Measuring the Impact of Exchange Rate on Industrial Output in Nigeria

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Abstract

The role exchange rate plays in the determination of industrial output has long been addressed by various scholars in developed and developing countries alike. However, because of its continuous relevance and importance in the determination of the output of the industrial sector, this paper contributes to the body of literatures by investigating the impact of exchange rate on industrial output in Nigeria. Various econometric methods such as the Augmented Dickey Fuller unit root test, the Box Jenkins O.L.S methodology and the Chow break point test were employed on time series data from 1986 to 2016. The empirical findings reveal that albeit, no long run relationship exist between exchange rate and industrial output, the Box Jenkins O.L.S results reveal a positive and significant effect of exchange rate on industrial output in Nigeria. In addition, the Chow break point test affirms that a structural shift actually occurred in the pattern and direction of exchange rate and industrial output in Nigeria from the beginning of the 4th republic in 1999. The study recommends that although, exchange rate drives industrial output in Nigeria but this should be carefully managed to prevent inflationary spiral in prices of goods and services through contagious effect.

Keywords: Exchange Rate, Industrial Output, Fluctuation, Box Jenkins, , O.L.S.

1. Introduction

The role of exchange rate in any economy is very significant as it directly and indirectly affects domestic price level, profitability of traded goods and services, allocation of resources and investment decisions. Exchange rate movement and exchange rate uncertainty is an important factor which investors take into consideration in their decision to invest abroad (Unugbro, 2007). Foreign capital inflows are generally perceived as something desirable to the industrialized and developing countries. It can eliminate foreign exchange shortages, improve standard of living, deepen and broaden the financial markets. Capital inflows have also helped individual countries to absorb shocks either internal such as harvest failures to external such as fluctuations in commodity prices or recessions in industrial economies (Unugbro, 2007). Considering the major determinants of foreign investment, exchange rate risk is possibly seen as the most important determinant of foreign investment flows (Aranyarat, 2010).

Fluctuation in exchange rate often times tends to increase the risk and the uncertainty of transactions (internal and external) and predisposes a country to exchange rate related risks. In theory, it is generally agreed that exchange rate fluctuation affects output negatively or positively. It is believed that the negative impact of exchange rate fluctuation may come directly through uncertainty and adjustment costs, and indirectly through its effect on allocation of resources and government policies (Aliyu, Yakub, Sanni, and Duke, 2013).

In Nigeria and indeed many developing countries, the price of foreign exchange plays a critical role in the ability of the economy to attain optimal levels in production activities. In the wake of policy change, occasioned by the introduction of structural adjustment programs (SAP) in July, 1986, which led to the emergence of the flexible exchange rate as oppose to fixed exchange rate as a regime that was in place before the policy change. During the fixed exchange rate regime, the

supply of foreign exchange was highly subsidized through the overvaluation of domestic currency. The essence of the policy was to maintain a relatively cheaper cost of importation of industrial raw-material and equipment, so as to sustain the policy of import substitution industrialization strategy.

Fluctuation in exchange rate is an important factor that affects economic performance, due to its impact on macroeconomic variables like outputs, imports, export prices, interest rate and inflation rate (Adeniran, Yusuf and Adeyemi, 2014). Despite the fact that the Nigeria government has embarked on several strategies aimed at improving industrial production and capacity utilization, in recent times the sector is still experiencing a decline in output. The unimpressive performance of the sector in Nigeria is mainly due to massive importation of finished goods with severe implication on exchange rate and inadequate financial support for industrial activities, which ultimately has contributed to the reduction in capacity utilization in the country (Obamuyi, Edun and Kayode, 2013). The persistent depreciation in the exchange rate has led to a shortage of foreign exchange for the importation of the essential inputs for the industrial sector which has led to high costs of production in the country.

2. Review of Past Studies

Serve´n (2003) examined empirically the link between real exchange- rate uncertainty and private investment in developing countries, using a large cross-country time series data set. The paper builds a GARCH-based measure of real-exchange-rate volatility and finds that it has a strong negative effect on investment, after controlling for other standard investment determinants and taking into account their potential endogeneity. Rohan (2001) also found similar result on the effect of real exchange rate changes on multinational "firms and incorporates the effect of intra-industry competition on the relation between exchange rates and "firm value. Consistent with theoretical predictions, there is significant exposure to exchange rate shocks. Moreover, there is evidence of time-variation in exchange rate exposure, which is consistent with changes in the competitive environment within the industry.

Polodoo, Seetanah and Padachi (2011) examine the impact of exchange rate volatility on the macroeconomic performance of Small Island Developing States (SIDS). Taking a sample of 15 SIDS, the study analyzes econometrically the impact of exchange rate volatility on major macroeconomic variables, namely economic growth, external trade and foreign direct investment on the SIDS. The OLS with robust standard errors results indicate that, exchange rate volatility impacts negatively on current account balance but positively on the growth rate of the economies studied. In a dynamic setting, however, exchange rate volatility does not influence the macroeconomic variables.

In Nigeria, Jonathan and Kenneth (2016) analyze the link between exchange rate fluctuations and private domestic investment in Nigeria. The descriptive statistics of the variables included in the model show the existence of wide variations in the variables as depicted by the standard deviation of the exchange rate variable that was unusually high. The findings suggest that, the depreciation of the currency and interest rate does not stimulate private domestic investment activities in Nigeria.

Ikechukwu (2016) investigates the effects of volatility clustering in exchange rate on firm's performance in Nigeria, examining cross sectional data for the most active 20 companies listed on the Nigerian Stock Exchange. The results show that exchange rate fluctuation has significant negative impacts on the rate of return on assets, asset turnover ratio and the portfolio activity and resilience, thus, showing the significant negative impact of exchange rate fluctuation on firm performance in Nigeria between 2004 and 2013. Omorokunwa and Ikponmwosa (2014) investigate the dynamic relationship between exchange rate volatility and foreign private investment in Nigeria from 1980 to 2011. The finding include among other things that; exchange rate volatility has a very weak effect on the inflow of Foreign Direct Investment (FDI) to Nigeria, both in the long run and in the short run and that exchange rate volatility has a weak effect on foreign portfolio investment in the short run but a strong positive effect in the long run.

Osinubi and Amaghionyeodiwe (2009) investigate the empirical evidence on the effect of exchange rate volatility on Foreign Direct Investment (FDI) in Nigeria, using secondary time series data from 1970 to 2004.The study utilized the error correction model as well as OLS method of estimation. The results suggest, among others, that exchange rate volatility need not be a source of worry by foreign investors. Also, the study further reveals a significant positive relationship between real inward FDI and exchange rate.

Taiwo and Adesola (2013) investigate the impact of unstable exchange rate on bank performance in Nigeria using two proxies for bank performance, namely loan loss to total advances ratio and capital deposit ratio. Government expenditure, interest rate,

real gross domestic product were added to exchange rate as independent variables. The two models specified show that the impact of exchange rate on bank performance is sensitive to the type of proxy used for bank performance. Loan loss to total advance ratio shows that fluctuating exchange rate may affect the ability of lenders to manage loans resulting into high level of bad loans while capital deposit ratio does not have significant relationship with exchange rate.

Jongbo (2014) examines the impact of real exchange rate fluctuation on industrial output by investigating the effect of misalignment of real exchange rate on the output of the Nigeria industrial sector. The result shows that real exchange rate play a significant role in determining the industrial output. The study further reveals that the capacity utilization ratio is low, the case of which may not be too far away from, partly epileptic power supply, lack of adequate and appropriate technology and so on. Adelowokan, Adesoye and Osisanwo (2015) examine the effect of exchange rate volatility on investment and growth in Nigeria over the period of 1986 to 2014. The results confirm the existence of long run relationship between exchange rate, investment, interest rate, inflation and growth. Finally the results show that exchange rate volatility has a negative effect with investment and growth while exchange rate volatility has a positive relationship with inflation and interest rate in Nigeria.

Other relevant empirical studies on the relationship between exchange rate and industrial output as well as the impact of exchange rate fluctuations on manufacturing/industrial output include Owoeye and Ogunmakin (2013), Ayeyemi (2013) and Igue and Ogunleye (2014). Others are Ilechukwu and Nwokoye (2013), Ikechukwu (2016), Lawal (2016) and Abdallah (2016) among others.

3. Methodology and Empirical Findings

3.1 Sources of Data

The data for the study is culled from the Central Bank of Nigeria (CBN) Statistical Bulletin (various issues). The annual time series data spanned through the period 1986 which marks the advent of exchange rate liberalization in Nigeria to 2016.

3.2 The Model

The theoretical foundation for this study is the traditional flow model as further extended by Campa and Goldberg (1999). The model states that exchange uncertainty affects firm's output and investment behavior. The firm's production function is given as:

$Q_t^s = A_1 L_1 \propto K_t^{1-\propto}$ ---------- (1)

$Q_t^s = Q^T + Q^N$ ----------. (2)

Q represents goods produced which can be divided into tradable and non-tradable goods, K and L are capital and labour inputs respectively, A is an arbitrary function representing managerial skills. It is further assumed that exchange rate is the source of uncertainty in the model, Exchange rate affected non tradable goods through the procurement of input from abroad while its effect on tradable is through import of raw materials and export. In addition, the representative firm faces product demand curve given as:

$Q_1^d = A_2(P_T/P_N)^{-N}$ ---------- (3)

Where Q_1^d denote goods demanded and P_T and P_N denote the prices of traded and non-traded goods respectively. A_2 is a function of internal and external functions (such as firm size, government policy and exchange rate policy). The parameter –N stands for the price elasticity of demand for traded goods. Since this study is interested in examining the impact of exchange rate fluctuation on industrial output in Nigeria.

Arising from the above, the empirical equation for this study is stated thus.

$$IDO = \gamma_0 + \gamma_{1t} EXR + \mu \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Where IDO = Industrial Output procied by annual manufacturing output data; EXR = Exchange Rate of the naira to the US dollars. γ_0 = Intercept of the equation; γ_{1t}= the slope of the equation and μ = the stochastic error term.

In a-priori terms, γ_0 is expected to be positive, while γ_{1t} is expected to be negative i.e $\gamma_0 > 0$. $\gamma_{1t} < 0$.

3.3 Empirical Results

Before proceeding to analyzing the data, it is customary to subject the series to unit root test to affirm their stationarity because time series data are more often than not unstable and un-stationary in their present form. The reason being that, the mean and variance of time series data are non- constant overtime. To this end, we subjected the series to both the Augmented Dickey Fuller unit root test by Dickey and Fuller (1981) and the Phillips Perron (PP) test by Phllips and Perron (1988) as presented in table 1 below.

Table 1: ADF and PP Unit Root Test (1986-2016)

Vars	ADF (Level)	ADF(1st D)	PP (Level)	PP (1st D)	Order of Integration
IDO	1.5789(0.96)	-3.5277(0.00}***	1.1275(0.92)	-3.5225(0.00)***	I(1)
EXR	1.6511(0.97)	-4.6970(0.00)***	1.6677(0.97)	-4.7525(0.00)***	I(1)

***, ** and * indicate significance at 1, 5 and 10 percent respectively

Source: Authors' Computation, 2017.

From the results in table (1) above, it is vivid that both series (IDO and EXR) contain unit roots at levels and are therefore not stationary in their present form. However, they became stationary after subjecting them to 1st difference test are therefore I(1) series.

Having confirmed the order of integration to be I(1), we then proceeded to finding the long run relationship between the variables. We employed the one-step Johansen co-integration technique and the results of the both the Trace and Max-Elgen statistics show no co-integrating equation at 5 percent. In addition, the result of the co-integration test conducted from the error correction test also confirms that no co-integrating relationship exist between the variables.

Applying the Engel and Granger two-step methodology of testing for co-integration between variables, we obtained the O.L.S residuals of the series and subjected it to a stationary test using the Augmented Dickey Fuller (ADF) test for stationarity. The result is presented in table 2 below.

Table 2: ADF Unit Root Test for Co-Integration

Variable	ADF @ Levels	Order of Integration
RESID01	*-1.5401(0.11)*	No co-integration

***, ** and * indicate significance at 1, 5 and 10 percent respectively

Source: Authors' Computation, 2017.

The two-step Engel and Granger methodology also confirms that no-integration exist between and among the variables since the residual series is not stationary at levels. Hence, there is no co-movement between industrial output and exchange rate. The existence of no co-integration via both the two co-integrating methods made to adopt the Box Jenkins (methodology to determine the short run relationship between the variable (Box and Jenkins, 1976). Thus, equation (4) is now re-stated in first difference form as enunciated in the Box Jenkins methodology below.

$$FDLIDO_t = \gamma_0 + \gamma_{1t} FDLEXR_t + AR(1) + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

Where FDIDO= is the 1st difference of Industrial Output, FDEXR = the 1st difference of exchange rate and $AR(1)$ is the autoregressive component. Equation (5) can be estimated with or without the $AR(1)$ component. The overparameterized models of equation (5) revealed an unnecessarily high R^2 and this led us into the parsimonius model with a moderate R^2 as shown in table (3).

Table 3: Box Jenkins O.L.S Results (1986-2016); Dependent Variable: FDLIDO.

Variable(s)	Coeff	t-statistics	Prob
C	-1450862	-1.34	0.1902
FDLEXR	77770.47	7.83	0.0000***
R^2	0.6792	DW stat 0.3050	
Adjusted R^2	0.6681	Akaike 33.1020	
F-statistics	61.4011	Scwartz 33.1945	
Prob (f-stat)	0.0000		

***, ** and * indicate significance at 1, 5 and 10 percent respectively

Source: Authors' Computation, 2017.

The results show that exchange rate is positively related to industrial output and is found significant at 1 percent, albeit the exchange rate sign is not in line with a-priori expectation. The R^2 of 0.6792 is indicative of approximately 68 percent variation in industrial output being explained by exchange rate. The significance of f-statistics at 1 percent confirms the significance of the parameter estimates and the overall regression. The DW statistics of 0.30 shows no serious auto-correlation problem in the model and the Akaike and Schwartz criteria are at their lowest ebb.

In addition, we conducted a Chow breakpoint test to ascertain whether there exist a structural break in the pattern and direction of exchange rate in relation to industrial output in Nigeria using year 1999 as the break point. The significance of the Chow statistics of 9.8079 (see appendix 1) at the 1 percent level confirms the presence of a structural shift in pattern of exchange and industrial output since the beginning of the present democratic dispensation (4th republic) in Nigeria. The exchange rate increased astronomically from N21.88 in 1988 to N92.34 in 1999 against the US dollar while industrial output also jumped from N1053408.06m to N1314286.14m during the same period (see appendix 2 and 3).

4. Conclusion and Policy Implications

From the foregoing analysis, the impact of exchange rate has been proved not only to be positive but has been found to be a significant factor influencing the level of industrial output in the Nigerian economy. The policy implication of the direct relationship between exchange rate and output of the Industrial sector is that the fall in exchange rate of the Nigerian naira to the US dollar drives the industrial sector output in Nigeria particularly from the beginning of the 4th republic in 1999. This however should be managed with caution, as unabated fall in a country's currency can have serious contagious and inimical effects on the economy as it's presently being witnessed via inflationary spiral in prices of goods and services in Nigeria.

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Appendix 1

Chow Breakpoint Test: 1999

Null Hypothesis: No breaks at specified breakpoints

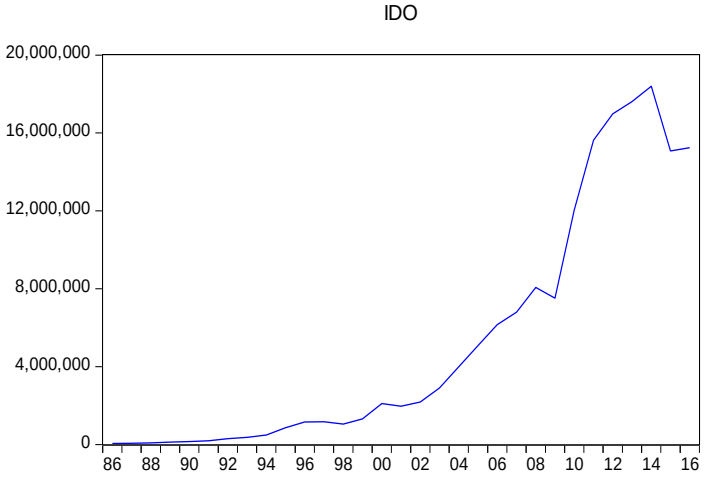
Varying regressors: All equation variables

Equation Sample: 1986 2016

F-statistic	9.807951	Prob. F(2,27)	0.0006
Log likelihood ratio	16.92925	Prob. Chi-Square(2)	0.0002

Wald Statistic	19.61590	Prob. Chi-Square(2)	0.0001

Appendix 2



Appendix 3