

EXCHANGE RATE VOLATILITY AND INDUSTRIAL SECTOR OUTPUT IN NIGERIA

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DOI: 10.29816/sjss.7.2.17

ABSTRACT

This paper examined exchange rate and industrial sector growth in Nigeria. The study utilized annual time series data sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin and National Bureau of Statistics (NBS) covering the period of 1980 to 2015 using the vector autoregressive (VAR) modeling. The vector error correction result showed that labour stock exerts a negative significant effect on industrial output while exchange rate volatility and capital formation do not show a significant effect on industrial output in Nigeria. This result indicated that despite the volatility in the naira exchange rate, it has not endangered the growth prospect in the industrial sector. The implication of this is that, the sluggish growth in industrial productivity in Nigeria is traceable to the poor quality of labour force in the country. It is therefore recommended that government should improve the quality of labour force through on- the -job training, study programme for adults, increase expenditure on health facilities and services that affect life expectancy, strength, stamina and vigour of labour force. Also, better organisation of work, creation of appropriate attitude, incentives and better management of labour force will go a long way to improve industrial sector output in Nigeria.

Key words: Exchange rate volatility, Labour, Capital, Industrial sector.

1. Introduction

Industrial sector plays a greater role in the economic development of any nation. Industrialisation broke the vicious cycle of underdevelopment of all developed nations of the world and it has been the backbone of economic development.(Ayeyemi, 2013). Based on the realization of the significant role of industrialization in the growth process, the phenomenon has induced the hypothesis that the manufacturing sector is the engine of economic growth, the so-called “engine of

growth argument”. The growth in industrial sector output impacts on the growth rate of the economy via backward and forward linkages by creating avenue for employment, while enhancing foreign exchange earning thus enhancing skills acquisition and adequate utilization of available resources (Jelilov, Enwerem and Isik, 2016). The world economies are linked directly or indirectly through asset and goods markets. This linkage is made possible through trade and foreign

exchange. Therefore, exchange rate is an important consideration to the understanding of the growth path of every country (Ilechukwu and Nwokoye, 2015). The exchange rate is generally recognised as a measure of international competitiveness. It is also known as the index of competitiveness of a country currency. An inverse relationship exists between this index and competitiveness. That is, the lower the value of a country exchange rate index, the higher the competitiveness of the currency of that country (Iqbal, Major and Habib, 2011).

The erratic fluctuations in exchange rates also referred to as exchange rate volatility is defined as the day to day, month to month variability in exchange rate without any trend (Marston et al, 1988). Exchange rate volatility affects industrial productivity through different channels. A depreciation in exchange rate in the absence of domestic sources for input and inadequate infrastructure will raise the cost of production, which will in turn make the locally produced goods less competitive compared to the imported counterparts, thus, reversing the benefit of cheaper exports expected from depreciation of any currency (Jongbo, 2014). On the contrary, large currency depreciations may deteriorate firm's net worth through the 'balance-sheet-effect', as the dollar-denominated debt burden of firms' increased (Aguilar, 2004; Patrap and Urrutia, 2004). The low productivity and under utilization of productive capacity that characterized Nigerian industrial sector has been largely attributed to a misalignment in the real exchange rate (Jongbo, 2014). The Naira exchange rate has witnessed a continuous slide in all the segments of the foreign exchange market (that is, official, bureau de change and parallel markets). The premium between the official and parallel market remained wide. Given the import dependent nature of the Nigerian industrial sector, the Naira exchange rate vis-à-vis the

currency of her major trading partners has continued to depreciate of (Jongbo, 2014).

Although many factors combined explained the general adverse macroeconomic condition in Nigeria, the exchange rate policy has been frequently identified as a major contributor. Although several ad hoc measures were taken to stem the deteriorating tide of the Nigerian economy from the late 1970s to early 1980s, it was until 1986 that a comprehensive economic adjustment programme was put in place to restructure the economy. Exchange rate reform was a major component of an economic reform agenda that was further intensified under the Nigerian Economic Empowerment and Development Strategy (NEEDS). The goal of exchange rate reform is to systematically attain an appropriate value for the Nigerian currency that would serve as a major incentive for exports but disincentive for increased imports. In this light, Nigeria implemented a fixed exchange rate system with the aim of realizing these objectives. However, the implementation of fixed exchange rate system engendered overvaluation of the domestic currency, serving as a disincentive for increased exports through non-competitiveness of the country's non-oil exports. On the other hand, the overvalued exchange rate enhanced imports thereby exacerbating the already precarious balance of payment position. These policies have left the domestic currency in constant depreciation without stability, while the nation's imports and non-oil exports appear to be non-responsive to this scenario (Ogbonna, 2011).

Against the analytical background several studies conducted on exchange rate volatility and industrial sector output produced mixed results. In addition, most of these existing studies that utilised the dynamic modelling approach such as vector auto-regression and cointegration techniques among others were conducted using data from industrialised and

emerging market economies such as the United Kingdom, United States of America, Pakistan etc (See Paulo and Baer, 2014; Oskooee, Harvey, and Scott; 2012; Iqbal, Major and Habib, 2011). There is scarce evidence on the effect of exchange rate volatility on industrial output in Nigeria. The existing evidence in Nigeria were either on the manufacturing or tourism sub-sector (See Ogbaba, Oji and Abba, 2016; Enekwe, Matthew and Nwoha, 2013; Lawal, 2016; Mumuni, 2016), the result which cannot be generalized for the aggregate sector. Other existing Nigeria country specific studies used the ordinary least squares technique in their analysis (See Ilchukwu and Nwokoye, 2015; Jongbo, 2014) even in the context of the newly developed econometrics tools of analysis with superior desirable properties. This study therefore seeks to improve on the existing literature by focusing attention on the industrial sector in aggregate and employing the use of vector error correction modelling in the analysis. The broad objective of this study is to examine the effect of exchange rate volatility on industrial output in Nigeria. The study specifically investigate the trend of exchange rate and industrial sector output, examine the dynamic relationship between exchange rate volatility and industrial sector output and analyse the bidirectional relationship between exchange rate volatility and industrial output in Nigeria.

The annual time series data sourced from the Central Bank of Nigeria statistical bulletin covering the period of thirty five (35) years (1980 to 2015) which. This period covers the major economic reforms episode particularly the post-1986 Structural Adjustment Program (SAP) era of 1986-1994 with serious implication on the Naira exchange rate. The study used the line graph and normality test to analyze the trend of exchange rate and industrialization in Nigeria and the multivariate vector error correction modelling

(VECM) was use to assess the dynamic relationship between exchange rate volatility and industrial output. This is because VECM is advantageous as it avoids model specification error since it does not require any explicit a priori functional form relation of the variables and it permitted short-run dynamic adjustment following an innovation or shock as all variables return to their long-run values (Iyoboyi and Olarinde, 2014). The remaining sections of this study are organized as follows: Section two focuses on the review of some relevant literature and theoretical framework. Section three deals with the methodology, analysis and discussion of results while section four, is on the conclusion and policy recommendations.

2. Literature Review

Industry describes an environment where firms develop their business supplying similar products or services to a market. Basically, an industry is a feedback system comprising of firms and a market. On the one hand, firms provide services or products to satisfy potential customers' needs. On the other hand, potential customers have needs that must be satisfied. Firms and markets dynamically interact over time through a process of adjustment between consumers' requirements and firms' products (Martin, 2003). Industrial growth can then be regarded as the advance use of mechanized system of production in order to boost production output so as to achieve certain macro-economic objectives such favourable of payment, stability in foreign exchange, strong global economic presence, improved standard of living of the populace, and so on (Ayeyemi, 2013). Exchange rate is the relative price of two monies and attempts to model the relative price in terms of the relative supply of and demand for those monies" (MacDonald and Taylor, 1989). In the literature, the concept of exchange rate volatility takes a

very specific meaning. "Exchange rate volatility is the day to day, month to month variability of exchange rate, a variability that may have no trend to it" (Marston et al, 1988). According to Krugman (2001) it is the value of a currency compared to another currency. It expresses the national currency's quotation in respect to foreign ones.

Economic theory has explained exchange rate between two currencies and its implication on the domestic and foreign economy relying on different assumptions. The purchasing power parity (PPP) is one of the earliest and perhaps most widely recognized theory of exchange rate. The theory states that the exchange rate between two currencies would be equal to the relative national price levels by assuming the absence of trade barriers and transactions cost and the existence of the purchasing power parity (PPP). The PPP doctrine would be equivalent to the application of the law of one price if all the countries produced exactly the same tradable goods. One of the main limitations of this theory is that the choice of the base year for the relative purchasing power parity (PPP) is often arbitrary. The traditional flow model, views exchange rate as the product of the interaction between the demand for and supply of foreign exchange. In this model, the exchange rate is in equilibrium when supply equals demand for foreign exchange (Olasadebe, 1991). The exchange rate adjusts to balance the demand for foreign exchange which depends on the demand that domestic residents have for domestic goods and assets. On the assumption that the foreign demands for domestic goods is determined essentially by domestic income, relative income plays a role in the determination of exchange rate under the flow model. The monetary approach however is based on the importance of money and it identified exchange rate as a function of the relative shift in money stock. The monetary approach views the exchange rate

as being the relative prices of two asset (national monies) determined primarily by the relative supplies of and demand for those monies and that the equilibrium exchange rate is attained when the existing stocks of the two monies are willingly held (Gbosi, 2003). The monetary approach postulates that the exchange rate is determined primarily by three key factors, namely relative real income and the interest rate differentials.

Several empirical studies conducted to investigate the effect of exchange rate volatility and industrial sector output produced mixed result. While evidence abound supporting the claim that exchange rate volatility have a negative effect on industrial sector output, there also evidence in support of positive effect of exchange rate volatility on industrial sector output. For instance, Ilechukwu and Nwokoye (2015) examined the impact of exchange rate stability on industry output in Nigeria using annual time series data from 1980 to 2013. The study employed the use of the ordinary least square technique. The result of the study showed that domestic capital, foreign direct investment, population growth rate, and real exchange rate were significant determinants of industrial output. In another study, Jongbo (2014) investigate the impact of real exchange rate fluctuation on industrial output in Nigeria. The Ordinary Least Square (OLS) method of regression was employed in obtaining the numerical estimates of the coefficients of the equation. The results show that real exchange rate play a significant role in determining the industrial output and also in addition, availability of foreign exchange increase through contentious export drive from both oil and non-oil products will contribute tremendously to increase industrial output. The study further revealed that the capacity utilization ratio is low the cases of which may not be too far away from, partly epileptic power supply, lack of adequate and appropriate technology

and so on and also that the impact in bidirectional (real exchange rate in industrial output and vis-versa).

Ogbeba, Oji and Abba (2016) also examined the effects of exchange rate fluctuation on tourism sector output in Nigeria for the period of 1995 to 2015, using the Vector Error Correction Model (VECM), granger causality test and co-integration approach to ascertain this relationship. Results revealed that exchange rate fluctuation indeed has a significantly negative effect on tourism sector output in Nigeria, and that an increased fluctuation reduces the contribution of the tourism sector to GDP. The granger Causality test result showed that there is a unidirectional causality and long run relationship between contribution of tourism sector to GDP and the contribution of the Tourism sector to employment, real effective exchange rate, and the international number of tourist arrival. Enekwe, Matthew and Nwoha (2013) examined the effects of exchange rate fluctuations on manufacturing sector in Nigeria over a period of 25 years (1985–2010). The study used four (4) variables such as manufacturing gross domestic product (MGDP), manufacturing foreign private investment (MFPI), manufacturing employment rate (MER) and Exchange rate (ER). Manufacturing gross domestic product (MGDP) stands as dependent variable while manufacturing foreign private investment (MFPI), manufacturing employment rate (MER) and Exchange rate (ER) as independent variables. Descriptive statistics and multiple regressions were employed and the results indicates that manufacturing foreign private investment (MFPI) and Exchange rate (ER) have positive effect on manufacturing gross domestic product (MGDP).

Lawal (2016) examined the effect of exchange rate fluctuations on manufacturing sector output in Nigeria from 1986 to 2014, a period

of 28 years. Data sourced from Central Bank of Nigeria (CBN) statistical Bulletin and World Development Indicators (WDI) on manufacturing output, Consumer Price Index (CPI), Government Capital Expenditure (GCE) and Real Effective Exchange Rate (EXC) were analyzed through the multiple regression analysis using Autoregressive Distribution Lag (ARDL) to examine the effect of exchange rate fluctuations on manufacturing sector. Using ARDL it was discovered that exchange rate fluctuations have long run and short run relationship on manufacturing sector output. The result showed that exchange rate has a positive relationship on manufacturing sector output but not significant. Mumuni (2016) examined the effect of exchange rate variability on manufacturing sector performance in Ghana. Using time series data from the period 1986-2013 and employing the autoregressive distributed lag (ARDL) approach, the empirical results show that there exists both a short as well as long run relationship between exchange rate and manufacturing sector performance. Thus, in Ghana as the exchange rate appreciates, the manufacturing sector performance improves and as it depreciates, the sector is adversely affected.

Paulo and Baer (2014) explore the within sector–country variation to study the relationship between currency over/undervaluation and manufacturing sectors growth using a panel data set covering 39 countries in Latin American and 22 manufacturing sectors (2-digit) within 1995–2008. The study find that the import content of exports might be an important driver of this result at a sectoral level. At a macro-level, the openness and the income per capita of a country are important factors. Oskooee, Harvey, and Scott (2012) investigated the effects of the post-Bretton Woods increase in exchange-rate volatility using industry-level data to further isolate the causes of these

ambiguous results. The study investigates U.S. trade with South Korea, both at the bilateral level and for 96 U.S. export and 29 U.S. import industries. We find that exchange rate volatility has significant short-run effects on most industries' exports and imports. In the long run, however, only 16 exporting industries and seven importing industries are affected by volatility (some positively and some negatively). Most affected industries are small, as measured by their trade share. Iqbal, Major and Habib (2011) investigate whether uncertainty or fluctuations in exchange rate affect the macroeconomic variables in Pakistan. Although, there are large number of macroeconomic variables, but out of these only four variables i.e, GDP, FDI, growth rate and trade openness have been included in this study. These variables have been taken as dependent variables and real exchange rate volatility has been selected as an independent variable. GARCH model has been applied in this study to calculate volatility of real exchange rate and Ordinary Least Square regression technique has been used to investigate the relationship between dependent and independent variables. Finding of this study confirmed the impact of exchange rate volatility on macro economic variables in Pakistan. It is also concluded that exchange rate volatility positively affects GDP, Growth rate and trade openness and negatively affects the FDI. Vinod and Kaushik, (2007) investigated the role of human capital formation on industrial growth in eighteen developing countries (Nigeria inclusive) between the period 1982-2001, using time series and panel regressions. The Ordinary Least Squares method was used to estimate the data. Findings from the time-series regression revealed that the elasticity of gross domestic product (GDP) with respect to human capital (adult literacy) was greater than 1, for 13 of the 18 countries sampled. For Nigeria, one percentage increase in literacy

level will increase GDP by 73%. The coefficient of the labour force variable for Nigeria was negative at -0.1296, implying that a one per cent increase in the size of the labour force will reduce GDP by about 13%. Lawanson, (2009) using a macro data also investigated the role of investment in health and education on industrial productivity in Nigeria between 1983 and 2007. The study adopted Error Correction Mechanism (ECM) and found a positive relationship between human capital and economic growth in Nigeria, although the link was weak. Only tertiary enrolment and education expenditure positively spurred economic growth. Health expenditure, primary and secondary enrolment had no relationship with economic growth.

3. Methodology

The Solow exogenous long run economic growth model provides the theoretical foundation for this study. The model suggests that, long run economic growth is determined by capital accumulation, labour or population growth and technological progress. Thus, output is produced using two factors of production which are labour (L) and capital (K). The aggregate production function that satisfies the neoclassical growth conditions assumes that economic growth path is stable. That is the elasticity of substitution must be asymptotically equal to one. The relationship between output, capital, labour and technological progress in Solows' growth model is presented in equation (1) as follow:

$$Y_{(t)} = K_t^\alpha [A_t L_t]^{1-\alpha} \text{-----}(1)$$

where: t is time; $0 < \alpha < 1$ is the elasticity of output; $Y_{(t)}$ represents total production; A technology or knowledge which enters the model through labour (i.e labour augmenting technology); L represents effective labour. More generally, Equation (1) is presented as:

$$Y_t = f(K_t, L_t) \text{-----}(2)$$

The Solow growth model can be expanded to capture the macroeconomic environment in

the country which is influence significantly by exchange rate volatility since the country relies majorly on oil revenue. In line with the theoretical framework and the model employed in the study conducted by Ilechukwu and Nwokoye, (2015) on the long-run impact of exchange rate on Nigeria's industrial output where the study employed industrial output as the dependent variable while gross capital formation, effective labour, inflation rate, exchange rate and balance of trade were the explanatory variables. This

study adapted the model by making using of industrial output proxy by real industrial sector GDP as the dependent variable while gross capital formation, effective labour stock proxied by the population growth rate and exchange rate were the explanatory variables to avoid complexity in modelling and associated problems. The functional relationship between exchange rate volatility and industrial sector output is specified as follows:

$$IOUP = F(CAP, LAB, EXR) \text{ ----- (1)}$$

The transformation of the model into a VAR model is expressed in a system as:

$$IOUP_t = c_1 + \sum_{i=1}^p \pi_{11,i} IOUP_{t-i} + \sum_{i=1}^p \pi_{12,i} CAP_{t-i} + \sum_{i=1}^p \pi_{13,i} LAB_{t-i} + \sum_{i=1}^p \pi_{14,i} EXR_{t-i} + \mu_{1,t} \text{ ----- (2)}$$

$$CAP_t = c_1 + \sum_{i=1}^p \pi_{21,i} CAP_{t-i} + \sum_{i=1}^p \pi_{22,i} IOUP_{t-i} + \sum_{i=1}^p \pi_{23,i} LAB_{t-i} + \sum_{i=1}^p \pi_{24,i} EXR_{t-i} + \mu_{2,t} \text{ ----- (3)}$$

$$LAB_t = c_1 + \sum_{i=1}^p \pi_{31,i} LAB_{t-i} + \sum_{i=1}^p \pi_{32,i} IOUP_{t-i} + \sum_{i=1}^p \pi_{33,i} CAP_{t-i} + \sum_{i=1}^p \pi_{34,i} EXR_{t-i} + \mu_{3,t} \text{ ----- (4)}$$

$$EXR_t = c_1 + \sum_{i=1}^p \pi_{41,i} EXR_{t-i} + \sum_{i=1}^p \pi_{42,i} IOUP_{t-i} + \sum_{i=1}^p \pi_{43,i} CAP_{t-i} + \sum_{i=1}^p \pi_{44,i} LAB_{t-i} + \mu_{4,t} \text{ ----- (5)}$$

The VAR (p) system equation (2) to equation (5) can be represented in a reduced form within a matrix framework as:

$$\begin{pmatrix} IOUP_t \\ CAP_t \\ LAB_t \\ EXR_t \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{pmatrix} + \sum_{i=1}^p \begin{pmatrix} \pi_{11} & \pi_{12} & \pi_{13} & \pi_{14} \\ \pi_{21} & \pi_{22} & \pi_{23} & \pi_{24} \\ \pi_{31} & \pi_{32} & \pi_{33} & \pi_{34} \\ \pi_{41} & \pi_{42} & \pi_{43} & \pi_{44} \end{pmatrix} \times \begin{pmatrix} IOUP_{t-i} \\ CAP_{t-i} \\ LAB_{t-i} \\ EXR_{t-i} \end{pmatrix} + \begin{pmatrix} \mu_{1,t} \\ \mu_{2,t} \\ \mu_{3,t} \\ \mu_{4,t} \end{pmatrix}$$

In the estimation, the time series properties of the data set was examined using the Jarque-Bera Normality test, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests as well as the Johansen cointegration test.

The short-run dynamics and long-run causality between exchange rate volatility and industrial sector output was estimated using the vector autoregressive approach (VAR). The main advantage of VAR is that it avoids model specification error because it does not require any specific a priori function form for the relationship among the variables. It also permit short run dynamic adjustment following an innovation or shock since all variables return to their long-run equilibrium values in line with cointegration equation.

4. Results and Discussion

i. Descriptive Statistics

The result of the descriptive analysis which shows the nature of the distribution of the data of is presented in table 1 as follows:

Table 1: Descriptive Statistics

	IOUP	CAP	LAB	EXR
Mean	4169077.	1913902.	115455.1	69.75812
Median	1162439.	175286.6	111156.0	21.96860
Maximum	18402191	14112170	178914.0	193.2792
Minimum	20174.65	6562.600	68447.00	0.540700
Std. Dev.	5863600.	3992462.	33020.80	66.59816
Skewness	1.389068	2.157998	0.323438	0.269619
Kurtosis	3.498644	6.106339	1.918928	1.358999
Jarque-Bera	11.95003	42.41574	2.380751	4.475492
Probability	0.002541	0.000000	0.304107	0.106699
Sum	1.50E+08	68900455	4156384.	2511.293
Sum Sq. Dev.	1.20E+15	5.58E+14	3.82E+10	155236.0
Observations	36	36	36	36

Source: Author, 2017.

The result of the descriptive analysis indicates that all the variables are positively skewed and highly symmetrical since their means are greater than their medians. industrial sector output and capital formation are positively skewed since their skewness coefficient is greater than one while labour and exchange rate are negatively skew. The positive values of the kurtosis of all the variables established the fact that these variables are leptokurtic in nature. the values of the Jarque-Bera statistic show that both industrial sector output and capital formation are normally distributed since the p-values are statistically significance at 5% level except for exchange rate and labour stock.

ii. The Test for ARCH effect

In order to test for volatility in exchange rate over the period, the residual obtained from the exchange rate volatility model using GARCH(1,1) must satisfy two conditions. That is, it must has ARCH effect and the volatility must be clustered otherwise the variable is not volatile. The result of ARCH test is presented in table 4 below:

Table 2: ARCH effect test result.

Variance Equation				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.96E+10	5.28E+11	0.056089	0.9553
ARCH	0.977881	0.351003	2.785963	0.0053
GARCH	0.354843	0.499078	0.710997	0.4771

Source: Authors' computation, 2017.

The result of the estimation of conditional variance equation indicates that exchange rate is volatile because the coefficient of the ARCH component is significant at 5% level of significance. Also, the summation of the coefficients of the ARCH and GARCH component (0.977881 and 0.354843) is close to one which showed that the volatility is persistent. This indicates that exchange rate volatility is persistent over the entire period:

Figure 1: Volatility clustering

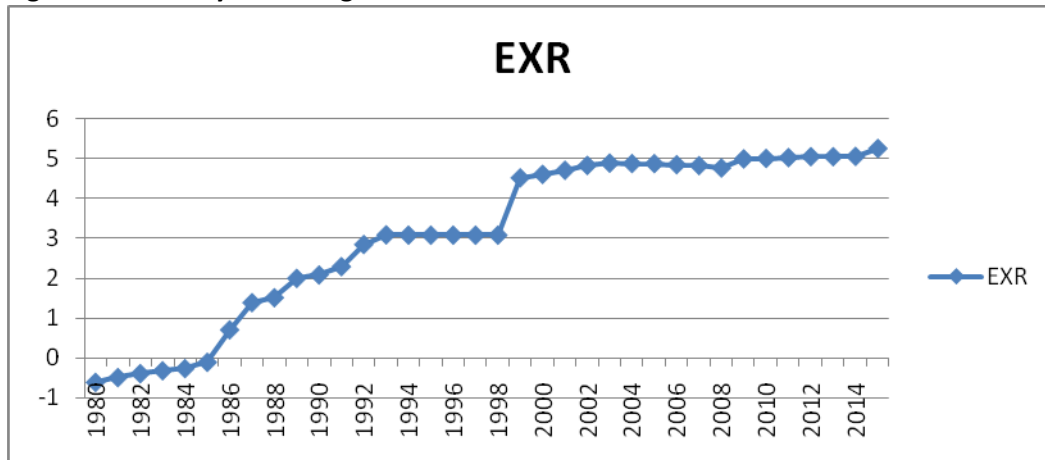
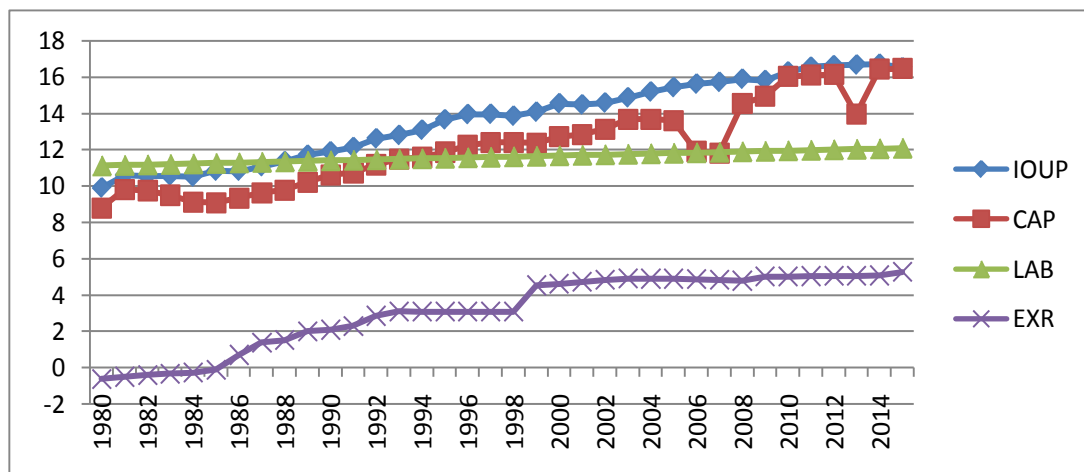


Figure 2: Trend Industrial output, capital and labour



Source: Author, 2017.

The trend analysis of exchange rate also supported the fact that exchange rate is volatile in Nigeria over the entire period since figure one which shows a significant variation in the trend of exchange rate in Nigeria. In figure two, there is evident for a sluggish growth in industrial output and capital formation. The movement in labour stock was virtually constant over the entire period while there was a significant variation in the trend of exchange rate in Nigeria.

iii. Lag Selection

Table 3: Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-348.4337	NA	4.44e+09	33.56511	33.76407	33.60829
1	-281.1682	102.4998	34915557*	28.68268	29.67747	28.89858*
3	-281.1682	102.4998*	34915557*	28.68268*	29.67747*	28.89858*

Source: Author, 2017

Based on the result in table 3 a maximum of 1 lag as suggested by sequential modified LR test, Final prediction error, Akaike information criterion (AIC) and Hannan-Quinn information criterion (HQ) was used in the analysis.

iv. Unit Root Test

The choice of an appropriate lag is an important factor in autorregresive models since too many numbers of lags reduces the degree of freedom while too view lags affect the size the test. A maximum number of 2 lag was used in the unit root and cointegration tests and in the bound test, as suggested by Akaike information criterion (AIC). The study used both the Phillips-Perron and the augmented Dickey-Fuller (ADF) unit root tests by to test for the presence of the unit roots in the data.

Table 4: Unit root test results.

	Variables	ADF test (Prob)	PP test (Prob)	Order	Stationary at
		Cons &trend	Cons &trend		
Level	IOUP	0.9057	0.8746	-	-
	CAP	0.0414	0.0935	I(0)	Level (ADF)
	LAB	0.2341	0.8590	-	-
	EXR	0.5067	0.4925	-	-
First Diff	Δ IOUP	0.0003	0.0002	I(1)	1 st Diff
	Δ CAP	0.0000	0.0000	I(1)	1 st Diff
	Δ LAB	0.0303	0.0462	I(1)	1 st Diff
	Δ EXR	0.0006	0.0006	I(1)	1 st Diff

Source: Authors' computation, 2017

Result in table 4 using the Augmented Dickey Fuller test, suggested that except for capital stock, other variables are non stationary at levels but at first difference all the variables becomes stationary at 5% level of significance. The Phillip Perron test result suggests that none of the variables was stationary at levels but at first difference all were the variables were found to be stationary at 5% level of significance.

v. Cointegration Test

Table 5: Johansen Cointegration Test Results

Hypotheses	Trace			Max-Eigen		
	Eigenvalue	Λ_{trace}	Critical Value (0.05)	Eigenvalue	Λ_{Max}	Critical Value (0.05)
$r=0$	0.596565	57.75357	63.87610	0.596565	30.86313	32.11832
$r \leq 1$	0.367309	26.89044	42.91525	0.367309	15.56426	25.82321
$r \leq 2$	0.190395	11.32618	25.87211	0.190395	7.181116	19.38704
$r \leq 3$	0.114775	4.145064	12.51798	0.114775	4.145064	12.51798

Source: Author, 2017.

Note: r indicates the number of cointegrating vectors; Λ_{max} denotes maximal eigenvalues and Λ_{trace} trace test statistics.

** Rejection of the null hypothesis at 5% level. Trace and Max-eigenvalue tests indicates no cointegration at the 0.05 level

The Johansen cointegration test reported in table 5, indicates that the hypothesis of no cointegration among the variables cannot be rejected since $P > 0.05$. From the result, there is no cointegrating vector among the variables of interest using both maximal eigenvalues and trace statistics. This established the absence of long run relationship (cointegration) among the variables in the model. This necessitate the use of vector autoregressive modelling because when the variables are cointegrated, the VECM or ARDL is appropriate but if they are not, the vector autoregressive model is appropriate.

vi. VAR Estimates

In VAR methodology, much interest is not on the coefficients of VAR, because it does not make much meaning in economics; rather the focus is on the variance decomposition and the impulse functions. The method invert the system and then variations attributed to each set of innovation or regimes are generated after decomposition, which have direct economic interpretations. The coefficient of VAR estimates is presented in table 6 while the variance decomposition is reported in table 7 as follows:

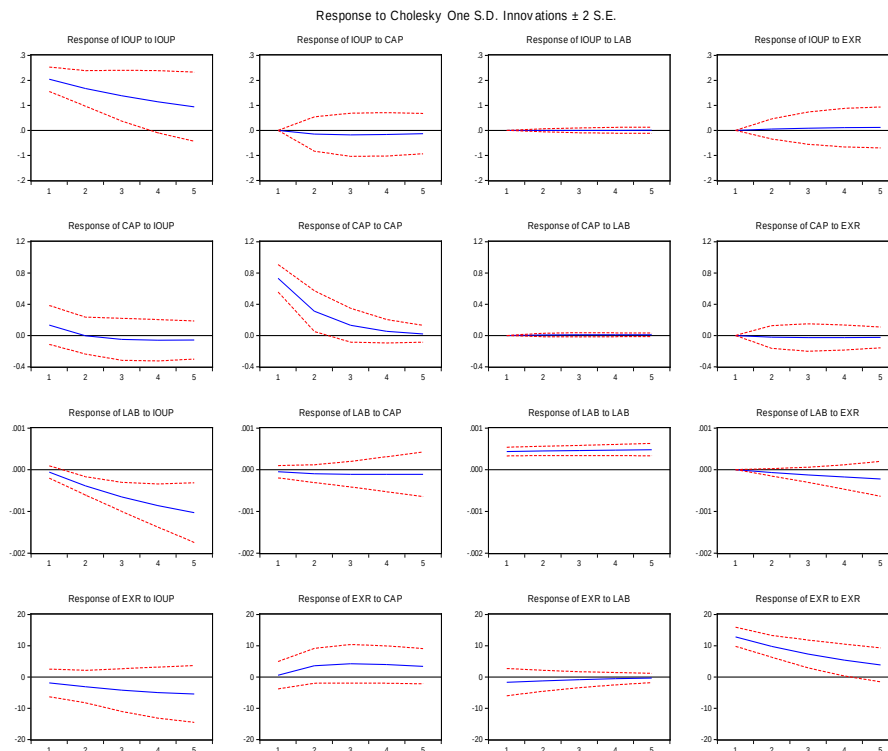
Table 6: Result of VAR Estimates

Dependent Variables	IOUP _{t-1}	CAP _{t-1}	LAB _{t-1}	EXR _{t-1}
IOUP_t	0.836809 (0.14517) [5.76452]	-0.305906 (0.52860) [-0.57871]	-0.001634 (0.00031) [-5.21232]	-10.83538 (9.29515) [-1.16570]
CAP_t	-0.020965 (0.04683) [-0.44769]	0.426605 (0.17052) [2.50177]	-5.86E-05 (0.00010) [-0.57979]	4.293904 (2.99855) [1.43199]
LAB_t	1.168081 (1.20683) [0.96789]	7.125201 (4.39446) [1.62140]	1.013324 (0.00261) [388.794]	112.1211 (77.2750) [1.45094]
EXR_t	0.000401 (0.00157) [0.25554]	-0.001632 (0.00572) [-0.28554]	-5.12E-06 (3.4E-06) [-1.51069]	0.763236 (0.10052) [7.59301]
C	-10.92073 (12.1053) [-0.90215]	-71.25706 (44.0792) [-1.61657]	-0.103902 (0.02614) [-3.97437]	-1184.493 (775.116) [-1.52815]
R-squared	0.991970			
Adj. R-squared	0.990900			
F-statistic	926.5406			
Log likelihood	8.619823			
Akaike AIC	-0.206847			
Schwarz SC	0.015346			

Standard errors in () & t-statistics in []

The VAR estimates presented in Table 6 showed that there is statistical evidence that changes in industrial sector output are significantly influenced negatively by changes in labour stock ($\beta = -0.001634$, $t = 5.21232$, $p < 0.05$) while exchange rate volatility and capital formation showed no significant effect on industrial sector output Nigeria. The implication of this is that, the sluggish growth in industrial productivity in Nigeria is traceable to the poor quality of labour force in the country. It is therefore logical from the result to say that the exchange rate devaluation which has been preponderant in Nigeria especially since the introduction of SAP in 1986 has not been very useful in enhancing industrial sector growth.

Figure 3: Impulse Response chart of industrial Output to Shocks from exchange rate volatility, capital formation and labour stock



Vii. Variance Decomposition

The variance decomposition in VAR separates the variation in an endogenous variable into component. Thus, variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR. The reduced form of the VAR obtained using Sims's recursive Choleski decomposition method is reported as follows:

Table 7: Results of variance decomposition of industrial output (IOUP) from VAR

Variables	Horizon	IOUP	CAP	LAB	EXR
IOUP	1	0.204304	0.000000	0.000000	0.000000
		(0.02442)	(0.00000)	(0.00000)	(0.00000)
	2	0.167329	-0.015185	-0.000172	0.005141
		(0.03534)	(0.03429)	(0.00304)	(0.02013)
	3	0.138377	-0.017915	-0.000242	0.008588
		(0.05087)	(0.04320)	(0.00486)	(0.03213)
	4	0.114380	-0.016178	-0.000177	0.010540
		(0.06210)	(0.04320)	(0.00583)	(0.03847)
	5	0.093977	-0.013208	1.16E-06	0.011329
		(0.06915)	(0.04031)	(0.00618)	(0.04084)

Source: Author, 2017.

The result of the impulse response in figure 3 and Variance decomposition in Table 7 reveals that at 5 horizon, industrial output does not explained its own shocks [$p(0.069) < p(0.05)$] while exchange rate volatility, labour stock and capital stock explained variation in industrial output since their p-values is statistically significant at 5% level. This result aligned with VAR estimates and theoretical postulates which pointed out that causation between exchange rate volatility and industrial output is negative.

Viii. Heteroscedasticity Test

It has been assumed that the error terms are homoscedastic. That means the error terms are assumed to have a constant variance; otherwise they are said to be heteroskedastic. Heteroskedasticity occurs when the variance of error term is not constant. The study employed White's General heteroscedasticity test as a post estimation test. Gujarati (2004) asserts that the general test of heteroscedasticity proposed by White does not rely on the normality assumption and is easy to implement.

Table 8: Heteroscedasticity Test Result

Heteroskedasticity Test: ARCH			
F-statistic	0.047413	Prob. F(3,25)	0.8293
Obs*R-squared	0.050835	Prob. Chi-Square(3)	0.8216

Source: Author, 2017.

The result in Table 8 displayed two types of tests for heteroskedasticity. As it can be seen from the table, both the F-statistic and Chi-Square versions of the test statistic gave the same conclusion that there is no evidence for the presence of heteroscedasticity, as evidenced by the p-values in excess of 0.05

6. Conclusion and Recommendations

Based on evidence from the result the study concluded that exchange rate volatility does not have a significant effect on industrial output in Nigeria. This result indicated that, despite the volatility in the naira exchange rate, it has not endangered the growth prospect in the industrial sector. This result pointed to the effectiveness of the exchange rate policy in Nigeria with regards to industrial macroeconomic environment. The implication of this is that, the sluggish growth in industrial productivity in Nigeria is traceable to the poor quality of labour force in the country. On the

basis of the findings, the study recommended that in order to stimulate industrial performance in Nigeria government should improve the quality of labour force through on- the -job training, study programme for adults, increase expenditure on health facilities and services that affect life expectancy, strength, stamina and vigour of labour force for them to be effective in productive activities. Also, better organisation of work, creation of appropriate attitude, incentives and better management of labour force will go a long way to improve industrial sector output in Nigeria.

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