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Bank Credit and Manufacturing Sector Output in Nigeria: A Nonlinear Approach

Ashiru Ibrahim[1], Lukman Abdulrahman[1], Anas Bafeto Abubakar[1]

[1]*Department of Economics, School of Postgraduate Studies, Nigerian Defence Academy, Kaduna, Kaduna State*

Correspondence Email: Ibrahimashiru@gmail.com

Abstract
This study examines the nexus that exists between bank credit and manufacturing sector output in Nigeria between 1981 and 2019 using the nonlinear autoregressive distributed lag (ARDL) model and Granger causality. Unlike most other studies, this study employs the use of bank credit to the manufacturing sector as a proxy for bank credit. The NARDL method used is to investigate the asymmetric relationship suggested in the literature. Results from the bounds test reveal that a long-run relationship exists between bank credit, manufacturing output and lending interest rate. Furthermore, the Wald test for asymmetry showed that there is a long-run asymmetry in the impact of bank credit on manufacturing output. Meanwhile, estimates reveal that positive changes in bank credit are positively associated with manufacturing output, while negative changes in bank credit are negatively related to manufacturing output in the long run. In the short run, however, there appears to be no significant impact of bank credit and lending rates on manufacturing output. More so, results reveal a unidirectional causality running from output to bank credit, lending rates to bank credit and lending rates to output. This study, therefore, concludes that the growth-led finance postulate is valid in this case and that finance encourages output growth in the manufacturing sector in the long run with an error correction of 21%.

Keywords: Bank Credit, Manufacturing Output, Lending Rates, Nonlinear ARDL
JEL Classification: E2, E5, G2

1. Introduction

In every nation, one of the most important macroeconomic objectives is to achieve steady growth and development. The manufacturing sector plays a key role in the achievement of this objective in a modern economy as it has many benefits which are central to economic transformation (Ogar, Nkamare & Effiong, 2014). The manufacturing sector of the industrial sector is seen as an engine of growth and development and cannot be undermined. Kaldor (1966) believes that an operative manufacturing sector leads to fast economic growth, gives a way out for high level of unemployment as well as a mechanism for sustained development over a long duration. Goshit, Dabwor and Kromtit (2018) opined that investment capital is

more quickly created in the manufacturing sector than in other sectors of the economy and at the same time, encourages links that are more robust and broader amongst other sectors of the economy. Countries such as the USA, Germany, China and Japan have through their manufacturing sector, speed up their rate of growth and development. This is resulting from the realisation that the manufacturing sector allows economies to attain full employment of their resources in encouraging employment and output growth and in the process, improve the standard of living of the populace.

Successive Nigerian governments have over time, enacted laws and formulated policies which are aimed at improving the performance of the manufacturing sector and industrial sector at large. One of such policies is the National Economic Empowerment and Development Strategy (NEEDS) that was aimed at invigorating the financial system to set a stage for sustainable progression in the manufacturing sector. This is due to the realisation of the role of finance in the growth of the manufacturing sector. The growth of an economy to a large extent, depend on the level of funding received by the manufacturing sector (Ogunmuyiwa, Okuneye & Amaefule, 2017).

The financial sector is perceived as the conduit of growth in every economy, through which the developments of other sectors are achieved. This is because of the financial conduit roles ascribed to it.The financial sector through financial institutions seeks out funds from the surplus sectors in form of savings and idle funds and apportions such to entrepreneurs who need funding for their ideas and business ventures, for a return in form of interest on loans (Ademu, Dabwor & Ezie, 2019). Financial institutions make structures available for monetary administration and the foundation for the management of liquidity in the system. Banks, therefore, have to be very effective in their roles as intermediaries for deposits mobilisation and channelling such to the productive sector of the economy particularly the manufacturing sector. The monetary authorities in a bid to bolster the confidence of savers in the financial system established the Nigerian Deposit Insurance Corporation (NDIC) to cover insurance for deposits in financial institutions. Again, the CBN embarked on several banking reforms, one of which was the 2004 banking consolidation which saw the paid-up capital base of banks raised from 2 billion Naira to 25 billion naira which forced the merger and acquisition of the weak banks thereby leaving only 25 strong banks in operation (Soludo, 2004). Between 1981 and 1990, commercial banks credit to the manufacturing sector was below 10 billion naira. However, the volume rose to a little above 10 billion naira in 1991 and has since, sustained a steady incline up until 2019 when it peaked at 2.6 trillion naira (CBN, 2020).

Despite all efforts put in place to encourage the growth of the Nigerian manufacturing sector, its performance has not been commensurate with efforts put into it as the sector has been experiencing stunted growth and its contributions to Gross Domestic Product (GDP) has remained almost insignificant (Manufacturers' Association of Nigeria, MAN, 2015). Between 1981 and 1993, the contribution of the manufacturing sector to GDP has stayed below 20 per cent with the peak during that period in 1988 at 19.8 per cent. However, in 1994, it rose to a mere 20.1 per

cent of GDP and sustained a steady decline afterwards until it was 12.2 per cent in 2001 and thereafter, remained below 10 per cent until 2019 when it slightly rose to about 11.6 per cent (CBN, 2020). The persistent underperformance of the manufacturing sector in defiance of all revitalising efforts may not be unconnected to bottlenecks in accessing finance particularly from commercial banks which hold about 90 per cent of total financial sector assets but concentrate their credits mostly in the oil and gas sector which is perceived to be more lucrative (Daniel, Oluwatobi, Taiwo & Julius, 2017). This problem has called for the need to examine the impact of bank credit to the manufacturing sector on manufacturing sector output.

Previous works on this topic have not had a consensus in their results on the relationship between bank credit and manufacturing sector output. For instance, some studies concluded that bank credit significantly influences manufacturing sector output (Asaleye, Adama & Ogunjobi, 2018; Daniel et al., 2017; Ume, Obasikene, Oleka, Nwadike & Okoyeuzu, 2017), while others find no significant relationship between the duo (Aminu, Raifu & Oloyede, 2019; Elijah, 2018; Emmanuel, Olupeeka & Adeyinka, 2020; and Toby & Peterside, 2014; among others).The lack of consensus has given rise to another strand of literature that posits that bank funding of the manufacturing sector is only growth encouraging up to a point, after which it becomes a deterrent to growth (Law & Singh, 2014). This has led scholars such as Ademu et al. (2019); Kalu, Okoyeuzu, Okechukwu and Ukpere (2019); and Hung (2009) among others, to believe that there might be a non-linear relationship between bank credit and output. It is based on this that, this study is set out to examine the relationship between bank credit and the manufacturing sector output in Nigeria between 1981 and 2019 using a non-linear approach.

The rest of this study contains the literature review, where related theories and empirical studies are discussed; the methodology, where the procedure of data analyses are discussed; results, where findings are presented and discussed; and conclusion, where the major findings are summarised and recommendations are made.

2. Literature Review

Theoretical Underpinning

This study is hinged on the framework of finance-led growth postulate. This view was first brought to light by Schumpeter(1934) when he postulated a circular flow occurring in the economy. According to Schumpeter(1934), the economy is in a stationary and competitive state in which there is no interest rate, no profit, no involuntary unemployment, no savings and no investments. In this hypothetical economy, the same goods are produced yearly and the circle is broken only by innovation, which is funded by bank credits.

Schumpeter (1934) allotted a key role to bank credit in the development of the real sector by assuming that loans facilitated to the real sector are the main reasons for innovation and by extension, growth of the real sector. He further assigned importance to interest rates as the cost of this credit which the entrepreneurs have to

pay back when they begin to make profits, hence, bringing the economy back to its optimum level after an initial wave of increase in earnings. From his view, Schumpeter (1934) believes that finance precedes growth. Scholars such as Gurley and Shaw (1960) are in support of his opinion as they believe that the financial sector supports the real sector with the required finance for growth. However, despite the wide acceptance of the finance-led growth postulate, economists such as Robinson (1953) and Jung (1986) among others have disagreed with the former's opinions arguing that growth in the real sector necessitates the supply of finance.

Empirical Review

From both theoretical and empirical evidence, there has been a lack of consensus as to the relationship between bank credit and the manufacturing sector. For instance, studies like that of Aigbomian and Mamudu (2020) study the impact of bank credit on the growth of the manufacturing sector in Nigeria using an error correction model. They study find a significant cointegration relationship, the short-run estimates indicate that oil revenue and manufacturing credit from deposit money banks have a positive significant impact on manufacturing sector growth, while corruption in the banking sector significantly retards the growth of the manufacturing sector. Additionally, interest rate and exchange rate are found to have an insignificant impact in determining manufacturing sector output. Meanwhile, Emmanuel, et al. (2020) in their investigation of the role of commercial bank credit on real sector performance in Nigeria from 1990 to 2017, used ordinary least squares and found that commercial bank credit and bank lending rates had no significant impact on manufacturing sector output.

More so, Aminu et al. (2019) in their study on the nexus between manufacturing sector output and financial development employed the use of a cointegration and causality model in analysing data from 1984 to 2016. Results from Granger causality indicated a bi-directional causality between credit to the private sector and the manufacturing sector output. Furthermore, the authors found a long-run relationship between the variables. Again, the short-run estimates indicate an insignificant relationship between credit to the private sector and the manufacturing sector output while in the long run, a positive significant relationship was found. Meanwhile, in both the long and short run, interest rate was found to exert a negative significant impact on manufacturing sector output.

Using a Non-linear Autoregressive Distributed Lag (NARDL) model, Ademu et al. (2019) in their examination of the nexus between bank credit and the Nigerian manufacturing sector output in Nigeria used annual time series data covering the period between 1986 and 2017. Regressing manufacturing sector output on commercial bank credit, the bounds test result indicates the presence of a long-run relationship. The results for the short run further indicate a positive relationship between manufacturing output and negative shocks of bank credit from the current period up to the two-period lag. More so, positive shocks of bank credit at the current period was seen to exert a positive influence on manufacturing output while it changes to a negative relationship at the one-period and two-period lags. This, however, returned to a positive impact at the three-period lagged bank credit variable. Concluding the Wald test result, the study concludes that both the

negative and positive shocks are significant in determining manufacturing sector output.

In another study, Andabai (2018) investigate the nexus between bank credit and manufacturing sector growth using annual time series data from 1990 to 2017 in Nigeria using a vector error correction model. Results indicate a cointegrating relationship between the variables. Causality test results indicate that all variables included in including credit to the private sector and interest rates neither jointly nor individually Granger-cause manufacturing sector output. The study concludes that, credit to the private sector has no significant relationship with manufacturing sector output. Elijah (2018) employed an autoregressive distributed lag model in analysing the impact of bank credit on the manufacturing sector output using Nigerian data from 1986 to 2016. Results from the bounds test indicate that the variables are cointegrated. In the long run, all explanatory variables including credit to the private sector and lending rates are not significant in explaining manufacturing sector growth in the long run while in the short run, credit to the private sector, money supply and lending rates have a positive significant relationship with manufacturing sector growth while savings rate has a significant negative relationship with manufacturing sector output. Meanwhile, results from causality indicate the presence of a one-way causality from credit to the private sector to manufacturing sector growth. Asaleye et al. (2018) employed a vector error correction model, dynamic ordinary least square and Granger non-causality in assessing the financial sector and manufacturing sector nexus in Nigeria from 1981 to 2016. Results reveal a bi-directional causality between credit to the private sector and the manufacturing sector output in Nigeria. A positive significant relationship was observed between credit to the private sector and manufacturing sector output.

In another study, Mesagan, Olunkwa and Yusuf (2018) investigated the financial development and manufacturing sector growth nexus using Nigerian annual data from 1981 to 2015. Results from the error correction model indicate the presence of a long-run relationship between the variables. Furthermore, short-run estimates indicate the existence of a positive and significant relationship between credit to the private sector and manufacturing sector output while interest rate was observed to have a negative significant impact on manufacturing sector output. Meanwhile, in the long run, they find no significant relationship between interest rate and bank credit with manufacturing sector output. Daniel et al. (2017) investigate the nexus between bank credit and manufacturing sector output in Nigeria using annual time series from 1978 to 2015. Employing the Engle-Granger two-step error correction model, they study found a long-run relationship between the variables. Additionally, estimates show that, in both long and short run, manufacturing capacity utilisation, capital formation and bank loans to the manufacturing sector have a positive significant impact on the manufacturing sector growth. The authors conclude that bank credits are critical to the growth of the manufacturing sector in Nigeria.

Again, investigating the relative impact of bank credit on the Nigerian manufacturing sector, Ume et al. (2017) employed an autoregressive distributed lag model in analysing annual time series data from 1986 to 2013 and found a long-run

relationship between manufacturing sector output and the explanatory variables. The short-run estimates indicate that volume of bank credit and interest rate have positive and negative significant relationships with manufacturing sector output respectively while in the long run, the volume of bank credit and exchange rates have a significant positive relationship with manufacturing sector output while interest rates uphold a negative significant relationship. Ogunmuyiwa et al. (2017) examine the nexus between bank credit and manufacturing sector growth in Nigeria from 1999 to 2014. Employing an ARDL model, they find a long-run relationship between manufacturing sector output and bank credit. Furthermore, the short-run estimate indicates that bank credit only begins to be significant in influencing manufacturing output from twoprevious periods and the two-period lag of bank credit had a negative relationship with manufacturing sector output. John and Terhemba (2016) examine the effect of commercial bank credit on manufacturing sector output in Nigeria from 1980 to 2015 using a partial adjustment model. Results show that bank loans and advances, and broad money supply have a positive and significant impact on manufacturing sector output while lending rates and inflation rates have negative significant impacts on manufacturing sector output. Additionally, the AR1 variable, which is the dependent variable lagged by one period is found to be insignificant in determining manufacturing sector output at the current period. Ogar et al. (2014) while assessing the contributions of commercial bank credit on the Nigerian manufacturing sector from 1992 to 2011 using ordinary least square. Estimates indicate that there is a positive significant relationship between commercial banks credit and manufacturing sector growth while interest rate is insignificant in explaining manufacturing sector growth. They conclude that access to bank credits encourages more investment in the manufacturing sector.

Employing the same method with annual time series data from 1981 to 2010, Toby and Peterside (2014) assessed the roles of banks in manufacturing sector finance in Nigeria. They study found that commercial banks loans to the manufacturing sector are insignificant in explaining manufacturing output while merchant banks credit to the manufacturing sector has a positive and significant impact on manufacturing sector output. They conclude that the roles of banks in growing the Nigerian manufacturing sector are very limited. A review of previous studies has shown gaps in the literature, which this study will attempt to minimise. This study is different from previous studies in that it uses credit to the manufacturing sector as against credit to the private sector as a proxy for bank credit and follows the required systematic procedure involved in time series analysis unlike Daniel et al. (2017); Aigbomian and Mamudu (2020); and Toby and Peterside (2014) who neglected the necessary steps involved in time series analysis thereby rendering their methodologies unreliable. Secondly, this study considers the possibility of an asymmetry in the relationship as suggested by Ademu et al. (2019) and hence, employs a test of the asymmetric relationship.

3. Methodology

To achieve the research objectives, this study considers the Non-Linear ARDL approach of Shin, Yu and Greenwood-Nimmo (2014), the Wald test for long run asymmetry testing, and the Pairwise Granger Causality by Granger (1969) approach.

Model Specification

The model estimated for this study is adopted from Ademu et al. (2015), who used a non-linear ARDL framework in estimating the relationship between bank credit and the manufacturing sector. Their model in its linear functional form is given as follows:

$$MSO = f(BC) \quad \ldots\ldots 1$$

Where; MSO is manufacturing sector output and BC is the bank credit. Albeit adopting the model by Ademu et al. (2015), this study differs from the former in that it incorporated a proxy for lending interest rate to control for the cost of obtaining capital thereby giving the functional form as follows:

$$MANQ = f(CMAN, LINT) \quad \ldots\ldots 2$$

Where; *MANQ* is manufacturing sector output measured in billions of Naira, *CMAN* is credit to the manufacturing sector measured in billions of Naira and *LINT* is lending interest rate measured in per cent. Data for both *MANQ* and *CMAN* were obtained from CBN Annual Statistical Bulletin, 2020 while data for *LINT* were obtained from World Bank 2020 World Development Indicators and all series cover the period from 1981 to 2019.

Test for Stationarity

The time series properties of the variables were tested using the Phillips-Perron stationarity test by Phillips and Perron (1988). The essence of testing for a unit root in time series analysis is to avoid bias or spurious results from the analysis because of the wrongful linear combination of stationary and non-stationary series. Therefore to avoid this problem and provide robust and accurate results, the properties of the series need to be examined by first ascertaining the order of integration of the series.

$$\Delta\hat{u}_t = \alpha_0 + \alpha_1\hat{u}_{t-1} + \varepsilon_t \quad \ldots\ldots 3$$

The above Phillips-Perron unit root equation is a simple AR(1) process. This corrects for any autocorrelation and heteroskedasticity in the errors and as such it gives robust estimates when the series has serial correlation and time-dependent heteroscedasticity (Odhiambo, 2009).The test compares the test statistic with the McKinnon critical value at 5 per cent, where a higher test statistic in absolute terms signify the stationarity of the variable at the level it is tested.

NARDL Model

The NARDL model developed by Shin et al. (2014) is a widely used method of examining asymmetric relationships. It is derived from the standard ARDL model with the difference lying in the incorporation of choice explanatory variables

decomposed into positive and negative cumulative sums. NARDL, therefore, carries all the attributes of the standard linear ARDL such as the ability to combine stationary and non-stationary series, giving robust estimates for small sample sizes, among others, which favours it above other methods of cointegration analysis such as, the nonlinear threshold Vector Error Correction Model (VECM) or smooth transition model. For empirical analysis, equation **(ii)**is transformed into its general linear ARDL form given in the below equation:

$$\Delta logMANQ_t = a_0 + \alpha_1 \sum_{i=0}^{n} \Delta logMANQ_{t-i} + \alpha_2 \sum_{i=0}^{n} \Delta logCMAN_{t-i} + \alpha_3 \sum_{i=0}^{n} \Delta LINT_{t-i} + \delta_1 logMANQ_{t-1} + \delta_2 logCMAN_{t-1} + \delta_3 LINT_{t-1} + \mu_t \quad \ldots\ldots 4$$

Where; Δ is a difference operator,$\alpha_1 - \alpha_3$ are short-run parameters and$\delta_1 - \delta_3$ are parameters of levels coefficients. To get the non-linear equation, *CMAN* was decomposed into its positive and negative cumulative sums using the formula given as follows:

$$CMAN_t^{POS} = \sum_{j=1}^{t} \Delta CMAN_j^{POS} = \sum_{j=1}^{t} \max(\Delta CMAN_j, 0) \quad \ldots\ldots 5$$

$$CMAN_t^{NEG} = \sum_{j=1}^{t} \Delta CMAN_j^{NEG} = \sum_{j=1}^{t} \min(\Delta CMAN_j, 0) \quad \ldots\ldots 6$$

Substituting the decomposed *CMAN* (i.e. $CMAN^{POS}$, which is the positive changes of credit to the manufacturing sector and $CMAN^{NEG}$, which is the negative changes) in the linear ARDL in equation**(iv)**, it gives the NARDL model for this study as below:

$$\Delta logMANQ_t = a_0 + \alpha_1 \sum_{i=0}^{n} \Delta logMANQ_{t-i} + \alpha_2 \sum_{i=0}^{n} \Delta logCMAN_{t-i}^{POS} + \alpha_3 \sum_{i=0}^{n} \Delta logCMAN_{t-i}^{NEG} + \alpha_4 \sum_{i=0}^{n} \Delta LINT_{t-i} + \delta_1 logMANQ_{t-1} + \delta_2 logCMAN_{t-1}^{POS} + \delta_3 logCMAN_{t-1}^{NEG} + \delta_4 LINT_{t-1} + \mu_t \quad \ldots\ldots 7$$

Bounds Test

To test for cointegration among the series, the f-statistic gotten from estimating the linear ARDL in **(iv)**is compared to the critical values given by Pesaran, Shin and Smith(2001). If the f-statistics is greater than the upper bound value at 5 per cent, it means there is cointegration among the series and hence, the long run and short-run asymmetric models which are given in equations**(viii)**and**(ix)**respectively are estimated. However, in a case where the derived f-statistic is less than the lower bound 5 per cent value, it then means there is no cointegration among the series.

$$logMANQ_t = a_0 + \delta_1 logMANQ_{t-1} + \delta_2 logCMAN_{t-1}^{POS} + \delta_3 logCMAN_{t-1}^{NEG} + \delta_4 LINT_{t-1} + \mu_t \quad \ldots\ldots 8$$

$$\Delta logMANQ_t = a_0 + \alpha_1 \sum_{i=0}^{n} \Delta logMANQ_{t-i} + \alpha_2 \sum_{i=0}^{n} \Delta logCMAN_{t-i}^{POS} + \alpha_3 \sum_{i=0}^{n} \Delta logCMAN_{t-i}^{NEG} + \alpha_4 \sum_{i=0}^{n} \Delta LINT_{t-i} + \emptyset \varepsilon_{t-1} + \mu_t \quad \ldots\ldots 9$$

To test for the presence of a significant asymmetric relationship, in the long run, a Wald test is conducted on the respective model using the reduced form of **(vii)** in the following equation:

$$-\beta^{POS}/_{\partial} = -\beta^{NEG}/_{\partial} \quad \ldots\ldots 10$$

Where;∂ is the lag value of the dependent variable, used in testing for long run asymmetry while β represents long-run coefficients. If the effects are equal (i.e. if the null hypothesis is not rejected), then it implies that there is no significant asymmetric relationship.

Granger Causality Test

To determine the causal relationship among the series, we employed the pairwise Granger causality by Granger (1969). It tests a null hypothesis of "no causality" against its alternative. To conduct the test, the following equations, which predict a variable from its past values and the past values of another variable, were also estimated.

$$LogMANQ_t = \lambda_0 + \lambda_1 \sum_{i=0}^{n} LogMANQ_{t-i} + \lambda_2 \sum_{i=0}^{n} LogCMAN_{t-i} + v_t \quad \ldots\ldots\ldots 11$$

$$LogCMAN_t = \lambda_0 + \lambda_1 \sum_{i=0}^{n} LogCMAN_{t-i} - \lambda_2 \sum_{i=0}^{n} LogMANQ_{t-i} + v_t \ldots\ldots\ldots\ldots 12$$

4. Results

This section contains the presentation and discussion of results from data analysis; it begins with the unit root test for stationarity of series.Results from the test for stationarity using the Phillips-Perron approaches were presented in Table 1. From the table, it is observed that all series including (MANQ, CMAN and LINT) have their test statistics greater in absolute terms than the corresponding critical values only at the first difference. This implies that all the series included are non-stationary series, but only became stationary after first differencing. This finding sets the basis for the conduct of a cointegration test to see if the series is integrated in the long run or not.

Table 1: Unit Root Tests with Intercept and no Trend

Variables	Levels		First Difference		Remark
	PP	5% Critical value	PP	5% Critical value	
LogMANQ	-0.1802	-2.9411	-4.4751	-2.9434	I(1)
LogCMAN	-0.8395	-2.9411	-4.8658	-2.9434	I(1)
LINT	-2.4703	-2.9411	-6.8525	-2.9434	I(1)

Source: Author's Computations Using E-Views 10, 2021

Going further from a test for stationarity, the results of the ARDL bound test for cointegration are presented in Table 2. From the table, it is observed that the f-statistics obtained (27.66) is greater than the upper bound critical values at all levels. This implies that, during the period of study, a long-run relationship exists between manufacturing sector output, bank credit to the manufacturing sector and lending interest rate.

Having established that there is a long-run relationship between the series, the long-run estimates of the coefficients are presented in Table 3. It is observed that of the included series, only lending interest rate (*LINT*) is not statistically significant in influencing manufacturing sector output in Nigeria judging from its probability value of 0.1159 which is greater than 0.05 (5 per cent).

Table 2: Bounds Test (Dependent Variable: LogMANQ)

Test Statistics	Value	K=3
F- Statistics	27.65758	
Critical Value Bounds Significance	I(0)	I(1)
10%	2.37	3.2
5%	2.79	3.67
2.5%	3.15	4.08
1%	3.65	4.66

Source: Author's Computations Using E-Views 10, 2021

The positive changes in manufacturing sector credit (LogCMAN_POS) has a coefficient of 0.75 which implies that a billion naira positive shock in credit to the manufacturing sector will give rise to a 0.75 billion naira increase in man manufacturing output in the long run while the negative changes of credit to manufacturing (LogCMAN_NEG) has a coefficient of -51.86 which implies a reduction of manufacturing output by 51.86 billion naira for every billion naira decrease in manufacturing credit. This lends support to the Schumpeterian view of finance and output as it suggests that bank credit is one of the key drivers in the growth of the manufacturing sector and by extension, the economy at large. This is because, even in the long run, bank credit still encourages output growth in the manufacturing sector. The result is in conformity with the findings of Ume et al. (2017), Ogar et al. (2014), and Asaleye et al. (2018) among others.

Table 3: Long-Run Estimates (Dependent Variable: LogMANQ)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LogCMAN_POS	0.745604	0.064490	11.56160	0.0000
LogCMAN_NEG	-51.85711	23.78353	-2.180379	0.0372
LINT	0.069026	0.042638	1.618899	0.1159
C	3.057185	0.347085	8.808181	0.0000

Source: Author's Computations Using E-Views 10, 2021

In Table 4, the study presents the results of the short-run relationship. It is observed from the table that both lending interest rate and negative manufacturing credit changes have their probability values greater than 0.05 hence, are not statistically significant determinants of manufacturing output in the short run. Again, the positive change is observed to be missing from the analysis thereby implying that, it is not important in the short run. This result suggests that in the short run, there may be other sources of financing production in the manufacturing sector that are of more importance than bank loans. Nevertheless in the long-run, as seen from Table 3, bank credits become necessary in the finance of manufacturing output. Again, the error correction coefficient (ε_{t-1})has a probability value less than 0.05 and has the desired sign, therefore implying that it is statistically significant. The small coefficient size implies a weak error correction, one in which in the case of a disturbance in the system, there is an adjustment towards long-run equilibrium at a speed of 21 per cent. Meanwhile, the coefficient of multiple determination (R^2) is 0.41 which implies that, only about 41 per cent variations of manufacturing output are determined by interest rates and credit to the manufacturing sector, leaving

about 59% to other factors not captured in the model, suggesting that perhaps there might be other more important facts which determine manufacturing output.

Table 4: Short-Run Estimates (Dependent Variable: D(LogMANQ))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LogCMAN_NEG)	-0.714576	4.273258	-0.167220	0.8683
D(LINT)	0.001292	0.004801	0.269071	0.7897
ε_{t-1}	-0.211608	0.016903	-12.51904	0.0000
R^2 =0.406967, Adj. R^2 =0.372083, Durbin-Watson stat = 1.873365				

Source: Author's Computations Using E-Views 10, 2021

In Table 5, the result for the Wald test for long run asymmetry is presented. It is observed that for all three statistics used in testing, the null hypothesis of no long-run asymmetry is rejected as all test statistics have their probability values less than 0.05 (5 per cent) hence, the result indicates the presence of a long-run asymmetric relationship between bank credit to the manufacturing sector and manufacturing sector output. Furthermore, results from Granger causality as seen in Table 6 shows that, there is a one-way causality running from manufacturing output to bank credit to manufacturing, thus suggesting that it is the expansion of the manufacturing sector that generates the need for finance. This is in contrast to Asaleye et al. (2018), who discovered a bi-directional causality between bank credit and manufacturing output. Meanwhile, lending interest rates is also seen to Granger cause credit to the manufacturing sector, thereby suggesting that borrowing habits depend on the levels of lending interest rates as the cost of borrowing determines if investors will borrow or not, as well as the amount to borrow.

Table 5: Wald Test for Long-run Asymmetry

Test Statistic	Value	Degree of Freedom	Prob.
t-statistic	2.239213	32	0.0322
F-statistic	5.014076	(1, 32)	0.0322
Chi-square	5.014076	1	0.0251

Source: Author's Computations Using E-Views 10, 2021

Similarly, further results from Table 6 shows a one-way causality running from lending interest rates to manufacturing output. This may not be unrelated to the fact that since borrowing decisions are dependent on the rate charged on interest, the interest charged will also have a key role in the expansion of manufacturing output produced by investments made with the borrowed funds.

Table 6: Pairwise Granger Causality

Null Hypothesis:	F-Statistic	Prob.
LOGMANQ does not Granger Cause LOGCMAN	6.67560	0.0038
LOGCMAN does not Granger Cause LOGMANQ	0.04600	0.9551
LINT does not Granger Cause LOGCMAN	5.70129	0.0076
LOGCMAN does not Granger Cause LINT	1.99582	0.1525
LINT does not Granger Cause LOGMANQ	4.34672	0.0214
LOGMANQ does not Granger Cause LINT	0.67005	0.5187

Source: Author's Computations Using E-Views 10, 2021

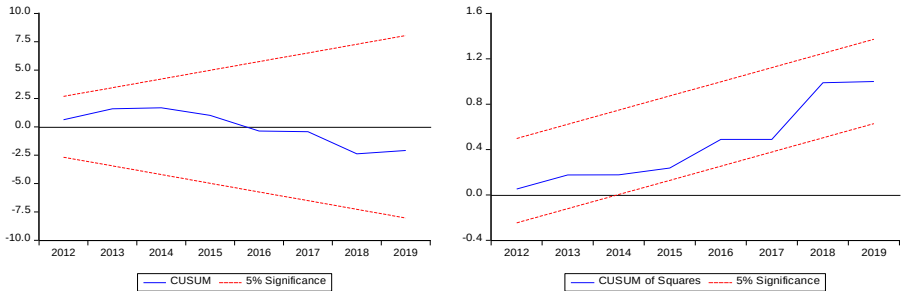
The results for the diagnostic tests conducted to ascertain the fit and reliability of the estimates are summarised in Table 7. From the table, it can be discerned that all four tests presented have their probability values greater than 0.05 (5 per cent) hence, the null hypotheses are accepted.

Table 7: Model Diagnostics

Test Statistics	P-value
Serial Correlation: F-statistic(2, 28)	0.9326
Heteroskedasticity: F-statistic(6, 30)	0.3181
Normality: Jarque-Bera	0.616660
Specification Error: F-statistic(1, 29)	0.5220

Source: Author's Computations Using E-Views 10, 2021

More so, the stability test results for CUSUM and CUSUM of squares presented in Figure 1 show the acceptance of the null hypothesis of stability of estimates since in both cases, the estimated trend line does not exceed the upper and lower boundaries. This means that the model meets the requirements of the classical linear assumptions and thus, the estimates can be trusted.



Source: Author's Computations Using E-Views 10, 2021

5. Conclusion and Recommendations

This study focused on exploring the relationship between bank credit asymmetry and the manufacturing sector output in Nigeria between the periods 1981 and 2019. The study used manufacturing output as a percent of GDP and as a proxy for manufacturing output while bank loans to the manufacturing sector were used as a proxy for bank credit and the lending interest rate was employed as a control for the cost of lending. The study found that there is a long-run relationship between bank credit, manufacturing output and interest rates while the Wald test for long run asymmetry revealed the presence of an asymmetric relationship between bank credit and manufacturing sector output.

NARLD estimates suggest that positive changes in bank credit, in the long-run, is positively related to output while negative changes are negatively related to output. Meanwhile, in the short run, both the positive and negative changes in bank credit have no significant roles in determining manufacturing output. What this simply suggests is that firms in the manufacturing sector may rely more on equity financing in the short run while in the long run, they would have expanded to a point that equity financing would be insufficient hence, may need to resort to

borrowing from banks to supplement. This is supported by the relatively small proportion of variations explained by the model from the R-squared value. The nexus between bank credit and output in the manufacturing sector is further strengthened by the results of causality which suggests that growth precedes finance, thereby contracting Schumpeter (1934) and that borrowing decisions are dependent on the rate of interest being charged. This study, therefore, recommends that monetary authorities make lending rates more attractive to enable investors to borrow more to finance their production activities.

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