Exchange Rate Volatility and the Performance of Manufacturing Sector in Nigeria (1981 – 2016)

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Abstract

The study examined the effect of exchange rate volatility on the performance of manufacturing sector in Nigeria for the period of 1981 to 2016. Annual data were sourced from World Development Indicators of World Bank and Statistical Bulletin of the Central Bank of Nigeria. Based on the result of unit root test, an ARDL technique of estimation was employed. The result from Bounds Test for cointegration revealed the evidence of long-run relationship among manufacturing sector's value added, exchange rate, exchange rate volatility, interest rate, inflation, import and gross capital formation. Findings from the study revealed that the impact of exchange rate volatility on manufacturing sector's performance is positive and significant both in the long-run and short-run. In addition, the study found that the impact of exchange rate on manufacturing sector's output is positive but not significant in the long-run while its impact is negative and significant in the short-run. Furthermore, the effect of import on manufacturing sector's performance is negative and significant in the long-run and short-run.

Keywords: Exchange Rate, Exchange Rate Volatility, Manufacturing Sector and ARDL

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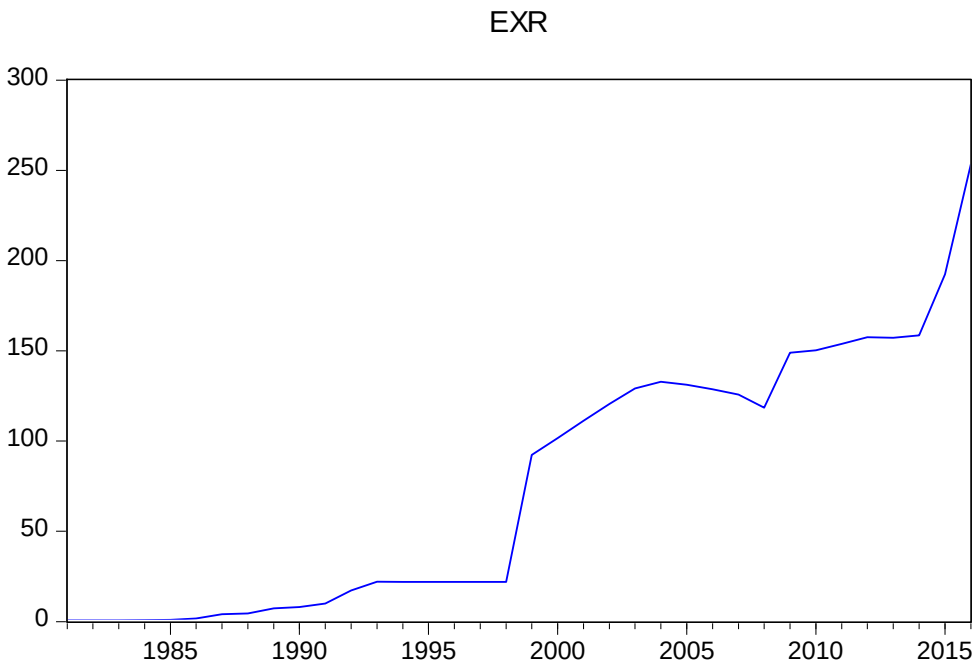
1. Introduction

Exchange rate is an important macroeconomic variable used in determining the international competitiveness of a nation. It is being regarded as an indicator of competitiveness of currency of a country. Exchange rate is the rate at which one currency is exchanged for another. It is an important economic variable as its appreciation or depreciation affects the performance of all the sectors in an economy and most especially the manufacturing sector (Hashim and Zarma, 1996; Odili, 2014). The manufacturing sector plays a catalytic role in a modern economy and has many dynamic benefits that are crucial for economic transformation. Manufacturing sector is one of the sector whose success or failure depends on the stability of exchange rate. Similarly, in emerging economies, such as Nigeria, exchange rate plays a critical role in the ability of the economy to attain optimal levels in production.

In the wake of policy change, occasioned by the implementation of Structural Adjustment Programme (SAP) in 1986, the subject of exchange rate fluctuation has become a topical issue in Nigeria. It is the goal of every economy to have a stable rate of exchange with its trading partners. In Nigeria, this goal was not achieved in spite of the fact that the country embarked on series of currency devaluation to promote export and stabilize the rate of exchange. Failure to achieve this goal subjected the Nigerian manufacturing sector to the challenge of a constantly fluctuating exchange rate. Hence, the impact of exchange rate on manufacturing sector is pronounced due to the sector's dependence on imported intermediate goods.

In advanced economies, the manufacturing sector is a leading sector in many respects. It is a quest for increasing productivity in relation to import substitution and export expansion, creating foreign exchange earnings capacity, raising employment, promoting the growth of investments at a faster rate than any other sector of the economy, as well as wider and more efficient linkage among different sectors (Fakiyesi, 2005). However, the manufacturing companies in Nigeria are faced with the problem of fluctuation in exchange rate which adversely affect their output. This is due to the fact that Nigerian manufacturing sector is highly dependent on importation of intermediate inputs and capital goods. Hence, the sector is increasingly dependent on the external sector for its import of non-labour input and this hampers the competitiveness of the sector.

The introduction of SAP in 1986 resulted to an upward swing in exchange rate with attendant consequence on other sectors of the economy (Okorontal and Odomena, 2016), and, a careful consideration of exchange rate in the last four decades in Nigeria revealed an upward trend over the years (as shown in Figure 1). For instance, exchange rate of Naira to Dollar increased from N0.6 in 1981 to N243.49 in 2016 (WDI, 2016). This portrayed a clear evidence of exchange rate volatility in the country. Exchange rate volatility manifests inform of increase in manufacturers' cost of production as they will have to pay more for imported inputs due to the persistent exchange rate depreciation. As documented by Ozturk (2006), exchange rate volatility is defined as the risk associated with unexpected movement in in exchange rate. In other words, exchange rate volatility is the risk associated with currency depreciation or appreciation. Hence, exchange rate volatility discourages investment and impedes productivity in an economy.



Source: World Development Indicator (2016)

Figure 1: Trend of exchange Rate in Nigeria (1981 – 2016).

Most of the studies particularly in Nigeria, though with conflicting findings, have focused on the relationship between exchange rate volatility and economic growth (see Okoronta and Odoemena, 2016; Nwosu, 2016; Nsofo, Takson and Ugwuegbe, 2017 and Iyeli and Utting, 2017). The few studies that examined the effect of exchange rate volatility in Nigeria have at best produced mixed results. While most studies have revealed that exchange rate volatility exerts a negative and significant effect on manufacturing sector (Olufayo and Fagile, 2014 and Opaluwa, Umen and Abu, 2010). Other studies such as (Akinlo and Adejumo, 2014 and Enekwe, Ordu and Abu, 2013) observed a positive and significant impact on the performance of manufacturing sector. However, ing-George (2013) found that exchange rate volatility has no significant effect on economic growth and manufacturing sector in Nigeria. It is therefore pertinent to assess the extent to which volatility in exchange affect the performance of manufacturing sector for the sector to assume its leading role in economic development.

The remainder of this study is organized as follows. Section two provides a literature review. Section three presents the methodology. The empirical analyses are presented and discussed in section four. Section five concludes.

2. Literature Review

The relationship between exchange rate volatility and economic growth has continued to generate controversy among the researchers. The argument is based on the fact that the exchange rate of Naira against dollar had been on the upward trend over the years. Whether the country has been benefiting from continuous depreciation of Naira remains an empirical issues. Several authors have investigated the effect of exchange rate volatility and economic growth but with mixed results. For instance, Odusola and Akinlo (2001) examined the linkage among exchange rate, inflation and

output in Nigeria. A structural VAR model was employed to capture the interactions between exchange rate and output. Evidence from the study showed a contractionary impact of the parallel exchange rate on output in the short run. Asher (2012) examined the impact of exchange rate fluctuations on the Nigeria economic growth for period of 1980 – 2010. The result showed that real exchange rate has a positive effect on economic growth.

Also, Nazar and Bashiri (2012) investigated the relationship between real exchange rate uncertainty and private investment in Iran for the period of 1988 to 2008 by using quarterly data and applying bivariate generalized autoregressive conditional heteroskedasticity (Bivariate GARCH) model in the Iranian economy. The study revealed that real exchange rate uncertainty significantly influences private investment and has a negative effect on it; while private investment uncertainty affects the level of private investment negatively.

Okorontah and Odoemena, (2016) investigated the effects of exchange rate fluctuation on economic growth of Nigeria. Using annual data for the period 1986-2012, the study employed the Ordinary Least Square (OLS) technique, the Johansson co-integration test and the Error Correction Mechanism (ECM) to examine the relationship between exchange rate and economic growth. The result suggests that there is no strong relationship between exchange rate and economic growth in Nigeria. It was therefore suggested that Nigeria improve its competitive capacity in the international market through export diversification.

Similarly, Nsofo, Takson and Ugwuegbe (2017) examined the extent of exchange rate volatility and its impact on economic growth in Nigeria covering the period of 1981 to 2015. Generalized Autoregressive Conditional Heteroscedasticity (GARCH) and Generalized Method of Moment (GMM) technique was employed. Findings from their study showed that there is persistent in exchange rate volatility in Nigeria. Furthermore, the found that exchange rate volatility and foreign direct investment have negative impact on output in Nigeria. Similar result was obtained by Nwosu (2016). The study is however in conflict with the findings of Iyeli and Utting (2017), who employed the Error Correction Model in discovering a positive long run relationship between exchange rate and gross domestic product in Nigeria.

In Nigeria, studies have been conducted on the impact of exchange rate volatility and non-oil export and manufacturing sector in particular. For instance, Opaluwa, Umeh and Ahmen (2010) studied the impact of exchange rate volatility on manufacturing sector in Nigeria between 1986 and 2005. The study focused principally on manufacturing GDP as the dependent variable and manufacturing foreign private investment, manufacturing employment rate and exchange rate as the explanatory variables. Findings from the study showed that exchange rate and manufacturing foreign private investment adversely affect the performance of manufacturing sector in Nigeria. Using the same data, Enekwe, Ordu and Nwoha (2013), investigated the effect of exchange rate volatility in Nigeria over the study period of 1985 to 2010. However, the result obtained from the study revealed that manufacturing foreign private investment and exchange rate have positive and significant effect on manufacturing GDP within the study period. This shows a clear evidence of disagreement in the two authors' findings despite the fact that they employed the same variables in their analysis.

In a related study, Akinlo and Adejumo (2014) investigated the impact of exchange rate volatility on non-oil exports in Nigeria. The authors employed the Error Correction model and quarterly data from 1986(1) to 2008(4). Finding from the study revealed that exchange rate volatility has positive and significant effects on non-oil exports in the long run while the short run impact of the exchange rate volatility is not significant. Similarly, Abdul-Mumuni (2016) examined the relationship between exchange rate volatility and manufacturing sector's performance in Ghana. Adopting the Autoregressive Distributed Lag (ARDL) technique, findings from the study revealed that the growth of manufacturing sector is positively related to exchange rate but negatively related to import. The result is in tandem with the finding of Lawal (2016) on manufacturing sector in Nigeria.

Similarly, King-George (2013) examined the effect of exchange rate fluctuations on the Nigerian manufacturing Sector. The author employed annual time series data on manufacturing gross domestic product a proxy for economic growth, exchange rate, private foreign investment and manufacturing employment rate were collected from the year, 1986 to 2010. Employing the Ordinary Least Square (OLS) method, the author found that exchange rate has no significant effect on economic growth of Nigeria and by extension on manufacturing sector. Furthermore, Olufayo and Fagile (2014) examined the impact of exchange rate volatility on the performance of Nigeria export sectors. The authors distinguished exports from oil and non-oil sectors. They adopted the econometrics method of Seemingly Unrelated Regression (SUR) and in testing the volatility of the exchange rate; they adopted GARCH (generalized autoregressive conditional heteroskedasticity) and examined the effect of floating exchange rate policy on the volatility of the nominal exchange rate. Using the GARCH model, they discovered that there exists volatility in the exchange rate of the country. Their study established the negative relationship between the volatility of exchange rate and export performance of oil and non-oil sectors using time series data of 1980 to 2011. Another striking revelation from their study was that the introduction of floating exchange rate system in Nigeria induces instability in the country exchange rate. Their finding is consistent with previous studies that the shift from fixed exchange rate to floating exchange rate brought about uncertainty in the exchange rate.

It is evident from the review above that empirical studies on exchange rate fluctuation and economic growth produced mixed result while the few that considered exchange rate and manufacturing sectors failed to provide conclusive result. Given the dependence of manufacturing sector on import for their intermediate and capital goods, there is need to examine the manner and extent through which fluctuation in exchange rate affects the performance of manufacturing sector in Nigeria. The study is of particular relevance because a vibrant manufacturing sector is a sine-qua-non for sustained economic growth and development in any economy. In addition, the study is of great importance to the economy given her quest to diversify the nation's economy base away from crude oil.

3. Methodology

The primary objective of this study is to examine the impact of exchange rate fluctuation on the performance of manufacturing sectors in Nigeria. To do this, we adapted the model of Abdul-Mumuni (2016). To account for exchange rate volatility and business uncertainty in Nigeria, we include exchange rate volatility (EXRVOL) and inflation (INFL) respectively into the original model and this is specified below:

$$MANU_t = \alpha_0 + \alpha_1 EXR_t + \alpha_2 EXRVOl_t + \alpha_3 INTRT_t + \alpha_4 INFL_t + \alpha_5 IMP_t + \alpha_6 GCF_t + \mu_t \qquad (1)$$

Where MANU represents manufacturing sector's value added as a percentage of gross domestic product (GDP). MANU is used to proxy the performance of manufacturing sector. EXR is the nominal exchange rate, EXRVOL captures volatility in exchange rate; INTRT and INFL represent the lending rate (interest rate) and inflation rate respectively. IMP is total imports as a percentage of GDP and GCF represents gross capital formation used to proxy investment. Exchange rate is expected to have positive effect on manufacturing sector, exchange rate volatility could be negative or positive depending on the direction of movement. Also, both import and interest rate expected to have negative effect while gross capital formation is expected to be positively related to manufacturing sectors performance. Annual data from world development indicator (World Bank, 2016) and Statistical Bulletin of Central Bank of Nigeria (CBN, 2016) were used for the analysis.

To ensure that variables are stationary, unit root tests was carried out using the Augmented Dickey Fuller (ADF) and Phillips-perron (PP) tests. In addition, to examine the long-run relationship among variables, Bound test cointegration approached proposed by (Pesaran *et al.* 2001) was conducted. To investigate the effect of exchange rate volatility on the performance of manufacturing sector in Nigeria, an Autoregressive Distributed Lag (ARDL) technique was employment based on its advantages over other techniques of estimation. Firstly, ARDL is integrating both the short-run and long-run relationship among variables of interest. Secondly, ARDL can handle variables with different order of integration apart from I (2) variables. Furthermore,the ARDL model is advantageous because it corrects for residual serial correlation and the problem of endogenous regressors by using the lags as instruments (Abdul-Mumuni, 2016). Following Pasaran *et al*. (2001), equation 1 can be expressed in ARDL specification as provided below:

$$\Delta MANU_t = \alpha_0 + \delta_1 MANU_{t-1} + \delta_2 EXR_{t-1} + \delta_3 EXRVOL_{t-1} + \delta_4 INTRT_{t-1} + \delta_5 INFL_{t-1} + \delta_6 IMP_{t-1} +$$
$$\delta_7 GCF_{t-1} + \sum_{i=1}^{p} \beta_1 \Delta MANU_{t-i} + \sum_{j=1}^{q} \beta_2 \Delta EXR_{t-j} + \sum_{k=1}^{q} \beta_3 \Delta EXRVOL_{t-k} + \sum_{l=1}^{q} \beta_4 \Delta INTRT_{t-l} + \sum_{m=1}^{q} \beta_5 \Delta INFL_{t-m}$$
$$\sum_{n=1}^{q} \beta_6 \Delta IMP_{t-n} + \sum_{s=1}^{q} \beta_7 \Delta GCF_{t-s} + \mu_t \qquad (2)$$

The first step in ARDL Bound testing approach is to estimate equation 2 to test for the existence of long run relationship among the variables of interest. This is done by conducting the F-test for the joint significance of the coefficients of the lagged levels of the variables, that is $H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = 0$ against the alternative hypothesis

$H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq 0$. Pasaran *et al.* (2001) proposed two critical bounds (upper and lower bounds) to test for co-integration among the variables. The long run relationship between variables exists if the computed F-statistic is greater than the upper critical bound (UCB). There is no co-integration between series if the F-calculated does not exceed the lower critical bound (LCB). The decision regarding co-integration is inconclusive if F-statistic falls between the LCB and UCB.

If cointegration is established, the conditional ARDL ($p, q_1, q_2, q_3, q_4, q_5, q_6$) for long-run would be specified as:

$$MANU_t = \alpha_0 + \sum_{i=1}^{p} \delta_1 MANU_{t-i} + \sum_{i=0}^{q_1} \delta_2 EXR_{t-i} + \sum_{i=0}^{q_2} \delta_3 EXRVOL_{t-i} + \sum_{i=0}^{q_3} \delta_4 INTRT_{t-i} + \sum_{i=0}^{q_4} \delta_5 INFL_{t-i}$$
$$\sum_{i=0}^{q_5} \delta_6 IMP_{t-i} + \sum_{s=0}^{q_6} \delta_7 GCF_{t-i} + \mu_t \quad (3)$$

The maximum lag length of ARDL ($p, q_1, q_2, q_3, q_4, q_5, q_6$) model in equation 3 would be selected based on any of Akaike Information Criteria (AIC) or Schwartz Bayesian Criteria (SBC).

The last step in the ARDL technique is to estimate the error correction model which requires the estimation of short run dynamic coefficients associated with the long-run estimate. The error correction model is specified below:

$$\Delta MANU_t = \theta_0 + \sum_{i=1}^{p} \beta_1 \Delta MANU_{t-i} + \sum_{j=1}^{q} \beta_2 \Delta EXR_{t-j} + \sum_{k=1}^{q} \beta_3 \Delta EXRVOL_{t-k} + \sum_{l=1}^{q} \beta_4 \Delta INTRT_{t-l} + \sum_{m=1}^{q} \beta_5 \Delta INFL_{t-m}$$
$$\sum_{n=1}^{q} \beta_6 \Delta IMP_{t-n} + \sum_{s=1}^{q} \beta_7 \Delta GCF_{t-s} + \lambda ECT_{t-1} \quad (4)$$

Where $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ and β_7 are the short-run dynamic coefficient of the model's convergence to equilibrium and λ is the speed of adjustment. ECT_{t-1} is the error correction term. Furthermore, following the work of (Caglayan and Rebecca, 2008), ARCH and GARCH methodology was used to generate exchange rate volatility. To compute exchange rate volatility, the study used monthly data over the period of 1981 to 2016 and estimate an ARCH specification for the growth rate of real exchange series. The monthly data on nominal exchange rate was obtained from the Central Bank of Nigeria Statistical Bulletin (2016 edition).

4. Empirical Results

The first preliminary step in any empirical analysis is to examine the descriptive statistic of data series employed. Specifically, we examined the mean, median, skewness, kurtosis and Jarque-Bera statistic of the variables to have insight to the distribution and normality of the residual term. The result of the descriptive statistic is presented in Table 1. Evidence from Table 1 revealed some level of consistency in data series as mean and median lie within the minimum and maximum

values except for exchange rate (EXR) and inflation (INFL). In addition, skewness, kurtosis and Jarque-Bera statistic jointly provide information on the normality of data series. It can be observed that the null hypothesis of normal distribution cannot be rejected for manufacturing value added (MANU), exchange rate (EXR), interest rate (INTRT) and IMPORT based on the value of their J-B statistic. However, the result further showed that the hypothesis of normal distribution is rejected for exchange rate volatility series (EXRVOL), inflation (INFL) and investment proxy with GCF.

Table 1

Descriptive Statistics

	MANU	**EXR**	**EXRVOL**	**INTRT**	**INFL**	**IMP**	**GCF**
Mean	6.183	69.017	0.108	17.779	19.603	20.636	12.773
Median	5.728	91.501	0.038	17.690	12.547	19.782	12.027
Maximum	10.437	131.297	1.863	31.650	72.836	36.482	35.221
Minimum	2.410	0.742	0.037	8.917	5.382	7.903	5.459
Std. Dev.	2.567	43.107	0.307	4.969	17.690	8.099	6.331
Skewness	0.115	-0.512	5.435	0.193	1.665	0.412	2.004
Kurtosis	1.769	1.609	31.546	3.521	4.527	2.318	7.539
Jarque-Bera	2.351	4.474	1399.534	0.631	20.120	1.719	54.992
Probability	0.309	0.107	0.000	0.730	0.000	0.423	0.000
Sum	222.595	2484.618	3.871	640.046	705.710	742.892	459.815
Sum Sq. Dev.	230.709	65036.470	3.292	864.092	10953.290	2295.710	1402.776
Observations	36	36	36	36	36	36	36

Source: Author's Compilation

To observe the relationship among our variables of interest, correlation analysis was carried out to preclude the possibility of multicollinearity among the variables in our model. Table 2 presents the result from the correlation matrix among the data series. It can be deduced from Table 2 that there was no evidence of multicollinearity among the variables used in our model. This is because there were no strongly correlated variables in the model Furthermore, evidence from Table 2 revealed that exchange rate volatility (EXRVOL), interest rate (INTRT) and import (IMPORT) are negatively related with the performance of manufacturing sector. This is not surprising as increase in lending rate discourages investment and by extension adversely affects the performance of manufacturing sector. In addition, increase in the price of imported goods adversely affect the performance of the manufacturing sectors. On the contrary, there was positive association between inflation, exchange rate and gross capital formation and manufacturing sector's performance in Nigeria.

Table 2

Correlation Matrix

	MANU	EXR	EXRVOL	INTRT	INFL	IMP	GCF
MANU	1.0000						
EXR	0.1192	1.0000					
EXRVOL	-0.0899	-0.2219	1.0000				
INTRT	-0.5741	-0.4928	0.0779	1.0000			
INFL	0.0008	-0.6095	0.1572	0.3706	1.0000		
IMP	-0.6478	-0.1588	0.0983	0.4232	-0.0079	1.0000	
GCF	0.716	0.250	-0.176	-0.538	-0.083	-0.260	1.000

Source: Author's Compilation

Before the estimation of the ARDL, it is important to test for the stationarity property of the variables to confirm their order of integration. To do this, we employed the Augmented Dickey Fuller (ADF) and Phillip-perron unit root tests and the result is presented in Table 3. Insight from the ADF and PP tests results showed that our variables are of different orders. They are combination of I(0) and I(1) variables. Since, the use of ARDL precludes variables of order 2 (I(2)) and beyond, the result in Table 3 justified the adoption of ARDL technique of analysis

Table 3

Unit Root Test Result (constant and Trend)

	ADF Test			**PP test**		
Variables	**Level**	**1st Diff**	**Order**	**Level**	**1st Diff**	**Order**
MANU	-1.056	-6.833***	I(1)	-0.982	-6.871***	I(1)
EXR	-1.807	-4.289***	I(1)	-1.852	-4.291***	I(1)
EXRVOL	-5.170***	-	I(0)	-5.172	-	I(0)
INTRT	-2.183	-5.170***	I(1)	-2.114	-6.685***	I(1)
INFL	-3.836**	-	I(0)	-2.734	-9.622***	I(1)
IMP	-2.709	-4.564***	I(1)	-2.62	-15.517***	I(1)
INV	-3.758***	-	I(0)	-3.896***	-	I(0)

Critical Value 1%=-4.244, 5%=-3.544, 10%=-3.205

Note: *,**,* denote 1%, 5% and 10% level respectively**

Having established the order of integration of our data series, the next step is to test for the existence of cointegration among the variable of interest. This study employed the Bound Test approach proposed by Pesaran *et al.* (2001). Evidence from Bound Test result in Table 4 revealed that our computed F-statistic is greater than upper critical bound I(1). This suggests that the null hypothesis of no cointegration is rejected.

Table 4

ARDL Bounds Test for Cointegration

Variables	**F-statistic**	**Cointegration**
F(MANU,EXR,EXRVOL,INTRT,INFL,IMP,GCF)	5.66***	Cointegration
Critical Values	Lower Bound	Upper Bound
1%	2.96	4.26
5%	2.32	3.50
10%	2.03	3.13

Note: *,**,* denote 1%, 5% and 10% level respectively**

Hence, the result confirmed the existence of long-run relationship the performance of manufacturing sector, exchange rate, exchange rate volatility, interest rate, inflation, import and gross capital formation in Nigeria.

Having established the existence of long run relationship among the variables, we proceeded to estimate equation 3 which represents the long-run model. The result is presented in Table 5.

Table 5

Estimated Long Run Coefficients

Variable	**Coefficient**	**t-Statistic**	**Prob.**
C	-3.0310	-1.1176	0.3006
EXR	0.0276	1.6461	0.1437
EXRVOL	18.0812***	9.7194	0.0000
INTRT	0.4129***	7.2629	0.0002
INFL	-0.0790	-1.7861	0.1172
IMP	-0.2846***	-11.2503	0.0000
GCF	0.4185***	8.0764	0.0001

Note: *,**,* denotes 1%, 5% and 10% level respectively**

Our empirical evidence reveals that the effect of exchange rate volatility is positive and significant at 5% level. This suggests that, in the long run, a unit increase in exchange volatility rate increases the manufacturing sector's performance by 18 units. However, the impact of exchange rate on manufacturing sector's performance, though positive, is not significant in the long run. Our results is in line with the study of Lawal (2016). Contrary to the existing literature, the study found that the effect of interest rate on manufacturing sector's performance is positive and significant. However, the result is in tandem with the findings of Abdul-Mumuni (2016) who observed a positive relationship between interest rate and manufacturing sector's output in Ghana. In addition, inflation exerts negative impact on the performance of manufacturing sector in the long run while the impact of import on manufacturing sector's performance is negative and significant in the long run.

Turning to our error correction model in equation 4, the result in Table 6 revealed that the error correction term is negative and significant. This further confirm the existence of long-run

relationship among the variables of interest. Unlike the long-run result, the impact of exchange rate on manufacturing sector's performance is negative and significant at 10%. This suggests that exchange rate appreciation adversely affect the performance of manufacturing sector in Nigeria. This is in tandem to economic theory because exchange rate appreciation encourage import which would reduce the demand for local goods. Similarly, both previous years' and current values of exchange rate volatility are significant, though with different signs. In addition, current year's interest rate, inflation, import and gross capital formation follow similar pattern with that of long-run relationship. However, their lag values, though significant at different levels, affect the performance of the sector in opposite direction. For instance, evidence from Table 6 revealed that a one unit increase in the previous year's interest rate reduces the performance of manufacturing sector by 0.3 units in the short run.

Table 6

Estimated Short-Run Coefficients

Variable	Coefficient	t-Statistic	Prob.
D(MANU(-1))	0.596251	2.777521	0.0274
D(EXR)	-0.021969	-1.913137	0.0973
D(EXR(-1))	-0.014645	-1.075877	0.3177
D(EXRVOL)	8.992753	5.439441	0.001
D(EXRVOL(-1))	-6.611723	-6.01585	0.0005
D(EXRVOL(-2))	-4.43732	-4.89994	0.0018
D(INTRT)	0.33227	2.611276	0.0348
D(INTRT(-1))	-0.314599	-2.732843	0.0292
D(INTRT(-2))	0.259888	2.206016	0.0632
D(INFL)	0.079523	3.665297	0.008
D(INFL(-1))	-0.085574	-3.952844	0.0055
D(INFL(-2))	0.107784	3.189056	0.0153
D(IMP)	-0.204341	-4.590587	0.0025
D(IMP(-1))	0.033366	1.110367	0.3035
D(IMP(-2))	0.048664	1.997779	0.0859
D(GCF)	0.276177	3.922701	0.0057
D(GCF(-1))	-0.066758	-0.749396	0.478
D(GCF(-2))	-0.222691	-3.613863	0.0086
CointEq(-1)	-1.33704	-6.008478	0.0005

Note: *,**,* denotes 1%, 5% and 10% level respectively**

Similarly, the effect of one year lag in inflation negatively affect the performance of the sector. Specifically, a unit rise in inflation would reduce manufacturing sector's performance by 0.08 unit in the short-run. However, both first and second year lags of gross capital formation are significant but negatively affect the performance of the sector in the short-run.

To confirm the stability of our model, we performed various diagnostic tests. The results of these test is presented in Table 7. Specifically, diagnostic tests such as Breusch-Godfrey Serial Correlation LM test, ARCH heteroscedaticity test Jarque-Bera test and CUSUM and CUSUMSQ

tests were performed to test for serial correlation, heteroscedaticity, normality and stability tests respectively of our chosen models. Evidence from Table 7 revealed that there is absence of serial correlation and heteroscedaticity as confirmed by the significance of f-statistic tests. In addition, the hypothesis of normality is accepted based on the value of J-B test suggesting that error term from the model is normally distributed at 5% level of significance.

Table 7

Diagnostic Tests

Tests	F-stat	Prob.
□2 SERIAL	0.885	0.52
□2 ARCH	0.016	0.901
J-B Test	5.451	0.065

Notes

1 ***,**,* denote 1%, 5%, and 10% level respectively
2 □2 SERIAL is LM test for serial correlation
3 □2 ARCH is for Heteroscedasticity test
4 J-B test is Jarque-Bera Normality test
5 F-statistic is not applicable to Jarque-Bera test

The result from Figure 2 and figure 3 demonstrated that the plots of both CUSUM and CUSUMSQ lie within the critical bounds of 5%. This suggest that our chosen models are stable and do no suffer from structural instability over the study period.

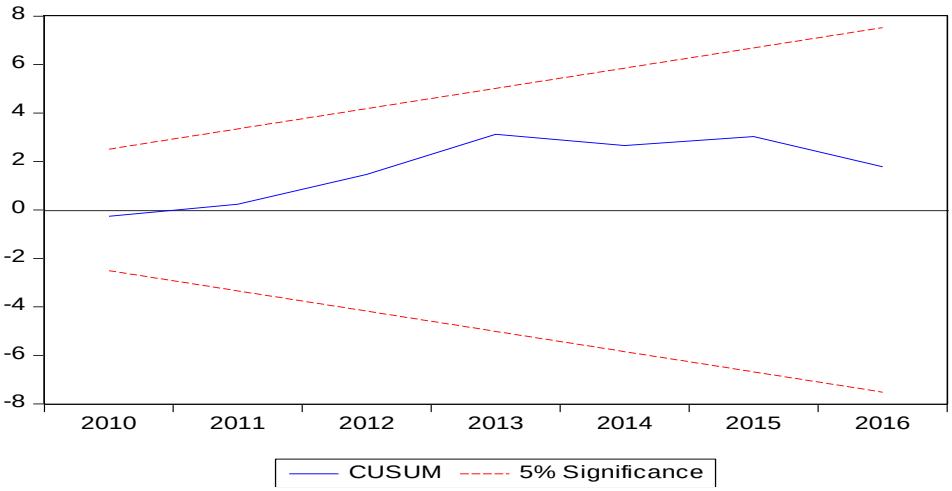


Figure 2: CUSUM Stability Test

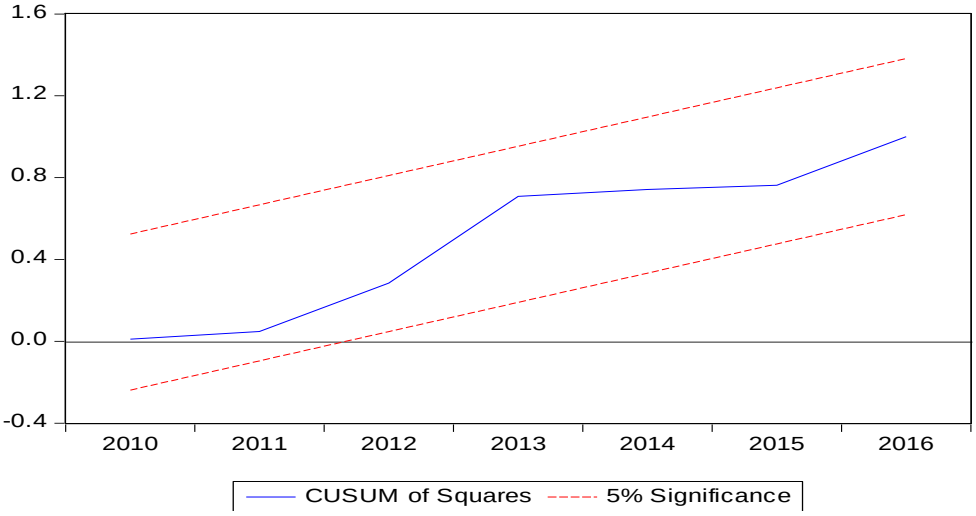


Figure 3: CUSUMSQ Stability Test

5. Summary and Conclusion

The study examined the effect of exchange rate volatility on the performance of manufacturing sector in Nigeria for the period of 1981 to 2016. Annual data were sourced from World Development Indicators of World Bank and Statistical Bulletin of the Central Bank of Nigeria. Based on the result of unit root test, an ARDL technique of estimation was employed. The result from Bounds Test for cointegration revealed the evidence of long-run relationship among manufacturing sector's value added, exchange rate, exchange rate volatility, interest rate, inflation, import and gross capital formation. This suggests that all the variables of interest move together in the long-run.

Findings from the study revealed that the impact of exchange rate volatility on manufacturing sector's performance is positive and significant both in the long-run and short-run. In addition, the study found that the impact of exchange rate on manufacturing sector's output is positive but not significant in the long-run while its impact is negative and significant in the short-run. Furthermore, the effect of import on manufacturing sector's performance is negative and significant in the long-run and short-run.

Based on these findings, policy makers and government should encourage and revisit the existing import-substitution industrialization strategies to encourage local manufacturers to produce those goods that are currently imported from so as to increase the demand and consumption for locally made goods. This would in turn boost the output and performance of manufacturing sector in the Nigeria. Furthermore, Central Bank of Nigeria should implement policies to address frequent fluctuations in exchange rate to protect the manufacturing sector from exchange rate movement.

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