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DOES MANUFACTURING SECTOR OUTPUT SIGNIFICANTLY PREDICT ECONOMIC GROWTH IN NIGERIA?

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ABSTRACT

The predictive power of the manufacturing output on growth is a topical issue, especially with the outbreak of the COVID-19 pandemic and its effects on global manufacturing and economic activities. As such, this study examines how Nigeria's manufacturing output can be observed in estimating economic growth. The ARDL model and OLS technique were employed in our assessments, and quarterly data was sourced from the CBN statistical bulletin for 2019 and the NBS annual report from 2010Q1 to 2020Q4. The study finds that manufacturing output positively and significantly affects growth in Nigeria and therefore can significantly predict further economic growth and, by extension, recession in Nigeria. It also recommends the need to improve the ease of doing business and security, adjusting interest rates for manufacturers, stabilize the exchange rate, develop infrastructure, and increase interventions in the manufacturing sector in Nigeria.

Contribution/ Originality: The study will serve as a policy document for policymakers and a reference point for other researchers wishing to examine the relationship between manufacturing sector output and economic growth. It will also improve the body of existing literature on the predictive power of manufacturing sector output and growth.

1. INTRODUCTION

Globally, growth and development are directly or indirectly linked with the manufacturing sector, as industrialization is seen as a fundamental means for its acceleration. According to Sola, Obamuyi, Adekunjo, and Ogunleye (2013), the standard for the production of goods and services and subsequent creation of jobs and the reward for factors of production are provided by the manufacturing sector. Furthermore, Adofu, Taiga, and Tijani (2015) define manufacturing as the production of products for sale through the application of equipment, machines, labour, compound, and organic substances, which involves handicrafts of individual work and techniques through the transformation of semi-finished goods to finished goods. In a contemporary economy, industrialization depends on technological advancement, a revolution from a long-established mode of production to a mass-production system which typically utilizes automated systems and administrative regulation that promotes high production. During the 2016 global financial crisis, Nigeria slumped into recession with a GDP growth rate of -6.617% and rose to 0.806% in 2017 and 2.208% in 2019 (NBS, 2019). With the Covid-19 pandemic and subsequent lockdown in March 2020, Nigeria's GDP growth rate reduced to 1.87% as of July 2020. The growth rate became negative (-6.10%) in the second

quarter of the same year and -3.62% in the third quarter. Nigeria's manufacturing sector is currently picking up, with an expansion in the manufacturing PMI to 50.2 index point (CBN, 2020).

There are four phases of the business cycle: expansion, peak, contraction, and depression. A recession occurs when the economy contracts and falls for at least two quarters (Balami, 2006). Due to the slowdown of the economic growth rate, the need to examine whether manufacturing output growth significantly predicts a Recession in Nigeria and to proffer a solution to that effect. Afolabi and Laseinde (2019) and Nwogwugwu, Metu, and Ihugba (2021) offer other insights into the sector that is concerned with manufacturing and its relationship with the growth of Nigeria's Economy. Despite the significant role played by the sector in stimulating economic growth as observed by Afolabi and Laseinde (2019) and Nwogwugwu et al. (2021), it is observed that few studies were directed at finding out how the output of the manufacturing sector impacts the Nigeria economic growth. Our study, therefore, looks to fill the gap in the literature using an Autoregressive Distributed Lagged model. We deem this study necessary due to the fact that previous literature has not conducted a robustness test, and our study did use a different model of Vector Autoregressive (VAR). The objective of the paper is to examine whether the countries manufacturing output can accurately predict a recession. The remaining paper is structured as follows: part two covers a review of related literature, part three details the methodological aspect of the study, part four deals with data presentation and analysis, and five is the conclusion as well as recommendations.

2. LITERATURE REVIEW

2.1. Theoretical Literature

The underpinning theory for this study is the Big Push Theory, which states that all the Less Developed Countries are required to launch into an era of self-sufficient economic development with respect to a massive outlay in strictly mutually dependent industries, with the goal of achieving rapid industrial development and the building of advanced economic infrastructure. The theory, based on the postulation of indivisibilities and non-appropriabilities in the production functions, also contends that such development cannot successfully launch if the expansion of infrastructure is kept to a small area.

2.2. Empirical Literature

Though empirical literature on the manufacturing sector-economic nexus in Nigeria is scarce, an extensive review of empirical and theoretical literature is documented by Chukwuedo and Ifere (2017), who opined that the output of the manufacturing sector, resources, and know-how are the main determinants of growth of the Nigeria economy. This study intends to identify important issues highlighted in the extant literature and extend the review to incorporate more recent studies connecting manufacturing sector output and economic growth, especially in Nigeria. Adeleye and Shittu (2018) investigated the relationship between inflation, manufacturing output, and economic growth using the Ordinary Least Square and Error Correction techniques and found that increase in manufacturing productivity tends to raise economic growth. Similarly, Yaya (2018) investigates the relationship between the manufacturing sector and the economic growth in the countries of ECOWAS using the first law of Kaldor. The study employed a Granger causality approach and found that manufacturing output has a causal relationship with economic growth while non-manufacturing validates Kaldor's first law.

In the same vein, Afolabi and Laseinde (2019) used annual data between 1981 and 2016 with ARDL as the model. They found a positive, though insignificant, relationship between Nigeria's manufacturing sector output and economic growth. Also, Nwogwugwu et al. (2021) employed a disaggregated approach to the manufacturing sector and Nigeria's economic growth nexus using the VECM approach, and found that the refining sector, among other manufacturing sub-sectors, had an effective influence on Nigeria's long-term economic growth.

While the manufacturing sector has shown to be important in stimulating growth in an economy, studies on the linkage are still lacking, hence the need to fill the gap.

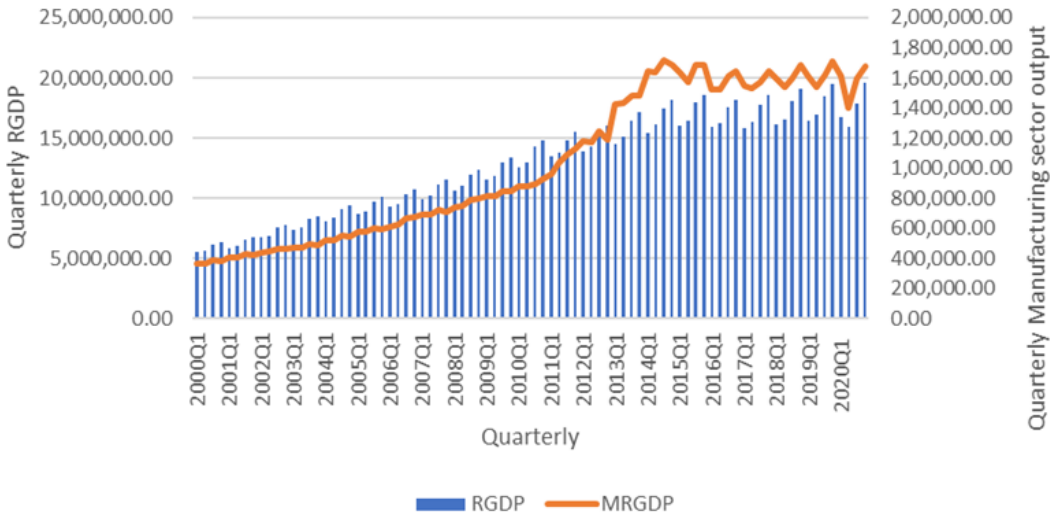

Figure 1. RGDP and manufacturing output trend in Nigeria from 2000Q1 to 2020Q4.

2.3. Trend Analysis

Figure 1 shows a correlation between the manufacturing output and the growth of the Nigerian economy from 2010Q1 to 2020Q4, presenting a trend revealing that increase in the real gross domestic output represents economic growth associated with a corresponding increase in the output of the manufacturing sector in Nigeria. A sharp decrease in RGDP was seen in the second quarter of 2020 accompanied by also a sharp decrease in the Nigerian manufacturing output, which may be attributed to the outbreak of the COVID-19 pandemic and its attendant consequences on economic activities around the globe. The country witnessed an era of recession in 2020Q2 with a growth rate of -6.10%. In the same period, the manufacturing sector witnessed a negative growth rate, suggesting that the manufacturing sector could significantly predict Nigerian economic growth.

3. METHODOLOGY

3.1. Data

The study sourced data from the Central Bank of Nigeria statistical bulletin 2019, CBN annual report 2020, and National Bureau of Statistics annual report 2020, and was gathered for the real gross domestic product (RGDP), manufacturing output (MAO), inflation rate (INFL), and the nominal exchange rate (NEXR) in Nigeria between 2000Q1 and 2020Q4. The exchange rate and inflation are included in the model to serve as control variables due to their importance in determining manufacturing output and the overall output growth of the economy.

3.2. Model Specification

Autoregressive Distributed Lag (ARDL) model was specified in line with the Pesaran, Shin, and Smith (2001) proposition as follows:

$$\triangle Y_i = \sum_{i=1}^{p} \alpha_i \triangle Y_{t-1} + \sum_{i=0}^{p} \beta_i \triangle X_{t-P} + \varepsilon_t \qquad (1)$$

Where: Y_t is the real GDP representing economic growth at time t, X_i is the independent variables at time t, α_i *and* β_i is the vectors of the parameters of the model and ε_t is the error terms for the model.

3.2.1. The Long-Run ARDL Model for Growth

The following model was used to obtain the coefficients showing the long-run relationship between manufacturing output and economic growth in Nigeria:

$$\triangle LOGRGDP_t = \alpha 1 + \beta 1 LOGRGDP_{t-1} + \lambda 1 LOGMAO_{t-1} + \eta 1 INFL_{t-1} + \gamma 1 LOGNEXR_{t-1} + \mu t1 \quad (2)$$

This Equation 2 presents the long run model linking manufacturing sector output and economic growth. $\beta 1, \lambda 1, \eta 1$ and $\gamma 1$ are the long-run coefficients capturing the long run impact of manufacturing output on growth.

3.2.2. The ARDL Bound Test Model for Growth

This model was used to test the presence or otherwise of a relationship between the manufacturing output and growth of Nigeria's economy in the long run under the null hypothesis of no level relationship between variables of the model. The presences of a level relationship between them provide the basis for the estimation of the short-run model and the error correction term as presented in Equation 3:

$$\triangle LOGRGDP_t = \alpha 2 + \beta 2 LOGRGDP_{t-1} + \lambda 2 LOGMAO_{t-1} + \eta 2 INFL_{t-1} + \gamma 2 LOGNEXR_{t-1} + \sum_{k=1}^{n} \beta 3 \triangle LOGRGDP_{t-1} + \sum_{k=1}^{n} \lambda 3 \triangle LOGMAO_{t-1} + \sum_{k=1}^{n} \eta 3 \triangle INFL_{t-1} + \sum_{k=1}^{n} \gamma 3 \triangle LOGNEXR_{t-1} + \mu t2 \quad (3)$$

Equation represents the bound test model that examines the presence of long run relationship between manufacturing output and economic growth.

3.2.3. The Short-Run and ARDL - ECM Model for Growth

Equation 4 was used to estimate the short-run coefficients and error correction terms of the model. The error correction term τ represents the speed of adjustment of the model to converge in the long run when there is a state of disequilibrium in the short run. The error correction term is expected to be statistically significant and less than zero.

$$\triangle LOGRGDP_t = \alpha 3 + \sum_{k=1}^{n} \beta 4 \triangle LOGRGDP_{t-1} + \sum_{k=1}^{n} \lambda 4 \triangle LOGMAO_{t-1} + \sum_{k=1}^{n} \eta 4 \triangle INFL_{t-1} + \sum_{k=1}^{n} \gamma 4 \triangle LOGNEXR_{t-1} + \tau ECM(-1) + \mu t3 \quad (4)$$

Where *LOGRGDP* is the natural logarithm of real gross domestic product, *LOGMAO* is the natural logarithm of the manufacturing sector output, *INFL* is the inflation rate, and *LOGNEXR* is the natural logarithm of the nominal exchange rate. The choice of the variables was based on theoretical facts that an increase in manufacturing output might likely raise the growth of output in an economy.

3.2.4. A priori Expectation

The coefficient of *LOGMAO* is expected to be positive, indicating a direct linkage between *LOGMAO* and *LOGRGDP*. The coefficients of *LOGNEXR* and *INFL* are expected to have negative signs, implying a negative relationship with *LOGRGDP*. Therefore, $\alpha i \; and \; \beta i > 0$ While, $\eta i, and \; \gamma i < 0$. In addition $\tau < 0$ is considered statistically significant.

3.3. Estimation Procedure

The ARDL and Ordinary Least Square (OLS) techniques were used to estimate the parameters of the model, variables of which were found to be stationary at levels and first difference, hence, the ARDL model was used. According to Pesaran and Shin (1999) and Pesaran et al. (2001), the advantage of ARDL was its ability and flexibility when variables are integrated, especially I(0) and I(1), which has been further corroborated and expanded by Laurenceson and Chai (2003). It is believed that the ARDL model can capture sufficient numbers of lags in the data generating process from a general-to-specific modeling framework.

3.4. Robustness

To guarantee the robustness of the model and the technique of analysis, a standard Vector Autoregressive model was employed using the log-likelihood technique. The standard VAR model is specified thus:

$$Y_t = c + \sum_{t=1}^{p} B_i Y_{t-i} + \varepsilon_t \quad (5)$$

Where Y_t c and ε_t are the m x 1 vectors of endogenous variables, constants, and error terms respectively, and B_i is an m x m matrix of coefficients for lagged variables. The vector of errors ε_t can be described as a standard innovation or shock with a mean of zero, which is also serially uncorrelated. The optimal lag p is obtained using the Schwarz Information Criterion (SIC).

4. RESULTS AND DISCUSSION

This section presents the results and discussion of the study.

Table 1. Unit root test.

Variables	Philip-Perron (PP)			Augmented Dicker-Fuller (ADF)		
	T-Stats	Prob.	Inference	T-Stats	Prob.	Inference
D(LOGRGDP)	-11.2	0.00	I(1)	-3.93	0.02	I(1)
D(LOGMAO)	-10.8	0.00	I(1)	-2.60	0.10	I(1)
INFL	-4.51	0.00	I(0)	-4.51	0.00	I(0)
D(LOGNEXR)	-7.18	0.00	I(1)	-7.35	0.00	I(1)

4.1. Discussion of Stationarity Result

Table 1 presents the unit root test results for the manufacturing output and growth of the Nigerian economy and reveals a mixture of I(0) and I(1) levels of integration, which justifies the choice of the ARDL model and the estimation technique of OLS.

Table 2. Lag selection.

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-38.8	NA	0.00	1.04	1.16	1.09
1	309	652*	0.00*	-7.04*	-6.45*	-6.80*
2	321	22.3	0.00	-6.96	-5.90	-6.53

Note: * represents the chosen lag length used for the estimate of the models of this study.

4.2. Discussion of Lag Length Selection Results

Table 2 presents the lag selection result for the manufacturing output and growth of the Nigerian economy and shows that lag 1 is the best lag for the ARDL model, indicated by the FPE, SC, and HQ results, which were in favor of lag 1.

4.3. Discussion of Model Selection Results

Figure 2 represents the maximum lags of the variables in the ARDL model estimate. Based on the model selection graph of Akaike information criteria (AIC), the ARDL model (1, 1, 0, 0) was demonstrated as the most appropriate model, hence its selection.

4.4. Discussion of the Long-Run ARDL Results

Table 3 contains the long-run coefficients of the nexus between Nigeria's manufacturing output and economic growth. The coefficient of *LOGMAO* of 0.64 and the corresponding probability value of 0.00 indicates that an increase in manufacturing output, in the long run, may likely lead to an increase in growth. This finding corroborates Adeleye and Shittu (2018) and Yaya (2018) who both found that manufacturing output has a positive and significant impact

on growth. This could be attributed to the fact that the manufacturing sector plays a key role in stimulating economic activities and growth, and could also be attributed to the ease of doing business policies of the current administration that encourage local and foreign manufacturers to invest more in the country. The coefficient of the *LOGMAO* representing the elasticity of economic growth to changes in manufacturing output was inelastic, meaning that economic growth will respond to change in manufacturing output by less than a change in the sector output.

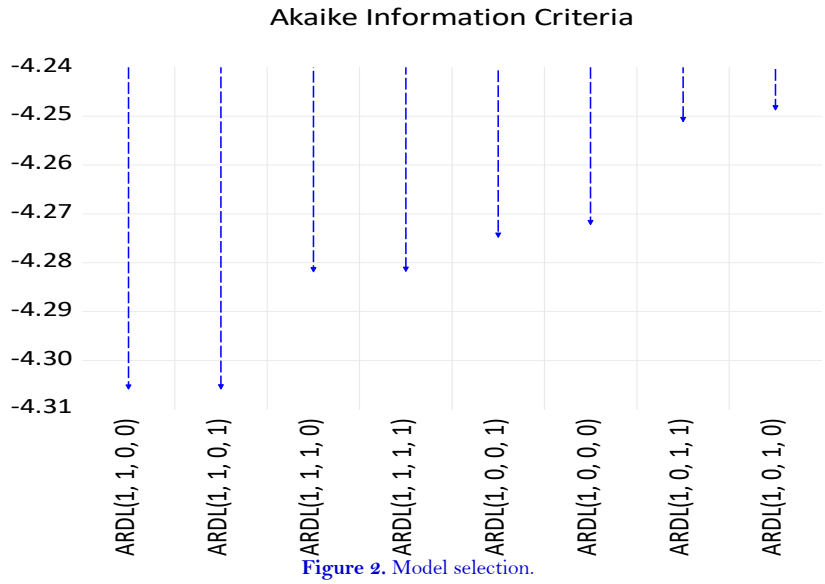

Figure 2. Model selection.

Table 3. ARDL Long-run Coefficients.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGMAO	0.64	0.07	9.13	0.00
INFL	-0.00	0.00	-0.15	0.88
LOGNEXR	0.01	0.04	0.26	0.80
R^2= 0.97, Adjusted R^2= 0.97, F-stat.= 512 Prob. of F-stat.= 0.00 D-W. stat.= 2.00				

In addition, the nominal exchange rate has a positive, though insignificant, impact on the economic growth of Nigeria's economy. The inflation rate, on the other hand, has a negative and insignificant impact on growth. R^2 of 0.97 shows that 97.1% of the total variations in the growth of the Nigerian economy were explained by *LOGMAO*, *LOGNEXR*, and *INFL*. Coincidently the R-square adjusted value of 0.97 was found high signifying that the model of the study is fit for policy. The F-statistic value of 512, which measures the joint significant impact of *LOGMAO*, *LOGNEXR*, and *INFL* on growth, was found to be significant by a probability value of 0.00. Durbin-Watson's statistic of 2.00 shows that there is no autocorrelation in the model.

Table 4. The long-run bound test result.

Test Statistic	Value	Significant level	I(0)	I(1)
Asymptotic: n=1000				
F-statistic	4.74	10%	2.72	3.77
	3	5%	3.23	4.35
		2.5%	3.69	4.89
K		1%	4.29	5.61
t-Bounds Test		H_0: No levels relationship		
Test Statistic	Value	Significant level	I(0)	I(1)
	-4.26	10%	-2.57	-3.46
		5%	-2.86	-3.78
		2.5%	-3.13	-4.05
t-statistic		1%	-3.43	-4.37

4.5. Discussion of the Long-Run Bound Test Results

Table 4 presents the long-run bound test result for the long-run relationship between manufacturing output and Nigeria's economic growth. F-Statistic values of 4.74 and the T-statistic value of -4.26 were found to be greater than the 5% upper-bounds, hence the null hypothesis was rejected. The study concludes that a long-run relationship exists between manufacturing sector output and the growth of Nigeria's economy. This necessitates the estimation of the short-run coefficients and the ARDL-ECM model.

Table 5. Short-run and ADRL-ECM results.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.20	0.27	4.45	0.00
D(LOGMAO)	0.58	0.15	3.87	0.00
CointEq(-1)	-0.38	0.09	-4.44	0.00
R^2	0.27	Mean dependent var		0.01
Adjusted R^2	0.25	S.D. dependent var		0.03
F-stat.	14.9	Durbin-Watson stat		2.00
Prob. of F-stat.	0.00			

4.6. Discussion of the ECM Regression Results

Table 5 contains the short-run coefficients for manufacturing output and the growth nexus for Nigeria. The coefficient of error correction term shows the speed of adjustment in an event of dis-equilibrium. The coefficient of D(LOGMAO) of 0.58 and the corresponding probability value of 0.00 imply that manufacturing output positively and significantly affects Nigeria's economic growth in the short run and further suggests that if manufacturing output increases, it could lead to an increase in growth but by a less than proportionate increase in the manufacturing output. The coefficient of the ECM term of -0.38 and the corresponding probability value of 0.00 implies that the model will converge at a speed of 38% quarterly. This means that it will take the model at most three quarters to adjust to equilibrium.

Table 6. Diagnostic test result.

Technique	F-Stat, Jarque-Bera, & J-stat/ (Prob).	Null Hypothesis	Decision
Serial Correlation	0.02(0.88)	No serial correlation	Accepted
Heteroscedasticity	2.69(0.10)	Homoscedascity	Accepted
Normality Test	10.8(0.01)	Normal distribution	Rejected

4.7. Discussion of Diagnostic Test Results

Table 6 revealed that there is no serial correlation and heteroskedasticity in the model of the study, as it further revealed that the data is not normally distributed. We therefore accept the null hypotheses of no serial correlation and no heteroskdasticity given the probability of greater than 0.05 as we reject that of the normality test with a probability value of less than 0.05.

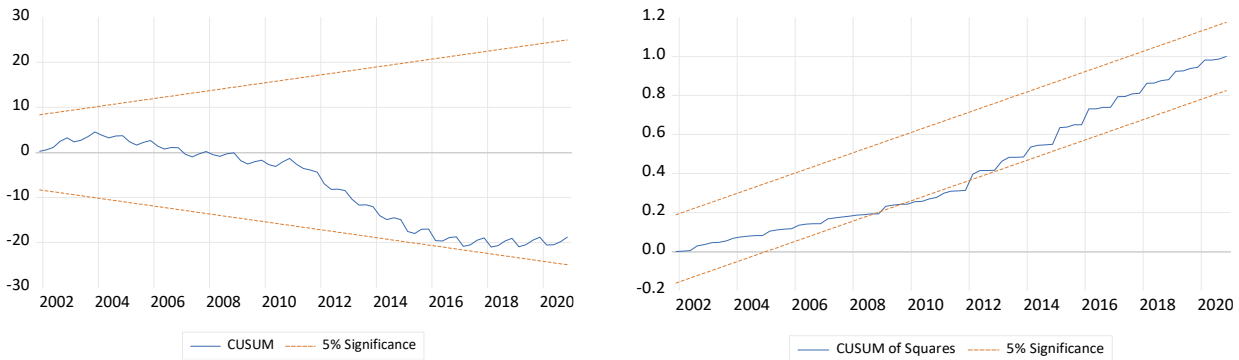

Figure 3. Stability test results using CUSM and CUSUM squares.

4.8. Discussion of Diagnostic Test Results

Figure 3 shows stability test results. The CUSUM and CUSUM of squares reveal that the model is stable, as the line falls within 5%. Therefore, the model passed the stability test.

4.9. Robustness Check VAR Results

The standard VAR was estimated to validate the ARDL result to achieve robustness.

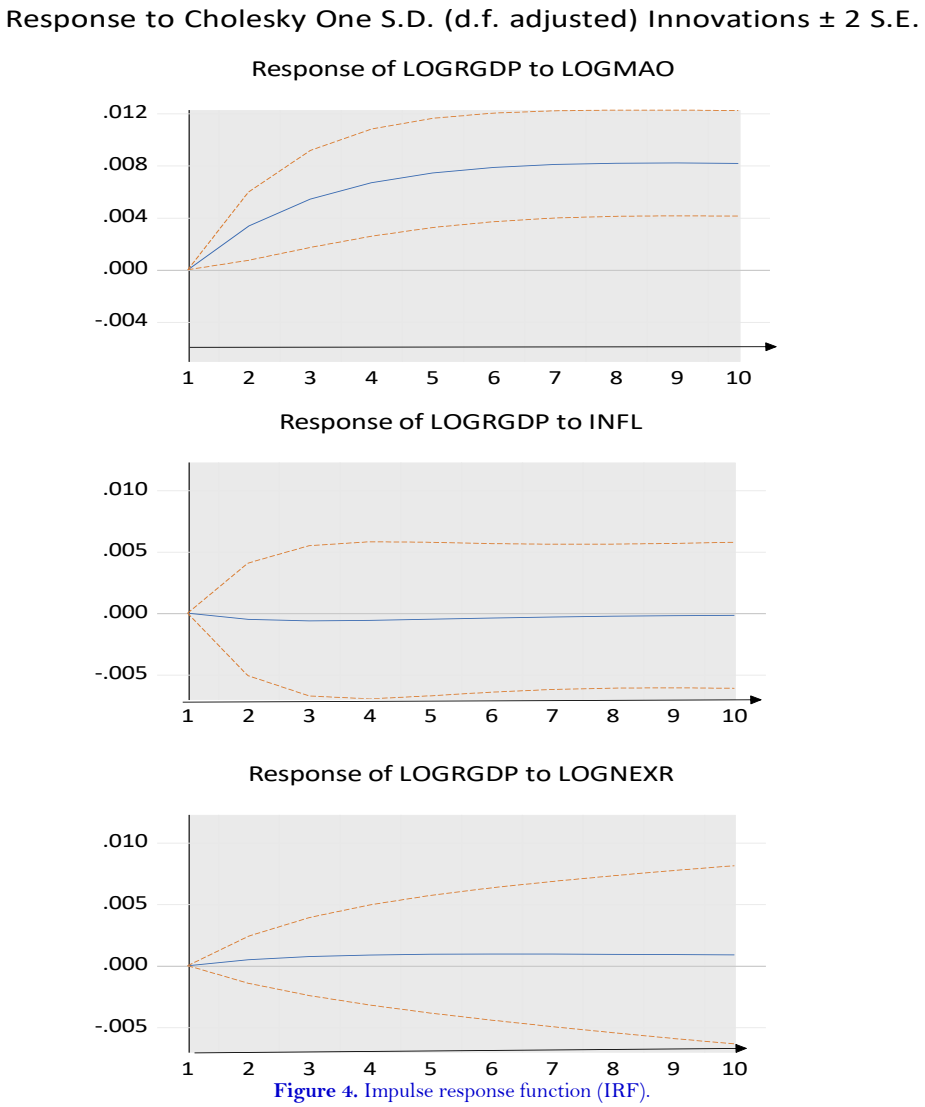

Figure 4. Impulse response function (IRF).

4.10. Discussion of VAR Robustness Test Results

Figure 4 presents the response of growth to standard deviation shock emanating from Nigeria's manufacturing output. Theoretically, we expect the manufacturing output (LOGMAO) to have a positive impact on growth, which is proved in the ARDL results presented above. The VAR result revealed that economic growth (*LOGRGDP*) responded positively and statistically significantly to shocks emanating from the manufacturing output (*LOGMAO*) in the short and long run, indicating that an increase in manufacturing output could lead to a significant increase in growth in Nigeria. This validates the ARDL results and further buttresses the robustness of the results of this study, which was further supported by the variance decomposition result below.

Table 7. Variance decomposition.

Period	S.E.	LOGRGDP	LOGMAO	INFL	LOGNEXR
1	0.03	100	0.00	0.00	0.00
2	0.04	99.1	0.85	0.02	0.02
3	0.04	97.4	2.49	0.04	0.05
4	0.04	95.3	4.57	0.05	0.08
5	0.05	93.0	6.82	0.06	0.12
6	0.05	90.7	9.06	0.06	0.15
7	0.05	88.6	11.2	0.06	0.18
8	0.05	86.6	13.2	0.06	0.20
9	0.05	84.7	15.0	0.06	0.22
10	0.05	83.1	16.6	0.06	0.24

Note: Cholesky Ordering: LOGRGDP LOGMAO INFL LOGNEXR.

4.11. Discussion of the Variance Decomposition Result

Table 7 shows that economic growth responded more to a standard deviation shock emanating from manufacturing sector output than it does to a shock emanating from inflation and nominal exchange rate in Nigeria.

5. CONCLUSION AND POLICY RECOMMENDATIONS

The manufacturing sector played a vital role in predicting growth in Nigeria. In an attempt to achieve the desired growth, fiscal and monetary authorities have over the years made frantic efforts through several interventions and policies such as the ease of doing business policy to stimulate activities in the manufacturing sector, however, these efforts seem not to yield the desired goal. Few studies were conducted to examine the extent to which manufacturing output impacts the growth of the Nigerian economy, and to the best of our knowledge, little or no attention is accorded to the investigation of whether manufacturing output can significantly predict economic growth in Nigeria. Also, little or no attention was given to the area of examining the robustness of the results obtained.

Our study finds that manufacturing output impacts positively and significantly on the growth of the Nigerian economy in both the short and long run, as well as concludes that manufacturing output can significantly predict growth and by extension recession in Nigeria. Therefore, a percentage change in manufacturing sector output may likely increase the growth of Nigeria's economy.

Based on the finding of the study, it was recommended that fiscal and monetary authorities should enhance a favourable investment environment that could entice investors to Nigeria's manufacturing sector. This could be achieved by improving the ease of doing business policy by ensuring the security of lives and properties of the manufacturers, lowering the interest rate on manufacturing facilities (loans) relative to the global interest rate, stabilizing the exchange rate, developing infrastructures, and increasing interventions to the sector. When adopted, these strategies could reduce production costs and stimulate economic growth.

This study was conducted in Nigeria assuming a linear nexus between manufacturing output and growth. This negates the non-linear nexus perceived to exist between manufacturing output and growth. Hence, we recommend that future studies are conducted to look at the non-linear aspect of the nexus between manufacturing output and the growth of Nigeria's economy, as well as extending the scope of the study by incorporating more important variables in the model such as credit provided to the manufacturing sector, Foreign Direct Investment (FDI), Portfolio Investment (PI), and insecurity that is bedevilling the country.

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