigeria. Additionally, it contributes to existing knowledge, serving as a reference for further research on exchange rates and manufacturing sectors in other emerging economies.

In pursuance of this goal, Ezie, Sulaiman, and Abdelrasaq (2016) analyzed the impact of exchange rates on the growth of manufacturing production in Nigeria between 1986 and 2014 by employing the Ordinary Least Square (OLS) regression technique. The study's findings demonstrated a significant relationship between exchange rates and Nigeria's manufacturing production. The paper recommends that currency rate management tactics be adjusted and given enough time to develop. Frequently and arbitrarily abandoning plans has a negative impact on the exchange rate and is obviously bad for a business that depends on imports.

Ugwu Okereke (2017) examined the effects of EXCH on the performance of manufacturing enterprises in Nigeria between 1986 and 2016 using the companies' profitability as a proxy for performance. The study employed multiple regression analysis as its estimation approach, which is grounded in the OLS methodology. The study's findings showed a significant and favorable relationship between EXCH fluctuations and the financial performance of Nigerian manufacturing firms. Similar to this, Otokini *et al*. (2018) looked into the performance of Nigerian industrial production in connection to EXCH deregulation between 1980 and 2016. The empirical findings indicate that EXCH has a non-significantly positive long-term effect on manufacturing industry production.

Tams-Alasia, Olokoyo, Okoye, and Ejemeyovwi (2018), investigated the effects of exchange rate deregulation on Nigeria's manufacturing production performance between 1980 and 2016. The exchange rate and manufacturing output were tested for a long-term relationship using the normalized cointegration technique, and the direction of causation was ascertained using the Granger causality test. The findings demonstrated that the exchange rate has a non-significantly positive, long-term effect on manufacturing output. On the other hand, the unidirectional causal relationship between exchange rate and industrial output was established using the pairwise Granger causality test. As per the research, the monetary authorities have an obligation to manage exchange rates, and as such, they should encourage export diversification projects to augment foreign cash

inflow and strive towards exchange rate stabilization by employing suitable monetary policy tools.

Irene, Obi, Ezenekwe, nd Ukeje (2020), examined the effects of exchange rate fluctuations on the manufacturing sector performance of Nigeria from 1981 to 2018. This study employed the vector autoregressive (VAR) model to evaluate the annual time series data. The VAR estimation yielded empirical results indicating a considerable reduction in Nigeria's total industrial output due to exchange rate volatility. Therefore, the study encouraged organizations to identify the types and measurement of currency rate risk to which they are exposed in order to build particular exchange rate risk exposure management procedures to limit its negative implications.

2. Materials and Methods

Model specification

The underlying theories of this study is the Solow-Swan growth because it explains long-term output growth through capital accumulation, labor force growth, and technological progress. In an attempt to determine the effects of exchange rate and manufacturing output growth in Nigeria., the study modifies the model of Jongbo (2014), which measure exchange using real exchange rate, and it is use as a proxy for the independent variable, while manufacturing sectors output is used as a proxy for the dependent variable. This model is presented in equation 1.

MGDP=f(EXCH)……..…….……...(1)

In line with our objectives, the above model was modified to capture other variables such as inflation rate, lending rate of interest rate, labour force, gross fixed capital formation, foreign griculturl output, electricity consumption and government expenditure on internal security, which are used to represent the independent variables, while manufacturing gross domestic product is used to measure manufacturing output, which represents the dependent variable. Thus, the model for this study is formulated below as follows:

MGDP = f(EXCH, INF, INT, LABFR, GFCF, AO, ELECT, GXSECR)……(2)

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The above model can be stated in the econometrics form as;

$MGDP_t = \alpha + \beta_1 EXCH_t + \beta_2 INF_t + \beta_3 INT_t + \beta_4 LABFR_t + \beta_5 GFCF_t + \beta_6 AO_t + \beta_7 ELECT_t + \beta_8 GXSECR_t + \mu_t$……..……(3)

Where:

MGDP = Manufacturing output (% of GDP)
EXCH = Nominal exchange rate
INF = Inflation rate (%)
INT = Lending rate (%)
LABFR = Labour participation rate
GFCF = Gross fixed capital formation (% of GDP)

AO = Agriculturl Output (% of GDP)
ELECT = Electricity Consumption rate
GXSECR = Government expenditure on internal security to GDP
α = Constant Parameter
$\beta_1, \beta_2, \beta_3, \beta_4$nd $\beta_5, \beta_6, \beta_7$, and β_8 = Represents the coefficient of the explanatory variables.
A priori expectations: The figure in parenthesis represents a priori expectation about the sign of the coefficient.

Techniques of Data Analysis

The techniques of data analysis adopted for the study were based on the specific objectives of the study.

To investigate the existence of long run relationship between exchange rate and manufacturing output growth in Nigeria, the study employs the ARDL model and Bounds test.

The ARDL Model

This test for co-integration was developed by Pesaran *et al.* (2001). ARDL co-integration Technique is preferable when dealing with variables that are integrated of mixed order between I(0) and I(1) and, robust when there is a single long run relationship between the underlying variables in a small sample. The ARDL method does not require the unit root test of stationarity, but to avoid ARDL model crash in the presence of variables that are stationary at second difference, the unit root test will be carried out to determine the number of unit root in series of co-integration. The long run relationship of the underlying variables is detected through the F-statistic (Wald test). In this approach, long run relationship of the series is said to be established when the F-statistic exceeds the critical value bond (Nkoro and Uko, 2016). To ascertain the cointegration between the variables, equation 3 will therefore be expressed in the general ARDL model developed by Peasran *et al,* (2001).

The generalize ARDL (p,q) model is specified below as;

$$Y_t = \alpha_{0j} + \sum_{i=1}^{p} \delta Y_{t-1} + \sum_{j=1}^{q} \beta X_{t-1} + \varepsilon_j \quad \text{……..……..(4)}$$

Where Y_t is a vector and the variable in X_t are allowed to be purely I(0) or I(1) or cointegrated; β and δ are coefficients; α_0 is the constant; j=1,...,k;p,q are optimal lag order; ε_j is the vector of the error terms.

ARDL Bound Test of Cointegration

Following the bound testing approach proposed by Pesaran *et al*., (2001), the bound test for equation 6 can be examined by the following model in equation 5.

$$\Delta MGDP_t = \propto_o + \alpha_1 MGDP_{t-1} + \alpha_2 EXCH_{t-1} + \alpha_3 INF_{t-1} + \alpha_4 INT_{t-1} + \alpha_5 \boldsymbol{LABFR}_{t-1} + \alpha_6 INV_{t-1} + \alpha_7 FDI_{t-1} + \alpha_8 GXSECR_{t-1} + \sum_{i=1}^{n} \beta_1 \Delta MGDP_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta EXCH_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta INF_{t-1} + \sum_{i=1}^{n} \beta_4 \Delta INT_{t-1} + \sum_{i=1}^{n} \beta_5 \Delta \boldsymbol{LABFR}_{t-1} + \sum_{i=1}^{n} \beta_6 \Delta INV_{t-1} + \sum_{i=1}^{n} \beta_7 \Delta FDI_{t-1} + \sum_{i=1}^{n} \beta_8 \Delta GXSECR_{t-1} + \mu_t \quad \text{…….(5)}$$

Where $\beta_0 - \beta_5$ are short-run elasticities, $\alpha_0 - \alpha_5$ are long-run elasticities, Δ is first difference, μ_t is white noise, β_0 is constant term.

If the computed F-test exceeds the upper critical bounds value, then H0 is rejected signaling co-integration amongst the different variables. If the computed F-value is below the critical bound, we fail to reject H0. But if the computed F-value falls within the critical value bound, the result is inconclusive. If these series are found to be co-integrated, an unrestricted error correction version of the corresponding ARDL model can be estimated to trace the short-term dynamics of the model. The reparametrized result gives the short-run dynamics and long run relationship of the underlying variables.

Error Correction Model

To examine the short run relationship between exchange rate and manufacturing output growth in Nigeria, the study employs the error correction model (ECM) model. The error correction model (ECM) is used to detect the short-term and long-term dynamics of a variable around its stationary equilibrium value. For an adjustment in the shortrun distortions, error correction requires that the sign of the coefficient of the residual is negative and statistically significant. The greater the absolute value of the ECM coefficient, the more quickly the model fine-tunes to achieve long-run equilibrium. Based on Equation (5), the shortrun connections may be stated as an ARDL ECM as follows:

$$\Delta MGDP_t = \propto_o + \alpha_1 MGDP_{t-1} + \alpha_2 EXCH_{t-1} + \alpha_3 INF_{t-1} + \alpha_4 INT_{t-1} + \alpha_5 \boldsymbol{LABFR}_{t-1} + \alpha_6 INV_{t-1} + \alpha_7 FDI_{t-1} + \alpha_8 GXSECR_{t-1} + \sum_{i=1}^{n} \beta_1 \Delta MGDP_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta EXCH_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta INF_{t-1} + \sum_{i=1}^{n} \beta_4 \Delta INT_{t-1} + \sum_{i=1}^{n} \beta_5 \Delta \boldsymbol{LABFR}_{t-1} + \sum_{i=1}^{n} \beta_6 \Delta INV_{t-1} + \sum_{i=1}^{n} \beta_7 \Delta FDI_{t-1} + \sum_{i=1}^{n} \beta_8 \Delta GXSECR_{t-1} + \lambda ECMt - 1 + \mu_t \quad \text{.....….(6)}$$

Where $\beta_0 - \beta_8$ are short-run elasticities, $\alpha_0 - \alpha_8$ are long-run elasticities, ECM_{t-1} is one lag of error correction term, λ is the speed of adjustment parameter with a negative sign, Δ is first difference, μ_t is white noise, β_0 is constant term.

To examine the causal relationship between exchange rate and manufacturing output growth in Nigeria, the study employed the Angel Granger Causality test.

Granger Causality Model

Objective 2 was analyzed using the Granger causality test to investigate the nature and direction of causality between exchange rate fluctuations and manufacturing

output in Nigeria. The grandeur causality test is a statistical hypothesis test which can be used to determine the causal relationship between economic variables. In other words it can be used to test or determine whether One Time series data is useful in forecasting another. As noted by Gujarati and Portal (2009). If X grandeur causes Y, then changes in x should proceed change in Y. Thus, in a regression of Y on other variables (including its past values), if the last values of X are included and it's significantly improved the predictions of Y, then you can be referred that X Granger causes Y, if Y Granger causes X, the same condition apply. In this study, the Granger causality test was carried out based on the following equations:

$$MGDP_t = \sum_{i=1}^{n} \alpha_i MGDP_{t-i} + \sum_{j=1}^{n} \beta_j EXCH_{t-j} + \mu_t \quad \text{.....(7)}$$

$$EXCH_t = \sum_{i=1}^{n} \delta_i EXCH_{t-i} + \sum_{j=1}^{n} \theta_j MGDP_{t-j} + \mu_t \quad \text{.....(8)}$$

Where:

$MGDP_t$ = Manufacturing output at time t

$MGDP_{t-1}$ = represents the lagged values of Manufacturing output

$EXCH_t$ = Nominal Exchange rate at time t

$EXCH_{t-1}$ = represents the lagged values of Nominal Exchange rate.

α_i nd θ_j = Represents the coefficients for the lagged values for Manufacturing output.

β_j nd δ_i = Represents the coefficients for the lagged values for Real Exchange rate.

μ_t = Represents the error term.

If the estimated coefficient of X are statistically significant while those of Y are not, then it can be established that X Granger causes Y, and the same goes for Y, if there is only one directional relationship, it can be called a unidirectional causality, but if non Granger courses each other, they can be said to be independent although related.

Diagnostic Tests

Unit Root Test

The unit root test is involved with the testing for the order of integration of each variable. A series is said to be integrated of order I(1) if it needs to be differenced once to become stationary. The same holds for an I(2) series which will need to be differenced twice to become stationary. Thus a stationary series is integrated of order zero I(0) (i.e, no differencing is necessary). The study will employ the Augmented Dickey-Fuller (ADF) and the Philips-Perron (PP) unit root tests to determine the order of integration of each series.

3. Results and Discussion

Descriptive Statistics

The study conducted descriptive statistics to provide a comprehensive summary of the data used and it helps in understanding its characteristics. Descriptive statistics is important because it provides a concise summary of the main features of a dataset; allows

for a preliminary exploration of the data; helps identify data errors, inconsistencies, or missing values and creates a visual representation of data making it easier to understand patterns, and distributions. This is shown in Table 1.

Table 1: Descriptive Statistics of all Variables

	MGDP	EXCH	INF	LABFR	GFCF	AO	INT	ELECT	GXSECR
Mean	0.013187	127.7568	0.191316	6.122456	0.153947	0.052066	18.12974	0.054605	0.006174
Median	0.021511	123.1950	0.130000	1.105428	0.145000	0.038668	17.57000	0.044223	0.005350
Maximum	0.178962	425.9800	0.730000	167.6667	0.370000	0.357236	31.65000	0.916795	0.014400
Minimum	-0.21228	0.890000	0.050000	0.047281	-0.14	-0.03291	9.430000	-0.53052	0.003500
Std. Dev.	0.094508	118.9993	0.172332	26.99504	0.117486	0.058469	4.321962	0.192194	0.002451
Jarque-Bera	1.550243	5.501444	26.60630	1900.235	0.742179	613.2121	5.272359	202.3235	29.71348
Probability	0.460648	0.263882	0.000002	0.000000	0.689982	0.000000	0.271634	0.000000	0.000000
Observations	38	38	38	38	38	38	38	38	38

Source: Author's Computation (Eviews 10)

Table 1 presents the descriptive statistics of the macroeconomic variables used in this study. We note that exchange rate (EXCH) has the highest mean, median and maximum value, while government expenditure on internal security (GXSECR) has the lowest absolute mean, median, standard deviation and minimum values, and the total number of observation in our series is 38.

Correlation Matrix

The study also conducted a correlation matrix which is a useful statistical analysis technique that provides insights into the relationships between multiple variables in a data set. Some of the reasons for running a correlation matrix are that it helps to identify the strength and direction of relationships between variables; assists in variable selection by identifying highly correlated variables and provides valuable insights for decision-making and policy formulation. This is depicted in Table 2.

Table 2: Descriptive Statistics of all Variables

	MGDP	EXCH	INF	LABFR	GFCF	AO	INT	ELECT	GXSECR
MGDP	1	0.875435	-0.46848	0.04729	0.39672	0.199746	-0.20895	0.217497	-0.04205
EXCH	0.875435	1	-0.31667	0.101108	0.10007	-0.13835	-0.3882	0.091915	-0.42976
INF	-0.46848	-0.31667	1	-0.11128	0.507131	-0.11269	0.416816	0.046467	0.061319
LABFR	0.04729	0.101108	-0.11128	1	-0.14818	-0.06548	-0.06292	-0.14389	-0.15406
GFCF	0.39672	0.10007	0.507131	-0.14818	1	-0.14211	0.26083	-0.13987	-0.17223
AO	0.199746	-0.13835	-0.11269	-0.06548	-0.14211	1	0.089154	-0.00215	0.396117
INT	-0.20895	-0.3882	0.416816	-0.06292	0.26083	0.089154	1	0.292316	-0.03285
ELECT	0.217497	0.091915	0.046467	-0.14389	-0.13987	-0.00215	0.292316	1	-0.08087
GXSECR	-0.04205	-0.42976	0.061319	-0.15406	-0.17223	0.396117	-0.03285	-0.08087	1

Source: Author's Computation (Eviews 10)

From Table 2, MGDP and EXCH have a correlation of 0.08, and since it is close to 1, we say that MGDP and EXCH have a strong positive correlation. It means that when EXCH increases (Devaluation of the naira), MGDP through increase in export, occasioned by increased in domestic productivity this conforms to our stated apriori expectation. Again, LABFR, GFCF and AO have a positive correlation with MGDP, with their coefficients as 0.05, 0.39 and -0.20 respectively. While INF, INT and GXSECR have a negative correlation with their coefficients as, -0.47, -0.20 and -0.04 respectively.

Unit Root Test Results

The variables in the models were subjected to unit root tests to determine the stationarity of the variables. The test was carried out at levels and first differences of the chosen variables and was performed assuming intercept and trend in ADF and PP specifications. The null hypothesis states that each of the variables has unit root, that is, each is non-stationary whereas the alternative hypothesis states that each variable does not have unit root, that is, each variable is stationary. The unit root test result is contained in Table 3.

Table 3: ADF and PP Unit Root Result

Variable	ADF t-Statistic	Order of Integration	Variable	PP t-Statistics	Order of Integration
MGDP	-3.3355	I(0)	MGDP	-3.3355	I(0)
EXCH	-2.8125	I(1)	EXCH	-2.8125	I(1)
INF	-2.7718	I(1)	INF	-2.7718	I(1)
INT	2.7698	I(1)	INT	2.7698	I(1)
LABFR	-4.0887	I(0)	LABFR	-4.0887	I(0)
GFCF	-5.3234	I(1)	GFCF	-5.3234	I(1)
AO	-6.5512	I(1)	AO	-6.5512	I(1)
GXSECR	-3.0951	I(1)	GXSECR	-3.0951	I(1)
ELECT	-3.4352	I(0)	ELECT	-3.4352	I(0)

Source: Author's Computation (Eviews 10)

The decision rule states that for variable to be stationary at any level, the absolute value of the t-statistic must be higher than the absolute critical value at 5% level of significance. From the result in Table 3, unit root for both (ADF) and (PP) test shows that all the variables used for this study were stationary at level and first difference. EXCH, INF, INT, GFCF**,** AO and GXSECR are all stationary at first difference, while MGDP, LABFR and ELECT are stationary at level. Based on the mixed order of integration between I(0) and I(1) among our variables, this justifies adoption of ARDL techniques to investigate the effect of inflation on economic growth in Nigeria.

Cointegration Test Results

Cointegration among time series variables suggests that series may behave in different way in the short run but that they will converge towards common equilibrium behaviour in the long run. The ARDL Bounds Test will be used to test for cointegration in the model. The cointegration test result is contained in Table 4.

Table 4: ARDL Bounds Test Result for Cointegration

Test Statistic	Value	Significant Level	Bound Lower I(0)	Bound Upper I(1)
F-Statistic	12.63			
k	8	10%	1.95	3.06
		5%	2.22	3.39
		1%	2.79	4.1

Source: Author's Computation (Eviews 10)

The co-integration test was conducted to ascertain the long run relationship among the variables after the data have been ascertained to be free from unit root. Table 4 shows the results of the cointegration analysis. It can be seen that the calculated F-statistics value of 12.63 exceeds the lower bound critical value of 2.22 and upper bound critical value of 3.39 at the 5% level of significance. This means the null hypothesis of no co-integration among the variables is rejected at the 5% level, hence there exist cointegration (a long run relationship) between the variables, and this shows that exchange rate and manufacturing sectors output growths (as well as other independent variables in the model) are bound by a long run relationship. Thus, the result is a sufficient condition for fitting ECM. The presence of a long run relationship between exchange rate and manufacturing sectors output growth in Nigeria. This implies that, if exchange rate on is effectively managed, it can serve as policy tool for boosting manufacturing sectors output in the long run.

ARDL Long Run Estimates

The first specific objective was to investigate the existence of long run relationship between exchange rate and manufacturing sectors output growth in Nigeria using ARDL model. The result is presented in the Table 5.

Table 5: ARDL Long Run Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH	0.220516	0.000197	2.620916	0.0179
INF	-0.572951	0.121534	-4.714329	0.0002
LABFR	0.201837	0.000666	2.756537	0.0135
GFCF	0.739792	0.169738	4.358425	0.0004
AO	0.654115	0.436403	3.790340	0.0015
INT	-0.016145	0.006257	2.580405	0.0195
GXSECR	-0.495425	8.245266	-3.698537	0.0018
ELECT	0.164220	0.075408	2.177749	0.0438

EC = MGDP - (0.2205*EXCH -0.5730*INF + 0.2018*LABFR + 0.7398*GFCF + 0.6541*AO -0.0161*LINT + 0.4954*GXSEC + 0.1642*ELECT)

Source: Author's Computation (Eviews 10)

The result of the long run coefficient in Table 5 shows a constant value of 16.42. This indicates a negative and significant relationship between the constant and manufacturing sectors output growth. The constant reflects the value of manufacturing sectors output growth when all explanatory variables are held constant. From the ARDL result presented in appendix III, the coefficient of multiple determination R^2 is 0.90, meaning that 90% of the changes in manufacturing sectors output growth is accounted for by the independent variables. The Prob (F-stat) value of (0.000000) shows that the overall relationship in the model is significant.

The ARDL regression result in Table 5 shows that exchange rate has a positive and significant effect on manufacturing sectors output growth in Nigeria, given its

coefficient s 0.22. This result conforms to the a priori expectation. Also, labor force, gross fixed capital formation, agricultural output and electricity consumption have positive and significantly influence on manufacturing output in Nigeria. While inflation, interest rate and government expenditure on internal security shows a negative and significant effect on manufacturing sectors output growth in Nigeria and it agrees with our a priori expectation. Investment in capital assets, foreign direct investment and government expenditure on economic services were found to have a positive and significant effect on manufacturing sectors output growth in Nigeria. This conforms to both theoretical and our stated a priori expectations.

Short Run ARDL Estimates

The second specific objective was to investigate the existence of short run relationship between exchange rate and manufacturing sectors output growth in Nigeria using ARDL model. The result is presented in the Table 6.

Table 6: Short run Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.20726	0.018565	-11.16360	0.0000
EXCH	-0.09767	0.000435	-1.762374	0.0960
INF	-0.60653	0.102713	-5.905069	0.0000
LABFR	0. 09892	0.000195	4.696540	0.0002
GFCF	0.17938	0.061983	2.894070	0.0101
AO	0.74831	0.167265	4.473845	0.0003
INT	-0.00336	0.002864	-1.172858	0.2572
GXSECR	-0.23187	5.075251	-4.77452	0.0002
ELECT	0.17384	0.08541	2.03522	0.0577
CointEq(-1)*	-0.90861	0.081853	-12.93301	0.0000

Source: Author's Computation (Eviews 10)

The error correction term CointEq(-1) in the model has the expected sign (i.e. negative) and significant at 5% probability level. The existence of long-run equilibrium among the time series in the exchange rate and manufacturing sectors growth equation is validated by this result. The slope coefficient of the error correction term in absolute terms (-0.91) represents the speed of adjustment and is consistent with the hypothesis of convergence towards the long-run equilibrium. The value indicates that it will take the speed of about one year and one month in the case of disequilibrium in the short-run to be corrected in the long-run if the right policy measures are put in place.

Pair-wise Granger Causality Test Result

The Granger causality test was used to determine the nature and direction of causality between exchange rate fluctuations and manufacturing output in Nigeria. Table 7 present the Granger causality result.

Table 7: Pair-wise Granger Causality Test Result

Null Hypothesis:	Obs	F-Statistic	Prob.
EXCH does not Granger Cause MGDP	36	0.28413	0.0546
MGDP does not Granger Cause EXCH		0.67491	0.5165
INF does not Granger Cause MGDP	36	4.92590	0.0139
MGDP does not Granger Cause INF		2.50862	0.0978
LABFR does not Granger Cause MGDP	36	0.12838	0.8800
MGDP does not Granger Cause LABFR		2.00472	0.1518
GFCF does not Granger Cause MGDP	36	2.74696	0.0797
MGDP does not Granger Cause GFCF		0.06041	0.9415
AO does not Granger Cause MGDP	36	3.14529	0.0571
MGDP does not Granger Cause AO		0.31883	0.7294
INT does not Granger Cause MGDP	36	2.80222	0.0761
MGDP does not Granger Cause INT		0.76160	0.4755
ELECT does not Granger Cause MGDP	36	0.82447	0.4479
MGDP does not Granger Cause ELECT		0.15563	0.8565
GXSECR does not Granger Cause MGDP	36	0.31908	0.7292
MGDP does not Granger Cause GXSECR		0.15163	0.8599

The result indicates a unidirectional causality between exchange rate and manufacturing output growth, with causality running from real exchange rate to manufacturing output growth. Also, inflation, agricultural output, interest rate and gross fixed capital formation, Granger cause manufacturing output in Nigeria, with causality running from inflation, agricultural output, interest rate and gross fixed capital formation to manufacturing output. While labor force, electricity consumption and government expenditure on internal security does not Granger causes manufacturing output and vice versa. Our Granger causality test revealed a unidirectional causality between exchange rate and manufacturing output in Nigeria with the causality running from exchange rate to manufacturing output.

Diagnostic Test Results

Test for autocorrelation

The hypothesis to be tested includes:

H0: there is no autocorrelation

H1: there is autocorrelation

Decision Rule:

Do not reject H0 if the p-value is greater than 0.05, otherwise reject H0 and conclude that there is autocorrelation. Table 8 contains the correlation test result.

Table 8: Breusch-Godfrey Serial Correlation TestResult

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.181856	Prob. F(2,12)	0.3337
Obs*R-squared	4.900659	Prob. Chi-Square(2)	0.3863

Source: Author's Computation (Eviews 10)

From Table 8, the p-value 0.3863 > 0.05, therefore we accept the null hypothesis of no autocorrelation and conclude that there is no serial correlation amongst the variables. Also, the Durbin-Watson statistics also confirms the presence of no serial correlation, given its value as 2.21.

Test for Normality

The classical normal linear regression model assumes that each error term is distributed normally. This study will make use of the Jarque-Bera normality test to find out if the estimated errors are normally distributed. The following hypothesis will be tested:

H_0: The data follows a normal distribution

H_1: The data does not follow a normal distribution

Decision rule: Reject H0 if the histogram is not bell shaped and the p-value of the Jarque-Bera statistics is significant at 5% level of significance, otherwise we fail to reject H0. Figure 4.1 represents the normality test result.

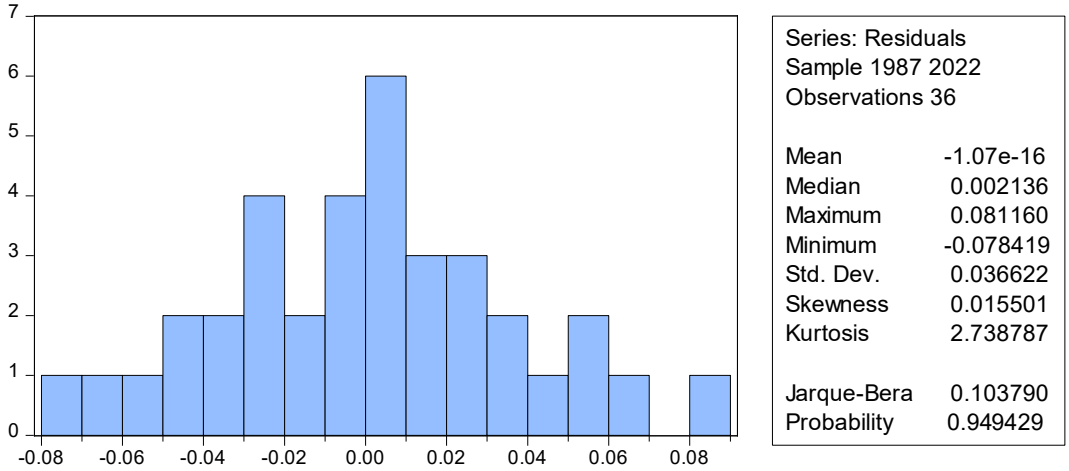

Figure 2: Histogram of Normality Test Result

From Figure 2, the histogram is bell shaped with a Jarque-Bera value of 0.10 and p-value of 0.95 which is greater than 0.05. Therefore, we accept the null hypothesis and conclude that the model follows a normal distribution.

Test for Heteroskedasticity

This test is basically focused on the variance of the error term. The test helps to ascertain whether the variance of the error is constant.

H_0: There is no heteroskedasticity

H_1: There is heteroskedasticity

Decision Rule:

Reject H_0 if the p-value of the F-statistic is insignificant (meaning that the p-value is greater than 0.05), otherwise we fail to reject H_0 and conclude that there is no heteroskedasticity in the model, if the . Table 9 shows the heteroskedasticity test result.

Table 9: Breusch-Pagan-Godfrey heteroskedasticity test result

Heteroskedasticity Test: ARCH			
F-statistic	0.032199	Prob. F(1,32)	0.8587
Obs*R-squared	0.034117	Prob. Chi-Square(1)	0.8535

Source: Author's Computation (Eviews 10)

From Table 9, the prob. Chi-square (0.8535) is greater than 0.05, therefore we accept the null hypothesis and conclude that our model is homoscedastic, meaning that the variance of the errors is constant across different values of the independent variables.

From the ARDL result, its shows that exchange rate has positive and significant effects on manufacturing sectors output growth in Nigeria in the long run, implying that a unit increase in exchange rate will bring about 22% increase in the manufacturing sectors output growth in Nigeria. While its has a negative and significant impacts on manufacturing sectors output growth in Nigeria in the short run, indicating that a unit increase in exchange rate will bring about 10% decrease in the manufacturing sectors output growth in Nigeria in the short run. This means that the effect of exchange rate is felt by the Nigerian manufacturing sector both in the long run and short run. Moreso, inflation, interest rate and government expenditure on internal security has negative and significant in the long run by 57%, 2% and 50% respectively.

Agricultural output has positive and significant effect in the long run by 65% and also has a positive and significant effect in the short run by 74%. Gross fixed capital formation assets shows a positive and significant effect on manufacturing sectors growth in Nigeria both in the long run and in the short run by 74% and 18% respectively. Labour participation depicts a positive and significant effect on manufacturing output growth in Nigeria both in the long and short run. Electricity consumption has a positive and significant effect on manufacturing output both in the long run and in the short run by 16% and 17%.

From the ARDL result, the research reveals that there is a statistically significant correlation between the exchange rate and manufacturing output in Nigeria, exhibiting both negative and positive relationships in both the short run and the long run. This implies that there exist some levels of instability in the Nigeria exchange rate within the period under investigation. In the short run, increase in exchange rate can negatively impact Nigeria's manufacturing output by increasing the costs of imported raw materials and components, squeezing profit margins. However, in the long run, a devalued naira

may enhance export competitiveness, positively affecting the manufacturing sector by boosting demand for locally-produced goods in the international market and encouraging innovation and investment.

Moreover, sudden currency devaluation can create uncertainty and volatility in the business environment, making it challenging for manufacturers to plan and make informed decisions. Overall, while devaluation may eventually improve export competitiveness, its immediate impact on increased costs and uncertainties can pose challenges for the manufacturing sector in the short run. Additionally, decrease in exchange rates poses challenges for exporters. A stronger domestic currency makes exports more expensive for foreign buyers, reducing international competitiveness and potentially leading to lower demand for domestically manufactured goods in global markets.

Devaluation can make imported goods more expensive. In the long run, this can incentivize domestic consumers and businesses to shift their preferences towards locally produced goods, reducing reliance on imports and supporting the growth of the domestic manufacturing sector. A more competitive export environment can attract foreign investment into the manufacturing sector. Additionally, domestic manufacturers may be motivated to invest in technology, efficiency improvements, and innovation to enhance their competitiveness on the global stage. This can contribute to long-term growth and sustainability.

Our findings indicated that interest rate has a negative and significant effect on manufacturing sectors output growth in Nigeria in the long. Higher interest rates lead to increased borrowing costs for businesses. Manufacturers often rely on loans to finance their operations and invest in new equipment. When borrowing becomes more expensive, they may cut back on expansion plans and investments, which can hinder production capacity and growth. Based on these findings, the policy implications are discernible. Relevant authorities at all levels should implement a managed exchange rate policy that seeks to promote exchange rate stability and ensure stabilize local currency. This can involve interventions in the foreign exchange market to prevent extreme fluctuations and reduce uncertainty for manufacturers. Stable exchange rates provide manufacturers with a predictable environment for planning and making investment decisions. This encourages long-term investments in machinery, technology, and workforce development, leading to increased output. A stable exchange rate helps control inflation by preventing rapid and unpredictable price increases. This price stability is crucial for manufacturers as it ensures that input costs remain relatively constant, allowing for efficient production planning and cost control.

Stable exchange rates are attractive to foreign investors looking to establish or expand manufacturing operations in a country. This can lead to increased capital inflows, technology transfer, and job creation within the manufacturing sector. Manufacturers can be more competitive in both domestic and international markets when exchange rates are stable. A stable currency makes it easier to predict production costs and pricing strategies, enhancing competitiveness. Stable exchange rates discourage speculative trading and financial market volatility, which can have adverse effects on the manufacturing sector.

This stability minimizes unnecessary financial risks that manufacturers might otherwise face.

4. Conclusion and Recommendations

This study has contributed significantly to the existing body of knowledge through its findings as it helps to advance the frontiers of knowledge. From the rate of adjustment parameters, the regression re-enforced the position that exchange rate could serves as one of the critical macroeconomic variables that can be effective in promoting manufacturing sector activities to achieve the desired output growth objectives. However, the major limitation to the smooth conduct of this study was the issue of lack of sufficient data for some macroeconomic variables that would have apparently influenced manufacturing activities in Nigeria.

In conclusion, the study suggests that relevant authorities should prioritize the design and implementation of a robust exchange rate management framework that not only guarantees exchange rate stability but also creates an enabling environment for the advancement of manufacturing activities. Successful implementation should encompass active collaboration between central banks, manufacturing stakeholders, and policy authorities, with a strong emphasis on instituting supportive measures that enhance manufacturing capabilities, boost productivity, and foster sustainable growth in manufacturing output. Finally, regular monitoring and adaptive policy adjustments are imperative to achieving the objectives of exchange rate stability and the promotion of a thriving manufacturing sector in Nigeria.

The study recommends that, relevant authorities at all levels should implement a managed exchange rate policy that seeks to promote exchange rate stability and ensure stabilize local currency. This can involve interventions in the foreign exchange market to prevent extreme fluctuations and reduce uncertainty for manufacturers.

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