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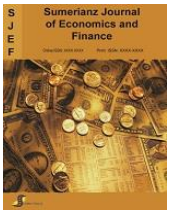

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Asymmetric Dynamics of Industrial Response to Exchange Rate Variation in Nigeria

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Abstract

Exchange rate policies are germane to industrial subsector development and the country at large. In this regard; the study examines the asymmetric pass through of official exchange rate policy on Nigerian industrial Subsector from 1970_{Q1} to 2019_{Q4}. Non-linear ARDL method of estimation was adopted to ascertain the long run and short run asymmetric relation between official exchange rate and industrial output subsector. The results confirmed the presence of both long run and short run asymmetries between manufacturing output and official exchange rate. In the long run, increase in official exchange rate (appreciation) portends a corresponding increase in manufacturing output, while decrease in official exchange rate (depreciation) is negatively related to manufacturing output. On the other hand, the short run dynamics revealed that positive changes in official exchange rate choked off industrial output though statistically insignificance while negative change (depreciation) crowded in industrial output in Nigeria in the period under review against a priori expectation. The result also indicated that the crowding out impact of official exchange rate depreciation is more enduring (long lasting) compared to the positive variations. The presence of asymmetry is novel and instructive for policy pundits, executors, theorists, monetary authorities and allied agents to take decisive steps in order to stem the debilitating effects of exchange rate misalignment to encourage domestic investors, attract foreign investors and thus, stimulate the industrial subsector.

Keywords: Exchange rates; Non-linear; ARDL; Asymmetries; Industrial output.

1. Introduction

Industrialization refers to structural changes in which industrial production dominates primary and agricultural production. A nation is said to be industrialized when an agrarian economy dominated by the use of elementary tools gives way to one in which machines and power tools are widely developed within a structural automated factory environment. Key features of industrialization include: application of scientific method to solve problems, mechanization and factory-based mass production, liberalization of the financial subsector, and enhanced labour mobility spatially and socio-economically (Mailafia, 2016).

Industrialization is said to be a significant measure of modern economic growth and development but the Nigerian industrial sector has suffered from decades of low productivity. Industrialization is generally argued to be capable of increasing the pace of economic growth and ensuring swift structural transformation of the economy. The critical role of the industrial sub-sector predicated on the fact that it acts as an engine of growth by broadening the productivity and export base of the economy, reducing unemployment and minimizing rural-urban drift as well as helping to reduce poverty.

Despite the abundance of natural and human resources, Nigerian has failed to achieve industrial development. Different policies and reforms by various governments aimed at turning the industrial sector around have largely been unsuccessful as the sectorial contribution of the industrial sector to gross domestic production remains very low and insignificant (Ewatan and Ike, 2014).

Various researchers have had submissions on importance of manufacturing subsector and its relative contributions to economic growth of nations. The manufacturing subsector had been adjudged to have the potentials of providing mass employment for low skilled workers, providing foundation for economic growth and longtime economic development. (Arvind and Danish, 2009; Ugarwal and Govt, 2002). Based on these several studies been carried out to examine the determinants of the growth of output in the Nigerian manufacturing sub-sector, exchange rate volatility is a major determinant (Olawumi and Ogungbenle, 2016).

The price at which one currency is exchanged for another is called the exchange rate. In Nigeria, management of exchange rate is vested in the Central Bank of Nigeria, and it comprises the optimal choice of the foreign exchange rate regime that would ensure both internal and external balances in the economy. This involves the sum total of the institutional frame work and measures put in place to propagate the exchange rate towards desired levels in order to

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stimulate the productive sectors, curtail inflation, ensure internal balance, and improve the level of export among others (Oloyede, 2014).

Exchange rates are important tool kits of monetary policy. Exchange rate volatility could affect industrial investment through some channels namely: the cost of imported inputs relative to other factors of production, price of exports relative to foreign competitors and the cost of external borrowing (Anubha, 2013). Firms may be unable to import adequate quantity of intermediate input from abroad as a result of exchange rate uncertainty. Therefore, the effect of exchange rate variation on industrial output is essential for the design of both exchange rate and industrial policies.

A large number of firms in Nigeria sourced their raw materials, equipment and machineries from abroad; hence they are highly vulnerable to the risk associated with exchange rate movements. For instance, suppose a Nigeria firm wishes to purchase some commodities from U.S with payment due after two (2) months, if the Naira unexpectedly depreciates relative to the U.S dollars; the Naira value of the purchase contract rises. This change imposes an additional higher cost on the importing firm, making its profit lower than anticipated.

The growth and performance of firms in Nigeria in the past decades have deteriorated beyond the rate at which they grew in the past three decades. A report by the Manufacturers Association of Nigeria (MAN) in 2019 indicated that more than 800 firms had closed down in the past 10 years and others had exited to neighboring countries due to high exchange rates uncertainty among other debilitating factors such as tough operating environment.

Given the importance of the manufacturing subsector in economic growth and development, and the "epileptic" contribution of this subsector to gross domestic product (GDP) and the relative importance of exchange rate in galvanizing industrial output, exchange rate in Nigeria have undergone several reforms since the enactment of the Exchange Control Act in 1962. It shifted from a fixed exchange rate regime in the 1960s to a pegged arrangement between 1970s and 1980s and various episodes of floating regimes since 1986 following the adoption of Structural Adjustment Programme (SAP) and till now, the exchange rate is evolving: Dual exchange rate system in 1986, Dutch Auction system in 1987, Interbank Foreign Exchange Market (IFEM) in 1989, Nigerian Exchange Window in 2015, Inventors and Exporters Forex Window in 2017.

The evolution of exchange rates through various regimes is not peculiar to Nigeria as many countries also experienced similar reforms since the breakdown of the Breton Wood System in 1973. Given these gamut of exchange rate reforms in Nigeria over the years, what has been the response of the industrial sub-sector to exchange rate variations? Which of them has a greater impact on industrial output: Exchange rate appreciation or depreciation? And which of them is preferred and why? These are some of the questions this study will provide answers. This study is structured into five sections; namely; the Introduction, Review of Literature. Section III examines the Evolution and Management of Exchange Rates in Nigeria. Section IV discussed the Research Methods while Section V dealt with Data Analysis and Discussion of Findings.

2. Review of Related Literature

2.1. Empirical Analysis

Several studies had examined the relationship between exchange rate variation and manufacturing output and firm's investment. Alleta *et al.* (2003), investigated the relationship between exchange rates uncertainty and firms' investment in Italy. Employing the dynamic error correction model, the study revealed that an increase in exchange rate volatility reduces firms investment spending. It was also shown that the impact of exchange rate on a firm depends on the sector it operates and the market power.

Based on industry level data for 22 manufacturing industries, Tarek *et al.* (2005), examined the relationship between exchange rates and industrial output between 1985 and 1997 in Canadian manufacturing industries. A GARCH model was adopted to measure exchange rate volatility. Two stage least squares and GMM estimation were conducted. The empirical findings indicate that the overall effect of exchange rate on output Canadian Manufacturing Industries were statistically insignificant. The analysis provided different evidences among output in different sectors. When exchange rate volatility is high, industries tend to reduce output. In a low volatility regime, output in manufacturing subsector increases.

Concentrating on North American Free Trade Agreement (NAFTA) economy, Miguel and Pablo (2009), investigated the responsiveness of Mexican economy to real exchange rate shocks using plant level data from 1984 to 1992. A balanced Panel Regression Analysis was employed using data in real exchange rate, and employment sales and expenses in manufacturing firms in Mexico. The evidence from the regression analysis indicates that after passage of North American Free Trade Agreement (NAFTA), exporting Firms exhibited higher growth rates of employment, sales and output compared to non-exporters. The results supported the view that the selected industries in Mexico had increased producers response to real exchange rate shocks.

The effect of real exchange rate changes on the manufacturing sector performance was also examined by Shaswana (2013). The study laid out the stylized facts regarding the transmission of industry specific real exchange rate shocks to firm level performance using data obtained from Indian firms. It was found that exchange rate movements have significant effect on firms' performance through the import cost channel but not through the export channel. This study implies that the impact of exchange rate on firms depends on their degree of market power.

Similarly, the study of Mustafa and Demir (2011) in Turkey, investigated the effects of exchange rates levels and volatility on the productivity growth of manufacturing firm with heterogeneous access to debt, domestic and foreign equity in Turkey. A Dynamic Generalized Method of Moment (GMM) estimation technique was adopted for the model. Exchange rate volatility was measured using GARCH (1, 1) model. In addition, standard deviation was applied for the first difference of the logarithm of the data. They found that, while exchange rate volatility affects

productivity negatively, access to foreign or domestic equity or debt market does not alleviate these effects. Also, foreign owned or publicly traded companies do not appear to perform significantly than the local private ones. Further evidences revealed that firm's productivity are positively related to access to external credit. Thus, the results show that while export oriented firms are affected less by exchange rate appreciation, they are more sensitive to exchange rate volatility.

In Colombia, Kandilov and Leblebicioglu (2011), investigated the impact of exchange rate volatility on firms' investment decision in manufacturing firms. The study used a variant of the methodology adopted by Mustafa and Demir (2011). It employed plant-level data of manufacturing firms and estimated a dynamic investment equation using the system GMM technique, GARCH technique and simple standard deviation of exchange rate to compare the results. The study found a significant and negative effect of exchange rate volatility, measuring either using GARCH model or standard deviation on firms' investment in Colombia. The findings show that the negative effect is mitigated for firms with higher markup exports and exacerbated for plants with larger volume of imported intermediates.

In Taiwan tourism industry, Chang (2014), examined the size effects of exchange rate volatility spill over for firm performance. BEKK-GARCH and VARMA –AGARCH specification was applied. It was found that there are size effects of volatility spillovers from the exchange rate to firm performance. A negative correlation was obtained between exchange rate and stock returns.

McAleer *et al.* (2009), argued that the model of conditional variance simultaneously, captures the properties of asymmetric effects and volatility spillovers in variables. Dayo (2016), using the Generalized Autoregressive Conditional Heteroskedasticity test (GARCH), examines the effect of exchange rate volatility on firms' investment decision in Nigeria. The results show that exchange rate volatility significantly affects firms' investment, hence productivity in Nigeria. Using non-linear Autoregressive Distributed lags (NARDL) on United States (U.S) data revealed short-run non-linear effects of exchange rate on industrial products index (IPI) and the short-run effects last into the long-run for all the sectors examined. This also shows the existence of a non-linear relationship between exchange rates and industrial production index.

Recently, the study of Ogunjimi (2020), showed that exchange rate dynamics has no asymmetric impact or sectorial performance in Nigeria. This implies that positive and negative exchange rate movements have the same impacts on sectorial output in the short and long-run. He further revealed that exchange rate dynamics (depreciation and appreciation) is positively related to agricultural and service sector output but inversely related to industrial output.

Given the observed contradictions on the impact of dynamic exchange rate on industrial output in the examined literatures, it becomes inevitable to undertake this study in order to settle what appears to be a lingering doubt.

3. Review of Exchange Rate Management in Nigeria Industrial Sub -Sector

The main objectives of exchange rate policy in Nigeria are to preserve the value of the domestic currency, maintain a favorable external reserves position and ensure external balance without compromising the need for internal balance and the overall macroeconomic stability. The use of exchange rate as an instrument of control in the Nigerian economy has been rather limited. During the period of fixed exchange rate (1960 -1986), Nigeria pegged its currency with the Great Britain Pound (GBP) Sterling until the devaluation of the Pound in 1967. Subsequently, the country's currency maintained parity with the US dollar up to 1973 when the Nigerian pound was changed to naira. This is because the exchange rate policy of pegging the naira to the US dollar were found to be a drag on the Nigerian economy thus, depleting the external reserves of the country. Fixed Exchange Rates were established for both the British pound sterling and the US dollar at £0.5833 and U.S $1.5200 to ₦1.00 respectively (CBN, 2002).

During the period of fixed exchange rate, the Nigerian currency was perceived to have been overvalued. In order to find a realistic value of the naira, a Second-tier Foreign Exchange Market (SFEM) emerged in September 1986, under the Structural Adjustment Programme .This marked the beginning of flexible or floating exchange rate regimes. Various related market-based exchange rate policies and different downward exchange rates have been experienced, as shown in Table 1.

Table-1. Exchange Regimes and Industrial Response in Nigeria

S/N	**Policy Measures**	**Exchange Rate**	**Industrial Response**
1	Dual exchange rate system (introduction of SFEM with the initial First Foreign Exchange Market) in September, 1986	The value of naira stood at #2.0206/USS	Low capacity utilization Contribution of industrial output to GDP stood at 7%
2	Dutch Auction System (DAS) of bidding was introduced in April, 1987	Naira depreciated to #4.00/USS	Contribution of industrial output to GDP fell to 6.5%. Low capacity utilization
3	Single Enlarged Foreign Exchange Market with various pricing methods in July, 1987 introduced.	Naira depreciated to #4.00/US$	Gradual movement from light industry to heavy manufacturing industries.
4	Creation of Inter-Bank Foreign Exchange Market (IFEM) in January, 1989	Naira depreciated to #12.00/US$	Gradual movement from light industry to heavy manufacturing firms continuous

5	Pegged exchange rate system was introduced in 1994 temporary.	Naira was pegged at #21.00/US$	Gradual movement from light industry to heavy manufacturing firms Contribution of industrial output to GDP fell to 4.8%
6	Autonomous Foreign Exchange Market (AFEM) in 1995	Naira remained unchanged at #21.00/US$	Contribution of industrial output to GDP fell to 4.6%. Establishment of multinational industries
7	Re-introduction of IFEM in October, 1999.	Naira depreciated drastically to #108.000/US$	Contribution of industrial output to GDP fell to 4.2%. Establishment of multinational industries continued.
8	Retail Dutch Auction System (rDAS) of foreign exchange management was introduced in July, 2002	Naira depreciated to #130.8500/US$	Contribution of industrial output to GDP fell to 4%. Low capacity utilization
9	Wholesale Dutch Auction System (wDAS) was introduced February, 2006 to October, 2013	Naira depreciated to #141.00/US$	Exit of multinational industries from Nigeria began.
10	Again, rDAS was reintroduced in 2013 to February 18, 2015. CBN closed the rDAS and moved from exchange rate management band of -/+5% midpoint of #169.68/U$ to #197/US$.	Exchange rate stabilized at #195.52/US$ in 2015.	Exit of multinational industries from Nigeria continued. High job loss persists.
11	Inclusion of 41 items in the list of items not valid for foreign exchange at the Nigerian exchange window, June 23, 2015 was introduced.	Exchange rate stabilized at #195.52/U$ in 2015.	Contribution of industrial output to GDP fell to 3% Low capacity utilization. High job loss persists.
12	Introduction of more flexible exchange rate regime, June 2016	Interbank rate closed at #283.00/US$ at end-June 2016.	Exit of multinational industries from Nigeria continued. Harsh operating environment. High job loss
13	Establishment of the Investors and Exporters forex window on April 21, 2017	The I&E exchange rate closed at #366.44/US$ at end-June 2017.	Low manufacturing export. High cost of imported input High job loss
14	Foreign exchange market was further liberalized on June 5, 2017 by allowing authorized dealers to sell their excess foreign currency trading limit positions without seeking prior approval from the CBN.	Interbank rate closed at #305.90/US$, against N305.00/US$ at end-December 2016.	Contribution of industrial output to GDP fell further High cost of imported input High import of industrial output
15	Foreign exchange market liberalization of 2017 continued till date with CBN financing foreign exchange to import subsector.	Naira depreciate further to # 360.00/ US$ in 2020.	High cost of imported input. High import of industrial output.

Sources: CBN Annual Reports (2015, 2017& 2019).

The intermittent changes in foreign exchange management policy and exchange rate fluctuations observed in Table 1 discouraged firms from undertaking investment, innovation and trade. It may also account for the reluctance of most firms to enter into the export market, thereby weakening investors' confidence in the sector. From another perspective, it also affected the price of imported inputs such as seeds, fertilizers, pesticides, and capital equipment, thereby reducing availability of agricultural commodities and income of farmers.

From the above table, it could be observed that exchange rate variation (misalignment) has affected industrial output and its contribution to Gross Domestic Product (GDP) over the years.

4. Method of Estimation

Literature reveals that several studies relating to industrial output and exchange interest rate are mostly investigated using the time series techniques involving Cointegration, Error-Correction Mechanism and sometimes Granger Causality Models. These techniques, while offering the chances of estimating the long and the short run linkages of their variables, assumes symmetric interaction between industrial output and exchange rate. However, exchange rate variation are usually the result of macroeconomic policies aimed at competitive rate to boost industrial output without dislocating other macroeconomic fundamentals. Therefore, it can be subject to periods of appreciates or depreciates.

Hence symmetries to techniques may not be sufficient to capture the mobile asymmetries in industrial output and exchange dynamics resulting among other from market situation and government policies. It is imperative to capture the asymmetries in order to highlight the essential differences in response of economic variable to positive and negative shocks. To solve this problem, (Shin Yu. and Mimmo, 2013) advanced a non - linear ARDL (NARDL) co-integration technique as an extension of the traditional ARDL to capture the asymmetric relations of both long run and short run of variables of interest.

4.1. Theoretical Frame Work

The empirical model in equation (1) below is anchored on the standard Is-Lm framework proposed by the structuralists: It has been argued in the literature that exchange rate has effect on output through the interaction between aggregate demand and supply, Kandil and Mirzale (2002) and Yagul (2013). This however justified the inclusion of lending interest rate and financial deepening in the equation. The Shin Yu and Mimmo, Non-linear ARDL estimation technique was applied to examine the relationship between industrial output and exchange rate variation in Nigeria.

4.2. Model Specification

To develop a full Non-Linear ARDL Model, it is pertinent to specify the asymmetric long run regression of industrial output as follows:

$$INDMt = f\left(\left(\frac{m2}{Gop}\right) t, INTt, \ OEXR_t^{+}, OEXR_t^{-}\right) \quad 1$$

Equation 1 could be expressed in operational form as;

$$INDMt = \beta_0 + \beta_1\left(\frac{m2}{GDP}\right)_t + \beta_2 INT_t + \beta_3 OEXR_t^{+} + \beta_4 OEXR_t^{-} + U_t \quad 2$$

Where $\left(\frac{m2}{Gop}\right)$ is the ratio of total money supply to GDP, INT is lending interest rate and OEXR is official exchange rate, while $\beta = (\beta_0, \beta_1, \beta_2, \beta_3, \beta_4)$ is a vector of long-run parameters to the estimated $OEXR_t^{+}$ and $OEXR_t^{-}$ in equation (2) are the partial sums of positive and negative changes in official exchange rate (these capture official exchange rate appreciation and depreciation respectively) $OEXR_t$ could be expressed as;

$$OEXR_t = \sum_{t=1}^{t} \Delta OEX\ R_t^{+} = \sum_{t=1}^{t} Max\ (\Delta OEXR_t, O) \quad 3$$

$$OEXR_t^{-} = \sum_{t=1}^{t} \Delta OEX\ R_t^{-} = \sum_{t=1}^{t} Min\ (\Delta OEXR_t, O) \quad 4$$

Following Shin Y. *et al.* (2011) equations can be situated in an ARDL framework. See Pesaran and Shin (1999) and Pesaran *et al.* (2001).

The Maximum and Minimum in equation 3 and 4 above represents the increases and decreases of the partial sum of the exogenous variables. From the above formulation, the long run relationship between industrial output and exchange rate increases (appreciate) is β_3. If β_3 is positive and significant, it predicts a direct impact of exchange rate on industrial output and vice-versa. Also, β_4 captures the long run relationship between industrial output and a reduction (depreciate) in exchange rate. If both β_3 and β_4 are insignificant; it indicates that increase and decrease in official exchange rate do not impact on industrial output.

In Shin Yu. and Mimmo (2013), the operational non-linear ARDL model is specified as follows:

$$\begin{aligned}\Delta InDM_t \ &= \propto_o + \propto_1 InDM_{t-i} + \propto_2 \left(\frac{M_2}{GDP}\right)_{t-i} + \propto_3 Int_{-i} + \propto_4 OEXR_{t-i}^{+} \\ &+ \propto_5 OER_{t=i}^{-} + \sum_{i=1}^{p} \curlywedge_1 InDM_{t-i} + \sum_{i=1}^{p} \curlywedge_2 \left(\frac{M_2}{Gdp}\right)_{t-i} \\ &+ \sum_{i=1}^{p} \curlywedge_3 \Delta Int_{t-i} + \sum_{i=1}^{p} (\curlywedge_{4\Delta OEXR_{t-i}^{+}} + \curlywedge_5 \Delta OE \times R_{t-i}^{-}) + U_t \quad 5\end{aligned}$$

Where all variables are as earlier defined and Ps are lag orders and $\beta_1 = \frac{\propto_2}{\propto_1}, \beta_2 = \frac{\propto_3}{\propto_1}$

$\beta_3 = \frac{\propto_4}{\propto_1}, \beta_4 = \frac{\propto_5}{\propto_1}$, are the long run effects of the level of financial deepening, interest rate variability, official exchange rate increase and official exchange rate decrease on industrial output in Nigeria during the period under review.

Official exchange rate increase (appreciation) is expected to have positive effect on industrial output while a negative relationship is expected between official exchange rate decrease (depreciation) and industrial output.

$\sum_{t=1}^{P} \curlywedge_4^{+}$ Captures the short-run effects of official exchange rate increase on industrial Output, while

$\sum_{t=1}^{P} \curlywedge_5^{-}$ Measures the short-run effects of official exchange rate decrease on the industrial output variable.

The asymmetric short-run of official exchange rate variation on industrial output variable are also captured in addition to the asymmetric long-run relation. Thus, the long run and short-run asymmetric relation between industrial output and official exchange rate are obtained from equation 5.

5. Results and Synthesis

The unit root test were conducted for all the variables using ADF and KPSS to ascertain the stationary level of the variables in order to avoid spurious results and also to ensure that none of the variables is I (2). The result of the ADF and KPSS are presented in Table 5.1 below and are based on 5 percent level of significance. The test equations for the unit root test are constant and a linear trend.

Table-5.1. Unit Root Tests using ADF and KPSS

	ADF			KPSS		
Variables	Levels	1st Diff.	1(D)	Levels	1st Diff	I(D)
$INDM_t$	-0.461	-3.326*	I(1)	3.219*	-	1(0)
$OEXR_t$	-3.323*	- -	I(0)	-0.214	-3.456**	I(1)
$LINT_t$	-3.492*	-	I(0)	-2.321	-4.61**	I(1)
M^2/GDP_t	-0.231	-3.411**	I(1)	-0.249	-3.624**	1(1)

Source: Authors test output. **Note**: * indicates variable that are stationary at, level and ** show stationary at first difference

The results of the Unit Root Test; index of manufacturing output, official exchange rates, lending interest rate and the ratio of narrow and broad money to GDP (Financial Deepening) are consistent for both ADF and KPSS. Thus, arising from both tests, the ADF and KPSS, the variables are integrated of order 0 and I. Official Exchange Rate and Lending Interest Rate are integrated of order 0, while Index of Manufacturing Output and the Ratio of Money Supply to GDP are integrated of order 1.

Having established that none of the variables is 1(2), we proceed to the bounds testing procedure to examine the existence of Cointegration among the variables of the models. The bounds F-Statistics for non-linear Cointegration are reported in Table 5.2. The bounds test indicate the existence of long run relationship between Index of Manufacturing Output and the stated determinants including the level of Financial deepening, lending interest rates an official exchange rates variation.

Table-5.2. Bounds Test For Non-linear Cointegration

NARDL Depdt variable	Computed F - value	Sign Level	Lower Bound I(0)	Upper Bound I(1)
Δ(INDM)	5.296	10% 5% 1%	2.629 2.699 3.624	2.792 2.832 3.692

Source: Authors computation

The F-statistic of 5.296 exceeds the critical upper bound at 5 percent significance level. From the results of the bounds test; we deduce that there is a co-movement between manufacturing output index, financial deepening, lending interest rates and official exchange rates.

Taking from these findings of the existence of long run relationships, we therefore, examine the manufacturing output index dynamics and its relation to the ratio of money supply to GDP. Lending interest rates, positive and negative changes in official exchange rates. The results of the test of symmetry in the long and short run are reported in Table 5.3. In the long run relationship, the null hypothesis of symmetry against the alternative of asymmetry was tested using the Wald Statistic

Table-5.3. Wald Tests for the present of long run & short run Asymmetry

Chi-Square Statistic	Values
16.202 (LR) 0.326 (SR)	0.0021 0.0024

Notes: The long-run and short-run asymmetries of the effects of exchange rate (appreciation and depreciation) on industry output variable using the wald test LR and SR and long-run and short-run respectively.

Given the significance of the probability value of the test, we reject the null hypothesis of no asymmetry. This implies that there is asymmetry or coefficients of the positive and negative changes not correlating. The estimated non-linear equation for which results are presented in Table 5.4

Table-5.4. Non-linear ARDL Estimation Results Independent variable (INDM)

Regressors	Coefficient	t-stat.	Prob.
Constant	0.321	0.562	0.062
INDM (-1)	5.646	4.321	0.002
$(m_2/G\Delta P)$ (-1)	5.440	2.051	0.021
INT(-1)	-5.091	-3.061	0.004
OEXR-P(-1)	4.069	4.564	0.003
OEXR -N(-1)	-6.110	-0.440	0.526
DINDM(-1)	3.560	0.521	0.303
DINDM(-3)	3.433	2.021	0.006
$D(m_2/GDP)(-1)$	1.033	4.929	0.001
$D(m_2/GDP)(-3)$	2.101	2.621	0.004
D(INT)	-1.396	-3.467	0.040
D(INT) (-2)	-2.104	-4.809	0.219

DOE x R-P(-1)	-1.309	-0.321	0.121
D OEXR -P(-3)	-1.328	-0.495	0.541
D OEXR -N(-2)	1.419	0.464	0.061
D OEXR -N(-3)	2.414	1.062	0.020
ECM(-1)	-0.266	-0.146	0.061
R^2	0.726	-------	-------
Adj. R^2	0.714	--------	-------
Jaeque-Bera	2.621	2.092	0.003
LM(1)	1.171	2.114	0.004
LM(2)	0.326	1.976	0.010
ARCH(1)	3.204	2.041	0.030
ARCH(2)	1.762	3.061	0.020

Note: Jack-Bera test is normality test, LM is the serial correlation test and the ARCH is the test for autocorrelation conditional heteroscedastity. Both the LM and ARCH are to up k lag of order 2.

From the Stepwise results presented in Table 5.4, there is the presence of asymmetry pass through given the decomposed values and signs of official exchange rates are not the same. This is confirmed by some insignificant values of the probabilities of the asymmetry results in Table 5.4. This implies that both positive and negative shocks from official exchange rates affect the manufacturing subsector in different ways. From the Table, we deduce a long run asymmetries between index of manufacturing output and official exchange rates shocks – (increase and decrease). Official exchange rate increase (appreciation) has significant positive or expansionary effect on manufacturing output to the value of 4.069 (0.003) while, official exchange rates decrease (depreciation) have insignificant negative (contractionary) effect on the same manufacturing output with a value -6.110 (0.526). This asymmetric effect of exchange rates on manufacturing output was evidenced in Nigeria during the Pre-SAP era when the manufacturing sub-sector contributed substantially to the Gross Domestic Product (GDP) at relatively high exchange rate when compared to the Post – SAP era when exchange rates plummeted drastically.

The long run effects of official exchange rate shocks on manufacturing output are in conformity with the predictions in the theory. Our findings on the contractionary official exchange rate depreciation on output are in line with, Yaqub (2010), Adelowokan *et al.* (2015), Oladapo and Iyabo (2019), however in contrast with Edwards (1989), Odusola and Akinlo (2001), Adewuyi (2005) and Ehinomen and Oladapo (2012). The short run dynamics as shown in Table 5.4 indicate a greater asymmetric impact of increase in official exchange rates on the index of manufacturing output though against stated a priori expectation.

The one period-lagged change in official exchange rates increase is negatively related to manufacturing output but insignificant with a value of -1.309 (0.121). the three period lagged variations in official exchange rate increase further reinforced and confirmed the negative effects of short run dynamic on manufacturing output with a value of -1.328 (0.541), while that of official exchange rate decrease is positive for both two and three period-lagged and statistically significant with value of 1.490 (0.001) and 2.414(0.020) respectively.

Contrary to theoretical expectations as evidenced in the short run dynamic could be adduced to the insufficient time period needed by manufacturers to adjust their investment portfolios to mitigate the official exchange rate mis-alignment at that point in time and other intervening macro-economic variables like inflationary pressure, low lending interest rates high capacity utilization and increase in local contents. The estimated non-linear model diagnostic tests presented in Table 5.4 well behaved. The results of the diagnostic test show error normality, absence of auto-correlation and ARCH effects at 5 percent level. The speed of adjustment (ECM) is correctly signed though not statistically significant -0.266 (0.061). Structural stability is conducted for the estimated equation using the CUSUM and CUSUMA and found to be stable as the line fall within the upper and lower boundaries at 5 percent level in both cases as shown in Figure 1 below.

Fig-1a. CUSUM

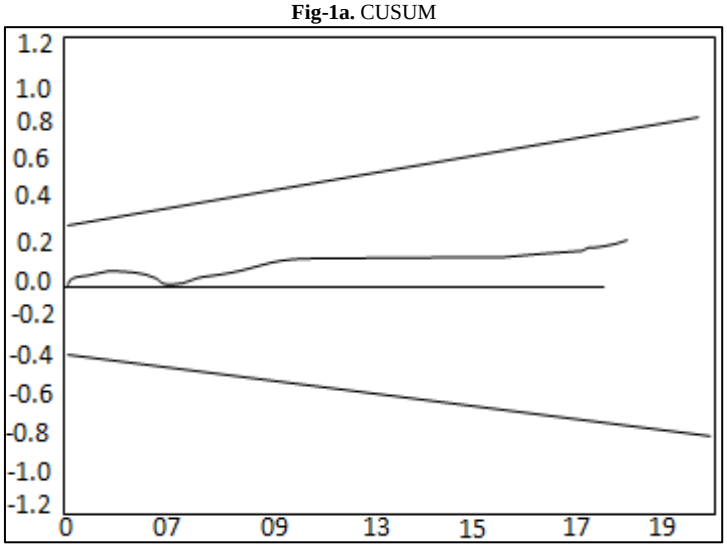
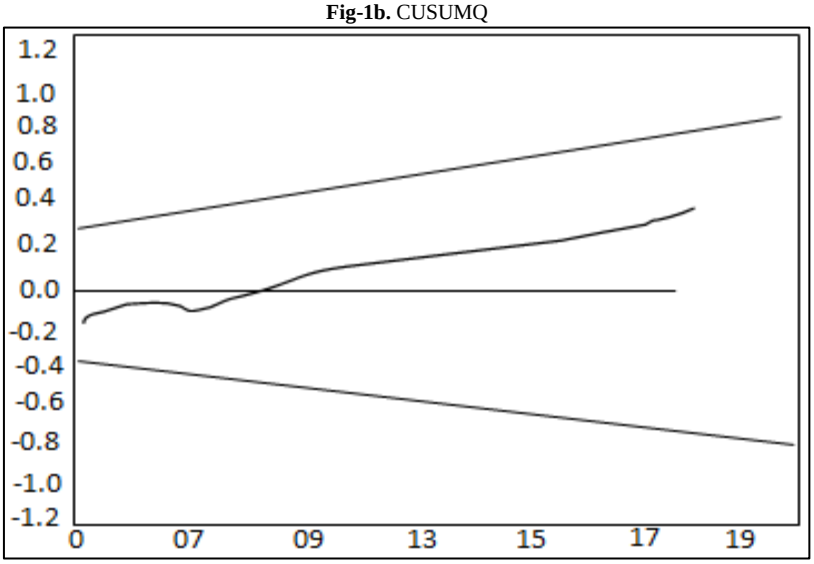
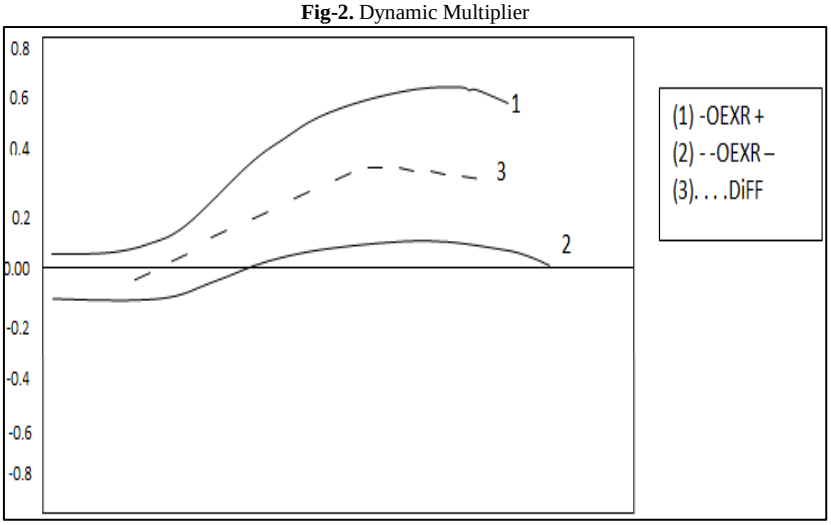


Fig-1b. CUSUMQ



The dynamic multiplier as shown in Figure 2 explains the responses of manufacturing output to both positive and negative shocks from official exchange rate.

Fig-2. Dynamic Multiplier



The index of manufacturing output responds slowly and positively to both positive and negative shocks in official exchange rate at the initial phase. More so, index of manufacturing output respond more to negative shocks than positive shocks initially, equilibrium is not at sight as the cumulative effects (difference) of both positive and negative shocks heightened during the period under review.

6. Conclusion

Exchange rate variations have a great impact on manufacturing output most especially in developing countries where local content in the manufacturing subsector is marginal. In this regard, we examined the effects on index of manufacturing output of positive changes (appreciation) and negative changes (depreciation) in official exchange rate.

The non-linear ARDL Cointegration framework is used to empirically determine the dynamics of official exchange rate increase (appreciation) and decrease (depreciation) on the output of the manufacturing subsector. From the empirical analysis, there exists non-linear cointegration between official exchange rate and manufacturing output. Evidence also supports both long run and short run asymmetries between manufacturing output and official exchange rate. In the long run increase in official exchange rate (appreciation) leads to a corresponding increase in manufacturing output, while decrease in official exchange rate (depreciation) is negatively related to manufacturing output.

In the short run, increase in official exchange rate is negatively related to manufacturing output though statistically insignificance, while decrease in official exchange rate shows positive and significant relationship with index of manufacturing output against a priori expectation. Other finding in the analysis include a positive and significant long run relationship between the ratio of money supply to Gross Domestic Product (GDP) and industrial output lending interest rate has negative and significant effects on industrial output in the long run and even in the short run conformity to a priori expectations.

Finally, we observed that official exchange rate increase (appreciation) and decrease (depreciation) have different asymmetric effects on the manufacturing subsector with depreciation having negative long lasting impact

on industrial output. This is why the policy makers and executors should take note of. Exchange rate policies are germane to manufacturing subsector development. Hence, monetary authorities and allied agents should take decisive steps to avoid exchange rate misalignment to stimulate the industrial subsector.

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