A Parametric Measure of Exchange Rate Volatility and Its Impact on Manufacturing Output in Nigeria

Jonathan O. Oniore* and Kenneth O. Obi**
Department of Economics, Bingham University, Karu, Nigeria
Department of Economics, Nnamdi Azikiwe University, Awka, Nigeria

Abstract

The link between exchange rate volatility and manufacturing sector performance remains a topical issue among economists and policymakers, as the sector has become increasingly dependent on the external sector for import of non-labour input. This study examined the relationship between exchange rate volatility and manufacturing output growth in Nigeria from 1970 to 2014 using non-parametric measure of volatility of the mean and standard deviation of exchange rate and parametric Generalised Autoregressive Conditional Heteroscedasticity (GARCH). The study found that, among others that: the standard deviation of exchange rate is unusually high and unusually low, suggesting that there is a substantial volatility in the exchange rate over the period under study; the degree of openness was negatively related to the contribution of manufacturing to gross domestic product and, as such, the recent trade liberalization efforts in Nigeria had not resulted in better manufacturing subsector performance or benefited the poor; and that both broad money supply (M2) and total government expenditure (TGE) were positively related to manufacturing subsector growth performance. The empirical results confirmed that exchange rate volatility have a significant negative effect on manufacturing sector performance. This implied that a policy that will enhance stability of the exchange rate will promote manufacturing sector growth performance; hence, government should not underplay exchange rate volatility in Nigeria, as it affects other important factors for manufacturing sector performance.

Keywords: Exchange rate, monetary policy, manufacturing economic growth,

JEL Classification: D51, E52, E62, O4, and L60.

Introduction

The Nigerian economy ambitiously aspires to become one of the twenty largest economies in the world by 2020 and the 12th largest economy by 2050, with GDP of not less than US$900 billion and a per capita income of $4,000 per annum (CBN, 2009). One of the surest ways of achieving this goal is to pursue rigorously and vigorously rapid and sustainable economic growth and development via

industrialization. Industrialization is a necessary condition for the development of an economy. In recognition of this role, the World Bank (1987) submitted that:

> Industrialization has a crucial role in long term development; it is one of the best training grounds for skill development; it is an important source of structural change and diversification; and it can increase flexibility of the economy and reduce dependence on external forces. Industrialization also provides employment, foreign exchange and domestic earnings.

Industrialized nations of the world achieved their present enviable level of development by emphasizing and channelling a considerably high percentage of their resources to industrial development, especially the manufacturing sector (Cookey and Onuchuku, 2009). In addition, rapid economic growth and development is not possible in any country that does not pay adequate attention to industrial development, particularly, the manufacturing subsector (Ukoha, 2000).

In an economy like Nigeria that is import-driven, the exchange rate stands as the most important factor that determines the performance of key sectors of the economy, including manufacturing. The growth rate of manufacturing was, however, slow and sluggish in the early 1970s. For instance, the share of manufacturing in the GDP in 1970 was 7.2 percent. It fell to 5.2 percent in 1975, before increasing gradually to 11.2 percent in 1982. Following the depressing state of the economy in the 1980s, the subsector's share in the GDP fell and remained in the range of 7.8 to 8.4 percent. With the unsteady growth in manufacturing since 1992, its contribution to the GDP fell— for instance, from 1993 and 2001, it ranged between 3.4 and 8.3 percent. Between 2002 and 2007, its share in the GDP witnessed only a marginal increase of 3.0 percent. A decline in manufacturing share in the GDP was, however, witnessed from 2008 to 2009. But it rose consistently from 7% in 2010 to 10% in 2014. The improved performance of the sector during this period could be linked to improved availability of inputs as a result of increased inflow of foreign exchange, as the sector became increasingly dependent on external sector for import of non-labour inputs. The inability to import, therefore, can impact negatively on manufacturing production. It is now clear that manufacturing in Nigeria is tied to foreign exchange earnings for the purchase of capital equipment, as 85 percent of ingredients used in this sector are imported, while only 15% is sourced locally (Manufacturers Association of Nigeria (MAN), 2016).

The link between exchange rate volatility and manufacturing sector performance has remained a topical issue among economists and policymakers alike since the period of currency differentials among nations (Ayinde, 2014). There is a vast of amount of literature (Carranza, Cayo and Galden-Sanchez, 2007; Oyejide,

1985; Olisadebe, 1991; Opaluwa, Umeh and Abu, 2010; Ayinde, 2014) available on this subject, using different samples, variables, economic and econometric techniques, such as standard deviations, where exchange rate volatility is measured according to the degree to which exchange rate fluctuates in relation to its mean overtime (cf. Carrera and Vuletin, 2002; Schnabl, 2007; Gadanecz and Mehrotra, 2013; Danladi and Uba, 2016). Using this measure is not without challenges. First, it assumes that the empirical distribution of the exchange rate is normal. Second, it does not reflect the distribution between unpredictable components of the exchange rate process, hence, failing to capture past data of the exchange rate. Consequently, exchange rate volatility measured in terms of deviation of the rate from the mean produces varying results that, at best, lead to ambiguity and inconclusiveness. However, the method is being updated in line with changing economic dynamics. One of such inventions is the incorporation of structural breaks into exchange rate literature/ economic activities. For instance, Glynn, Perera and Verma (2007) submitted that methods of estimation of economic relationship and modelling fluctuations in economic activities have been subjected to fundamental changes. The method of estimation of the standard regression model, ordinary least squares (OLS), is based on the assumption that the means and variances of these variables being tested are constant over time. For a discussion on the implications of ignoring structural breaks when they do exist, see Zainudin and Shaharudin (2001), Sensier and Van Dijk (2004), Andreou and Ghysels (2002), Aggarwal, Incland and Leal (1999), Perron (1997), and Zivot and Andrews (1992) among others.

The present effort is distinct in many ways: first, the treatment of the data series is detailed and unparalleled. Previous studies in Nigeria known to the authors have not considered structural breaks in the data employed. The study departs from this by employing Perron (2006) to determine the break points/dates as well as further investigate the properties of the time series employed. Given that the break points should be viewed as being correlated with the data, selecting the break exogenously could lead to an over-rejection of the unit root hypothesis. Second, there is the use of non-parametric and parametric measures, as there seldom exist studies that have explored the impact of exchange rate volatility on manufacturing performance using non-parametric and parametric measures. This is precisely the general thrust of this research work; it is, indeed, the overriding motivation for the study.

Trends in exchange rate volatility and manufacturing output in Nigeria

The Structural Adjustment Programme (SAP) introduced in 1986 was partly designed to revitalize the manufacturing sector by shifting emphasis to increased domestic sourcing of inputs through monetary and fiscal incentives. The

deregulation of the foreign exchange market was also effected to make non-oil exports, especially manufactures, more competitive, even though this also resulted in massive escalation in input costs. As discussed above, a look at the manufacturing sector over the years shows that the share of the manufacturing in the GDP has been relatively low—from 7.2 percent in 1970 to 5.2 percent in 1975, etc. Also, despite various efforts by the government to maintain a stable exchange rate, the naira depreciated throughout the 1980s. It depreciated from N0.61 in 1981 to N2.02 in 1986 and further to N7.90 in 1990, all against the US dollar. The policy of guided or managed deregulation pegged the naira at N21.89 against the US dollar in 1994. Further deregulation pushed it to N86.32 = S1.00 in 1999. It depreciated further to N120.97 in 2002 and N132.15 in 2005 and later appreciated to N118.57 in 2008. Towards the end of 2008 when the global financial crisis took its toll, the naira depreciated to N150.01 at the end of 2009. Presently, the value is N199 = $1.00. The Central Bank of Nigeria recently announced a flexible foreign exchange regime, thereby abolishing the dual exchange rate regime. Under the new plan, the official exchange rate of the naira will exist in a 'single flexible window', which will likely be determined by market forces.

The implementation of SAP was expected to bring about some improvements in the economy. For instance, the sharp exchange rate depreciation was expected to discourage importation and make export-oriented multinationals gain on their investments. During this period, the economy recorded wide fluctuation in exchange rate and manufacturing output, as depicted in Figure 1.

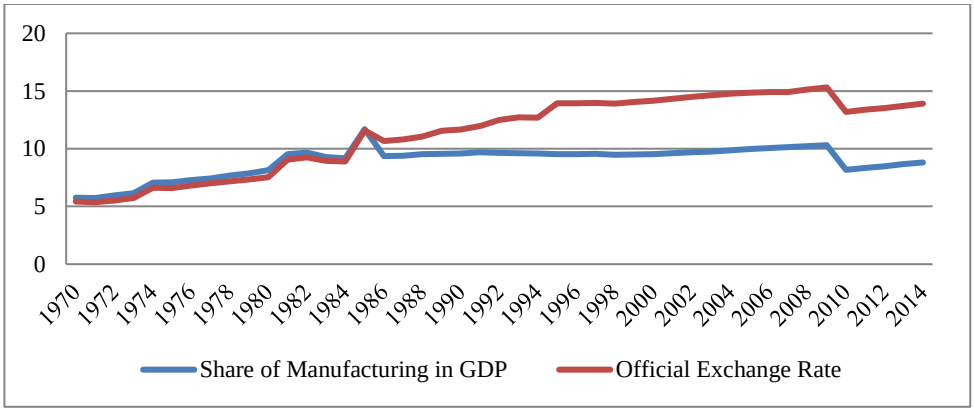

Figure 1: Movements in exchange rates volatility and manufacturing output in Nigeria, 1970-2014

Source: Underlying data from Central Bank of Nigeria Statistical Bulletin various years

Figure 1 shows the movements in exchange rates volatility and share of manufacturing in GDP (%) over the period 1970-2014. The figure shows that the share of the manufacturing in GDP was relatively low in the 1970s. Between 2002 and 2007, its share in GDP witnessed a marginal increase of 3.0 percent and rose consistently from 7% in 2010 to 10% in 2014. With respect to the exchange rate, it depreciated continuously from 1986 to 1998. This could be attributed to the policy of managed floating introduced by the government during this period. However, with the change of policy in the first quarter of 1999, the exchange rate depreciated massively. This downward trend continued up till 2003. The exchange rate experienced slight appreciation from 2004 to reach the highest level in 2008. However, the exchange rate depreciated sharply from 2008, only to maintain a relatively stable value from 2009 till early 2014. Thus, the clear pattern that emerges from figure 1 is that at very low exchange rate, the manufacturing sector growth performance is marginally above the exchange rate. Also, figure 1 shows some correlation between exchange rate changes and manufacturing output. Given these scenarios, it is imperative to investigate the nature of the relationship between the two variables in Nigeria.

Theoretical Literature

The earliest and leading theoretical arguments linking exchange rate volatility to output rests largely on the optimal currency area (OCA) theory, developed by Mundell (1961) and McKinnon (1963). This model focuses on trade and stabilization of the business cycle. It is based on concepts of the symmetry of shocks, degree of openness, and labour market mobility. According to the theory, a fixed exchange rate regime can increase trade and output growth by reducing exchange rate uncertainty and thus the cost of hedging, and also encourage investment by lowering currency premium from interest rates. On the other hand, it can also reduce trade and output growth by stopping, delaying or slowing the necessary relative price adjustment process.

Also, in the standard Dornbursch (1976) model, unanticipated monetary policy shocks generate large variations in the exchange rate. Here, nominal shocks affect real exchange rate but only in the short-run. Since real exchange rate deviates from its long-run equilibrium path, extant studies on the cause of the deviations and results are largely torn between two schools. Early studies documented the significant relationship between real exchange rate fundamentals, including supply and demand factors, where the former largely relate to the level of output capacity and expected to follow the Balassa–Samuelson hypothesis. This hypothesis assumes that productivity increases tradable sectors, hence pushing up sector wages. This in effect

puts an upward pressure on wages in the non–tradable sector and the economy as a whole. Since productivity does not increase in response to wage rise, prices of non-tradable goods are expected to rise, leading to increase in the relative price of non-tradable to tradable goods, hence, an appreciation of the domestic real exchange rate. The demand factors relate to the role of government expenditure, while the external shocks reflect changes in terms of trade, trade openness and capital flows.

Later theories focused on financial market stabilization of speculative financial behaviour, as it relates particularly to emerging economies. For instance, in their seminal work, Driskill and McCafferty (1980) examined exchange rate model in terms of uncertainty in a small open economy under a flexible exchange rate regime. Under rational expectations, they shed light on the capital mobility role. They claim that high capital mobility: (a) increases the portfolio variability when changes in anticipated assets relative returns take place; (b) decreases the exchange rate volatility which is caused by real shocks; and (c) increases the exchange rate volatility when unanticipated shocks occur within the economy. Turnovsky and Bhandari (1982) extended the Driskill–McCafferty analysis, focusing not only on the short-run effects of structural shocks of domestic and foreign variables on domestic economy, but also on the impact of the degree of capital mobility on the determinants' variance. Regarding exchange rate volatility, the existence of a shock in the foreign price level and the foreign nominal interest rate, in combination with the increasing capital mobility, leads to an increase in the variance of exchange rate, while the variance of foreign prices causes a decrease in the variance of exchange rate. Furthermore, the occurrence of a supply disturbance affects negatively the variance of exchange rate.

Driskill and McCafferty (1987) extended their previous work (Driskill and McCafferty, 1980) by: (i) including the assumption of risk-aversion and the analysis of the goods market and (ii) adding in the model the asset demand equation derived from optimizing behaviour rather than ad-hoc theory. They concluded that exchange rate volatility is affected positively by the variance of money supply shocks and that the existence of multiple equilibria is possible if changes in preferences and technology take place. Moreover, Manuelli and Peck (1990) considered an overlapping-generations model with stochastic endowments providing evidence that exchange rate volatility is not dependent on the fundamentals of the economy. On the other hand, shocks to these fundamentals significantly affect exchange rate volatility. Furthermore, Betts and Devereux (1996) implemented a pricing-to-market model, adopting some of the assumptions of the Obstfeld and Rogoff (1998) model. Their findings revealed that the greater the portion of goods under the pricing-to-market regime, the higher the relative exchange rate variance. In other words, the

model of pricing-to-market imposes a great impact on the uncertainty of the exchange rate.

Empirical Issues

On the empirical side, the controversy of the effect of exchange rate variation is equally not resolved. Although many researchers (Diaz-Alejandro, 1963; Pierrer-Richard, 1991; Kandil, 2004; Yaqub, 2010; Bakare, 2011; Adelowokan, Adesoye and Balogun, 2015) found evidence of the contractionary effects of depreciation, others (Fry, 1976; Edwards, 1992; Lyons, 1992; Adewuyi, 2005; Bahmani-Oskooee and Kandil, 2007; Opaluwa and Ameh, 2010; Ehinomen, and Oladipo, 2012) have found evidence of the expansionary effects of exchange rate depreciation.

In a study, titled 'Real exchange rate and US manufacturing profits: A theoretical framework with some empirical support using Marston's (1990) model of pricing-to-market,' Clarida (1997) identified two channels (valuation channel and volume channel), through which changes in the real exchange rate can shift the profits of a price-setting exporter. Also, employing the econometric approach developed by Johansen (1990; 1991), the study estimated a dynamic vector error correction model on quarterly data for real US manufacturing profits and five variables (domestically sold output, real exchange rate, real unit costs, relative price of domestically sold output, and real foreign income) that a theory suggests should be useful in accounting for the behaviour of real profits in an open economy. The finding suggested that holding constant domestic sales, real unit costs, relative price of domestic output, and real foreign income, the long-run elasticity of real profits with respect to the real exchange rate exceeded 0.80 units.

Simon-Oke and Aribisala (2010) investigated 'exchange rate deregulation and industrial performance: An assessment (1975 – 2006)' with the help of the cointegration technique and chow breakpoint test. They found that a long-run relationship exists between industrial productivity growth rate, ratio of industrial production to gross domestic product, exchange rate, interest rate and terms of trade; and that exchange rate deregulation has significant impact on industrial performance.

Opaluwa, Umeh and Abu (2010) examined the impact of exchange rate fluctuations on the Nigerian manufacturing sector during a twenty-year period (1986–2005). The econometric tool of regression was used for analysis. The results of the analysis showed that coefficients of the variables carried both positive and negative signs. Among the policy recommendations made was the need to strengthen the link between agriculture and the manufacturing sector through local sourcing of

raw materials, so that the reliance of the sector on import of inputs can be reduced to a reasonable level.

Kanagaraj and Ekta (2011) examined the level of foreign exchange exposure and its impact on Indian firms. They found that only 16 percent of the firms had exchange rate exposure at 10 percent level of significance. About 86 percent of the firms were negatively affected by an appreciation of the rupee, which confirmed that Indian firms were net exporters. On the determinants of exchange rate exposure, the study revealed that export ratio was positively, and hedging activity was negatively related to the exchange rate exposure of pure exporter firms.

Huchet-Bourdon and Korinek (2011) studied the impact of exchange rates and their volatility on trade flows in China, the Euro area and the United States in agriculture, manufacturing and mining. They found that exchange rate volatility impacted trade flows only slightly. Exchange rate levels, on the other hand, affected trade in both agriculture and manufacturing and mining sectors but did not explain in their entirety the trade imbalances in the three countries examined.

Jamil, Streissler and Kunst (2012) employed AR(k)-EGARCH(p,q) models to explore the impact of exchange rate volatility on industrial production before and after the introduction of common currency for eleven European countries, included in European Monetary Union, and for four European countries that did not adopt 'Euro' as common currency. They concluded that all the countries enjoyed benefits after the introduction of a common currency by the reduction in negative impacts of real exchange rate volatility.

Enekwe, Ordu and Nwoha (2013) employed four variables (manufacturing gross domestic product MGDP, manufacturing foreign private investments MFPI, manufacturing employment rate MER, and exchange rate, ER) in their study. In this case, MGDP stood as dependent variable, while MFPI, MER, and ER were independent. Descriptive statistics and regressions were employed. The result showed that all independent variables had significant and positive relations with the dependent variable.

Zakaria (2013) examined the impact of exchange rate volatility on trade using regression analysis of standard export demand models, while exchange rate volatilities were measured by GARCH (1,1) models. Results from the regression analysis showed that Malaysian exports to the US and Japan were significantly related with exchange rates volatility. The impact of exchange rate volatility on Malaysia export to US was found to be negative, while that of Japan was positive. Malaysia's exports to the UK and Singapore were found not significantly related to the volatility in the exchange rates. The findings clearly indicated that the

relationship between export performance and exchange rates volatility was ambiguous.

Akinlo and Lawal (2015) examined the impact of exchange rate on industrial production in Nigeria over the period 1986- 2010. The results obtained using Vector Error Correction Model (VECM) confirmed the existence of long-run relationship between industrial production index, exchange rate, money supply and inflation rate. Moreover, exchange rate depreciation had no perceptible impact on industrial production in the short-run but had positive impact in the long-run. Finally, the results showed that money supply explained a very large proportion of variation in industrial production in Nigeria.

Adekoya and Fagbohun (2016) studied the impact of currency devaluation on manufacturing output growth in Nigeria between 1980 and 2014, using the Engel-Granger cointegration for long-run relationship, ordinary least squares for long-run estimates and granger causality test for causal relationships. The findings revealed that inflation rate, exchange rate, interest rate and export variables (except import) exert positive effect on manufacturing output growth. The study suggested the need for currency appreciation rather than depreciation, as the sector depends heavily on the importation of equipment and machineries, as well as raw materials. The causality test showed there was a unidirectional causality running from exchange rate, import and credit to private sector to manufacturing output. The study therefore concluded that both monetary and exchange rate policies in Nigeria were not successful in achieving the growth of the manufacturing sector in Nigeria as expected. Thus, there was the need for the review of the exchange rate policy towards appreciation and a monetary discipline that would restore the value of the naira.

Unfortunately, the literature reviewed above was unclear about the direction of effects of exchange rate volatility on manufacturing output in Nigeria. In fact, the nature of the effects of exchange rate volatility on manufacturing output was unresolved. There was, therefore, the need for more empirical research on the subject matter. This was particularly important in view of the nature of exchange rate in developing countries like Nigeria. The current study thus contributes to bridging this research gap.

Methodology

The model

To motivate the empirical investigation, the study drew on the implications of the theoretical model in Paul and Muazu (2016) using a battery of econometric

techniques, including Generalised Autoregressive Conditional Heteroscedasticity (GARCH) and vector autoregressive (VAR) to examine the effect of real exchange rate volatility on economic growth in Ghana. Consequently, the multiple regression equation was structured as:

$$InM\_GDP = \beta_0 + \beta_1 InREXR + \beta_2 InM_2 + \beta_3 InTGE + \beta_4 InDOP + \mu \quad (3.1)$$

Where
M_GDP = manufacturing sector contribution to GDP,
REXR = real exchange rate,
M2 = broad money supply,
TGE = total government spending,
DOP = degree of openness,
In = natural logarithm,
β_0 = the intercept,
$\beta_1 to \beta_4$ = parameter estimate representing the coefficient of REXR, M2, TGE and DOP respectively.

Other fluctuations in the manufacturing output growth was measured by μ. For the necessity of uniformed scale of measurement and consistent interpretation of results, all variables were transformed to the natural logarithms. The log transformation of all the variables allowed for the coefficients to be interpreted as elasticities.

The study depended on secondary data that were obtained from the various issues of Central Bank of Nigeria's (CBN) statistical bulletins, National Bureau of Statistics and World Development Indicators for Nigeria (WDI). The study covered the period 1970 to 2014 due to availability of data. The expected signs of the coefficients of the controls, following the standard growth literature which hypothesize a positive relationship between output growth, broad money supply, government spending and degree of openness, were also expected to propel growth. The coefficient of government expenditure and trade openness was mixed. Following from the Keynesian proposition, the study expected government spending to boost output growth by raising aggregate demand. However, higher government expenditure could also negatively affect growth because of crowding-out effect of private investment, especially when the expenditure is heavily financed with taxes.

Modelling volatility

To measure volatility, some studies (Carrera and Vuletin, 2002; Schnabl, 2007; Gadanecz and Mehrotra, 2013) used the standard deviations where exchange rate

volatility is measured according to the degree to which exchange rate fluctuates in relation to its mean overtime. Using this measure is not without challenges. First, it assumes that the empirical distribution of the exchange rate is normal. Second, it does not reflect the distribution between unpredictable components of the exchange rate process, hence, failing to capture past exchange rate data. The empirical flaws of this measure restricts its use; hence, the use of the autoregressive conditional heteroskedasticity (ARCH) or generalised ARCH (GARCH). In this study, GARCH, developed by Bollerslev (1986), is adopted not only because exchange rate best follows the GARCH process (McKenzie, 1999), but also because it captures past values of the exchange rate as opposed to ARCH. Allowing the log of the real exchange rate to depend on its previous value for the mean equation, the study derived the GARCH model as follows:

$$InREXR_t = \alpha_1 + \beta_1 InREXR_{t-1} + \mu_t \quad (3.2)$$

$$y_t = \lambda_0 + \sum_{i=1}^{k} \lambda_i y_{t-1} + \varepsilon_t ; \varepsilon_t \sim N(0, \sigma_t^2) \quad (3.3)$$

$$\sigma_t^2 = \varphi + \sum_{i=1}^{q} \alpha_i \varepsilon^2_{t-1} + \sum_{j=1}^{p} \beta_j \sigma^2_{t-j} \quad (3.4)$$

Equation 3.3 (the conditional mean equation) is an autoregressive process (AR) of order *k*, AR(*k*). In the estimation process, the optimal lag length (*k*) is determined on the basis of minimum SIC (Schwarz's Bayesian Information Criterion). Parameter λ_0 is the constant; *k* is the lag length; and ε_t is the heteroskedastic error term with its conditional variance (σ_t^2). Equation 3.4 is the conditional variance equation specified as the GARCH (*p*, *q*) model, where *p* is the number of ARCH terms, and *q* is the number of GARCH terms. Several literature (Akgiray, 1989; Conally, 1989; Bera and Higgins, 1993; Floros, 2009) showed that a simple GARCH (1, 1) model is parsimonious and generally gives significant results. Therefore, the current study used AR(*k*)- GARCH(1,1) models to estimate the predicted volatility of the exchange rates studied.

Time series properties of the variables

Econometric studies have shown that most financial and macroeconomic time series variables are non-stationary and using non-stationary variables leads to spurious regression (Engel and Granger, 1987). Thus, the variables were investigated for their stochastic properties, using unit root test with structural break by Perron (2006) to determine the break points/dates, as well as further investigating the properties of

the time series employed since traditional tests for unit-roots (e.g. ADF and PP) are known to have low power in the presence of structural breaks, and have a tendency to 'detect' non-stationarity, which does not exist in the data. Table 1 presents the results of unit root tests with a structural break for the levels and first differences of the annual time series data for the period, 1970-2014.

From Table 1, the null hypothesis of a unit root was accepted for M2 (in the innovational outlier model). The null hypothesis of a unit root was accepted for REXR (in the additive outlier model). In the first difference, however, all the series tended to be stationary. The results confirmed that of Perron (1989) that in the presence of structural break, the standard ADF test or PP tests are biased towards acceptance of the null hypothesis of unit root in the data. Both the IO and AO approach revealed that all the variables had quite diverse structural breaks that depended on key policy changes. The results revealed that majority of the variables had unit root at level but found to be stationary at 1st difference in the presence of various structural breaks.

Table 1: Unit root tests with a structural break

	Innovational outlier model			*Additive outlier model*		
Variable	*t-statistics*	*Break date*	*Lag*	*t-statistics*	*Break date*	*Lag*
M_GDP	-16.88215*	1985	0	-5.805667*	1989	0
REXR	-6.364951*	1994	5	-0.842857	1985	0
M2	-3.238566	2010	7	-18.67889*	1998	9
TGE	-6.687311*	2006	7	-15.11089*	1997	8
DOP	-4.719882[*]	1985	0	-5.543171*	1981	0
ΔM_GDP	-12.35765*	1987	0	-12.29993*	1987	0
ΔREXR	-12.97160[*]	1995	0	-7.797843[*]	1993	2
ΔM2	-9.918134*	2000	9	-19.77855*	1995	9
ΔTGE	-3.933487	2006	7	-8.277431*	1995	9
ΔDOP	-12.46123*	1987	0	-12.77351*	1987	0

Note: [*], [**] and [***] denote significance at the 1, 5 and 10 percent level.
Source: Researcher's computation using e-views 9.5.

Table 1 presents the time of the structural breaks for each and every variable. For majority of the variables, the endogenously determined break date closely corresponds to the: (i) 1981 fall in the price of oil, which led to the downward revision of the Fourth National Development Plan 1981-1985; (ii) 1986-1988 Structural Adjustment Programme (SAP); (iii) 1988-1994 tariff policy reforms; (iv) 1995-2001 policy shift towards measures to promote capacity utilization, increase

manufacturing output and grant tax concessions to exporters; and (v), creation in 2002 of an industrial development coordination committee to attract foreign direct investment, stimulate competition and diversify the export base. Other structural breaks can be attributed to Wholesale Dutch Auction System (WDAS) in 2006, the occurrence of the 2007/2009 global financial crisis and the banking sector reform of 2005. For instance, 1987 emerged as the significant break years for M_GDP and DOP. This can be attributed to a deliberate policy shift by government towards export promotion, exchange rate liberalization, interest rate deregulation and encouragement of foreign investment in the context of SAP. The downward revision of the Fourth National Development Plan (1981-1985) and the promulgation of the austerity measures in 1982 affected such industrial subsectors as manufacturing, contribution to GDP with a structural break in 1984 (Table 1).

Empirical Estimations

Descriptive statistics and trend analyses (a first pass at the data)
Table 2 provides a first pass at the data by analysing the summary statistics of all the variables in the model.

Table 2: Summary statistics results

	M_GDP	*REXR*	*M2*	*TGE*	*DOP*
Mean	13684.22	57.23802	2435349.	1024281.	0.491161
Std. Dev.	18021.41	62.73879	4640443.	1638824.	0.396503
Skewness	4.707706	0.448889	2.001309	1.652754	2.187671
Kurtosis	28.59514	1.475062	5.716748	4.463494	8.038496
Jarque-Bera	1394.552	5.871448	43.87813	24.50288	83.49387
Probability	0.000000	0.053092	0.000000	0.000005	0.000000
Observations	45	45	45	45	45

Table 2 shows the summary of descriptive statistics of the variables included in the model in the study period. It shows the existence of wide variations in the variables, as depicted by higher average values. The analysis carried out in the Table shows that the standard deviation of the exchange rate has been unusually high during the study period. This depicts a high degree of volatility in the exchange rate during the period under investigation. The analysis was also fortified by the value of the skewness and kurtosis of all the variables involved in the model. All the distributions were positively skewed and variables with value of kurtosis less than three are called platykurtic (fat or short-tailed) and REXR variable qualified for this during the period under investigation. On the other hand, variables whose kurtosis value is greater than three are called leptokurtic (slim or long tailed) and M_GDP,

M2, DOP and TGE variables qualified for this during the period under investigation. Jarque-Bera test revealed that most of the data sets are not normally distributed. This is so because the probability values of the variables do not exceed 5%.

The trend of exchange rate volatility in Nigeria

Volatility in exchange rate is the unexpected movement, either upward or downward, of the exchange rate over a period of time. Therefore, as a result of its nature, it represents a risk associated with upward and downward movement of the exchange rate. Volatility in exchange rate has assumed various forms in Nigeria according to various studies in the literature. There are no general ways of measuring volatility, according to existing theories, because there is no consensus on the model of firm behaviour facing risk arising from fluctuations in exchange rates. Different statistical measures of exchange rate volatility have been proposed in the literature. However, two measures have widely been used: the simple standard deviation method and a volatility measure generated from a generalised autoregressive conditional heteroscedasticity (GARCH) process. Thus, to find the trend of exchange rate volatility in Nigeria and with a view to discovering a more reliable trend of exchange rate volatility, both parametric and non-parametric measures of exchange rate volatility were undertaken in this study.

Non-parametric measure of exchange rate volatility

The non-parametric measure of exchange rate volatility gives the estimation of the mean and the standard deviation of exchange rate. This is shown in Table 3.

Table 3: Means and standard deviation of exchange rate in Nigeria

Sample	*No of observation*	*Mean*	*Standard deviation*
1970-1978	9	0.650056	0.036049
1979-1987	9	1.405578	1.431276
1988-1996	9	28.24333	30.69395
1997-2005	9	109.9400	20.42438
2006-2014	9	145.9511	15.93468

Source: Researcher's computation (2016).

The analysis in Table 3 shows that the standard deviation of the exchange rate was unusually high and unusually low. This depicts a high degree of volatility in the exchange rate during the period under investigation. A higher degree of volatility would bring about higher risk to the economic agents involved in the manufacturing sector. The government of Nigeria should, therefore, always take cognizance of the exchange rate movement with a view to regulating it. The standard deviation method

has, however, been criticised for its wrong assumption that the empirical distribution of exchange rate is normal and for ignoring the distinction between predictable and unpredictable elements in the exchange rate process (Hook and Boon, 2000). Consequently, the study used a different approach to measure volatility in exchange rate, which is parametric in nature.

Parametric measure of exchange rate

The parametric measure of exchange rate volatility estimates volatility in exchange rate using the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) model. This is distinct from some past studies that employed traditional measures of volatility, represented by variance or standard deviation that are unconditional and do not recognize that there are interesting patterns in volatility study, time-varying and clustering properties. This lends credence to the choice of GARCH by this study. In general, the conditional mean equation and variance equation of GARCH model is presented in equations 3.3 and 3.4 respectively. Table 4 presents the parameter estimates and their corresponding p-value of AR(1)-GARCH(1,1) model for the exchange rates studied.

Table 4: Summary of the GARCH (1, 1) analysis

Mean Equation	*Coefficient*	*Z-statistic*	*Prob. values*	*Variance equation*	*Coefficient*	*Z-statistic*	*Prob. Values*
β_0	-0.051837	-0.024491	0.9805	∞	0.714848	0.508813	0.6109
REXR	-0.029663	-3.441666	0.0006	α	0.026965	0.131290	0.8955
LOG(M2)	0.448993	0.754140	0.4508	β	0.563301	0.828967	0.4071
LOG(TGE)	0.469294	0.715148	0.4745	REXR	0.001882	0.341248	0.7329
DOP	-0.372550	-1.238836	0.2154	LOG(M2)	-0.001005	-0.002705	0.9978
AIC	2.599464			LOG(TGE)	-0.037728	-0.107734	0.9142
SIC	3.081241			DOP	-0.284544	-0.675563	0.4993

Source: Researcher's computation (2016)

The statistically significant negative coefficient of the exchange rate volatility is not surprising. This is because exchange rate is a price; hence, its movements affect resource allocation in the economy. Thus, when exchange rate is highly volatile and uncertain, as was the case in Nigeria (especially with the adoption of a market-determined exchange rate since September 1986), it hinders the flow of transactions and movement of financial assets, goods and services. Evidently, this result points to the fact that exchange rate stability is central to the flow of foreign capital into Nigeria and that it impacts on manufacturing sector performance. A higher degree of volatility would therefore bring about higher risk in the economic

agents involved in manufacturing sector. The government of Nigeria thus needs to monitor and regulate exchange rate movement, because high exchange rate volatility can scare both local and foreign investors. This therefore portrays adverse effect on the manufacturing subsector.

Results of the mean equation for the GARCH model (Table 4) revealed that exchange rate is negatively related to the contribution of manufacturing to GDP, which is the dependent variable with the coefficient of -0.03 and Z-statistics of -3.44, coupled with the probability value of 0.0006. The results also show that broad money supply (M2) was positively related to manufacturing sector performance, with the coefficient of 0.45, Z-statistics of 0.75 and probability value of 0.4508. This implies that an increase in broad money supply by 1% led to an increase in the contribution of manufacturing to GDP by 0.45% during the period under investigation. Similarly, total government expenditure (TGE) was positively related to the dependent variable, with a coefficient of 0.47, Z-statistics of 0.72 and probability value of 0.4745. By implication, a 1% increase in government spending will lead to 0.47% in the contribution of manufacturing to GDP. One other dimension of the results relates to the negative and insignificant effect of degree of openness on the contribution of manufacturing to GDP in Nigeria. The degree of openness was negatively related to the contribution of manufacturing to GDP, with coefficient, Z-stat and probability values of -0.37, -2.24 and 0.2154 respectively. During the period under investigation, a 1% increase in degree of openness will lead to -0.37% decrease in the contribution of manufacturing to GDP. This means that the recent trade liberalization efforts in Nigeria have not resulted in better manufacturing subsector performance growth.

For the variance equation, the presence of the ARCH (1) effect (denoted as ∞) is the prevalence of volatility clustering of the foreign exchange series. The positive value of 0.714848 showed a high volatility clustering, while its probability value of 0.6109 indicated its insignificance to alter manufacturing sector performance. It is obvious that the persistence, as well as degree of volatility, of GARCH (1), depicted by β), was averagely 0.563301, which means that the exchange rate was moderately volatile for the period under review and could have also moderately affected the performance of the manufacturing sector. The hypothesis for the presence of asymmetric and leverage effects (as denoted by α) was thus rejected for foreign exchange in Nigeria. This indicated that individual investors cannot obtain abnormal or excess profit through arbitrage activities. Empirically, this is a clear departure from existing studies (Zakaria, 2013; Jamil, Streissler and Kunst, 2012; Enekwe, Ordu and Nwoha, 2013) which show a high negatively significant effect of exchange rate volatility on manufacturing performance.

Conclusion and Recommendations

The empirical estimates, using available time series data over a period of 45 years (1970- 2014) suggested that exchange rate has been moderately volatile and could have also moderately affected the performance of the manufacturing subsector. Moreover, the study found that the standard deviation of exchange rate was unusually high and unusually low, suggesting that there was substantial volatility in the exchange rate over the period under study. This shows high degree of volatility in the exchange rate in Nigeria. The study further revealed that the degree of openness was negatively related to the contribution of manufacturing to GDP and, as such, the recent trade liberalization efforts in Nigeria have not led to better manufacturing subsector performance growth, which benefits the poor. But both broad money supply (M2) and total government expenditure (TGE) were positively related to manufacturing subsector growth performance.

The findings therefore recommends that the government should provide a policy environment that will enhance stability of the exchange rate and, hence, promote manufacturing sector growth performance. The issue of exchange rate volatility should not be underplayed, as it affects other important factors for manufacturing sector performance. In this regard, the import content of both public and private expenditures can be controlled. One way of achieving this is to make policy pronouncements that ban the importation of goods and services that can be produced locally, so as to reduce the demand for foreign exchange, thereby reducing pressure on the local currency.

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