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Interest Rate and Exchange Rate Volatility on the Performance of Industrial Sector in Nigeria

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Abstract
The objective of this study is to empirically examine the impact of interest rate and exchange rate volatility on the performance of industrial sector in Nigeria between the periods of 1999 and 2019. Econometric technique of Generalized Autoregressive Conditional Heteroskedasticity (*GARCH*) *Model was employed to analyze the time series data sourced on the aforementioned variables. Findings of this study show that interest rate and exchange rate volatility have significant impact on the performance of the industrial sector. The coefficient of interest rate and exchange rate volatility respectively shows that one percent increase in interest rate and exchange rate volatility respectively will lead to 63% and 3% respectively decline in the performance of the industrial sector. Based on the findings of this study, the following recommendations are made: first, that Nigeria government should engage in stabilization policy targeting on stabilizes the naira currency. This can be achieve through stable interest rate over a period of time thereby give room to investor to be able to make better investment decision and subsequently improving the performance of industrial sector. second, base on the findings of this study, it is recommended that monetary authority should formulate and implements policy that will result to appreciation of naira currency such as diversification of economy that could result to increase in exportation of domestic goods in order to make naira competitive with international currency, this will help the investor to gain from exchange rate differential and consequently lead to the performance of industrial sectors.*
Keyword: Interest Rate, Exchange Rate Volatility, Performance, Industrial Sector

1. Introduction

It cannot be overemphasized that industrialization is one the comparative advantages developed nations have over developing nations, like Nigeria. This can be seen in the level and expansions of industrial sector

coupled with advancement in science and technology. Not in doubt, the industrial sector plays a very important role in any nation-Nigeria inclusive, and its benefits are crucial for economic growth, economic development, societal transformation and general well-being of the citizens. Indeed, the industrial sector creates channels for increase in productivity through manufacturing of goods and services, export expansion, sources of foreign exchange earnings, employment generation and raising the per capita income of individuals, which spurs patterns of consumption (Okuneye, 2019). More so, according Ayeyemi (2013), the industrial sector has equally been described as the heartbeat of every successful economy; this is due to the fact that it involves production and manufacturing of output in a large scale which simply opens up the economy to the outside world.

According to Tradingeconomics (2021) industrial production and capacity levels are expressed as an index level relative to a base year. In other words, they do not express absolute production volumes or values, but the percentage change in production relative to the base year. Nigeria Industrial Production Index data was reported at 100.800 2010=100 in December 2020. This records is a decrease from the previous number of 107.200 2010=100 for September 2020. The data reached an all-time high of 123.386 2010=100 in September 2015 and a record low of 91.259 2010=100 in December 2012. Industry-level data are useful for managers and investors within specific lines of business, while the composite index is an important macroeconomic indicator for economists and investors - fluctuations within the industrial sector account for most of the variation in overall economic growth.

However, one of the greatest impediments to industrialization in the developing nations like Nigeria, today, is the interest rate and exchange rate volatility that has been exhibiting significant fluctuation of up and down movement over the years. This instability over the years has not only distorted investment decision but it has affected the overall performance of the sector in Nigeria. According to Ayano (2014), an interest rate is the price a borrower pays for the use of money they borrow from a lender. Lending rate is the bank rate that usually meets the short- and medium-term financing needs of the private sector. This rate is normally differentiated according to creditworthiness of borrowers and objectives of financing. The terms and conditions attached to these rates differ among countries, however, limiting their comparability.

Furthermore, exchange rate volatility dynamic in Nigeria has its implications on the performance of the industrial sector. Evidence from literatures has shown that exchange rate volatility has both positive and negative impact on the performance of the sectors. This is because why

appreciation of naira will likely have positive impact on the performance of the industrial sector in lieu of using few naira to import industrial equipment and machinery thereby, gaining from naira exchange rate conversion. The devaluation or depreciation of naira will likely have negative impact on the performance of the industrial sector because more naira will be needed to import industrial equipment and machinery thereby, resulting to loss of naira exchange rate conversion.

However, Nigeria as developing nation still largely depends on the international market for the importation of some factors of production which includes the technical expertise (human capital development), finance, chemical, machinery and technology thus, necessitates the demand for foreign currency. Nevertheless, the extent to which both interest rate and exchange rate volatility impacted on the performance of Nigeria industrial sector over the period spanning between 1999 and 2019 called for empirical research. This is because the exact relationship among interest rate and exchange rate volatility and as well as the performance of Nigeria industries sector has been a controversial issue in the economics literature. Not all the economists and scholars agree on the potency of interest rate and exchange rate volatility as to stimulate the performance of Nigerian industrial sector. For instance, Mlambo (2020); Buabeng, Ayesu and Opoku (2019), in their respective studies, concluded that exchange rate has a negative impact on the performance of the industrial sector in Nigeria, while Ogunmuyiwa and Adelowokan (2018), in their studies established a positive relationship between exchange rate and the performance of the industrial sector. Thus, the effect of interest rate and exchange rate volatility on the performance of the sector is with mixed reactions in the contextual literatures.

Similarly, there is a divergent opinion between the classical economists and the Keynesians on interest rate. While the classical economists believed that government intervention is not necessary to regulate price in free market economy and that invisible hand which lies on the forces of demand and supply should be the mechanism that will regulate the economy, whereas the Keynesians argued that government intervention is inevitable to regulate the economy. While monetarist believed that increase in liquidity in the circulation via lower interest rate will lead to inflation, Keynesians believed that lower interest rate can lead to productivity expansion; employment creation and easy inflationary pressure. However, how these theories apply to the Nigerian economy calls for further research following the uncertainty of the relationship among interest rate, exchange rate and performance of the industrial sector in Nigeria. It is against this backdrop that this study examines the impact of interest rate and exchange

rate volatility on the performance of the Nigerian industrial sector over the period spanning between 1999 and 2019.

2. Literature Review

2.1 Theoretical Review

2.1.1 Interest Rate Parity (IRP) Theory

The interest rate parity theory (IRP) according to Keynes (1936) is a theory in which the differential between the interest rates of two countries remain equal to the differential, calculated by using the forward exchange rate and the spot exchange rate techniques. Interest rate parity connects interest, spot exchange, and foreign exchange rates. IRP theory comes handy in analyzing the relationship between the spot rate and a relevant forward (future) rate of currencies. The relevance of this theory to this study is that interest rate parity theory is a powerful idea with real implications.

First, this theory argues that the difference between the risk free interest rates offered for different kinds of currencies will determine the rate at which these currencies can be converted to each other in a forward transaction. Second, a forward contract, is a binding agreement to buy or sell something at a future date and a predetermined price which implies no further future negotiation on settled price. Many investors, engaged in forward contract in order eliminate the future risk (inflation) and allow for easy budgeting. Forwards are particularly common in the foreign exchange market and allow importers, exporters, banks, producers and governments to reduce risks for future transactions. Third, specifically, if investors can obtain a higher risk free interest rate in one currency than they can in the other, the currency offering the higher rate will change hands at a more expensive future price than the current price. However, as long as bank deposits and government bonds in a country are truly risk free, the parity theory holds perfectly in real life. Therefore, this theory is appropriate to examine the extent to which interest rate parity impacts on the performance of industrial sector in Nigeria.

2.1.2 Purchasing Power Parity Theory

The purchasing power parity theory was propounded by Gustav (1918). The theory posited that rate of exchange between two countries depends upon the relative purchasing power of their respective currencies. While the value of the unit of one currency in terms of another currency is determined at any particular time by the market conditions of demand and supply, in the long run, the exchange rate is determined by the relative values of the two currencies as indicated by their respective purchasing powers over

goods and services. In other words, the rate of exchange tends to rest at the point which expresses equality between the respective purchasing powers of the two currencies. This theory is relevant to this study in order to examine the impact of exchange rate on performance of industrial sector in Nigeria. PPP allows economists and investors to determine the exchange rate between currencies for the trade to be on par with the purchasing power of the countries' currencies. Essentially this means that adjustments are made to exchange rates so that a product has the same price when sold in different countries (based on the same currency). It is a theory that says that a basket of goods in one country should cost the same in another country once you account for the exchange rate.

2.2 Empirical Review

Mlambo (2020) examines the impact of exchange rate on the performance of manufacturing industries in SACU states. The study employed the panel group FMOLS and PMG approaches for the period 1995 to 2016. Results showed that exchange rate, imports and FDI have a negative relationship with performance of manufacturing industries while, exports and inflation had a positive relationship with manufacturing performance. However, the study model did not include interest rate as predictor variable that can impact on performance of industrial sector.

Buabeng, Ayesu and Opoku (2019) examined the effect of exchange rate fluctuations on the performance of manufacturing firms in Ghana for the period 1990 to 2018. The study used the bounds test approach to co integration within the framework of autoregressive distributed lags model as the estimation strategy. The results reveal that exchange rate and monetary policy rate has a negative and significant relationship with manufacturing firm performance. While, the study geographical scope is limited to Ghana its finding may not likely be applicable to Nigeria due to country differences.

Falaye, et al (2019) examined the impact of exchange rates on the performance of the Nigerian manufacturing sector over a period of 25 years (1990-2014). The study employed unit root test, Johansen co-integration test, Granger causality test and error correction model to analyze the long-run relationship and causal relationship. Finding of the study revealed that an exchange rate in particular devaluation of the Naira has a negative impact on the performance of the Nigerian manufacturing sector. More so, the study found that interest rates and capacity utilization rates (CUR) have a positive significant relationship with the performance of the sector. The study scope ended in 2014, however, due to economic transformation since then, the study finding may be adequate to explain the present situation.

Ezenwakwelu, Okolie, Attah, Lawal and Akoh (2019) examine the effects of exchange rate management on performance of Nigerian Manufacturing Firms. A balanced panel of annual observations from ten large-scale manufacturing firms listed on the Nigerian Stock Exchange, collected between the periods of 2015 - 2017. Finding of the study revealed that exchange rate fluctuations had significant negative effect on productivity of the manufacturing firms; flexible exchange rate had not significantly enhanced performance of the manufacturing firms. The study scope did not include interest rate, more so, the study data did not extended to 2019.

Ogunmuyiwa and Adelowokan (2018) investigated the impact of exchange rate on industrial output in Nigeria from 1986 to 2016. The study employed econometric methods of Augmented Dickey Fuller unit root test, the Box Jenkins O.L.S method and the Chow break point test on time series data sourced. The findings of the study revealed that no long run relationship exist between exchange rate and industrial output, the Box Jenkins O.L.S results reveal a positive and significant effect of exchange rate on industrial output in Nigeria.

Orji, Ogbuabor, Okeke and Anthony-Orji (2018) examine the impact of exchange rate movements on the manufacturing sector in Nigeria over the period 1981–2016. Time series data and ordinary least square (OLS) estimation technique were employed for the analyzed the impact independent variables have on the dependent variable. Findings of the study revealed that exchange rate movements play a significant role in the manufacturing sector's performance in Nigeria.

Akinmulegun and Falana (2018) examine the effects of exchange rate fluctuation on the Industrial Output Growth in Nigeria using time series data sparring from the period 1986 to 2015. Johansen's Co-Integration model was employed to explore the long-run relationship among the variables used, while the Vector Error Correction model (VECM) was used to evaluate the short and long-run dynamic among the variables and the Granger Causality used to measure contemporaneous relationship among the endogenous variables. The results of the analysis indicate a unidirectional causality from Exchange rate to Industrial output. The response of industrial output to the shock from exchange rate was positive and significant.

Lawal, Atunde, Ahmed and Asaleye (2016) examine the impact of exchange rate fluctuation interest rate and money supply on economic growth in Nigeria from 2003 – 2013. The study employed Autoregressive Distributed Lag (ARDL) model to estimate the study model. Finding of the study showed that exchange rate fluctuation has no effect on economic growth in the long run though a short run relationship exists between the two.

However, none of these study reviewed examined the impact of interest rate and exchange rate volatility on the performance of industrial sector in Nigeria between1999 and 2019.

3. Methodology

This study is a ex-post factor research design. The study makes use of secondary data sourced from the World Bank Development Indicators (2019); Central Bank of Nigeria statistical Bulletin (2019). The quantitative data were analyzed with the econometric technique of Generalized Autoregressive Conditional Heteroskedasticity (GARCH).

3.1 Model Specification

The model specification of this study follows the generalized autoregressive conditional heteroskedasticity (GARCH). The models were introduced by Engle (1982) and generalized as GARCH (Generalized ARCH) by Bollerslev (1986); Taylor (1986). These models are widely used in various branches of econometrics, especially in financial time series analysis. Three distinct specifications involves in GARCH model, One for the conditional mean equation, one for the conditional variance, and one for the conditional error distribution.

The simplest form of GARCH(1,1) specification is as follows;

$$Y_t = X_t'\theta + \epsilon_t \quad \_\_\_\_\_ 1$$

$$\sigma^2 t = W + \alpha\epsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad \_\_\_\_\_ 2$$

In which the mean equation given in (1) is written as a function of exogenous variables with an error term. Since $\sigma^2 t$ is the one-period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation specified in (2) is a function of three terms:

i. A constant term: w

ii. News about volatility from the previous period, measured as the lag of the squared residual from the mean equation: ϵ^2_{t-1}(the ARCH term)

iii. Last period's forecast variance: $\sigma^2 t-_1$(the GARCH term)

The GARCH(1,1) refers to the presence of a first-order autoregressive GARCH term (the first term in parentheses) and a first-order moving average ARCH term (the second term in parentheses). An ordinary ARCH model is a special case of a GARCH specification in which there are no lagged forecast variances in the conditional variance equation—i.e., a GARCH(0, 1). This specification is often interpreted in a financial context, where an agent or trader predicts this period's variance by forming a weighted

average of a long term average (the constant), the forecasted variance from last period (the GARCH term), and information about volatility observed in the previous period (the ARCH term). Thus, model specification of this study is as follows;

$$h_t = \varphi + \theta ht_{t-1} + b_1 u_{t-1}^2 \quad \text{3}$$

Therefore,

$$IPI_t = \varphi + INR_{t-1} + INR_1 u_{t-1}^2 + EXR_{t-1} + EXR_1 u_{t-1}^2 \quad \text{4}$$

Where:

IPI_t = industrial production index at a period of time (t), serve as a proxy for performance of industrial sector, it measures levels of production and capacity in the manufacturing industries, relative to a base year.

INR_t = interest rate at a period of time (t), serve as a proxy for lending rate to investors in the Nigeria industries.

EXR_t = exchange rate at a period of time (t), serve as a proxy for conversion rate at which naira is exchanged for foreign currency in particular United State dollar.

Note, over the years both interest and exchange rate have not been relatively stable, there is evident of volatility in both aforementioned variables.

The Apriori Expectation: $b_1, b_2 < 0$

4. Results and Discussion

Table 1: Series of Unit Root Test

Series of Augmented Dickey-Fuller Test (ADF) Output Results

Coefficients	Critical Values at 5%	ADF Values	Probability	Comments
D(IPI)	-3.029970	-6.155404	0.0001	I(0)
D(EXR)	-3.029970	-2.413099	0.1514	I(I)
D(INR)	-3.029970	-4.366956	0.0033	I(0)

Source: Researchers Computation Using (Eviews 10 Output)

Table 1 present the series of unit root tests of (ADF). The results show that not all the variables are stationary of order I(0) in first differencing, the result show that Industrial Production Index (IPI) and Interest Rate (INR) are stationary at first differences while Exchange Rate (EXR) is non-stationary.

Table 2: General Autoregressive Conditional Hetroscedacity

GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1) + C(7)*INR + C(8) *EXR

Variable	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	5.448728	0.519718	10.48400	0.0000
INR	-0.635003	0.057137	-11.11367	0.0000
EXR	0.027425	0.004051	6.769874	0.0000
Variance Equation				
C	-4.184415	0.664459	-6.297476	0.0000
RESID(-1)^2	0.161182	0.042598	3.783778	0.0002
GARCH(-1)	0.859155	0.036587	23.48267	0.0000
INR	0.205092	0.041277	4.968638	0.0000
EXR	0.001894	0.000556	3.403844	0.0007
T-DIST. DOF	2.318366	0.255069	9.089159	0.0000

R-squared	0.612160	Mean dependent var	1.068571
Adjusted R-squared	0.569067	S.D. dependent var	2.218951
S.E. of regression	1.456641	Akaike info criterion	4.068228
Sum squared resid	38.19247	Schwarz criterion	4.515880
Log likelihood	-33.71639	Hannan-Quinn criter.	4.165380
Durbin-Watson stat	2.092152		

Source: Researchers Computation Using (Eviews 10 Output)

Table 2 presents, GARCH regression estimation, the first part of the output gives a summary of the settings used during estimation. The method employed ML ARCH - Student's t distribution (BFGS / Marquardt steps).The result shows that 21 observations was captured in the study after 227 iterations, Coefficient covariance computed using outer product of gradients. The second part presents both the mean and variance estimation of GARCH model.

The mean equation;

IPI = 5.448728 GARCH + -0.635003 INR + 0.027425EXR …….....4

The result of the mean equation shows that both the parameters coefficients of GARCH and exchange rate are positive and statistically significant while the coefficient of interest rate is negative and statistically significant with probability value of 0.00 which is less than 0.05 percent level of significance. This result that average values of these parameters coefficients explained the present value of the performance Nigeria industrial sector. That is, with the coefficient value of -0.635003 interest rate (INR) suggests that about 63 percent decline in the performance of industrial sectors in Nigeria is attributed to the average interest rate over the years. Similarly, with the coefficient value of 0.027425 exchange rates (EXR) imply that about 3 percent decline in the performance of industrial sectors in Nigeria can be

explain by exchange rate volatility over the years understudy.
The estimated variance equation is presented as follows:

$$IPI = C(-4.184415) + 0.205092^{*}INR + 0.001894^{*}EXR + 0.859155^{*}GARCH(-1) + 0.161182^{*}RESID(-1)^{\wedge}2$$

$$T - test = [-6.297476]\ [4.968638]\ [3.403844]\ [23.48267]\ [3.783778] \quad (5)$$

The result shows that all the parameter coefficients values of understudy variables with exception of the constant variable are positive and statistically significant. This suggests that both interest and exchange rate are statistically significant in forecasting and determine the performance of industrial sector in Nigeria between the period understudy. This give the result of GARCH(-1) model with coefficient of 0.859155 about 86 percent the time varying volatility including a constants (-4.184415) plus its components interest rate with the coefficient of (0.205092 about 21 percent and exchange rate with coefficient of 0.001894 about 1 percent that depend on its past error of 0.161182 about 16 percent. More so, the result shows that the T-distribution is positive and statistically significant. The distribution is peaked (leptokurtic) long tail to the right relative to the normal.

Furthermore, the R-Square often refers as the coefficient of determination also known as a measures of the goodness-of-fit, is 0.61, approximately 61%. This means that 61% of the changes in the performance industrial sector (PIS) at time t, are explained by the changes in the explanatory variables while, the remaining 39% could be explained by factors outside this model represented by error term. Adjusted R-squared, value is the same as R-Square that is 57% variation in the dependent variable is explained by only those independent variables that, in reality, affect the dependent variable. More so, Durbin-Watson statistic (DW) is 2.26 approximately 2 shows there is no serial autocorrelation.

5. Conclusion and Recommendations

The study was carried out to examine the impact of interest rate and exchange rate volatility on the performance of the industrial sector in Nigeria, spanning 1999 to 2019. Previous empirical studies on the impact interest rate and exchange rate volatility has on the performance of industrial sector in Nigeria in the past were subject of controversies with divergent outcomes. General Autoregressive Conditional Hetroscedacity (GARCH) analysis was conducted with the aid of E-view 10 to ascertain the exact impact the interest rate and exchange rate has on the performance of industrial sector in Nigeria.

The estimated GARCH model is reported as follows; the mean equation results show that interest rate has negative and statistically significant impact on the performance of the industrial sector in Nigeria within the sampled period of 1999 and 2019. More so in the mean equation exchange rate has positive and statistically significant impact on the performance of industrial sector in Nigeria within the sampled period of 1999 and 2019.

Furthermore, the finding from this study shows that there is evidence of volatility among the variables understudy.

Therefore, the foregoing results lead to the following conclusions, that interest rate and exchange rate volatility have significant impact on the performance of the Nigerian industrial sector over the period spanning between 1999 and 2019. As manifested from the findings of this study, the following recommendations are suggested: first, that Nigeria government should engage in stabilization policy targeting on stabilizes the naira currency. This can be achieve through stable interest rate over a period of time thereby give room to investor to be able to make better investment decision and subsequently improving the performance of industrial sector. second, base on the findings of this study, it is recommended that monetary authority should formulate and implements policy that will result to appreciation of naira currency such as diversification of economy that could result to increase in exportation of domestic goods in order to make naira competitive with international currency, this will help the investor to gain from exchange rate differential and consequently lead to the performance of industrial sectors.

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