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EXCHANGE RATE AND INDUSTRIAL OUTPUT IN NIGERIA: SECTORAL ANALYSIS

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Ebenezer Adesoji Olubiyi[1], Toluwalope Ogunro[2]
[1]Federal University of Agriculture Abeokuta, Department of Economics, Nigeria.
olubiyiea@funaab.edu.ng , ORCID: 0000-0002-7569-6917
[2]Lead City University, Department of Economics, Ibadan, Nigeria.
ogunro.toluwalpope@lcu.edu.ng , ORCID: 0000-0001-6517-056X

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ABSTRACT

Purpose- The Nigerian manufacturing sector is performing below expectations despite government's proactive measures to address critical issues in the sector. A key driver of performance in this sector is the volatile exchange rate, but the direction of this effect is unknown. To shed more light on it, this study considers two types of exchange rates, namely effective and interbank exchange rates and studies manufacturing sector based on product classification.

Methodology: An Auto Regressive Distributed Lag estimator was adopted to estimate the relationship between sectoral output and volatile exchange rate using quarterly data from 2010:1 to 2023:4.

Findings- The volatility of each of the exchange rates is computed by utilizing eGARCH(1,1) based on monthly exchange rate data from 2010:1 to 2023:12. With the aid of autoregressive distributed lag (ARDL), the result indicates that interbank exchange rate volatility matter more than effective exchange rate in the Nigerian manufacturing sector. Further, exchange rate volatility in the manufacturing subsectors is more of a short-run than long-run phenomenon. Specifically, textiles, electrical & electronics, and wood & wood products are adversely affected by interbank exchange rate volatility. Textile, chemicals and oil refining are adversely affected by effective exchange rate volatility. Interbank exchange rate volatility encourages oil refining (up to three lags) and vehicle assembly. In the long run, interbank exchange rate volatility facilitates the performance of electrical & electronics, textile and vehicle assembly while effective exchange rate significantly affects electrical & electronics. Nonmetallic, iron & steel, plastic, cement products are affected negatively by both interbank and effective exchange rate volatility while interbank exchange rate volatility drags the activity in the oil refining products. Economic implications and recommendations are offered based on the findings.

Conclusion- It is therefore concluded that interbank exchange rate volatility matter more than effective exchange rate in the product categories of the manufacturing sector in Nigeria. Further, interbank exchange rate has detrimental effect on most of these products, both in the short and long runs.

Keywords: Industry studies, manufacturing, generalized autoregressive conditional heteroskedasticity, foreign exchange
JEL Codes: L61, L66, C140, F11

1. INTRODUCTION

The industrial sector's contribution to economic growth and development cannot be overemphasized. Advanced countries' robust and persistent growth is inextricably linked to a functioning industrial, especially the manufacturing sector. Although, the service sector is leading in its contributions to economic growth in these countries, its performance is sustained by a productive manufacturing sector. Impliedly, a country's unproductive industrial sector can make an economy dormant leading to rising unemployment, low income, low demand, and low output. This puts the economy in a vicious circle of underdevelopment.

Nigeria is faced with this dilemma given the suboptimal performance of the manufacturing sector. Table 1 presents information on sectoral contributions to Gross Domestic Product growth (GDP) in the country. Observably, the industrial sector's contribution to Nigeria's GDP is unambiguously low. Specifically, in year 2010, the sector accounted for less than 25 percent of GDP. More worrisome is the performance of the manufacturing sub-sector which accounted for 6 percent of GDP in 2010 but rose markedly to 15 percent in 2022. On average, the sector contributed 10 percent to GDP between 2010 and 2022 in contrast to services and agriculture which posted an average of 52 percent and 26 percent respectively (Table 1). Noticeably, the share of manufacturing in industrial sector output averaged 39 percent, suggesting that other sub-sectors constituting mineral resources accounted for 61 percent. This strüktüre confirms the dependence of the economy on mineral

resources. By implication, the dismal economic growth in Nigeria could be traced to the abysmal performance of the industrial sector in general and the manufacturing sector in particular. But what could be responsible for the abysmal performance of the sector? Several factors such as the lack of adequate economic infrastructure, deficient governance institutions, and insecurity were appalling justifications (Adewuyi and Olubiyi, 2020), however, exchange rate volatility is one of the few controversial factors for the dwarfing performance of the sector.

Researchers have assessed the influence of exchange rate movement and volatility on industrial output. Results from received evidence can be categorized into three. The first set of empirical works claim that the effect is positive and significant (Jongbo, 2014). The second set affirms that exchange rate volatility abates industrial output (Loftaliopour *et al*, 2013). The third set shows that exchange rate volatility have no significant effect (Ogunmuyiwa *et al*, 2018; Hakeem, *et al*, 2018). There is yet another set of empirical works that claim that the effect of exchange rate volatility is period-specific. In this regard, industrial output may not be affected by exchange rate in the long run but it does in the short run (Ogunmuyiwa *et al*, 2018).

Table 1: Sectoral Contribution to GDP

Main Sector	2010	2015	2019	2020	2021	2022	Avg performance (2010-2022)
Agriculture	25%	20%	27%	28%	31%	24%	26%
Industry	24%	21%	22%	24%	23%	31%	22%
Services	50%	58%	50%	46%	44%	44%	52%
Manufacturing	6%	9%	12%	13%	15%	14%	10%
Manufacturing in industry	26%	47%	42%	45%	47%	44%	39%
REER volatility	**0.10**	**1.96**	**0.02**	**0.06**	**0.14**	**0.17**	**0.18**
Inter bank exc. rate vol.	**0.04**	**2.39**	**0.37**	**1.96**	**1.99**	**1.98**	**1.13**

Note: share of each sector in GDP expressed in percentage. Services contributed most to GDP, followed by agriculture and then industry. Industry is composed of mining and quarrying and manufacturing. The contribution of manufacturing to industry is less than 50% in any year and the average contribution between 2015 and 2022 was 39%. Needless to say that the contribution of manufacturing is the least, posting an average of 10% between 2010 and 2022.

Source: computed. Underlying data from the Central Bank of Nigeria online statistic database, available at http://statistics.cbn.gov.ng/cbn-onlinestats/DataBrowser.aspx

Two observations can be noted from this evidence. First, industrial sector was studied as a whole. The implication of this is that if some sub-sectors in the industrial sector do not respond to exchange rate, or responds positively or negatively, it will be assumed that such effect is applicable to all the sub-sectors. Table 1 indicates that manufacturing sector performed below par but this sub-sector is part of industrial sector. Thus, a positive or negative or no significant effect may be observed in the industry as a result of dominant performance of a particular sub-sector (say, mineral resources). The figures for exchange rate (both nominal effective and interbank) lend credence to this. Both types of exchanges have been depreciating over time but industrial and manufacturing sectors exhibit inconsistent changes, and so, it can be argued that exchange rate movement has no bearing on the behaviour of these sectors (Table 1).

Second, most studies concentrate on exchange rate movement but not the persistence or the volatility of the variable, whereas, what matters to producers, particularly those whose inputs are import dependent or those whose large proportion of their output is tradeable is affected by the unexpected fluctuation of exchange rate. As can be observed in Table 1, periods of increase in the volatility of each of these exchange rates coincided with period of increase in the percentage share of industrial value added in GDP and the share of manufacturing sector in industrial sector. Thus, it may be conjectured that the dynamics of these sectors is positively driven by exchange rate volatility. However, if sector-specific analysis were carried out, the result may be different. But the good thing is that the outcome may be more useful to policy makers than the one obtained from the aggregation model. This aggregation bias is usually committed and can mislead policy makers in their foreign exchange and industrial policies decisions. It can also mislead other investors in the industrial sectors. This aggregation bias is not resolved when analyzing the manufacturing sector. In the case of Nigeria, and following the standard classification of industrial output, there are thirteen (13) sub-sectors in the manufacturing sector (Table 2;).

The structure of the manufacturing sub-sector is such that food and beverages accounted for the major share in manufacturing output (47.7 percent), followed by textile, apparel and footwear (19.7 percent) while electrical & electronics recorded the lowest (0.1 percent), trailing motor vehicles & assembly (1.2 percent). This divergent performance of the manufacturing sub-sectors may be due to different response to exchange rate volatility. Unlike what was observed in the aggregates, three manufacturing subsectors had continuous decline in their share in total manufacturing output (food and beverages, wood and wood products and oil refining), two indicate consistent increase (cement and paper products), while textile is inconsistent and electrical & electronics is constant. This implies that the first three manufacturing products may

likely respond negatively to exchange rate volatility, electrical & electronics and textile may not likely be affected by exchange rate volatility. Further, other products may likely exhibit positive response to exchange rate volatility.

This simple but important analysis clearly indicates that appropriating a positive, negative or neutral effect of exchange rate on the manufacturing sector in its aggregates may becloud the performance if sub sectoral analysis is discarded.

Table 2: Contribution of Each Manufacturing Sub-Sector to Manufacturing Output

Sub-sector	2010	2015	2019	2020	2021	2022	Avg performance (2010-2022)
Oil Refining	7.1%	2.8%	0.9%	0.3%	0.1%	0.1%	3.3%
Cement	6.2%	8.4%	13.4%	17.6%	22.0%	22.8%	9.8%
Food Beverage and Tobacco	64.2%	47.8%	38.0%	37.1%	33.5%	34.0%	47.7%
Textile, Apparel and footwear	9.9%	20.9%	23.4%	22.0%	21.0%	19.6%	19.7%
Wool and wool product	3.4%	2.9%	2.6%	2.3%	1.9%	1.9%	2.8%
Paper products	0.7%	0.7%	1.2%	1.3%	1.4%	1.3%	0.9%
Chemical and Pharmaceutical	0.7%	2.1%	2.7%	2.5%	2.3%	2.4%	1.9%
Non-metallic products	1.7%	3.5%	5.5%	5.7%	6.4%	6.4%	3.8%
Plastic and Rubber Products	0.9%	3.0%	3.9%	3.1%	2.7%	2.7%	2.7%
Electrical and Electronics	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Basic Metal, Iron & Steel	1.2%	2.3%	2.7%	2.2%	1.8%	1.9%	2.2%
Motor Vehicles & Assembly	0.6%	0.8%	1.2%	2.5%	4.0%	3.9%	1.2%
Other Manufacturing	3.2%	4.8%	4.4%	3.3%	2.8%	2.9%	4.0%
Nominal Effective Exc. rate	96.7	102.0	178.7	185.1	193.1		142.1
Interbank exchange rate	151.1	1195.5	306.9	400.0	426.0		257.1
REER volatility	**0.10**	**1.96**	**0.02**	**0.06**	**0.14**	**0.17**	**0.18**
Inter bank exc. rate volatility	**0.04**	**2.39**	**0.37**	**1.96**	**1.99**	**1.98**	**1.13**

Note: the contribution of each sub-sector in the manufacturing sector is expressed in percentage. Food and beverages accounted for around 48% of manufacturing output. This is followed by Textile and footwear sector with about 20% while the least was electrical and electronics. Source: computed. Underlying data from the Central Bank of Nigeria online statistic database, available at http://statistics.cbn.gov.ng/cbn-onlinestats/DataBrowser.aspx

Although it is not sufficient to establish anything concrete from this descriptive analysis, however, it allows further exploration into the issue at hand so as to unravel the exact relationship and possible direction of relationship between exchange rate volatility and sectoral output growth. Further, received evidences consider just one exchange rate volatility, but experience has shown that firms source foreign exchange from other means such as the interbank. As can be observed, interbank exchange rate is not only higher than effective exchange rate, but also highly volatile. Is there a link between manufacturing sector performance and volatile interbank exchange rate?

This study therefore seeks to explore further how exchange rate volatility influences the aggregate industrial sector output and each of the manufacturing sub-sectors. Most studies on exchange rate volatility and manufacturing output in Nigeria utilized annual data owing to the herculean task required to get high frequency data on sectoral output. But the implication is that the reports that spur volatility usually peters out with time. Thus, this study utilizes quarterly data from 2010:1 to 2022:4 based on data availability. The output of this research work is expected to help policy makers and producers in the manufacturing sector to understand the role of exchange rate volatility in industrial performance. This should provide information about the issues surrounding exchange rate policy in relation to industrial activity. Also, it will help the investors in determining their expectations when exchange rate fluctuations set in.

After the introductory section, section two reviews received theoretical and empirical literature while section three discusses the methodology adopted. Section four presents and discusses the findings and sector five provides summary of findings alongside basic conclusion, policy implications and recommendations.

2. LITERATURE REVIEW

Theoretically, there are three major channels through which exchange rate volatility affects industrial output, namely commodity price, currency crisis and trade. The commodity price channel is induced by monetary policy. Specifically, monetary authorities could alter demand pattern through interest rate changes in their bid to deal with inflation rate. In this case, the authorities may tend to raise monetary policy rate in order to stem the pressure of inflation rate. But the increase in interest rate will alter good prices, affect import input, and hence output prices. The increase in output price may cause consumers to switch demand. The demand switch will alter industrial output. Whether overall manufactured output will increase or not depends on the reaction of consumers to the monetary policy.

From the aspect of currency crisis, if a strong currency (like the US dollar or Pounds or Euro) appreciate against another strong currency (say Euro against the Yen), all currencies pegged to the currency will also appreciate, thereby weakening the relative price competitiveness, to reduction in exports, and to reduction in external account. Further, the cost of servicing may be affected by exchanger rate volatility. Appreciation of foreign currency for which domestic economy is indebted leads to higher cost of debt servicing and this affects allocation of funds for domestic production and hence reduction of industrial output. Ethier (1973) among others demonstrates theoretically that higher exchange rate volatility is inimical to trade. In this regard, risk-averse traders will reduce or even stop producing temporarily during high exchange rate swing. But risk-neutral producers tend to maximize projected returns. In this regard, they tend to increase projected marginal utility of revenue from output and so, they boost production in the face of exchange rate volatility.

The summary of the theoretical effect of exchange rate volatility on industrial output is not straightforward. The effect could be inimical, it could be enhancing or even neutral. Hence, the best way to assess the effect is through empirical evidence. Jongbo (2014) investigates the effect of real exchange rate fluctuation on industrial output in Nigeria, utilizing data from 1990 and 2012 in the context of ordinary least square. Result indicates that exchange rate fluctuation actually increases industrial output. Ishimwa and Ngalawa (2015) examined the effect of exchange rate volatility on manufacturing exports in South Africa employing quarterly data from 1990: Q1 to 2014: Q1. Exponential GARCH (EGARCH) was used to generate the exchange rate volatility and data was analysed using autoregressive distributed lag (ARDL). The result suggests that increase in exchange rate volatility has a positive effect on manufacturing output in the long run, but in the short run, no significant effect is observed. Pamba, (2023) examined the impact of exchange rate volatility on exports in South Africa, results from NARDL show that positive shocks have a greater but statistically insignificant effect on exports than negative shocks.

Oseni et al., (2019) examined exchange rate volatility and industrial output growth in Nigeria using an ARDL technique. Findings reveal that industrial production is an increasing function of volatile exchange rate. Ukunwa et al., (2022) applied the VECM technique to examine the relationship between aggregate industrial output and exchange rate from 1981-2021. The study found a negative and insignificant relationship. Ogunjimi (2020) examined exchange rate dynamics and sectoral output in Nigeria using ARDL and NARDL techniques on data spanning from 1981-2016. Sectors examined include agriculture, industry and service, the study found that dynamics in exchange rate improve agricultural sector performance while such could not be established for the industrial sector.

Arachi (2018) computes exchange rate volatility using SMA model. The study focuses on five major trading partners of Sri Lanka and five products. The real effective exchange rate and its volatility negatively impact real exports for the selected exporting partners in the long run. Ogunmuyiwa and Adelowokan (2018) shows that there is no long run effect of exchange rate volatility on industrial output in Nigeria in the dataset spanning 1986 to 2016 in the context of ARDL although, in the short run, it has a positive and significant effect on industrial output. Jani *et al* (2012) focuses on the effect of exchange rate volatility on industrial output in four EU countries that did not adopt Euro as common currency. The authors employed monthly data from 1980:M1 to 2009:M4 and utilized an autoregressive of order *k* (AR(k)) in the context of EGARCH for calculating volatility. The pooled instrumental variable (IV) method reports that introducing a common currency was beneficial to countries by reducing the negative impact of real exchange rate volatility. However, the currency gain across countries was not uniform. In Iran, Lotfaliporn and Zabini (2013) in their sectoral panel data analysis from 1995 and 2009 found a negative and significant effect of real exchange rate on manufacturing investment in the Sys-GMM method employed.

Palodoo *et al* (2016) provides evidence of the effect of exchange rate volatility on manufactured trade in a panel of 18 African countries from 1995 and 2012. The authors employed import-export model in the context of dynamic panel data. They also utilized z-score and exponential GARCH as measures of volatility. The result from the random effect indicate that real effective exchange rate and its volatility explains manufactured exports and imports. In particular, the findings indicates that exchange rate volatility is inimical to manufactured trade in Africa. Also in Nigeria, Aidi *et al* (2018) employ quarterly data starting from 1980:Q1 to 2016:Q4 and utilize ordinary least square to estimate the output model. The volatility measure favours EGARCH and the result of the model indicate that exchange rate volatility inhibits industrial performance, measured by industrial value added.

Some recent studies on the effect of exchange rate volatility on manufactured output include Buabeng (2019), Falaye *et al* (2019), Ojeyinka (2019), Mambo (2020), Ali (2020), and Oladipo *et al* (2023). In the study of Buabeng (2019), exchange rate volatility and monetary policy rate negatively affect industrial output in Ghana in the dataset spanning 1990 to 2018 in the context of ARDL. Falaye *et al* (2019) find that devaluation reduces industrial performance in Nigeria in their ECM method with data capturing 1990 to 2014 period. Also, Ojeyinka (2019) analysed data from 1981 to 2016 using ARDL method; the study found a negative and significant effect of exchange rate on manufactured output in the short run.in Nigeria. . In Nigeria Ali (2020) find that exchange rate volatility has negative effect of manufacturing performance in Nigeria using the period 1981 and 2018 in the context of ARDL. The study of Oladipo *et al* (2023) compute exchange rate volatility using GARCH (1,1). The result shows no persistence of shocks in the volatility of exchange rate in Nigeria during 1981-2022 period. Results from the ARDL indicate that exchange rate is highly volatile and has negative effect on manufacturing output. Takpa et al., (2023) explored the relationship between the real exchange rate and the manufacturing sector in Nigeria from 1999-2021. Using a vector autoregressive estimator, the study found a negative and insignificant relationship between exchange rate and manufacturing output. Abiola (2024) could not find a significant effect of exchange rate volatility on manufacturing growth in the ARDL method of data covering 1978 and 2022. However, the study of Bakla *et al* (2024) for Nigeria reports that exchange rate volatility positively and significantly affect manufacturing sector export the authors estimated an autoregressive distributed lag of data spanning 1985 to 2022 and utilized GARCH (1.1) to proxy exchange rate volatility and finds that increase in exchange rate volatility enhances manufactured exports in the long run.

Table 3: Summary of Empirical Evidence Showing the Effect of Exchange Rate Volatility on Output

#	Author(s) and date	Location	Theory and methodology	Results of the effect of exchange rate volatility on output
1	Jongbo (2014)	Nigeria	OLS	Proactive and significant
2	Ishimwa and Ngalawa (2015)	South Africa	eGARCH (1,1) to generate volatility and ARDL for estimation	No significant effect in the short run but significant positive effect in the long run
3	Pamba, (2023)	South Africa	NARDL	Positive shocks to exchange rate fluctuation (depreciation) has greater, albeit insignificant effect
4	Oseni et al., (2019)	Nigeria	ARDL	Positive effect
5	Ukunwa et al., (2022)	Nigeria	VECM	Negative but insignificant
6	Ogunjimi (2020)	Nigeria	N(ARDL)	Positive and significant effect on agriculture output but insignificant effect on industrial output
7	Arachi (2018)	Sri Lanka	SMA model	Negative effect
8	.Ogunmuyiwa and Adelowokan (2018)	Nigeria	ARDL	Positive and significant in the short run but insignificant in the long run
9	Jani *et al* (2012)	4 EU countries	eGARCH for volatility and pooled IV model for estimation	Negative
10	Lotfaliporn and Zabini (2013)	Iran	SYS-GMM	Negative and significant
11	Palodoo *et al* (2016)	18 African countries	Dynamic Panel Data Random effect, employ *z*-score and GRACH to generate volatility	Negative
12	Aidi *et al* (2018)	Nigeria	OLS, using eGARCH to generate volatility	Negative
13	Buabeng (2019)	Ghana	ARDL	Negative
14	Falaye *et al* (2019)	Nigeria	ECM	Negative
15	Ojeyinka (2019)	Nigeria	ARDL	Negative and significant
16	Ali (2020	Nigeria	ARDL	Negative
17	Oladipo *et al* (2023)	Nigeria	GARCH(1,1) for volatility and ARDL	Negative on manufacturing output
18	Takpa et al., (2023)	Nigeria	VECM	Negative, albeit insignificant
19	Abiola (2024)	Nigeria	GAARCH (1,1) for volatility, ARDL	Insignificant

20	Bakla *et al* (2024)	Nigeria	GARCH (1, 1) for volatility, ARDL	Positive and significant effect in the long run

The summary of the empirical findings **s** provides diverse result across countries and over time (Table 3). Observably, empirical evidences from Nigeria are also diverse. Some studies found negative relationship; other studies found positive relationship while some studies could not establish any significant effect of exchange rate volatility on manufacturing sector output (Table 3). However, it was observed that the common approach across the empirical models is the modeling of the manufacturing sector as a single sector disregarding the variation in pattern of some manufacturing sub-sectors. To avoid aggregation bias, it is important to disaggregate the manufacturing sectors and study how exchange rate volatility affect each of the sub-sector. It is our belief that this sectoral level analysis will provide more insight into how exchange rate volatility affects manufacturing sector performance and this could be of help to policy makers.

3. DATA AND METHODOLOGY

3.1. Model Specification

Following Bahmani-Oskooee and Mohammadian (2017) with a slight modification, a flavour of demand-supply model is specified as follows

$$Y_t = f(VOL_t\ , MP_t\ , FP_t, X_t) \tag{1}$$

That is sectoral value addition Y_t depends on exchange rate volatility(VOL_t), monetary policy (MP_t), fiscal policy (FP_t) and other catchall variables (X_t). From the theoretical point of view, monetary policy affects the industrial sector when the monetary authorities are trying to tame inflation rate. In particular, the monetary authorities deal with high inflation rate by raising interest rate. But the increase will lead to increase in cost of production, reduce investment and hence, reduction in output. From the demand side, the increase in interest rate will reduce purchasing power (holding money income constant), demand and hence, reduce production. Not only that, increase in interest rate will raise the opportunity cost of holding money, reduce demand and hence production. Ultimately, interest rate is expected to reduce industrial output. However, investors might decide to increase production in the face of increased interest rate if there is potential for future profit. Also, the opportunity cost of holding money may not be high even when interest rate increases, particularly when income is low and stagnant. Hence, the direction of effect of interest rate on industrial output depends on the nature of goods produced in the sector.

Government provides public goods to facilitate economic activity in which industrial sector plays a major role. Economic infrastructure such as good roads, stable electricity supply, research and development, functional political and economic governance are some important ways government intervene in the economy. This is captured in the model as fiscal policy and proxied by government final expenditure that accounts for both recurrent and capital expenditure. The catchall variables considered in this study are the capital market and the foreign exchange market activities. Functional capital market provides avenues for firms to ease financial constraints. Hence, it is expected that improved stock market activity should enhance sectoral output since firms can source for funds to overcome financial constraints. This is captured by stock market capitalization. Foreign exchange is key to importing important factor inputs such as raw materials and capital goods. Access to foreign exchange market allows producers whose production are import-input-intensive to import these factor inputs with ease. In this study, sectoral foreign exchange supply are considered, namely foreign exchange in the industrial , manufacturing, minerals , food and beverage and in oil and gas sector.

Exchange rate volatility is computed first identifying the type of exchange rate for which volatility is referred. For this study, real effective exchange rate is employed. Specifically, real effective exchange rate is computed using equation 2, that is,

$$C = \sum_{i=1}^{n}\left(\omega_{hf,t}R_t\right) \tag{2}$$

Where $R_t = \mathbf{e}_{hf,t}\frac{P_{ft}}{P_{ht}}$ (3)

$$\mathbf{e}_{hf,t} = \frac{C_t^h}{C_t^f} \tag{4}$$

Equation 1 states that real effective exchange rate (R_t) is sum of the product of weighted trade between home and foreign ($\omega_{hf,t}$) and real exchange rate (R_t). The real exchange rate is defined in equation 3 as the product of nominal bilateral exchange rate ($\mathbf{e}_{hf,t}$) and international relative price ($\frac{P_{ft}}{Pht}$). The terms P_{ft}, P_{ht}, C_t^h, and C_t^f stand for foreign price, domestic price, foreign currency and domestic currency respectively. The effective exchange rate specified in equation 2 is used to compute its volatility. There are several approaches utilized in the computation of exchange rate volatility (or any volatility of macroeconomic and financial variables). The approaches commonly employed in the literature include simple standard deviation, moving average of standard deviation and the time-varying autoregressive conditional heteroskedasticity (ARCH).

In the case of ARCH effect, the argument is that the dynamic of the series (exchange rate in this case) is time-dependent, that is, information providing the value of the exchange rate is time dependent. Starting from the Engel (1982) autoregressive (AR) effect of the form

$$\mathcal{g}_t = a_0 + a_1\varphi_{t-1} + \varepsilon_t \quad (5)$$

Where ε_t is the residual term. The squared of the estimated residual is then estimated by its lags

$$\varepsilon_t^2 = \gamma_0 + \gamma_1\varepsilon_{t-1}^2 + v_t \quad (6)$$

The ε_{t-1}^2 is the autoregressive term and γ_1 estimates by how much the residual is autoregressive (depends on the past residuals). If there is no autoregressive in the process then γ_1 will not be significantly different from zero. Otherwise, $\mathcal{g}_t$ series is said to be volatile, and its volatility is time-varying. This is the famous autoregressive conditional heteroskedasticity (ARCH) effect. But the residuals may influence the variance, in which case, not only the residual is not constant but also the variance is not also constant (Engle, 1982). The problem of residual influencing variance of a series is inevitable in a high frequency data, such as monthly, weekly or daily data. This problem is dealt with by simultaneously estimating the mean and variance as indicated in equations 7 and 8

$$\mathcal{g}_t = a_0 + \sum_{i=1}^{z} a_i\varphi_{t-i} + \varepsilon_t \quad (7)$$

$$\sigma_t^2 = \tau_0 + \sum_{i=1}^{z} \tau_i\varepsilon_{t-i}^2 \quad (8)$$

That is, the variance of the residual (σ_t^2) is explained by the squared of the previous residuals. Recall the ε_{t-i}^2 is the ARCH effect and expectedly, the coefficient τ_i should take on a positive value. Additionally, the value is expected to be less than 1. The closer it is to 1 the slower the mean reverting. But what if the current variance also depends on the lagged variance? Hence, equation 7 becomes

$$\sigma_t^2 = \tau_0 + \sum_{i=1}^{z} \tau_i\varepsilon_{t-i}^2 + \sum_{j=1}^{n} \rho_j\sigma_{t-j}^2 \quad (9)$$

Equation 9 is the generalized ARCH-type (GARCH (1,1)) model, which is commonly utilized in computing exchange rate volatility. The third term in equation 8 is the GARCH effect. It is also expected to be positive. Meanwhile, $\tau_i + \rho_j$ should be less than 1 if the shock will be temporary. But if the shock is not temporary, then the sum can be greater than 1. Also, the closer the shock to 1 the slower the mean reverting (the shock tends towards being permanent). In a special case where the sum is zero, then there is no existence of volatility in the system. if ρ_j is not significantly different from zero while τ_i does, then, the system reduces to ARCH effect only.

In the event that the series affected by its past event, the current residual and the variance, such that

$$\mathcal{g}_t = a_0 + \sum_{i=1}^{z} a_i\mathcal{g}_{t-i} + \varepsilon_t + \rho_j\sigma_t^2 \quad (10)$$

then the series follows volatility of GARCH-M. However, if ρ_j is not significantly different from zero, the series only does not exhibit GARCH-M type. It is, however, important to check if the series exhibits GARCH-M because this type of volatility so as to know if the series conceives important news in the residuals and variance or not.

It is one thing to establish that the volatility conceives a particular news, it is another thing to know whether the news is symmetric or not. A case of asymmetry of exchange rate behaviour (among other macroeconomics variables) have been examined in the literature. All the ARCH/GARCH models specified above assumed that the news is symmetry. But asymmetry is inevitable because news could be positive (good news) or negative (bad news). The threshold GARCH (tGARCH) developed by Zakoian (1994) incorporates the possibility of information asymmetry in the volatility and this is specified in equation 10

$$\sigma_t^2 = \tau_0 + \sum_{i=1}^{z} \tau_i\varepsilon_{t-i}^2 + \sum_{j=1}^{n} \rho_j\sigma_{t-j}^2 + \delta\varepsilon_{t-i}^2 * D_{t-1} \quad (11)$$

The term D_{t-1} is the dummy and it checks how significant nature of the shock is. If δ is not significantly different from zero then the shock (either negative or positive) is not important, and so, investors can ignore the importance of news (either good or bad) in the exchange rate volatility. But suppose the presence of positive or negative news is important in the exchange rate market, does good news overweigh bad news? This question is important for firm owners in the industrial sector, particularly those whose input are import-dependent and those whose output are mostly exported. Following Nelson (1991), an exponential GARCH (eGARCH) is developed as follows

$$\sigma_t^2 = \tau_0 + \tau_1\left|\left(\frac{\varepsilon_{t-1}^2}{\sigma_{t-1}^2}\right)^{1/2}\right| + \theta\left(\frac{\varepsilon_{t-1}^2}{\sigma_{t-1}^2}\right)^{1/2} + \vartheta ln(\sigma_{t-1}^2) \quad (12)$$

In equation 10, the value of θ is the focus that indicates if the volatility follows tGARCH or not. If the value of the estimator is negative, then the bad news overweighs the good news. If the value is positive, then the good news overweighs the bad

news. If the value is very close to zero, then there is no case for information asymmetry. Which of the ARCH-type is valid for the computation of real exchange rate volatility? It is important leave it open and allow the information criteria to determine which is best explains the nature of exchange rate volatility to be included in equation 1. Specifically, equations 7, 8, 9, 10, and 11 for ARCH, GARCH (1,1), GARCH-M, tGARCH and eGARCH respectively are estimated and information criteria are employed to choose the best suited volatility model. the information criteria are Akaike information criterion, Schwartz information criterion, and Hanna-Quinn information criterion. The lowest value recorded across the models for each of these criteria is the appropriate and the most valid model. Having detected the valid model, data for volatility are then generated from the volatility model chosen. As indicated earlier, exchange rate volatility can have a positive or negative effect on any of the sectoral output depending on how the producers react to exchange rate dynamics.

3.2. Method of Analysis

Usual routine econometric tests associated with the autoregressive distributed lag (ARDL) are carried out. One of such test is the unit root. Received statistical tests for unit root include Dickey-Fuller, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) while Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests for stationarity. Results from these various tests are rarely dissimilar. Consequently, the ADF is employed for this study. Consider the model for which series *y* is to be tested in equation 13.

$$\Delta y_t = \zeta_t + \Im_t + \eta y_{t-1} + \sum_{i=1}^{n} \lambda_i \, \Delta y_{t-1} + e_t \tag{13}$$

where ζ is constant, $\Im_t$ is trend, and $\sum_{i=1}^{n} \lambda_i \, \Delta y_{t-1}$ is the augmentation. The purpose of this augmentation is to allow for any autoregressive data generating process in any order greater than 1. Whether the series possesses a unit root or not depends on the value of λ.. If the series does not possess unit root, then the value of the parameter should be zero. Alternatively, if the series possesses a unit root, then, it is nonstationary.

This study employs autoregressive distributed lag (ARDL) because it can indicate when exchange rate volatility is relevant (short run, long run or both runs) to sectoral output. Besides, ARDL can deal with series that exhibit a mix of I(0) and I(1). Further, under certain plausible assumptions, ARDL can address the issue of endogeneity problem usually encountered in macroeconomic analysis (Jalil et al, 2008; Pesaran and Pesaran 1997). Also, ARDL produces efficient and consistent coefficients because it corrects for possible serial correlation (Pesaran and Shin, 1999 and Pesaran and Shin, 2001). Based on this, Schwarz-Bayesian Criterion (SBC) and Akaike Information Criterion (AIC) are employed to determine the optimal lag length included in the unit root test ARDL model. The estimable ARDL, after log linearizing relevant variables is indicated in equation 14

$$\Delta \ln Y_t = \gamma_0 + \sum_{i=1}^{a1} \vartheta_{1i} \Delta lnY_{t-i} + \sum_{i=1}^{a2} \vartheta_{2i} \Delta VOL_{t-i} + \sum_{i=1}^{a3} \vartheta_{3i} \Delta lnMP_{t-i} + \sum_{i=1}^{a4} \vartheta_{4i} \Delta lnFP_{t-i} + \sum_{i=1}^{a5} \vartheta_5 \Delta lnX_{t-i} + \vartheta_5 lnY_{t-1} + \vartheta_6 lnVOL_{t-1} + \vartheta_7 lnMP_{t-1} + \vartheta_8 lnFP_{t-1} + \vartheta_8 lnFP_{t-1} + e_t \tag{14}$$

Equation 14 is estimated separately for industry and manufacturing as a whole, and for thirteen sub-sectors in the manufacturing sectors. These include oil refining; cement; food, beverage, and tobacco; textile apparel and footwear; wood and wood products; pulp, paper and paper products; chemical and pharmaceutical products; non-metallic products; plastic and rubber products; electrical and electronics, basic metal, iron and steel, motor vehicles & assembly and other manufacturing. All these are the sectoral classification of the manufacturing sector in Nigeria. This study seeks to unravel the influence of exchange rate volatility on each of these sub-sectors.

Data on all the variables, that is, sectoral output, effective exchange rate, monetary policy rate, market capitalization, foreign exchange to the oil refining, foreign exchange to food, beverage and tobacco and foreign exchange to manufacturing are obtained from the online data repository of the Central Bank of Nigeria, publicly available at www.statistics.cbn.gov.ng/cbn-onlinestats/DataBrowser.aspx . All the data are obtained on quarterly basis from 2010:1 to 2023:4. However, data used to compute volatility (equations 8 to 11) are obtained on monthly basis from 2010:M1 to 2023:M12. After choosing the appropriate volatility model, the monthly volatility data generated are later converted to quarterly data using *high to low frequency data approach*. As indicated in equation 14, all the series are log linearized except the volatility series. According to equation 13, both short run and long run models are estimated for each sector. Some post estimation tests such as serial correlation, heteroskedasticity, RESET, and test for stability of the model (CUSUM and CUSUM of Square) are carried out in order to validate the predictive ability of the models.

4. RESULTS AND DISCUSSIONS

4.1. Volatility and Descriptive Statistics

The result of the volatility models is shown in Table 4. Out of the four models estimated (equations 8, 9, 10 and 12) which is ARCH, GARCH (1,1), GARCH-MM, and eGARCH (1,1), all the information criteria identified eGARCH (1,1) as the appropriate type of volatility for both interbank exchange rate and nominal effective exchange rate. This implies that the nature of volatility of

exchange rate in Nigeria is such that positive and negative news is important in the foreign exchange market. The eGARCH(1,1) series generated is copied and included in the dataset developed for the estimation of equation 14.

Table 4: Result of the GARCH-Type and Selection Criteria for Choosing Appropriate Nature of Volatility

ARCH-TYPE	Interbank Exchange Rate			Nominal Effective Exchange Rate		
	AIC	SIC	HQIC	AIC	SIC	HQIC
ARCH	5.941	6.014	5.973	6.346	6.424	6.377
GARCH(1,1)	5.958	6.056	5.998	5.488	6.047	5.988
GARCH-M	5.901	5.999	5.941	6.359	6.457	6.398
eGARCH(1,1)	5.69	5.81	5.740	**5.443**	5.712	5.641

Note: AIC, SIC, HQIC correspondingly stands for Akaike information criterion, Schwartz information criterion and Hanna-Quinn information criterion; the Table indicates that all the information criteria favours FGARCH (1,1) for each of the models.

From the descriptive statistics presented in Table 5, the average values of industrial output from quarter 1 of 2010 and quarter 4 of 2023 was 8,565.7 billion naira while the mean value of the manufacturing sector was 3,581.54 billion naira in the period under review. The average values of each of the sectoral output is also indicated in Table 5. Other manufacturing goods posted an average of 127.22 billion naira while oil refining sector posted 54.98 billion naira. Going through the average values of the sub-sectors, food, beverages and tobacco recorded the highest, with 1,435.5 billion, followed by textile with 753.14 billion naira while cement is the third largest sub-sector in the manufacturing sector as it posted an average value of 557.64 billion naira between 2010:1 and 2023:4. Complementing the trend analysis in Table 5 electrical & electronics sub-sector recorded the least average performance with 2.62 billion naira average of output in the manufacturing sector. Further, paper & paper product posted 41.19 while oil refining recorded 54.98-billion-naira worth of output. Clearly, electrical & electronics and oil refining, the two critical sectors that could enhance overall economic performance is not performing really well. Given this different performance across sub-sectors, it is important to unravel how each sub-sector is affected by exchange rate shocks.

The descriptive statistics also present the properties of foreign exchange used by the entire industry, the manufacturing sector, the food and oil refining sub-sectors. The average foreign exchange used in the industrial sector of Nigeria during the period under review was 605.53 billion naira while that which went to the manufacturing sector was 320.8 billion naira. Observably, foreign exchange used up in the oil refining sector (447.06 billion naira) is greater than that which was used in manufacturing sector. Out of the sub-sectors, mineral (iron and steel) sector recorded the least foreign exchange use (30.34 billion naira). This is followed by food, beverage & tobacco recorded the least, posting an average of 280.3 billion naira. How has foreign exchange used in each of these sub-sectors influenced their individual output? Does highest foreign exchange that goes into oil refining enhances oil refining value added? Does availability of foreign exchange in the industrial, manufacturing and its sub sectors significantly matter for their respective output? Results from the estimation models is expected to provide answers to these questions. Meanwhile, average government spending in the period under review was 4,293.45 billion naira and the average market capitalization was 27,969.52 billion naira. Further, the average monetary policy rate was 15.62. The average nominal effective exchange rate was 142 while that of inter-bank exchange rate was 257.1. In terms of exchange rate volatility, interbank exchange rates tend to be less volatile on average (0.002) than nominal effective exchange rate volatility (0.01).

Table 5: Descriptive Statistics of the Variables

Sectors	Mean	Maximum	Minimum	Std. Dev.	Jarque-Bera	Prob-value (J-B)	Obs
INDUSTRY	8565.70	38560.92	3284.29	6898.58	175.37	0.00	52
MANUFACTURING	3581.54	18067.69	875.41	3410.18	148.75	0.00	52
OTHER MANUFACTURING	127.22	514.35	28.73	94.43	97.85	0.00	52
OIL REFINERY	54.98	115.33	5.02	30.99	1.93	**0.38**	52
CEMENT	557.64	4074.50	54.47	**849.97**	135.46	0.00	52
CHEMICAL AND PHARM. PRODUCTS	79.82	432.56	5.20	**86.94**	97.27	0.00	52
BASIC METAL, IRON AND STEEL	76.14	339.20	10.99	64.21	100.01	0.00	52
NON-METALLIC PRODUCTS	183.45	1147.26	13.97	**234.73**	118.43	0.00	52
MOTOR VEHICLE AND ASSEMBLY	83.30	706.92	5.26	**150.83**	139.30	0.00	52

ELECTRICAL AND ELECTRONICS	2.62	12.91	0.62	2.46	130.37	0.00	52
PULP, PAPER AND PAPER PRODUCTS	41.19	255.38	5.98	**52.11**	122.19	0.00	52
PLASTIC AND ROBBER PRODUCTS	101.58	482.06	8.39	95.72	76.43	0.00	52
WOOD & WOOD PRODUCTS	84.96	327.05	29.92	56.82	130.38	0.00	52
TEXTILE, APPAREL AND FOOTWEAR	753.14	3770.95	80.30	731.43	113.37	0.00	52
FOOD, BEVERAGE AND TOBACCO	1435.50	5979.90	565.18	1032.79	186.87	0.00	52
FOREX TO FOOD PRODUCTS	280.26	530.60	92.75	132.76	4.76	0.09	52
FOREX TO INDUSTRIY	605.53	1023.02	339.92	132.68	1.77	0.08	52
FOREX MANUFACTURING	320.84	473.58	120.21	89.68	0.87	0.02	52
FOREX MINERALS	30.34	356.72	3.33	**48.62**	3378.52	0.00	52
FOREX OIL PRODUCTS	447.16	1346.16	80.20	315.98	3.35	0.19	52
GOVERNMENT SPENDING	4293.45	12164.15	899.81	**4348.58**	9.53	0.01	52
MARKET CAPITALIZATION	27969.52	46438.63	11632.19	8544.04	1.75	**0.42**	52
MONETARY POLICY RATE	15.62	18.86	11.50	2.10	7.53	0.02	52
INTB	257.1	445.5	150.5	90.3	26.3	0.00	52
NEER	142.0	206.0	9.3	44.6	7.47	0.02	52
VOLINTB	0.002	0.51	0.002	**0.003**	26.3	0.01	52
VOLNEER	0.01	0.12	0.001	0.02	151.1	0.00	52
ARCH EFFECT VOLINB				0.16			
ARCH EFFECT VOLNEER				0.54			

Note: VOLINTB and VOLNEER indicates volatility of interbank exchange rate and volatility of nominal effective exchange rate. The volatility was obtained from the GARCH(1,1). Monetary policy rate is the annualized official interest rate set by the Central Bank of Nigeria. All other values are in billion naira.

Observably, the rate of volatility of these exchange rates are relatively low. It is also revealed that most of the series exhibits large dispersion around its mean. Specifically, standard deviation values of output of cement, chemicals, metal, vehicle assembly, paper and paper products are greater than their mean, indicating that there is evidence of over dispersion in the data. Similarly, the standard deviation of foreign exchange in the mineral sector (iron and steel), government spending and volatility of interbank exchange rate also greater than their respective mean. Besides, out of all the series, data for market capitalization and output of the oil refining sector are normally distributed while the rest are not. All these statistical properties indicate that ordinary least square cannot be the appropriate estimation technique.

It is also important to inspect possible multicollinearity among the dependent variables. Table 6 indicates that only interbank and nominal effective exchange rate volatility has strong multicollinearity. By implication, these two variables cannot be combined in the same model.

Table 6: Pairwise Correlation Coefficients of the Dependent Variables

	A	B	C	D	E	F	G	H	I	J
A	1.00	0.59	0.7	0.59	0.62	-0.37	0.04	0.26	0.72	0.72
B		1	0.58	0.46	0.45	-0.28	0.46	0.28	-0.32	-0.35
C			1	0.55	0.48	-0.27	0.06	0.22	-0.61	-0.60
D				1	0.25	0.11	-0.08	-0.12	-0.24	-0.28
E					1	-0.63	0.12	0.72	-0.61	-0.51
F						1	-0.28	-0.67	0.78	0.72
G							1	0.32	0.03	-0.02
H								1	-0.65	-0.60
I									1	0.97
J										1

Note: A, B, C, D, E, F, G, H, I, J stands for foreign exchange to food, beverages and tobacco products, foreign exchange to the industrial sector, foreign exchange to manufacturing sector, foreign exchange to the mineral sector, foreign exchange to oil products, government final consumption expenditure, market capitalization, monetary policy rate, volatility of the interbank exchange rate and volatility of the nominal

effective exchange rate (FGARCH(1,1)respectively. Strong correlation exists between effective and interbank exchange rate volatility; thus, each variable enters each model separately.

4.2. Short-Run and Long-Run Models

The short run analysis begins with how exchange rate volatility influences the industrial sector, the manufacturing sector and other manufacturing sector. Following equation 14, the dynamic and conditional error correction results for industrial, manufacturing and other manufacturing sectors is presented in Table 7 The short run effect is indicated in the bottom panel of the Table. Owing to the strong correlation between effective and interbank exchange rate volatility, separate models are estimated. Observably, industrial sector is affected negatively and significantly by own lagged period. In particular, current industrial activity reduces by 0.4% for 1% increase in the activity of the sector, three quarters back. Thus, if industrial activity increases by 1% in the first quarter say, the effect will be felt significantly in the fourth quarter. But it is the case that the negative effect begins to manifest from the succeeding quarter, albeit not significant. Foreign exchange allocated to the industrial sector does not have immediate significant impact, but the fund is crucial to the activity of the sector. As can be read off, a 1% increase in foreign exchange in the current quarter exacts 0.3%, 0.2% and 0.3% increase in the first, second and third quarter respectively. Other variables, including effective exchange rate volatility, have no influence on the industrial activity. Thus, the major driver of Nigeria industrial sector is access to foreign exchange. This is not surprising since the sector is imports input dependent, particularly the mining and quarrying sector. When interbank exchange rate variable replaces effective exchange rate, the direction of effect is not different but there is a slight change in the magnitude of response of current industrial activity to own lagged values in the interbank model than in the effective exchange rate model. Further, unlike the absence of the effect of effective exchange rate volatility on industrial output, the volatility of interbank exchange rate shows positive but insignificant effect. This could be informed by nonresponse of many major sectors (particularly the oil sector) to exchange rate swings.

The manufacturing sector significantly responds to one lagged period of own output, lagged periods of foreign exchange used in the manufacturing sector, and effective exchange rate volatility. Observably, current manufacturing output is reduced by 0.35% if immediate last quarter output increases by 1%. The negative effects in both industrial and manufacturing sectors should not be considered as counterintuitive but as a sign of convergence in those sectors. Increase in foreign exchange allocated to the manufacturing sector drags the activity, albeit not immediately. Although the influence of a change in foreign exchange, two quarters back on the current manufacturing output is insignificant, it is important and in fact, negative. Meanwhile, interbank exchange rate shows negative but insignificant effect.

Table 7: Short Run Dynamic and Conditional Error Correction Results of the Effects of Exchange Rate Volatility on Sectoral Output (Industry, Manufacturing, Other Manufacturing)

Variables	Industry		Manufacturing		Other Manufacturing	
C	-0.36	-0.50	-2.41*	-1.60	-3.16	-5.73***
IND(-1)*	0.13**	0.18**				
MANUF(-1)			-0.05**	-0.12**		
OTHERMANUF(-1)					-0.54**	-0.27**
FOREXIND(-1)	-0.24**	-0.22***				
FOREXMANUF(-1)			0.20	0.11	-0.17	0.43**
GOVT	0.08	0.07*	-0.05*	0.03*	0.13**	0.15*
MKTCAP(-1)				0.07	0.63**	
MPR	0.04**	0.04	-0.03	-0.01	-0.07	0.04
VOLNEER(-1)	-0.08		0.36**		0.10	
VOLINTB(-1)		0.01		0.22**		0.36*
D(IND(-1))	-0.23	-0.17				
D(IND(-2))	-0.01	-0.06				
D(IND(-3))	-0.44**	-0.48**				
D(MANUF(-1))			-0.35**	-0.27		
D(OTHERMANUF(-1))					-0.27 (-1.59)	-0.38** (-2.28)
D(FOREXIND)	0.12	0.10				

D(FOREXIND(-1))	0.32*	0.32**				
D(FOREXIND(-2))	0.24*	0.22*				
D(FOREXIND(-3))	0.29***	0.29***				
D(FOREXMANUF(-1))			-0.22**	-0.12	-0.48**	-0.29**
D(FOREXMANUF(-2))			-0.16	-3.60		
D(MKTCAP)			-0.06	-0.04		
D(MPR)			0.05*	0.06**		
D(GOVT(-1))					0.36	0.24**
D(GOVT(-2))					0.50***	0.19*
D(MKTCAP(-1))					-0.37**	
D(MPR)					0.12**	0.14**
D(MPR(-1))					0.16**	
D(VOLNEER(-1))	0.39		0.17		0.89	
D(VOLNEER(-3))			-0.59*		-1.22**	
D(VOLINTB)				-0.15		-0.41

Note: The table shows the results of short run dynamic and conditional error correction in Industrial, Manufacturing and Other Manufacturing outputs; ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the bracket are t-statistics. IND, MANUF, OTHERMANUF, FOREXIND, FOREXMANUF, GOVT, MKTCAP, MPR, VOLNEER and VOLINTB stand for industrial output, manufacturing output, other manufacturing output, foreign exchange in the industrial sector, foreign exchange in the manufacturing output, government expenditure, market capitalization, monetary policy rate, nominal effective exchange rate volatility and interbank exchange rate volatility respectively.

While the reason for the negative effect of exchange rate volatility on manufacturing output is reasonable and explanatory, that of the negative effect of foreign exchange and positive effect of monetary policy rate appears counterintuitive. However, if there are some sub-sectors in the manufacturing sectors where foreign exchange is not efficiently utilized, and if these sectors account for the large proportion of the sector's activity, then it could be assumed that foreign exchange is inimical to manufacturing output owing to inefficient use of the fund. Thus, this result exposes possible underutilization or inefficient use of foreign exchange allocated to the manufacturing sector. Notably, this sector is sensitive to both effective and interbank exchange rate volatility. Specifically, manufacturing sector will reduce by 0.6% and 0.2% if effective and interbank exchange rate increase by 1% respectively, albeit the effect is not immediate. In fact, it takes three quarters before the negative and significant effect manifests. (in the case of nominal effective exchange rate volatility). Thus, while industrial sector shows no significant effect of exchange rate volatility, manufacturing sector does.

In the case of other manufacturing sector, the immediate own lag has negative and significant (in the case of model that includes interbank exchange rate) effect. Further, foreign exchange to the manufacturing sector shows negative and significant effect. In fact, the magnitude of effect is higher than that of manufacturing sector. An indication that the inefficient use of foreign exchange allocated to the manufacturing sector is highly pronounced in the sector called *other manufacturing*. Unlike the case of industrial and manufacturing sectors, government spending, market capitalization, MPR, and exchange rate volatility are important in driving the sector. Government spending is very important in enhancing the activity of this sector. Specifically, a 1% increase in the spending will raise other industrial sector activity by 0.24% in the first quarter following the period of the shock and additional 0.5 (when nominal exchange rate is considered) and 0.2% (when interbank exchange rate is considered) in the second quarter. Monetary policy rate is also positive but at the same time, negligible. A 1% increase in MPR leads to at most 0.2% in the current period and additional 0.16% in the following quarter. This also indicates that while MPR is important in driving the manufacturing sector, the impact of its upward review will not be felt on the output of the manufacturing sector. It takes two quarters before this sector can be affected negatively by the activity of the capital market. In the case of exchange rate volatility, only effective exchange rate volatility significantly affects other manufacturing sector. Observably, it is the case that this sector is highly sensitive to exchange rate volatility. In specific term, if the volatility rises by 1%, the output of other manufacturing sector will dwarf by 1.2%. However, interbank exchange rate volatility does not significantly affect other manufacturing sector.

The top panel of Table 7 indicates the contribution of each variable to the long run convergence of each model to its long run after the shock. In the case of the industrial sector, the current quarter accounts for 13% of the shocks while the other 87% will be accomplished in the next 6 and a half quarters. In the case of manufacturing sector, the first period accounts for 5% of the shock while the rest 95% is accounted for by approximately 8 quarters and 1 month. The adjustment in the other manufacturing sector is very fast such that it took less than two quarters before the adjustment is complete.

4.2.1. Analysis of Exchange Rate Volatility and Sectoral Output: Non-Metallic Products, Basic Metals, Iron & Steels, and Motor Vehicle & Assembly

The result from Table 8 indicates that changes in the lagged values of non-metal products, changes in market capitalization, monetary policy rate and interbank exchange rate volatility have important influence on non-metal products. Out of all these drivers, only monetary policy rate positively affects non-metal products. Non-metal products is negatively and significantly affected by own first to third lags. Market capitalization have negative and significant effect on the non-metal output. Specifically, increase in the first lag and second lag of market capitalization by 1% will lead to 0.23%, and 0.15% decrease in non-metal product respectively. Although monetary policy rate positively and significantly influences non-metal products, the effect is mild, posting 0.1% increase for a 1% increase in monetary policy rate. Government spending is also important in enhancing non-metal output. Interbank exchange rate volatility posted negative but mild and insignificant effect. In this case, non-metal output will reduce by 0.1% if interbank exchange rate volatility increases by 1%. Hence, non-metal products do not respond to exchange rate volatility, but it shows a dwarfing effect.

Iron & Steel products also respond to changes in own lags (up to 3), foreign exchange in the mineral sector, lags of market capitalization (up to 2), current and previous government spending (up to 3 lags) and interbank exchange rate. Second lag of iron & steel exerts a significant positive effect. This implies that the productivity in the non-metal sector cannot be overemphasized. If second lag of the sector increases by 1%, current output will also increase by approximately 4%. Foreign exchange allocated to iron & steel have no significant, albeit positive effect. This indicates that more of such funds may likely enhance the production of iron & steel. Current government spending indicates positive but insignificant effect on the product. However, the first to third lag of government spending show negative effect with the third lag being significant. In this case, if the third lag of government spending increases by 1%, metal & steel products will fall by 0.32%. This implies that it will take 3 quarters before the negative effect of government spending is manifested in the sub-sector. The negative and insignificant effect of interbank exchange rate on iron & steel suggests that the sub-sector may be inhibited by continuous increase in interbank exchange rate volatility. Meanwhile, it is the case that changes in effective exchange rate volatility does not contribute to changes in iron & steel products. The insignificant effect might be attributed to possible activation of hedging instruments that could weather the storm of the volatility. It could also be the case that exchange rate is not well utilized in the sector, this is because foreign exchange in the mineral sector drags, rather than propel it.

Table 8: Short Run Dynamic and Conditional Error Correction Results of the Effects of Exchange Rate Volatility on Sectoral Output (Metals, Iron and Steel and Vehicle Assemblies)

	NON-METALLIC PRODUCTS.		BASIC MET., IRON & STEEL		VEHICLES & ASSEMBLY	
C	-4.51**	-7.45***	-10.38***	-13.59***	-8.69***	-16.84***
METAL(-1)*	-0.18**	-0.32***				
IRSTEEL(-1)*			-0.70***	-0.93***		
VEHICLE(-1)*					-0.12	-0.29**
FOREXMIN**	0.05	0.05	0.00	0.06		
GOVT(-1)	0.17*	0.29**	0.60***	0.64***	0.49***	0.83***
MKTCAP(-1)	0.27**	0.39***	0.55***	0.71***	-0.10	-0.03
MPR(-1)	0.00	0.02	0.09**	0.10**	0.14**	0.23***
VOLNEER(-1)	0.26**		0.32**		0.51***	
VOLINTB(-1)		0.44***		0.63**		0.70***
D(METAL(-1))	-0.41**	-0.28*				
D(METAL(-2))	-0.42**	-0.24				
D(METAL(-3))	-0.60***	-0.44**				
D(IRSTEEL(-1))			0.16	0.21		
D(IRSTEEL(-2))			0.25	0.36*		
D(IRSTEEL(-3))			-0.20			
D(VEHICLE(-1))					-0.44***	-0.36**
D(VEHICLE(-2))					-0.26**	-0.01
D(VEHICLE(-3))					-0.42**	-0.23*
D(FOREXMIN)				0.02		
D(FOREXMIN(-1))				-0.10		
D(FOREXMIN(-2))				-0.10**		
D(FOREXMIN(-3))				-0.06		
D(FOREXMANUF)						0.57***
D(FOREXMANUF(-1))						-0.13
D(FOREXMANUF(-2))						0.16
D(MKTCAP)	-0.03	-0.03	0.05	0.12		
D(MKTCAP(-1))	-0.16	-0.23**	-0.39**	-0.48**		
D(MKTCAP(-2))	-0.10	-0.15**	-0.41***	-0.48***		

D(GOVT)		0.13	0.03	0.09	0.08	0.23**
D(GOVT(-1))			-0.04	-0.05	-0.54***	-0.75***
D(GOVT(-2))			-0.10	-0.02	-0.51***	-0.66***
D(GOVT(-3))			-0.34***	-0.32**	-0.21	-0.32**
D(MPR)	0.11**	0.09**			-0.02	0.01
D(MPR(-2))					-0.14**	-0.16***
D(MPR(-3))					-0.08	-0.13**
D(VOLNEER)					-0.39	
D(VOLNEER(-1))					-1.15***	
D(VOLINTB)		-0.07		-0.04		-0.48
D(VOLINTB(-1))						-0.30
D(VOLINTB(-2))						0.77*
D(VOLINTB(-3))						0.85*

Note: The table shows the results of short run dynamic and conditional error correction in Industrial, Manufacturing and Other Manufacturing outputs; ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the bracket are t-statistics. IND, MANUF, OTHERMANUF, FOREXIND, FOREXMANUF, GOVT, MKTCAP, MPR, VOLNEER and VOLINTB stand for industrial output, manufacturing output, other manufacturing output, foreign exchange in the industrial sector, foreign exchange in the manufacturing output, government expenditure, market capitalization, monetary policy rate, nominal effective exchange rate volatility and interbank exchange rate volatility respectively.

The vehicle assembly sector is also affected by own lags (up to 3), foreign exchange to the manufacturing sector (both current and lags), government spending (both current and lags), monetary policy rate (both current and lags), current and lags of effective exchange rate volatility, and interbank exchange rate. This implies that vehicle assembly products are driven by all the variables considered except market capitalization. The sector shows short run convergence, implying that current output is inhibited by previous output. This sub-sector benefits from foreign exchange allocated to the manufacturing posting 0.6% increase for a 1% increase in the fund. Only current government spending indicates significant enhancing effect, but it will eventually inhibit the activity in the sector, particularly in the third quarter following the increase. The structure of government spending could be attributed to this pattern of effect. Specifically, it seems the sector benefits from recurrent expenditure rather than capital expenditure. The sector responds negatively and significantly to the second lag of monetary policy rate. That is, 1% increase in the monetary policy rate in two quarters and three quarters back will have approximately 0.2% and 0.1% reduction in the sub-sector respectively.

Exchange rate volatility is an important driver of vehicle assembly in the short run. Both effective and interbank exchange rate have significant, albeit negative effect. Specifically, a 1% increase asynchronous effective exchange rate will dwarf vehicle assembly by 1.2% while 1% increase in the second and third lags of interbank exchange rate will increase the product by 0.8% and 0.9% respectively. What this suggests is that sectors respond differently to changes in exchange rate volatility, depending on the type of exchange rate window. In the case of vehicle assembly, the volatility of interbank exchange rate enhances their activity, going to second and third quarters after the shock. The producers in this sector appear to focus on future profit and so perceive it reasonable to produce in the face of interbank exchange rate volatility, may be with an expectation that the volatility will peter out.

The convergence to long run equilibrium after disturbance in the non-metal products exists but sluggish. In particular, 32% of the adjustment of equilibrium will be accomplished in the current quarter while the rest 68% will be accounted for by succeeding quarters. This implies that it takes around 2 quarters and some weeks before the system adjusts fully. In the case of basic metals, iron and steel, the adjustment is almost complete in the current quarter that the disturbance occurs while for vehicles & assembly, the adjustment is extremely sluggish as it takes about 3 quarters and some weeks for the adjustment to complete. Therefore, if there is distortion in any of these sectors, it will take less than one year before the adjustment is complete.

4.2.2. Electrical & Electronics, Food & Beverage and Textile, Apparel and Footwear

Next sub-sectors that is analysed are electrical & electronics, food & beverage and textile & apparel. Electrical & electronic does not significantly respond to own lag, even though the direction of effect indicates it is positive (Table 9). The positive sign suggests that the sector is endowed with potential resources. It can also indicate that demand motivates more production and supply. Further, foreign exchange allocated to the manufacturing sector is not significantly beneficial to the electrical and electronic sector. In the first, second and third quarter, the effect of foreign exchange on this sector's output is negative and significant. This means that electrical & electronics sub sector is strangulated by the allocation of foreign exchange to the manufacturing sector. What could inform this worrisome situation is that the condition to access the fund may be complex and stringent in such a way that producers incur additional costs in accessing it. The current government spending has a negative but insignificant effect on electrical and electronic output. The first lag has a positive and significant effect, second lag exerts positive but insignificant effect while the third lag has a negative and significant effect. Hence, government spending does not have a consistent effect on the production of electrical and electronic products in Nigeria. Only interbank exchange rate volatility has important and significant effect on the sector. Current and first lag have

insignificant effect while the second lag has a significant effect. Hence, exchange rate volatility is inimical to the electrical and electronics sector. Observably, the magnitude of response is notable in the second lag. In particular, a 1% increase in interbank exchange rate volatility two quarters back will dwarf current output of the electrical & electronics by 1.6%. It must be noted however that effective exchange rate does not influence the activity of the sector. Further, monetary policy rate and market capitalization are not relevant to the activity of the sector. This is not surprising because most companies in the electrical and electronic are not formally listed on the first-tier floor of the stock exchange in Nigeria.

Food and beverage sector does not respond significantly to own lag, current foreign exchange allocated to the manufacturing sector, current value of market capitalization, and monetary policy rate. A significant effect is observed by the first lag of foreign exchange allocated to the manufacturing sector and market capitalization. Unfortunately, food and beverage sector respond negatively to foreign exchange. A 1% increase in foreign exchange leads to 0.2% reduction in food and beverage output. However, government spending enhances the output of this sector to the tune of 0.15% for a 1% increase in spending. The sub-sector also benefits from the activity of the stock market as it responds markedly to the activity of the market. In this case, if the stock market capitalization improves by 1%, food and beverage sector will also improve by 1.8%. The sensitivity of this sector to stock market activity is not unconnected with the fact that many companies in this sector are formally listed in the floor of stock market and so, they do benefit from the activity. Only interbank exchange rate volatility is important in driving this sector. But it must be noted that the effect is mild, insignificant and positive. Blue chip companies in the food and beverages sub-sector are the product of foreign direct investment hence, the insignificance of the interbank exchange rate indicates that these companies have access to exchange rate, also they do initiate available hedging instruments to deal with possible volatility in the exchange rate.

Table 9: Short Run Dynamic and Conditional Error Correction Results of the Effects of Exchange Rate Volatility on Sectoral Output (Electrical & Electronics, Food & Beverage and Textile & Apparel)

	ELECT & ELECT		FOOD & BEVERAGE		TEXTILE, APPAREL AND FOOTWEAR	
C	-12.75***	-12.57***	-2.98**	-3.17***	-1.26	-5.14***
ELECT(-1)	-0.32**	-0.56**				
FOREXMANUF(-1)	0.88***	0.79***			0.01	0.39***
GOVT(-1)	0.05	0.09	-0.08	0.01	-0.07	0.05
MKTCAP(-1)	0.27***	0.12	-0.05	0.05	0.21	0.05
MPR(-1)	-0.02	0.01	-0.01	0.00	-0.06	0.02
VOLINTB(-1)	1.05***	1.17***	0.44***	0.45***	0.32**	0.49***
D(ELECT(-1))		0.19				
D(FOOD(-1))			-0.21	-0.23		
D(FOREXMANUF)	0.10	0.20			0.27**	0.37***
D(FOREXMANUF(-1))	-0.70***	-0.72***			-0.19*	-0.22**
D(FOREXMANUF(-2))	-0.54***	-0.43***			-0.14	-0.06
D(FOREXMANUF(-3))	-0.46***	-0.42***				-0.20
D(FOREXFOOD)			-0.04	0.01		
D(FOREXFOOD(-1))			-0.19**	-0.14**		
D(GOVT)	-0.16	-0.14	-0.15**		-0.15	-0.08
D(GOVT(-1))	0.23**	0.20**			0.13	
D(GOVT(-2))	0.12	0.07			0.11	
D(GOVT(-3))	-0.22**	-0.16**				
D(MKTCAP)			-0.05	-0.02	0.16**	-0.10
D(MKTCAP(-1))			0.09*		0.16*	
D(MPR)				0.04	0.02	
D(MPR(-1))					-0.13**	
D(VOLNEER)					-0.06	
D(VOLNEER(-1))					0.30	
D(VOLNEER(-2))					-0.13	
D(VOLNEER(-3))					-1.16***	
D(VOLINTB(-1))		-0.16				-0.49
D(VOLINTB(-2))		-1.63***				

Note: The table shows the results of short run dynamic and conditional error correction in Industrial, Manufacturing and Other Manufacturing outputs; ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the backet are t-statistics. IND, MANUF, OTHERMANUF, FOREXIND, FOREXMANUF, GOVT, MKTCAP, MPR, VOLNEER and VOLINTB stand for industrial output, manufacturing output, other manufacturing output, foreign exchange in the industrial sector, foreign exchange in the manufacturing output, government expenditure, market capitalization, monetary policy rate, nominal effective exchange rate volatility and interbank exchange rate volatility respectively

Textiles and apparels sector responds positively and significantly to foreign exchange allocated to the manufacturing sector. Although in the first and third quarter, the sector suffers from the fund. Similarly, government spending does not significantly

influence the activity of this sector, except that the first lag shows a positive effect. Current and first lag of market capitalization positively and significantly affects the textiles and apparel sub-sector. Like food and beverage, a good percentage of textile and apparel companies are list on the stock exchange and so, they benefit from the activity of the stock exchange market. Monetary policy rate is inimical to the activity of this sub-sector. If the previous monetary policy rate rises by 1%, current output will diminish by 0.13%. Concerning exchange rate volatility, both effective and interbank are important. However, effective exchange rate volatility is not only important but also significant. A crucial inspection of how textile and apparel respond to exchange rate volatility reveals that these sets of volatility is rather mild but persistent, starting from the third lag to the current value (in the case of effective exchange rate) and up to the first lag (in the case of interbank exchange rate). Therefore, effective exchange is more important and persistent than interbank exchange rate volatility. Observably, a 1% increase in the third lag of effective exchange rate reduces textile and apparel output by 1.2%. Hence, this sector is highly sensitive to effective exchange rate volatility and it acts as a drag to the sector.

Table 10: Short Run Dynamic and Conditional Error Correction Results of the Effects of Exchange Rate Volatility on Sectoral Output (Paper, Plastic, and Wood)

	PAPER & PAPER PRODUCTS		PLASTIC & RUBBER PRODUCTS		WOOD AND WOOD PRODUCTS	
C	-4.45**	-5.95***	-10.32***	-12.42***	-0.53	-0.68
PAPER(-1)	-0.10***	-0.12**				
PLASTIC(-1)			-0.52***	-0.50***		
WOOD(-1)					0.03*	0.05*
FOREXMANUF(-1)	0.16	0.13*	-0.07	0.49**	0.07	0.19**
GOVT(-1)	0.02	0.18**	0.55	0.32	-0.02	-0.08
MKTCAP(-1)	0.16	0.19**	0.60***	0.37**	0.00	-0.09
MPR(-1)	-0.01	0.02	0.08**	0.07**	-0.01	-0.01
VOLNEER(-1)	0.48***		0.28**		0.07	
VOLINTB(-1)		0.43***		0.82***		0.20**
D(PAPER(-1))	-0.20					
D(PAPER(-2))	-0.04					
D(PAPER(-3))	-0.38**					
D(PLASTIC(-1))			0.00	-0.26		
D(PLASTIC(-2))			0.04	-0.06		
D(PLASTIC(-3))			-0.31**	-0.36***		
D(WOOD(-1))					-0.26	-0.26
D(WOOD(-2))						0.31
D(FOREXMANUF)	0.21			0.19		
D(FOREXMANUF(-1))	-0.22*			-0.43**		
D(FOREXMANUF(-2))	-0.27**			-0.22**		
D(FOREXMANUF(-3))				-0.30		
D(GOVT)		-0.02	0.03	0.12		
D(GOVT(-1))			0.05	0.11		
D(GOVT(-2))			-0.08	0.14		
D(GOVT(-3))			-0.26**	-0.15*		
D(MKTCAP)	0.00	-0.05	-0.03	0.07	-0.11	
D(MKTCAP(-1))			-0.43**	-0.25*		
D(MKTCAP(-2))			-0.39***	-0.17		
D(MKTCAP(-3))			-0.17			
D(MPR)	0.06				0.05	0.02
D(VOLNEER)	-0.13				-0.30	
D(VOLNEER(-1))	0.03					
D(VOLNEER(-2))	0.05					
D(VOLNEER(-3))	-1.20***					
D(VOLINTB)		0.01		0.25		-0.30
D(VOLINTB(-1))						0.38
D(VOLINTB(-2))						0.29
D(VOLINTB(-3))						-0.49**

Note: The table shows the results of short run dynamic and conditional error correction in Industrial, Manufacturing and Other Manufacturing outputs; ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the bracket are t-statistics. IND, MANUF, OTHERMANUF, FOREXIND, FOREXMANUF, GOVT, MKTCAP, MPR, VOLNEER and VOLINTB stand for industrial output, manufacturing output, other

manufacturing output, foreign exchange in the industrial sector, foreign exchange in the manufacturing output, government expenditure, market capitalization, monetary policy rate, nominal effective exchange rate volatility and interbank exchange rate volatility respectively

Overall, the speed of convergence sluggish but comparatively fastest in the electrical and electronic sub-sector. Specifically, more than half of the adjustments will be accounted for by the current period and so, the adjustment will complete in less than two quarters. This is not the case in food and beverages where it takes more than 7 quarter (close to 2 years) before the adjustment can be completed. In the textile and apparel, it will take more than 6 quarters before the system adjusts to its long run equilibrium.

4.2.3. Paper and Paper Products, Plastic and Rubber Products, Wood & Woodwork

Table 10 indicates that the third lag of paper and paper products, foreign exchange allocated to the manufacturing sector, and effective exchange rate volatility significantly affect this product (paper and paper products). The present output of this product is negatively affected by its third lag; this suggests that it takes three quarters before a significant dwarfing effect of paper products will surface. Although foreign exchange allocated to the manufacturing sector has a significant effect, it strangulates the activity of this sector. This indicates that foreign exchange is inimical to paper and paper product sub-sector. It should also be noted that the dwarfing effect is persistent as it occurs in the first and second lag. Current government spending and market capitalization also show inhibiting, albeit insignificant effects. While interbank exchange rate volatility does not have a significant effect, effective exchange rate volatility has. Observably, current and previous volatility have important inhibiting effect. However, it is only the third lag that indicates a significant effect. Further, paper and paper products is highly sensitive to effective exchange rate. In this regard, a 1% increase in volatility will reduce the activity of this sub-sector by 1.2%. Therefore, exchange rate volatility is detrimental to the activity of paper and paper product.

Like the paper and paper product, plastic and rubber product is also affected significantly, albeit negatively by own third lag. Unlike paper and paper products, plastic and rubber products respond significantly to government spending, and market capitalization. In either of these cases, the effect does not take place immediately. The third lag of government expenditure, the first and second lags of market capitalization have detrimental effect. Interbank exchange rate volatility shows positive and mild but insignificant effect. Hence, plastic and rubber product are not affected, in any way, by exchange rate volatility. If any, the effect is likely to be positive. Nigeria is endowed with natural resources needed to produce plastics and rubber. Essentially, the sub-sector appears not to depend massively on import inputs and therefore, may not be significantly exposed to exchange rate uncertainty. Perhaps this is the reason why the sub-sector does not benefit from the foreign exchange allocated to the manufacturing sector, and it is not exchange.

Wood and wood product do not respond significantly to all the variables considered except the third lag of interbank exchange rate volatility. In this regard, a 1% increase in the third interbank exchange rate volatility engenders 0.5% reduction in wood and wood product. Clearly, changes in exchanged rate volatility does not have immediate effect on this sub-sector. Observably, interbank exchange rate volatility has a persistent effect as the effect begins from the current period up to the third period. Thus, it can be conjectured that exchange rate volatility cannot be ignored in this sub-sector. It must also be taken into account that market capitalization, monetary policy rate and effective exchange rate contribute to the performance of this sector. Speed of convergence is fastest in plastic and rubber products as about 52% of the adjustment takes place in the period of the shock to the system while the remaining 48% is accounted for in the following quarter. This indicates that this sub-sector adjusts to equilibrium quickly when there is any change in the variable. This cannot be said of paper and paper product that takes about 10 quarters (two and a half years) before the adjustment is complete, including the period when the shock took place. The adjustment in the wood and wood product is so sluggish that it takes roughly 20 quarters (about five years) before the adjustment can complete.

4.2.4. Cement, Chemicals & Pharmaceutical Products and Oil Refining

The assessment of exchange rate volatility and the sectoral output of cement, chemicals and oil refining is shown in Table 11. Five variables significantly affect the cement sector. These are lag values of cement product, foreign exchange allocated to the manufacturing sector, market capitalization and the third lag of interbank exchange rate. Some variables that show important but insignificant effects are government spending, monetary policy rate, and effective exchange rate volatility. A 1% increase in the asynchronous values of cement will reduce current output by 0.5%. First and second lag values of foreign exchange to the manufacturing sector have inhibiting effect on the performance of this sub-sector. This means that the sector is hurt by foreign exchange allocated to the sub-sector. Also, first and second lag values of market capitalization drag the cement sub-sector. Interbank exchange rate volatility has a marked positive effect. In this regard, if interbank exchange rate volatility increases by1%, cement output will increase by approximately 0.6%. Cement sub-sector in Nigeria is significant to building and structural design services. A leading cement manufacturing in West Africa is owned by a Nigerian. Although cement sub-sector is capital and natural-resource intensive, Nigeria is endowed with the natural resources needed in the sub-sector. Further, the human capital required are sourced more at the domestic level than foreign. Cement is one of the

lucrative products owing to rural and urban housing development. Thus, producers in this sub-sector may be concerned about the future income rather than the present utility, thereby still produce in the face of increase in exchange rate volatility.

Table 11: Short Run Dynamic and Conditional Error Correction Results of the Effects of Exchange Rate Volatility on Sectoral Output (Cement, Chemicals and Oil refining)

	CEMENT		CHEMICALS		OIL REFINING	
C	-5.46***	-9.83***	-2.44	-7.11**	2.87	4.49
CEMENT(-1)	-0.14*	-0.31**				
CHEM(-1)			-0.28**	-0.25**		
OILREF(-1)					-0.89***	-0.90**
FOREXMANUF(-1)	0.19	0.28**	-0.11	0.12		
FOREXOIL(-1)					-0.35	-0.64
MKTCAP(-1)	0.27**	0.36**	0.43	0.20	0.08	0.32
GOVT(-1)	0.09	0.36**	0.01	**0.43****	0.11	0.39*
MPR		0.03		0.10**		
MPR(-1)	-0.03		-0.10		0.40***	0.53***
VOLNEER(-1)	0.47**		0.26		-1.10*	
VOLINTB				0.13		
VOLINTB(-1)		0.56***				-2.05**
D(CEMENT(-1))	-0.48***	-0.40**				
D(CHEM(-1))			-0.20	-0.23		
D(CHEM(-2))			-0.20	-0.28		
D(CHEM(-3))			-0.44**	-0.52***		
D(OILREF(-1))					0.11	0.19
D(OILREF(-2))					-0.20	-0.13
D(OILREF(-3))					-0.37**	-0.32**
D(FOREXMANUF(-1))	-0.23**		-0.48			
D(FOREXMANUF(-2))	-0.14		0.168			
D(FOREXOIL)					0.54**	0.53**
D(FOREXOIL(-1))					0.76**	0.83***
D(FOREXOIL(-2))					0.61**	0.71**
D(FOREXOIL(-3))					0.38	0.37
D(MKTCAP)	0.011	0.01	-0.02	-0.08	0.45*	0.56**
D(MKTCAP(-1))		-0.2	-0.32**	-0.34**		
D(MKTCAP(-2))		-0.2**				
D(GOVT)		0.11	0.164	0.19		
D(GOVT(-1))		-0.2	0.278	0.08**		
D(GOVT(-2))			0.51**	0.10**		
D(GOVT(-3))			-0.15	-0.28**		
D(MPR)	0.047		0.053		0.24**	0.32**
D(MPR(-1))			0.13		-0.27**	-0.28**
D(MPR(-2))			0.14*			
D(VOLNEER)	-0.12		0.231		0.35	
D(VOLNEER(-1))			0.42			
D(VOLNEER(-2))			-1.82**			
D(VOLINTB)		-0.1				0.12
D(VOLINTB(-1))		0.46				0.12*
D(VOLINTB(-2))		0.59**				0.11*
D(VOLINTB(-3))						0.20*

Note: The table shows how short run dynamic movement in Cement, Chemicals and Oil refineries products correspondingly responds to changes in exchange rate volatility and other catchall variables. ***,**,* indicate significant at 1%, 5% and 10% respectively

Results of Chemical and plastic products model indicates that own third lag, firs lag of market capitalization, second and third lags, second lag of monetary policy rate, and second lag of effective exchange rate volatility have significant effect on the growth of value addition of chemical and plastic products. In a way, present output of chemical and plastic products is inhibited by the changes in the last three periods. Further, the asynchronous market capitalization also dwarfs the performance of the sub-sector. However, it is the case that this sub-sector benefits immensely from government spending as previous government spending enhances current output growth of chemicals and plastic products. Further, monetary policy rate is an enhancing mechanism through which the sub-sector thrives. The MPC is so important that both current and up to the second lag contribute to the growth of this sector. Albeit only the second lag has significant enhancing effect. Meanwhile, effective exchange rate dwarfs the activity of this sub-sector. In particular, a 1% increase in effective exchange rate, two quarters back will reduce the contemporaneous output by about 0.6%. Hence, exchange rate volatility is detrimental to the

performance of the chemical & pharmaceutical products. This is surprising because most of the companies in this sub-sector are multinationals and it is expected of them to weather off any possible exchange rate fluctuations with many hedging available to them. But with the fact that current and the first lag have no significant effect; it must be the case that these companies may be initiating the hedging instruments to a certain extent.

In the oil refining sub-sector, own lag, contemporaneous and asynchronous foreign exchange allocated to the oil sector, market capitalization, monetary policy rate (both current and lags) and interbank exchange rate significantly influence the activity of this sub-sector. In particular, 1% increase in the current, first lag and second lag of foreign exchange allocated to the oil sector raises oil refining production by around 0.5%, 0.8% and 0.7% respectively. This suggests that foreign exchange is seemingly persistent in driving oil refining in Nigeria. Also, 1% increase in the first lag, second lag and third lag of interbank exchange rate volatility will increase oil refining by 0.1%, 0.2% and 0.2% respectively. Hence, not only is foreign exchange persistent in driving oil refining sub-sector, exchange rate volatility does as well. Oil refining is an essential commodity in Nigeria and the producers are sure of demand availability. Thus, any fluctuation will be beneficial to them. The speed of convergence of cement sub-sector is more sluggish than that of chemicals and pharmaceutical products while the speed of convergence in the oil refining is the fasters. For instance, as much as 90% of the adjustment to equilibrium is achieved, should there by any disturbance in the oil refining sector. This is not the case in chemicals and pharmaceuticals that takes only 28% in the current period. From the short run results, it is clear that exchange rate volatility affects sub-sectors differently in magnitude, direction of effect and significance. A cursory look suggests that sectors that produce essential commodities such as cement, oil refining, and food and beverages indicate positive response and, in some cases, significant. Some sectors with listed companies on the stock exchange market and multinationals tend to weather the storm of possible exchange rate volatility with hedging instruments at their disposal.

4.3. Long-Run Results

The long run results assessing the response of sectoral output to exchange rate volatility and other important variables is presented in this section. Table 12 shows the case of the industrial, manufacturing and other manufacturing sectors. Industrial sector as a whole does not respond significantly to changes in foreign exchange to the industrial sector, government spending, market capitalization and exchange rate volatility. The insignificant effect could be traced to the problem of lumpiness, in which case, the effect could be crowded out by a particular subsector, and the subsector could be traced to manufacturing. As can be observed, foreign exchange allocated to the manufacturing sector and market capitalization play significant role in influencing the performance of the subsector. It is also the case that interbank exchange rate volatility significantly drags the performance of the manufacturing sector. In particular, manufacturing sector has a 1.84% reduction in the long run output following a 1% increase in interbank exchange rate volatility. Thus, it can be asserted that while effective exchange rate is a short run phenomenon in the short run, interbank exchange rate volatility is a long run phenomenon. Meanwhile, it is clear that both volatility are detrimental to the performance of the manufacturing sector. It is also important to point out that the long run effect is higher than the short run effect. Other manufacturing output is affected positively and significantly by market capitalization. Hence, the manufacturing sectors has long run benefit from stock market capitalization.

The long run results for non-metallic, iron & steel and vehicle assembly is presented in Table 13. Government spending, stock market capitalization and the two types of exchange rate volatility are significant in driving non-metallic products. Increase in government spending and improvement in the performance of the stock market capitalization enhance the performance of this sub-sector. Meanwhile, stock market capitalization tends to be more important than government spending. This suggests that although public economic infrastructure is less important compared to sourcing for funding in this sector. Both effective exchange rate volatility and interbank exchange rate volatility have negative effect on non-metallic products, albeit it is relatively more telling for interbank exchange rate volatility. Specifically, a 1% increase in effective exchange rate volatility reduces non-metallic products by about 1.4% while the same percentage increase in effective exchange rate volatility only reduces non-metallic products by 0.5 percentage point. Generally, non-metallic products are exposed to exchange rate uncertainty in Nigeria. Government spending, stock market capitalization, monetary policy rate and exchange rate volatility (both effective and interbank) have significant effect on the performance of the iron and steel sub-sector. It is also important to observe that all these drivers, except exchange rate volatility have positive effect, indicating that any increase in the values of any of the drivers will also engender increase in the production of iron and steel.

Effective exchange rate and interbank exchange rate adversely affects the performance of iron and steel sub-sector. A 1% increase in the effective exchange rate leads to 0.45% reduction in the value added of the iron and steel while the same percentage increase in interbank exchange rate volatility will dwarf the sector by 0.68%. This outcome also suggests that interbank exchange rate volatility more influences the activity of the iron and steel sector than effective exchange rate. Also, it is clear that iron and steel products are exposed to exchange rate uncertainty and the exposure tends to drag the performance of the sector. Foreign exchange allocated to the manufacturing sector, government spending, monetary policy rate and exchange rate volatility indicate significant effect on the activity of the vehicle assembly sub-sector. Like the other

two sectors (indicated in Table 13), vehicle assembly sub-sector is highly sensitive to foreign exchange allocated to the sector and to government spending. Specifically, the size of effect of the two drivers are magnificent. This implies that public economic infrastructure alongside availability of foreign exchange will engender massive production of vehicle assembly in Nigeria.

Table 12: Long Run (Level Equation) Results for Industry, Manufacturing and Other Manufacturing

	INDUSTRY		**MANUFACTUIRNG**		**OTHER MANUFACTURING**	
FOREXIND	1.87	2.82				
	(0.97)	(0.59)				
FOREXMANUF			4.28*	0.91*	-0.32	1.60
			(1.93)	(1.94)	(-0.78)	(1.47)
GOVT	-0.61	-0.93	-1.06	0.29	0.24	0.56
	(-0.51)	(-0.35)	(-0.30)	(0.66)	(0.55)	(1.25)
MKTCAP	0.05	-0.04	0.56**	0.55**	01.15***	0.35*
	(0.10)	(-0.04)	(2.85)	(2.07)	(4.72)	(1.86)
MPR	-0.34	-0.53	-0.54	-0.08	-0.13	0.13
	(-0.82)	(-0.49)	(-0.46)	(-0.47)	(-0.77)	(0.80)
VOLNEER	-0.26		-1.74		0.18	
	(0.76)		(0.51)		(0.45)	
VOLINTB		-0.05		-1.84*		1.33
		(-0.03)		(1.96)		(1.51)
C	2.80***	6.22**	-51.75***	-13.43*	-5.79*	-21.37**
	(3.31)	(2.31)	(-4.52)	(-1.95)	(-1.97)	(-2.45)
OBS	48	48	48	50	48	48
			Diagnostic Tests			
Jarque-Bera	0.56	0.39	0.59	0.14	0.61	0.11
	[9.73]	[0.82]	[0.74]	[0.93]	[0.74]	[0.95]
B-G Corr LM	2.09	0.73	1.06	0.82	1.87	0.40
	[0.11]	[0.58]	[0.40]	[0.52]	[0.16]	[0.81]
B-P-G Hetero	0.82	0.81	0.95	1.30	0.78	0.84
	[0.65]	[0.65]	[0.53]	[0.26]	[0.72]	[0.64]
Hetero (ARCH)	0.26	0.37	1.67	0.06	0.01	0.29
	[0.61]	[0.55]	[0.20]	[0.80]	[0.94]	[0.59]
RESET	1.52	0.38	1.89	0.06	2.11	0.97
	[0.22]	[0.54]	[0.37]	[0.80]	[0.16]	[0.34]

Note: The table shows how long run movement in Industrial, Manufacturing and Other Manufacturing products correspondingly responds to changes in exchange rate volatility and other catchall variables. ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the bracket are t-statistics while values in squared bracket are probability values of F-distribution for each test. Similar to the first two products discussed under Table 12, high rate of effective and interbank exchange rate volatility tends strangulate the activity of the vehicle assembly sub-sector. A cursory look at the magnitude of effect reveals that interbank exchange rate volatility more affects this sub-sector than effective exchange rate volatility. Specifically, for a 1% increase in effective exchange rate, activity of the vehicle assembly will reduce by 0.37% whereas the same percentage increase in interbank exchange rate volatility will reduce the activity of the sector by 2.41%. Therefore, tis sector is highly sensitive to exchange rate uncertainty and the more uncertain the exchange rate is, the more it harms the sector.

Table 13: Long Run (Level Equation) Results for Metals, Iron & Steel and Vehicles Assembly Products

	NON-METALLIC PRODUCTS.		BASIC MET., IRON & STEEL		VEHICLES & ASSEMBLY	
FOREXMANUF			-0.0002	0.07	2.70**	2.65***
			(-0.003)	(0.70)	(2.54)	(3.64)
FOREXMIN	0.30	0.14				
	(1.08)	(1.20)				
GOVT	0.97**	0.90***	0.85***	0.69***	4.18**	2.87***
	(2.98)	(4.84)	(7.33)	(4.48)	(2.09)	(3.55)
MKTCAP	1.53***	1.20***	0.78***	0.76***	-0.85	-0.12
	(3.63)	(5.28)	(5.32)	(7.12)	(-0.71)	(-0.30)
MPR	-0.01	0.06	0.13**	0.11**	1.22	0.80**
	(-0.05)	(0.85)	(2.89)	(2.79)	(1.43)	(2.36)
VOLNEER	-0.48**		-0.45**		-0.37*	
	(2.33)		(2.45)		(1.77)	
VOLINTB		-1.35***		-0.68**		2.41***
		(4.67)		(2.63)		(4.01)
C	-25.54***	-22.98***	-14.74***	-14.60***	-74.68*	-58.29***
	(-4.50)	(-7.77)	(-10.07)	(-12.55)	(-1.98)	(-4.21)
OBS	48	48	48	48	48	48
Diagnostic Tests						
Jarque-Bera	2.47 [0.30]	2.94 [0.02]	0.97 [0.62]	0.20 [0.91]	1.21 [0.55]	0.22 [0.89]
B-G Corr LM	1.07 [0.39]	0.10 [0.90]	2.70 [0.05]	0.69 [0.61]	1.87 [0.15]	0.70 [0.60]
B-P-G Hetero	1.22 [0.31]	0.96 [0.51]	2.46 [0.12]	1.54 [0.15]	0.60 [0.88]	0.77 [0.73]
Hetero (ARCH)	1.00 [0.32]	0.75 [0.39]	9.11 [0.00]	0.11 [0.74]	0.92 [0.34]	2.49 [0.12]
RESET	3.18 [0.00]	0.24 [0.63]	2.87 [0.01]	2.41 [0.02]	0.11 [0.91]	0.33 [0.74]

Note: The table shows how long run movement in Metals, Iron & Steel and Vehicle Assembly products correspondingly responds to changes in exchange rate volatility and other catchall variables. ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the bracket are t-statistics while values in squared bracket are probability values of F-distribution for each test

The long run results for electrical & electronics, food & beverage products and textile are indicated in Table 14. Observably, the results differ markedly from the earlier ones. For instance, unlike it appears in Table 13, foreign exchange allocated to the manufacturing sector is germane to the electrical & electronic and textiles sectors. Further, government expenditure is not significant, albeit, positive in influencing electrical & electronics and textiles. Most importantly, neither effective exchange rate nor interbank exchange rate volatility have significant effect on food and beverages. Foreign exchange, market capitalization, and exchange rate volatility have enhancing effect on electrical & electronic value added. It is also observed that food and beverages do not respond significantly to changes in the values of any of the drivers, exchange rate volatility inclusive. This outcome clearly spells out the nature of this product – essential commodities. Meanwhile, the positive effect in the case of exchange rate volatility suggests that the producers of this product see that they can focus on future revenue they will receive rather than being deceived by the utility they will derive. Of course, food production is important in any economy and the fact that most of the factor inputs for food are sourced domestically, its response to exchange rate volatility may not be noticed. Even from the demand side, once the future revenue is expectedly guaranteed, it motivates producers to increase production in the face of exchange rate volatility. Textiles products are not significantly affected by effective exchange rate. However, interbank exchange rate volatility shows otherwise. It is also important to observe that textiles products are highly sensitive to changes in interbank exchange rate uncertainty, even though the direction of effect is positive. In particular, a 1% increase in interbank exchange rate uncertainty will raise value addition of textiles products by 3.1

percentage points. Therefore, it is clear that textile sub-sector is highly sensitive to interbank exchange rate volatility in Nigeria.

Table 14: Long Run (Level Equation) Results for Elect & Elect, Food and Textiles Products

	ELECT & ELECT		FOOD & BEVERAGE		TEXTILE, APPAREL AND FOOTWEAR	
FOREXMANUF	2.78**	1.42***			0.02	2.47*
	(2.74)	(3.63)			(0.02)	(1.84)
FOREXFOOD			-2.18	1.55		
			(-1.19)	(1.37)		
MKTCAP	0.85**	0.22**	0.41	0.37	1.37**	0.34*
	(2.34)	(2.48)	(0.90)	(0.97)	(2.98)	(1.94)
GOVT	0.15	0.17	0.73**	0.03	-0.43	0.32
	(0.42)	(0.75)	(2.09)	(0.07)	(-0.45)	(0.74)
MPR	-0.06	0.01	0.09	-0.01	-0.39	0.12
	(-0.52)	(0.16)	(0.68)	(-0.07)	(-1.0)	(0.97)
VOLNEER	3.32**		-3.90		2.09	
	(2.89)		(-1.12)		(1.54)	
VOLINTB		2.09***		3.27		3.11**
		(4.210)		(1.54)		(2.42)
C	-40.15***	-22.49***	26.44	-22.79	-8.10	-32.30***
	(-3.89)	(-6.90)	(0.95)	(-1.59)	(-0.68)	(-3.19)
OBS	48	48	49	49	48	48
Diagnostic Tests						
Jarque-Bera	3.82	2.32	1.81	1.77	0.029	2.399
	[0.147]	[0.314]	[0.439]	[0.148]	[0.864]	[0.662]
B-G Corr LM	0.9784	0.3302	1.866	0.4331	0.432	0.381
	[0.434]	[0.855]	[0.142]	[0.783]	[0.653]	[0.820]
B-P-G Hetero	0.7449	0.5161	2.183	1.5823	0.161	0.494
	[0.716]	[0.928]	[0.03]	[0.137]	[0.192]	[0.919]
Hetero (ARCH)	0.1223	0.2925	0.511	2.3442	0.166	0.335
	[0.728]	[0.591]	[0.478]	[0.133]	[0.685]	[0.566]
RESET	1.4129	0.3035	0.528	2.5934	0.126	0.579
	[0.2546]	[0.582]	[]0.468]	[0.628]	][0.9008	[0.566]

Note: The table shows how long run movement in Electrical & Electronics, Food and Textiles products correspondingly responds to changes in exchange rate volatility and other catchall variables. ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the backet are t-statistics while values in squared bracket are probability values of F-distribution for each test.

Paper products respond significantly to government spending, market capitalization, and interbank exchange rate volatility. However, foreign exchange allocated to the manufacturing sector is also important to the sub-sector. Both effective exchange rate volatility and interbank exchange rate volatility indicate negative effect. Observably, interbank exchange rate volatility significantly dwarfs the activity of the paper products in Nigeria. In this case, a 1% increase in the interbank exchange rate will reduce the value added of the sub-sector by about 1.8%. This suggests that most firms in this sub-sector are risk averse and so, reduces production in the face of increased volatility of interbank exchange rate. The insignificant effect of effective exchange rate could be as a result of the fact that these firms tend not to benefit from centrally dictated exchange rate. The seemingly sensitive response to interbank exchange rate volatility points to the fact that the performance of this sector is at the mercy of exchange rate uncertainty. A slight rise in the uncertainty will dwarf the production of the sector.

Similar to the long run result of the paper sub-sector, the plastic sub-sector also responds positively to government expenditure, stock market capitalization, and monetary policy rate. Unlike the paper sub-sector, the plastic sub-sector

responds positively and significantly to foreign exchange allocated to the manufacturing sector and monetary policy rate. The negative and significant effect of both effective exchange rate volatility and interbank exchange rate volatility indicates that this sub-sector will be affected adversely by persistent exchange rate volatility. Comparably, interbank exchange rate more affect the activity of this sub-sector than effective exchange rate. Specifically, a 1% increase in interbank exchange rate volatility will engender about 1.7% reduction in the plastic sub-sector whereas the same percentage increase in interbank exchange rate will only dwarf the sub-sector's activity by 0.5%. None of the highlighted variables in Table 15 have significant effects on the activity of the wood sub-sector. Observably, there is also a sign of negative effect of both effective and interbank exchange rate volatility. Hence, all the sub-sectors assessed in Table 14 responds negatively to exchange rate volatility, and the volatility is more telling in the plastic sub-sector.

Table 15: Long Run (Level Equation) Results for Paper, Plastic and Wood Products

	PAPER & PAPER PRODCUTS		PLASTIC & RUBBER PRODUCTS		WOOD AND WOOD PRODUCTS	
FOREXMANUF	0.66	0.56	0.14	0.97*	-2.72	-3.59
	(0.65)	(1.52)	(0.75)	(1.87)	(-0.26)	(-0.47)
GOVT	0.17	0.77***	1.05***	0.65***	0.69	1.49
	(0.19)	(3.17)	(8.03)	(3.29)	(0.40)	(0.61)
MKTCAP	0.66*	0.82**	1.14***	0.74**	0.04	1.70
	(1.87)	(2.75)	(5.64)	(2.91)	(0.01)	(0.56)
MPR	-0.13	-0.07	0.16**	0.14**	0.30	0.17
	(-0.48)	(-0.84)	(2.73)	(2.48)	(0.26)	(0.43)
VOLNEER	-0.95		-0.54**		-2.77	
	(-1.11)		(-2.65)		(-0.21)	
VOLINTB		-1.79***		-1.65***		-3.75
		(-3.44)		(-3.35)		(-0.40)
C	-5.48	-5.05***	-1.76***	-2.90***	2.21	2.63
	(-1.27)	(-5.73)	(-9.35)	(-7.71)	(0.17)	(0.29)
OBS	48	51	48	48	50	48
			Diagnostic Tests			
Jarque-Bera	6.24	12.59	2.73	0.97	0.02	2.40
	[0.04]	[0.00]	[0.26]	[0.61]	[1.89]	[0.23]
B-G Corr LM	1.54	0.01	1.10	1.92	1.45	2.92
	[0.22]	[0.99]	[0.38]	[0.14]	[0.24]	[0.04]
B-P-G Hetero	0.70	1.45	2.50	1.41	2.26	1.24
	[0.79]	[0.20]	[0.01]	[0.20]	[0.03]	[0.30]
Hetero (ARCH)	0.00	0.40	1.94	0.22	2.87	0.40
	[0.96]	[0.53]	[0.14]	[0.64]	[0.10]	[0.53]
RESET	0.56	1.34	1.65	3.26	2.53	1.78
	[0.58]	[0.19]	[0.20]	[0.00]	[0.02]	[0.08]

Note: The table shows how long run movement in Paper, Plastic and Wood products correspondingly responds to changes in exchange rate volatility and other catchall variables. ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the bracket are t-statistics while values in squared bracket are probability values of F-distribution for each test.

Turning to the case of cement, chemical and oil refining sub-sectors, foreign exchange allocated to the manufacturing sector, market capitalization, government spending, and exchange rate volatility have significant effect on cement sub-sector (Table 16). In the long run, market capitalization posts a 1.2% increase in the output of cement for a 1% increase in the activity of the market. Similarly, government final expenditure increases cement output by 1.2% for a 1% increase in the spending. The positive effect suggests that both market capitalization and government spending enhance the activity of the cement sub-sector. The magnitude of effect also indicates that these factors (government and stock market activities) are critical to the growth of the cement sub-sector. Observably, cement sub-sector benefit importantly from the foreign exchange allocated

to the manufacturing sector. Coming to the exchange rate volatility, cement sub-sector is highly sensitive to effective exchange rate volatility compared to the interbank exchange rate volatility.

Table 16: Long Run (Level Equation) Results for Cement, Chemicals and Oil Refining Products

VARIABLES	CEMENT		CHEMICALS		OIL REFINING	
FOREX	1.31	0.90**	-0.40	0.47	-0.39	-0.58
	(1.10)	(2.04)	(-0.29)	(0.63)	(-0.77)	(-1.46)
MKTCAP	1.91***	1.16***	1.56***	1.73***	0.09	0.29
	(3.03)	(3.87)	(3.04)	(3.12)	(0.38)	(1.48)
GOVT	0.63	1.17***	0.05	0.81	0.13	0.35***
	(1.38)	(5.55)	(0.06)	(1.27)	(0.57)	(2.16)
MPR	-0.21	0.11	0.35	0.39*	0.45***	0.48***
	(-1.11)	(1.51)	(-1.04)	(1.89)	(4.89)	(6.39)
VOLNEER	-3.29*		-0.95		-1.24	
	(1.94)		(0.75)		(-1.55)	
VOLINTB		-1.84***		-0.51		-1.87**
		(3.83)		(0.75)		(-2.53)
C	-38.51***	-32.13***	-8.87	-28.78***	3.24	4.08
	(-2.53)	(-6.28)	(-0.61)	(-4.08)	(0.40)	(0.72)
OBS	49	49	48	48	48	48
			Diagnostic Tests			
Jarque-Bera	0.13	4.02	0.23	1.74	0.77	2.35
	[0.938]	[0.164]	[0.932]	[0.419]	[0.681]	[0.309]
B-G Corr LM	0.79	0.66	0.64	1.02	0.21	0.54
	[0.343]	[0.627]	[0.639]	[0.412]	[0.928]	[0.71]
B-P-G Hetero	0.71	0.84	1.87	3.00	1.02	1.45
	[0.648]	[0.634]	[0.072]	[0.004]	[0.465]	[0.18]
Hetero (ARCH)	0.96	1.32	0.00	10.37	1.52	0.05
	[0.954]	[0.257]	[0.968]	[0.002]	[0.822]	[0.83]
RESET	0.91	1.07	0.00	6.56	0.08	0.67
	[0.246]	[0.397]	[0.967]	[0.001]	[0.934]	[0.51]

Note: The table shows how long run movement in Cement, Chemicals and Oil refineries products correspondingly responds to changes in exchange rate volatility and other catchall variables. ***,**,* indicate significant at 1%, 5% and 10% respectively. Values in the bracket are t-statistics while values in squared bracket are probability values of F-distribution for each test.

In particular, if real effective exchange rate volatility rises by 1%, the value added of cement will also increase by approximately 3.3%. Albeit the same increase in interbank exchange rate will only raise cement value added by approximately 1.8%. Therefore, exchange rate volatility is a long run phenomenon in the cement sub-sector and the effect is not only positive but notable. The positive effect could suggest that producers of cement are risk-lovers and base their decision on future revenue derivable from high exchange rate volatility. What could motivate this type of expectation is the rural and urban development taking place in Nigeria which requires the use of cement. Hence, cement producers could conjecture that their revenue will certainly increase in the face of high exchange rate volatility due to high demand for the products. In the case of chemical sub-sector, only market capitalization and monetary policy rate have long run significant impact.

Neither foreign exchange allocated to the manufacturing sector nor exchange rate volatility have significant influence on the performance of the sub-sector. Nigeria is endowed with mineral resources out of which chemicals are produced. Further, a good percentage of raw materials needed to exploit the commodity are sourced locally while the intermediate goods may last for some years. Meanwhile, there is a sign of adverse effect of exchange rate volatility on chemicals in the long run. In sum, it can be claimed that exchange rate volatility is not a long run issue in the chemical sub-sector, although a sign of adverse effect is observed. Oil refining is significantly affected by government spending, monetary policy rate and exchange rate volatility. Increase in government expenditure to the tune of 1% leads to 0.4% increase in the output of oil refining.

Monetary policy rate increases oil refining output by 0.5% for a 1% increase. This suggests that both government expenditure and monetary policy rate facilitate the activity of the oil refining sub-sector. A disturbing outcome is the fact that foreign exchange allocated to the manufacturing sector acts as a clog in the wheels of progress of the oil refining sector. However, owing to the fact that close to 100% of oil refining products such as petroleum products are imported from abroad (during the period under review) it is surprising that this sector is dragged by the foreign exchange supply to the oil sector. Meanwhile, oil refining sector responds negatively to exchange rate volatility. Observably, if interbank exchange rate volatility increases by 1%, oil refining will reduce by 1.9%. Therefore, interbank exchange rate is critical to the oil refining sector as it poses both short and long run effects. However, it is the case that this type of exchange rate volatility facilitates oil refining in the short run but it dwarfs it in the long run.

The result of the diagnostic tests for all the models from Table 12 to Table 16 indicate that there is no question about the validity of the results, given the outcome of the normality, serial correlation, time-dependence of the variance of the error terms (hetero), ARCH and specification tests. All the tests are in order given the values of the probability associated with the respective chi-square values. Consequently, the magnitude and direction of the coefficients for each sub-sector are appropriate for policy directive.

5. CONCLUSION AND POLICY IMPLICATIONS

The manufacturing sector of Nigeria is still performing below expectation. Consequently, researchers have been assessing factors driving the industrial sector in general and manufacturing sector in particular. Out of many factors identified, exchange rate volatility tends to be the most important factor, owing to the connection it has with both the supply and demand sides. Meanwhile, there is no agreement on the nature and direction of effect. One major reason for this diverse outcome is due to aggregation bias, in which case, all firms in the manufacturing sector are lumped into one. The lumping beclouds the real nature of effect on each sub-sector of manufacturing sector. Further, existing study focus on one type of exchange rate, mostly effective exchange rate. But most firms in Nigeria source foreign exchange from banks, and so, they are faced with dynamics of interbank exchange rate. This study therefore revisits the drivers of the manufacturing sectors, at the sub-sector level with particular focus on exchange rate volatility.

According to the results obtained from the ARDL method, both effective and interbank exchange rate volatility do not significantly affect the industrial sector as a whole either in the short run or in the long run. Interbank exchange rate volatility exerts short and long run inhibiting effect on the manufacturing and other manufacturing sectors. For the sub-manufacturing sectors, textiles, electrical & electronics, and wood & wood products are affected negatively by interbank exchange rate volatility. Similarly, textile, chemicals and oil refining are adversely affected by effective exchange rate volatility in the short run. Sub-manufacturing sectors that respond positively to interbank exchange rate volatility in the short run are cement, oil refining (up to three lags) and vehicle assembly. It turns out that textile products are exposed to both effective and interbank exchange rate volatility in the short run.

In the long run, electrical & electronics, textile and vehicle assembly are positively affected by interbank exchange rate volatility but it must be noted that effective exchange rate also significantly affects electrical & electronics. Nonmetallic, iron & steel, plastic, cement products are affected negatively by both interbank and effective exchange rate volatility while interbank exchange rate volatility drags the activity in the oil refining products. It is clear that effective exchange rate volatility does not have significant effect on eight sub-manufacturing sectors in the short run. These sectors are nonmetallic, basic metals, electrical & electronics, food & beverages, plastic, wood & wood products, cement and oil refining. Only chemicals and textiles do not respond to interbank exchange rate volatility in the short run. Further, six sub-sectors, namely food & beverage, textile (effective exchange rate only) paper & paper products, wood & wood products, chemicals, and oil refining do not respond significantly to either interbank or effective exchange rate in the long run.

The overall conclusion is that interbank exchange rate volatility matter more than effective exchange rate in the product categories of the manufacturing sector in Nigeria. Further, interbank exchange rate has detrimental effect on most of these products, both in the short and long runs. Meanwhile, up to 50 percent of the product categories do not respond to either interbank or effective exchange rate in the long run. Although manufacturing, and by extension industrial sector are not affected significantly by interbank exchange rate volatility, it will be wrong to assume that the product categories in the manufacturing sector do not also respond significantly to the volatility of this type of exchange rate.

The wisdom from this conclusion is that it is not proper to believe that all categories of manufactured products are affected by exchange rate volatility the same way. In fact, sectors that are critical to the economy, namely textiles, and electrical & electronics are adversely affected by interbank exchange rate volatility. Hence, these subsectors should not take interbank exchange rate volatility lightly. They may seek to hedge the volatility effectively in the forward exchange rate market. Alternatively, if it is possible, these sectors should avoid interbank exchange rate and try other official exchange rate. Cement, vehicle assembly and oil refining sub-sector should not bother about exchange rate fluctuations, particularly interbank exchange rate, at least in the short run. However, cement, oil refining sub-sectors should be conscious of the long run adverse

effect. Firms operating in the nonmetallic, basic metals, electrical & electronics, food & beverage, and textile may not bother about effective exchange rate fluctuations in the long run.

Generally, since the exchange rate appears not to be a long run phenomenon for most of these sub-sectors, it is recommended that firms should engage in forward exchange rate market where the short run risk can be absorbed. The monetary authorities are therefore advised to strengthen the activity of the forward exchange rate market. The sub-sectors are more adversely affected by interbank exchange rate. The monetary authorities are trying to unify exchange rate in Nigeria. While this step is in order, it should go along with the strengthening of the forward market, so that firms will find it convenient and comfortable to hedge short run exchange rate risk in the face of floating exchange rate regime.

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