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Exploring the Nexus Between Exchange Rate Volatility and Manufacturing Sector Output in Nigeria: A Quantitative Analysis

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Abstract

This study examined the impact of exchange rate volatility on the manufacturing sector output between 1980 -2024. Using the Autoregressive Distributed Lag Model, the study examined the long run and short run relationship between exchange rate volatility and manufacturing sector output in Nigeria. The estimated results revealed that exchange rate volatility had negative and statistically significant impact on manufacturing sector output in Nigeria. The study concluded that exchange rate volatility has negative impact on manufacturing sector output in Nigeria due to the overdependence of the manufacturing sector on imported raw materials and machines. The study therefore recommended amongst others that Manufacturers should explore diversifying their sources of inputs to include a mixture of local content which can help reduce vulnerability to currency fluctuations and enhance stability in the production process. This could help mitigate the negative effects and enhance the resilience of the manufacturing sector.

Keywords: *Nigeria, Exchange rate volatility, Manufacturing sector*

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Background to the Study

The manufacturing sector has been recognized as a key driver of economic growth in the majority of contemporary economies. It has the characteristics that make it the engine of growth, according to Kaldor (1966), as stated by Penélope and Thirlwall (2013), for two main reasons. To begin with, manufacturing has rising returns, both static and dynamic, while land-based activities and petty services have declining returns. Second, as the manufacturing sector grows and employs more people. It also acts as a buffer against unemployment, a source of wealth creation, and a conduit for sustainable development that can encourage industrialization in a given nation. However, since independence, the performance of the manufacturing sector in Nigeria has been unimpressive.

According to NESG (2018), the Herfindahl-Hirschman Index of 2,646 (HHI) reveals that Nigeria's manufacturing sector is weak, less competitive, and highly concentrated. A market with an HHI of less than 1,500 is regarded as a competitive marketplace; an HHI of 1,500 to 2,500 is a moderately concentrated marketplace, and a market with an HHI of 2,500 or greater to be a highly concentrated marketplace (Hayes, 2021). This development has caused competitive industries to relocate their factories abroad like Dunlop and Michelin. However, a few key industries such as beverages, textiles, cement, and tobacco kept the sector afloat but operated below half their capacity. As a major exporter of oil and one of Africa's largest economies, Nigeria has experienced exchange rate volatility over the past few decades. The exchange rate plays a crucial role in determining the economic scenery of a nation. In Nigeria, exchange rate volatility has been particularly pronounced due to the fluctuation of global oil prices, political instability, and inconsistent macroeconomic policies (Balogun, 2025). This fluctuation has raised critical questions about its implications for the broader economy and in particular the manufacturing sector output growth.

The relationship between exchange rate volatility and manufacturing sector output growth has been widely debated in the literature. For many emerging economies, including Nigeria, exchange rate volatility can have both direct and indirect effects on manufacturing sector output growth. On one hand, depreciation of the national currency can lead to increased export competitiveness, particularly in the oil and non-oil sectors. On the other hand, exchange rate volatility can increase the cost of imports, contribute to inflationary pressures, and exacerbate economic uncertainty, which can hinder investment and long-term growth in the manufacturing sector. Nigeria's economy is heavily dependent on oil exports, which makes it vulnerable to fluctuations in global oil prices. As a result, exchange rate movements are often influenced by changes in oil revenue, making the Nigerian economy particularly susceptible to external shocks. The Central Bank of Nigeria (CBN) has adopted various policies over the years to stabilize the exchange rate, including fixed, managed float, and floating exchange rate regimes. However, despite these efforts, the country has continued to experience significant currency fluctuations, leading to debates over the effectiveness of these policies in fostering sustained economic growth.

This study aims to explore the relationship between exchange rate volatility and manufacturing sector output in Nigeria, with a focus on understanding the impact of

exchange rate volatility on key economic variables such as, interest rate, government funding of manufacturing sector, and import. Using the Autoregressive Distributed Lag Model (ARDL), we investigate the dynamics between exchange rate volatility and manufacturing sector output growth, examining both short-term and long-term relationships. By providing empirical evidence, this research seeks to contribute to the ongoing discourse on the role of exchange rates in shaping the economic trajectory of emerging markets like Nigeria. Through this study, we seek to address the following key questions: How do exchange rate volatility affect the growth of the Nigerian economy? Are there specific sectors of the economy more sensitive to exchange rate fluctuations? What policy interventions can be recommended to minimize the negative effects of exchange rate volatility on Nigeria's manufacturing sector output growth? The findings of this study are expected to provide valuable insights for policymakers, economists, and businesses in Nigeria as they navigate the complexities of exchange rate management and economic development. The other sections of this paper are arranged as follows; Section two review theoretical and empirical literatures. The third section focuses on methodology. Section four looks at the presentation and analysis of results while the final section provides conclusion and recommendations.

Literature

Theoretical Review

This study is anchored on the Purchasing Power Parity (PPP) theory. The Purchasing Power Parity (PPP) theory is traceable to the Salamanca School back in the 16th century. However, its modern use as a theory of exchange rate determination began with the work of Gustav Cassel (1918). The theory states that exchange rates between different currencies are in equilibrium when their purchasing power is the same in each of the two countries. This means that the exchange rate between two countries should equal the ratio of the two countries' price levels of a fixed basket of goods and services. When a country's domestic price level is increasing (i.e., a country experiences inflation), that country's exchange rate must depreciate in order to return to PPP. The basis for PPP is the "law of one price". In the absence of transportation and other transaction costs, competitive markets will equalize the price of an identical good in two countries when the prices are expressed in the same currency.

A key aspect of purchasing power parity involves understanding that the nominal exchange rate and the purchasing power parity rate best represent certain types of goods and services. Tradable, non-perishable goods tend to trade nearer to the nominal exchange rate, while local non-tradable goods and services fall closer to the purchasing power parity rates. The implication is that there exists a sustainable cost advantage to producing tradable items in low- or middle-income countries such as Nigeria, not only because the worker cost is lower, but also because their pay goes further than in higher-income countries.

The PPP theory is relevant to this study because it postulates an ideal economic situation where exchange rates between two currencies (Naira and Dollar) are in equilibrium and support output growth as opposed to a situation of sharp disequilibrium in the exchange rates, a condition which is referred to as exchange volatility. Since Nigeria's import demand for inputs is high, a condition of volatile exchange rates may influence the performance of the

manufacturing sector. Similarly, the purchasing power parity theory is significant to this study because activities in the manufacturing sector involve international trading between two countries. An appropriate exchange rate differential is therefore critical for both imports of inputs and exports of manufactured goods.

Empirical Review

Some empirical studies have been conducted to ascertain the impact of exchange rate volatility on the manufacturing sector output. Udoye, Ugochi and Oguguo (2025) investigated the effect of exchange rate volatility on manufacturing sector output in Nigeria. The data was analyzed with econometric techniques involving Augmented Dickey Fuller tests for Unit Roots, Granger Cointegration Analyses and the Vector Autoregression Estimates was used. The findings of the Vector Autoregression Estimates reviled that nominal effective exchange and real effective exchange rate had positive and significant effect on manufacturing sector output in Nigeria while interest rate and exchange rate fluctuation had negative and insignificant effect manufacturing sector output in Nigeria. The study concludes that exchange rate volatility has adverse effect on manufacturing sector output in Nigeria.

Ita, Nkamare, Emefiele, Obioke and Okpunor (2023) examined the contributions of exchange on the growth of the manufacturing sector in Nigeria. Secondary data were extracted from the Central Bank of Nigeria statistical bulletin, 2020. The Ordinary Least Squares multiple regression technique was employed to examine the impact of independent on dependent variables. The findings revealed that the exchange rate had a negative and significant impact on the performance of the manufacturing sector, while money supply and trade openness had a positive and significant effect on the performance of the manufacturing sector. Ojo and Bamidele (2023) employed the ARDL model to analyze the nexus between monetary policy instruments and the growth of the manufacturing sub-sector in Nigeria. The study employed time series data between 1981 and 2021. The findings revealed that the exchange rate has a negative impact on the growth of the manufacturing sub-sector in Nigeria in the long run, inflation in Nigeria has a significant positive impact on the manufacturing sector in the long run and interest rate is positively related to the growth of the manufacturing sub-sector in Nigeria in the long run. All the independent variables are simultaneously significant.

Dini and Andryan (2023) examined the effect of monetary policies on manufacturing outputs in Indonesia. They employed the Engle-Granger Error Correction Model (E-G ECM) to analyze the data. Time series data from 2010 Q1 to 2021 Q4 were sourced from the Central Bureau of Statistics and Bank Indonesia. The empirical findings revealed that inflation significantly influenced manufacturing outputs in the short run. Meanwhile, broad money, foreign exchange reserves and interest rates did not affect manufacturing outputs. In the long run, broad money, inflation and the interest rate of Bank Indonesia significantly influenced manufacturing outputs, while the foreign exchange reserve did not significantly affect manufacturing outputs.

Ihezie (2022) studied the impact of exchange rate volatility on manufacturing output in the ECOWAS region, using time series data spanning from 1970 to 2019. The study employed

panel data analysis to examine the relationship between exchange rate volatility and manufacturing output among all the ECOWAS countries. GARCH was used to establish the existence of volatility; Dumitrescu & Hurlin Granger non-causality test for causality direction between manufacturing and exchange rate, while Panel fixed and random effect models were used to assess the magnitude of the effects of exchange rate volatility on manufacturing output in ECOWAS. The result of the volatility test from GARCH confirmed the presence of volatility in exchange rates across all the countries in ECOWAS. Furthermore, the random effect model results showed that exchange rate volatility has a positive and significant impact on manufacturing output in ECOWAS.

Efuntade and Efuntade (2021) investigated the relationship between exchange rates and manufacturing output in Nigeria. The research utilized secondary data to reach the objectives of this research work. Data were sourced mainly from the Central Bank of Nigeria (CBN) Statistical Bulletin, CBN Statement of Accounts and Annual Reports and the Nigerian Bureau of Statistics publications. Ordinary Least Squares (OLS) estimation techniques of regression analysis was adopted to obtain the numerical estimates of the coefficients in the model. The variables for which data were sourced include manufacturing output, manufacturing capacity utilization, exchange rate, government expenditure, inflation rates and interest rates for the period 1980 to 2020. The result of the regression estimate showed that the exchange rate and government expenditure on manufacturing sector variables have a positive and significant impact on manufacturing productivity, while consumer price index and manufacturing capacity utility rate variables have a negative and significant impact on manufacturing productivity. Interest rate, however, has a negative and insignificant impact on manufacturing productivity during the study period. The study concluded that the exchange rate, government expenditure on the manufacturing sector, consumer price index, manufacturing capacity utility and interest rate influence manufacturing output.

Krotamunobaromi, Akani and Nwosu (2020) investigated the relationship between exchange rate volatility and manufacturing sector output in Nigeria. The study used secondary data sourced from CBN annual statistical bulletin from 1982 to 2019. The Ordinary Least Squares model was adopted to analyze the relationship between the dependent and independent variables. The result revealed that official exchange rate volatility has a negative relationship with manufacturing output, while parallel exchange rate volatility has a positive relationship with manufacturing sector output in Nigeria.

Research Methodology

Based on the nature of this study, and the variables involved, this study however, employed the causal research design also called the explanatory research design. The data used in this study was secondary data ranging from 1980 to 2023, sourced from CBN Statistical Bulletin of various years, National Bureau of Statistics (NBS) and the World Development Indicators (WDI). The Autoregressive Distributive Lag (ARDL) model was used for the statistical validation of the relationship between dependent variable and independent variables.

Model Specification

To achieve the objectives of this study, the model of Ayobami (2019) was adapted for this study with modifications. Therefore, the mathematical/functional forms of the models for this study are stated as;

MANopt = f (EXRV, GFMS, INTR, IMP) ---------- (1)

Where;

MANopt = manufacturing sector output
EXRV = exchange rate volatility
GFMS = government funding of manufacturing sector
INTR = interest rate
IMP = manufacturing import

The stochastic or econometric specifications of equations (1) is expressed as;

$$MANopt_t = \alpha_0 + \alpha_1 EXRV_t + \alpha_2 GFMS_t + \alpha_3 INTR_t + \alpha_4 IMP_t + \varepsilon_t \quad \text{---------- (2)}$$

ARDL Model Specification

To obtain the long-run and short-run estimates of the manufacturing sector output model, the study re-specifies equations 1 into the dynamic Autoregressive Distributed Lag (ARDL) model of Pesaran, Shin and Smith (2001), as shown in equations 3.

$$\Delta MANopt_t = \alpha_0 + \alpha_1 MANopt_{t-1} + \alpha_2 EXRV_{t-1} + \alpha_3 GFMS_{t-1} + \alpha_4 INTR_{t-1} + \alpha_5 IMP_{t-1}$$
$$+ \sum \beta_6 \Delta MANopt_{t-1} + \sum_{i=0}^{q} \alpha_7 \Delta EXRV_{t-1} + \sum_{i=0}^{q} \alpha_8 \Delta GFMS_{t-1} + \sum_{i=0}^{q} \alpha_9 \Delta INTR_{t-1}$$
$$+ \sum_{i=0}^{q} \beta_{10} \Delta IMP_{t-1} + \lambda ECM_{t-1} + \varepsilon_t \quad \text{---------- (3)}$$

Results and Discussion

Zivot-Andrews Unit Root Test Test with Structural Breaks

The test for unit root was conducted based on the Zivot-Andrews unit root test approach and presented in table1 below.

Table 1: Results of Zivot Andrews (ZA) Unit Root Test with Structural Breaks

	ZA Test @ level				*ZA Test @ first difference*	
Variable	*ZA Statistic*	*Break Point*			*ZA Statistic*	*Break Point*
MANopt	-3.9855 (2)	1993			-5.2914 (2)**	1993
EXRV	-2.1758 (2)	2005			-5.2745 (2)**	2005
GFMS	-6.1252 (2)**	2004			-7.4864 (2)**	2002
INTR	-11.0997 (2)**	2005			-6.8850 (2)**	1996
IMP	-3.2403 (2)	1993			-6.4099 (2)**	1998
Sig. Level	**Crit. Values**					
1%	-5.34				-5.34	
5%	-4.93				-4.93	
10%	-4.58				-4.58	

*Note: Values in parenthesis are the lag length of variables, ** denote rejection of null hypothesis 5% level. Reject the null hypotheses of unit root when the test statistics is greater than the critical value in absolute terms.*

Table 1 presented the results of the time series properties of the variables using the Zivot-Andrews unit root test approach. The results revealed that *MANopt*, *MANcu*, *MANexp, EXRV* and *IMP* were non-stationery at level. However, these series became stationary after taking the first differences.

ARDL Bounds Cointegration Analysis

Given that some of our variables are stationary at level I(0) while others are stationary at first difference I(1), it becomes pertinent to ascertain whether their linear combinations could yield some long-run relationship. Given the mixed order of integration so observed, the appropriate test for cointegration to utilize is the autoregressive distributes lag (ARDL) bounds test. The test was conducted using the F-statistic, and it was required that the F-statistic must lie outside the 5% upper and lower bounds for cointegration to exist.

Table 2: Cointegration Test using ARDL Bounds Test

ARDL Bounds Test (F-STATISTICS)			
Estimated Model	**F-statistic**		**Conclusion**
$MAN_{opt} = f(EXRV, GFMS, INTR, IMP)$	5.3890**		Cointegrated
Critical Values	**Lower Bound**	**Upper Bound**	
10%	2.20	3.09	
5%	5.56	3.49	
1%	3.29	4.37	

*Note: I(0) and I(1) denote lower and upper bounds of the ARDL bounds test respectively. ** & *** shows statistical significance at 5% level & 10% level, respectively.*

Source: Author's Computation Using EViews 10.

The result of the test as captured in Table 2 where the F-statistic for the model reported to be 5.3890, was greater than the upper bound I (1) bound value of 3.49 at the 5% significance level. Hence, we reject the null hypothesis of no cointegration and conclude that there was cointegration or a long-term relationship among the variables.

Model Estimation

The fact that there exists a levels relationship among the variables in the model signals the need for the estimation of the ARDL model for the study to check how short-run distortions could be corrected in the long-run; and then to see the nature of the long-run behaviours of the variables in influencing the dependent variable. The results are shown in Tables 3,

Table 3: Results of the Short-run and Long ARDL Estimates (Manufacturing Output model)

	Coefficient	Std. Error	t-Statistic	Prob.
Long Run Equation				
EXRV	-0.586677	0.225916	-2.596878	0.0158
GFMS	0.377613	0.093078	4.056948	0.0005
INTR	-0.024491	0.010007	-2.447330	0.0221
IMP	0.822585	0.169441	4.854691	0.0001
C	0.708462	1.490944	0.475177	0.6390
Short Run Equation				
D(EXRV)	-0.034481	0.032211	-1.070451	0.2951
D(EXRV(-1))	-0.114909	0.035541	-3.233162	0.0035
D(EXRV(-2))	-0.142075	0.035376	-4.016185	0.0005
D(EXRV(-3))	-0.080616	0.034530	-2.334696	0.0283
D(GFMS)	0.085824	0.021682	3.958300	0.0006
D(GFMS(-1))	0.023333	0.020042	1.164195	0.2558
D(GFMS(-2))	0.062543	0.019181	3.260698	0.0033
INTR	0.006718	0.002888	2.326114	0.0288
IMP	0.225650	0.049305	4.576586	0.0001
ECM(-1)	-0.274318	0.043886	-6.250638	0.0000
R-Squared	0.618686	S.D. dependent var		0.095690
Adjusted R^2	0.526645	Akaike info criterion		-2.414508
S.E. of regression	0.065835	Durbin-Watson stat		2.207487

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively

The evidence from Table 3 revealed that exchange rate volatility (EXRV) and interest rate (INTR) had negative and statistically significant effect on manufacturing output in the long-run. It implies that a 1% increase in EXRV led to a decrease in manufacturing output by 0.5867 percent, and an increase in INTR cause a marginal decrease in manufacturing output by 0.02449 percent. Both variables had p-values of 0.0158 and 0.0221 respectively, which were all less than 0.05 level of significance, implying that they were statistically significant at 5% level.

On the other hand, the result showed that government funding of manufacturing sector (GFMS) and imports (IMP) had positive and statistically significant impact on the manufacturing output in Nigeria during the period under study. It implies that a 1% increase in GFMS and IMP led to increase in manufacturing output by 0.3776 percent and 0.8226 percent

respectively. Both variables had p-values of less than 0.05 which indicated statistical significance at 5% level. The positive and significant effect of GFMS on manufacturing output is theoretically plausible because, the necessary infrastructure such as electricity, access roads and loans to the sector have to be in place for manufacturing activities to flourish. The positive impact of imports is however contrary to economic expectations, but can be justified on the basis that, most of the inputs used in the sector were imported, therefore, an increase in such imports led to increase in the output in the long-run.

The adjusted R^2 value of 0.526645 suggested that, about 52.66% of the variations or changes in the manufacturing output in Nigeria were explained by the independent variables. Furthermore, the error correction model – ECM (-1) which indicates the speed of adjustment to the equilibrium in the event of disequilibrium was -0.274318 and negative and statistically significant as required. The implication of this finding is that in the event of disequilibrium, the short-run disequilibrium will have a slow speed of adjustment (27%) back to equilibrium.

Diagnostic Tests

Table 4: Results of the Diagnostic Tests

Diagnostic Test	Statistic	p-value
Heteroscedasticity (ARCH Test)	0.551595	0.8583
Autocorrelation (Breusch-Godfrey LM test)	0.675668	0.5191
Normality Test	1.367519	0.5047

The results of the several diagnostic tests to evaluate the accuracy and dependability of the estimates showed that the model was free from heteroscedasticity since the p-values of the Fstatistics was greater than 0.05. The result also shows that the model was free from the problem of serial correlation or autocorrelation since the p-values of the F-statistic is greater than 0.05. The residuals of the model were normally distributed since the p-values of the test statistic (Jaque-Bera test) was greater than 0.05.

Conclusion and Recommendations

The study investigated the impact of exchange rate volatility on manufacturing sector output in Nigeria covering the period from 1981 to 2021. The unit root properties of the variables were tested using the Zivot-Andrews test for stationarity. The Bayer-Hanck cointegration test was applied, which confirmed cointegration among the model variables. Further, the study applied the ARDL model to investigate the long-run and short-run relationship between exchange rates volatility and manufacturing sector output. The results revealed that the coefficient of exchange rate volatility was negative and statistically significant. This implies that there is a negative or inverse relationship between exchange rate volatility and manufacturing sector output in Nigeria. This finding aligns with A-priori expectation as it conforms to the findings of Krotamunobaromi, Akani and Nwosu (2020) and Yelwa and Kazeem (2019). On the other hand, the findings of the study disagreed with the studies of Ihezie (2022); which found a positive impact of exchange rate volatility on manufacturing

output. It is on this basis that the study concluded that exchange rate volatility has negative relationship with manufacturing sector output in Nigeria over the period of study.

Based on the findings, the study made the following recommendations:

1. Manufacturers should explore diversifying their sources of inputs to include a mixture of local content. Diversifying the sources of raw materials and intermediate goods in the production process can help reduce vulnerability to currency fluctuations and enhance stability in the production process. This could help mitigate the negative effects and enhance the resilience of the manufacturing sector.
2. Furthermore, structural reforms by government that come with exchange rate devaluation should be avoided, as these have negative effects on manufacturing sector output. Instead, policy tools such as interest rates and reserve requirements should be implemented to manage the money supply and inflation, which can help stabilize the exchange rate to enable local manufacturers afford the imports of raw materials and capital goods, given the current import-dependent nature of the sector.

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