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Impact of macroeconomic variables on the Nigerian manufacturing sector

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Abstract: The essence of this study is to examine the impact of macroeconomic variables and some salient socio-economic and political variables on the manufacturing sub-sector of the Nigerian economy by using the autoregressive distributed lag to analyze data source from 1986 to 2019 within the context of two macroeconomic theories: The Solow growth and the endogenous growth theories. The study noted that both the Solow growth theory and endogenous growth model are valid in the short run for the studied economy, but the result is not the same in the long run, as only the endogenous growth model was valid in the long run. The study noted that to achieve sustainable economic growth powered by strong manufacturing sector, there must be an alignment between the macroeconomic variables employed and the socio-political factors. The findings of the study have some policy implications.

Subjects: Economics; Environmental Economics; Finance; Industry & Industrial Studies

Keywords: Macroeconomic variables; gross domestic product; manufacturing sector; economic growth
JEL Classification: B22; C32; E4; E52

1. Introduction

Classical economic literature argued that a close relationship exists between the sectoral composition of an economy and its growth rate (Bhuiyan & Chowdhury, 2019; Paulo et al., 2017). They opined that industrialization is the core of technical progress and the engine of economic growth (Ullah et al., 2020; Fashina et al., 2018; A.I. A.I. Lawal et al., 2017; Adeleye et al., 2021). Strong evidence exists in the literature to support the notion of sector-specificity in attaining economic growth (Ferreira & de Santana Ribeiro, 2019; Lawal et al., 2018, 2019; Meier & Quaas, 2021). Hence, a unit of value-added does not necessarily need to be *the same* across the various segments of sectors in terms of sectoral contribution to the aggregate basket that leads to economic growth. Accordingly, a change in the productive structure of the manufacturing sector is desirable for emerging economies, as it possesses the ability of the sector in maximizing return to scale, high synergies, and linkage effects (Arjun et al., 2020; Ghosh & Mehul Parab, 2021). Manufacturing serves as the conduit that connects crude economics (characterized by agriculture and mining) to service-oriented economies, hence no economy can transmit from the primary producer or crude economy to service-oriented without the manufacturing sector (Juhro et al., 2020; Madsen et al., 2010; Dan & Yao, 2017). The manufacturing sector offers the platform through which emerging economies reduces the gap in technology.

Solow theory noted the predisposition of stationarity state where the aggregate contributions of manufacturing in the long run to economic growth will be zero(Douglas et al., n.d.; Isola et al., 2020; Salisu et al., 2020). Empirical evidence in the recent has debunked Solow's preposition as the long run per capita growth of manufacturing remains positive, suggesting the existence of exogenous technological progress(Argentiero et al., 2021; Chu, 2018; Hongsheng Zhang et al., 2021). The endogenous growth model modelled the technological progress induced by macroeconomic variables as factors that stimulate growth inwardly within an economy, which could be manufacturing sector induced. (Paulo et al., 2017; Ullah et al., 2020) noted that macroeconomic variables being the acid test that reflects the health of an economy, is key to determining the behaviour of the manufacturing sector. (Papetti et al., 2020; Y. Yu Zhang et al., 2019) noted that with positive movement in macroeconomic variables, manufacturing will continue to flourish. The manufacturing sector responds to the behaviours of macroeconomics variables, like inflation rate, interest rate and exchange rate. For instance, the ability of the manufacturing sector to access capital is dependent on the prevailing interest rate regime. Furthermore, the inflation rate shapes the movement in the demand for manufactured goods, first the input factors, and second, the demand for manufactured goods, without which manufacturing becomes less attractive (Ferreira & de Santana Ribeiro, 2019; Halkos et al., 2021). The exchange rate regime (especially in import-oriented economies like Nigeria) affects the ability of the manufacturing sector in maximizing trade openness that will support factor inputs like machinery, raw-material and technological transfer. An increase in money supply, especially commercial loans to the manufacturing sector is expected to boost manufacturing, to the extent that they are positively related. This position, however, has been contested by newer proponents of Solow's hypothesis, who noted that the direction of macroeconomic variables has little or no impact on the manufacturing sector, stating that the sector's contribution will end in zero contribution in the long run.

Against this background, this study attempt to study the role of macroeconomic factors in sharping the behaviour of the manufacturing sector in Nigeria. The study attempt to know the impact of RGDP, inflation rate, money supply, exchange rate, and interest rate on the manufacturing sector in Nigeria. The choice of these variables was induced by evidence in the literature, for instance, (Dan & Yao, 2017) has shown that inflation rate, interest rate, money supply, and exchange rate are the major policy variables that influence economic growth. (Lee & Mckibbin, 2018) documented that RGDP reflects the health of the economy.

Factoring the dynamic socio-economic and political environment, the study follows extant literature to calibrate human capital, financial development, technology transfer, service, and energy into our model (Lee & Mckibbin, 2018). This will allow us to calibrate the gains of departure from Solow's preposition into our model (Arjun et al., 2020). To examine the nexus between manufacturing, macroeconomic factors and the dynamic socio-economic and political environment proxy by human capital, financial development, technology, science, and energy, we employed the ARDL. This was premised on the model's advantages over alternative models like Johansen and Juseliu, 1992; Engle, R.F, 1987, among others.

The study mainly contributed to the literature by presenting new evidence on the importance of manufacturing industries on economic growth in Nigeria using ARDL estimation techniques. We intend to know whether macroeconomic variables influence the manufacturing sector in Nigeria. Does the Solow hypothesis hold in Nigeria? How has the dynamic socio-economic and political environment mirrored by a change in the human capital, financial development, technology, and service among others influenced the behaviour of the manufacturing sector in Nigeria? Our results will offer some policy implications.

The discussion on the drivers of manufacturing sectors vis-à-vis economic growth in Nigeria remains inconclusive, for instance, (Osakwe, 2019) examined the impact of monetary policy interventions on the performance of manufacturing sector in Nigeria by employing the ARDL model to examine no data comprising of treasury bill, monetary policy rate, cash reserve, money supply sourced from 1986 to 2017. The study noted that monetary policy at best impact on manufacturing sector in the short run, but not at long run. (Aza, 2014) noted that policy framework is key to manufacturing sector development in Nigeria, jettisoning the impact of macroeconomic policy. (Ogbuabor et al., 2018) noted that the role of Development Bank of Nigeria is key to advancing the course of manufacturing sector in Nigeria. The study noted that Development Bank of Nigeria help the industrial sector in Nigeria via the Small and Medium Scale Enterprises. (Mohammed, 2019) examined the nexus between economic growth and manufacturing based on data sourced from 1999 to 2018, using the generalized least square. The study noted that a long-run relationship exists between exchange rate and economic growth on the one hand, and between exchange rate and manufacturing on the other hand.

Foreshadowing our results, we noted that the manufacturing sector is key to achieving economic growth, though the Nigerian economy rapidly moving towards a service-oriented economy. We equally noted that the inflation rate, exchange rate and interest rate are inversely related to the growth rate of the manufacturing industry in Nigeria. This suggests that an increase in any of these variables will have a negative consequence on the manufacturing sector. On the dynamic socio-economic and political variables, our study reveals that the human development index is not a significant factor in influencing the behaviour of manufacturing. The result on energy suggests a significant and positive relationship exists between energy and manufacturing in Nigeria. Our results have some positive implications.

The rest of the study is as follows: Section two (2) provides the literature review, section three (3) focused on methodology, Section presents the results and section 5 concludes the study.

2. Literature review

Two theoretical note governs this research, they are the Solow growth theory, and the endogenous growth theory. Each of these theories is briefly discussed as follows. The Solow growth model focuses on the long-run economic growth with savings and investment serving as core to achieving long-term growth. The model opined that in the long run, manufacturing contribution to the economic growth will be zero or near zero (Hongsheng Zhang et al., 2021; Munguía et al., 2019; Argentiero et al., 2021; Douglas et al., n.d.). The theory relies on the growth accounting model as the yardstick to measure sectoral contribution to the overall aggregate basket of growth in an economy. The validity of the Solow *proposition* has been extensively discussed in extant literature with mixed results (Argentiero et al., 2021; Hongsheng Zhang et al., 2021).

The second theoretical note that governs this work is the endogenous growth model which argues that economic growth is generated from within a system as a direct result of internal processes. The theory noted that the enhancement of an economy's human capital will lead to economic growth via the development of new forms of technology and efficient and effective means of production. The model noted that manufacturing is key to growth, and the success rate of manufacturing is dependent on the behaviour of macroeconomic variables on one hand (Bishnu et al., 2016; Lansing, 2012; Madsen et al., 2010; Meier & Quaas, 2021) and some salient socio-political variables like human capital financial development, service sector, technology transfer on the other hand (Arjun et al., 2020; Lansing, 2012; Vu, 2011).

2.1. Empirical review

The discussion on the determinants of economic growth remains an inconclusive debate in economic sciences as various authors have identified with mixed results the drivers of economic growth in different economies over the years. For instance (B & L, 2014; Paulo et al., 2017), have noted that economic growth is sector-driven, citing the role of energy/oil, trade, manufacturing, service, and the stock market, among others as the core drivers of growth. (Lin & Zhu, 2020) note that construction firms play crucial roles not only in achieving economic growth in China but also aid in achieving green growth as it helps in reducing carbon emission. The study employed some estimation techniques ranging from structural production layer difference (SPLD), and structural decomposition analysis (SDA) to analysis of data generating set sourced from 1992 to 2017 with the supply chain framework.

The study noted that to achieve sustainable growth, a concerted effort must be toward having a robust construction industry that is supported by the primary sector and supports the service sector. For the Indian economy, (Pulicherla et al., 2022) examined the role of the manufacturing sector in transiting the Indian economy from a self-reliant-based economy to an export-oriented "Make-in-India" economy. The study noted that macroeconomic variables, research and development (R&D), and technology are key to achieving the objectives of the transition policy.

(Doytch & Narayan, 2021) calibrated the role of renewable energy in the and the nexus between the manufacturing sector and economic growth on the one hand, and between the service sector and economic growth on the other hand. The study examined these relationships within the endogenous growth model and noted that renewable energy facilitates growth in the high growth sector with great effects driven by industrial energy consumption, rather than residential.

(Abubakr et al., 2021) noted that economic growth responds to both positive and negative oil rent asymmetrically in the long run across all sectors of Malaysia. The study further noted that while the agriculture and transportation sectors respond positively to shocks, the response of manufacturing and wholesale was negative. The results of the non-linear autoregressive distributed lag suggest that understanding sectorial variation induced by the role of oil rent shocks on each of the sectors is key to formulating an effective diversification policy.

(Moutinho et al., 2020) examined the nexus between economic and environmental drivers of sustainable economic growth characterized by a well-diversified portfolio for a team of selected OPEC countries within the context of the environmental Kuznets curve hypothesis. The study employed some econometric techniques including pool mean group, mean group, and dynamic fixed effect techniques. The results obtained suggested that the contribution of manufacturing sectors to the economy studied is not significant (See, also Moutinho & Madaleno, 2020).

(Zhenhui & Pal, 2022) employed a number of econometric techniques to analyze a panel of India's registered manufacturing firms and economy-wide and firm-level financial data in order to examine the nature of the relationship between financial liberalization and productivity of the Indian manufacturing sector. The study noted that throughout the studied period-1990 to 2000, financial liberalization impacts manufacturing significantly.

(Sheng Wu Liangpeng Wu and XianglianZhao 2022) examined the impact of green credit policy on external financing, economic growth, and energy consumption in the manufacturing industry in China using the DID method, the system GMM to analysis on data sourced from the year 2003 to 2016. The study noted that green credit finance negatively impacts manufacturing both in the long run and the short run. The study also noted that a bilateral causal relationship exists between energy consumption and economic growth, on the one hand, and between green financing and manufacturing.

For the UK and EU countries, (Dimas et al., 2022) employed an input-output model to quantify intangibles trade and innovations, to access the impact of changes in the manufacturing sector's contributions to the economic growth of the studied economies. The study noted that imported intangibles and patents are key to the growth rate of the manufacturing sector. The study highlighted the role of economic growth as a key factor in driving industrialization.

3. Data and methodology

Data for the current study were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin (various issues), and the World Development Indicators of the World Bank Group (various issues). The data generating set includes data on real gross domestic products (RGDP) (proxy of economic growth); inflation rate, exchange rate, money supply, interest rate, and commercial loans to the manufacturing sector. The dynamic socio-economic and political constructs comprise of data on human capital development proxy by education level (primary school enrollment), life expectancy, financial development, service, and energy. The data span from 1986 to 2019. The scope of the research was large enough to cover the period after the nation adopted IMF structural adjustment programme (SAP) and excluded the impact of Covid-19 as the data ended in the year 2019.

3.1. Estimation techniques

We employed the autoregressive-distributed lag (ARDL) model to examine the existence of a long-run relationship between our dependent variable and the *crops* of independent variables. Our choice of the ARDL model was induced by the fact that the model possesses some advantageous position over other existing methods like Jonesen & Juselius (1992). The ARDL advantages include: (i.) It can be employed regardless of the order of integration, i.e. either I (0) or I (1), given it is not I (2) or more; (ii) Its lagged specification is perfectly suited for our analysis because it allows examining the impact of past values of exploratory variables on the current level of dependent variables. (iii.) It allows for examination of both the long- and short-run relationships between the variables; (iv) It performs effectively in the face of small sample size data sets as experienced in the current study.

To investigate the existence of cointegration in our model, we express our model as follows:

$$MANF_{it} = \alpha_1 MANF_{it-1} + \beta_1 W_{it} + \beta_2 X_{it} + \delta_t + \emptyset_i + \varepsilon_{it} \tag{1}$$

The dependent variable (MANF) is the manufacturing added value, which was computed as the change in the log of manufacturing. The explanatory variables are represented by W and X. Where W it is the basket of the macroeconomic variables proxy by RGDP, exchange rate, financial development, inflation rate, interest rate, and money supply. The dynamic economic environment was represented by X which is a basket made up of energy, education, technology transfer, and the service sector. $\delta_t$and$\emptyset_i$ represent the short-run coefficients that account for fluctuations that are not influenced by deviations from the long-run equilibrium, ε_{it} represents the error term.

We determine the appropriate lag structure of the equation by employing the AIC and SBC criteria. For the diagnostic test, we employed the Breusch—Godfrey test for serial correlation, the Breusch—pagan—Godfrey test for heteroscedasticity, and the autoregressive conditional heteroscedasticity (ARCH Test). We employed the (Pesaran et al., 2001) bound test to examine the existence of a long-run relationship among the variables. This technique presents an unbiased parameter estimate of the long-run estimate, regardless of the endogeneity of some of the regressors. After confirming the adequacy of the models, we employed the F-bound test to examine the existence or otherwise of a long-run relationship between the variables. The rule of thumb is that the F-statistics must be higher than the upper (asymptotic) critical value/upper bound calculated by (Pesaran et al., 2001). The conclusion of the F-stat must be in line with the absolute value of the t-stat when it equally falls outside the upper critical bounds. The study also tests for the speed of adjustment in the long run. A priori, we expect the error correction coefficient to be negative and significant for us to establish a cointegrated relationship

The ARDL Bound Test techniques are presented as follows

$$\begin{aligned}\Delta \text{In}MANU_t = {} & \beta_{01} + \sum_{i=1}^{n1} \beta_{11}\,\Delta\text{InMANU}_{i-t} + \sum_{i=1}^{n2} \beta_{12}\,\Delta\text{In}RGDP_{i-t} + \sum_{i=1}^{n3} \beta_{13}\,\Delta\text{InEXC}_{t-i} + \\ & \sum_{i=1}^{n4} \beta_{14}\,\Delta\text{INF}_{t-t} + \sum_{i=1}^{n5} \beta_{15}\,\Delta\text{In}INT_{i-t} + \sum_{i=1}^{n6} \beta_{16}\,\Delta\text{InMSS}_{t-i} + \sum_{i=1}^{n7} \beta_{17}\Delta SER_{t-t} + \\ & \sum_{i=1}^{n8} \beta_{18}\,\Delta\text{In}FD_{i-t} + \sum_{i=1}^{n9} \beta_{19}\,\Delta\text{In}ENG_{t-i} + \sum_{i=1}^{n10} \beta_{110}\Delta TECH_{t-t} + \sum_{i=1}^{n11} \beta_{111}\Delta EDU_{t-t} + \\ & \phi_{11}\text{InMANU}_{i-t} + \phi_{12}\text{InRGDP}_{t-1} + \phi_{13}\text{InEXC}_{t-1} + \phi_{14}\text{INF}_{t-1} + \phi_{15}\text{InINT}_{t-1} + \\ & \phi_{16}\text{InMSS}_{t-1} + \phi_{17}\text{InSER}_{t-1} + \phi_{18}\text{FD}_{t-1} + \phi_{19}\text{InENG}_{t-1} + \phi_{120}\text{InTECH}_{t-1} + \\ & \phi_{21}\text{InEDU}_{t-1} + \varepsilon_{t1}\end{aligned} \tag{2}$$

Where *In* represents the log of the variables, MANU, RDGP, EXC, INF, INT, MSS, SER, FD, ENG, TECH, EDU represents manufacturing added value, real gross domestic products, exchange rate, inflation rate, interest rate, money supply, service, financial development, energy, technology transfer, respectively. Δ is the first difference operator, $\beta_0; \beta 11 \ldots .\beta 21;$ $n_1 \ldots n_{11;}$ $\phi_{11} \ldots \phi_{20}$ and ε_{t1} represents the constant term, short-term coefficients, long-run coefficients lag length and the error terms, respectively. We examined the existence or otherwise of a cointegrating relationship among the variables in the long run by testing the null that H_0: $\beta_1 = \beta_2 = \beta_3 \ldots\ldots \beta_n = 0$ against the alternate hypothesis $H_1:\beta_1 \neq \beta_2 \neq \beta_3 \ldots \beta_n \neq 0$, by calculating the F—Test developed by (Pesaran & Shin, 1995) and modified by (Narayan et al., 2016), and compared the results with the upper and lower critical values given by (Pesaran et al., 2001).

The rules say, if the calculated F-value exceeds the critical values, we reject the null of no cointegration whether or not the variables are I(0) or I(1), if otherwise, we accept. However, if the calculated F-statistics lays between the lower and upper critical bounds, our results become inconclusive. Empirically, establishment of cointegration among the variables necessitates estimating the Error Correction Model so as to show the speed of adjustment back to equilibrium from a short-run shock. We present the Error Correction Model (ECM) representation of the ARDL approach as follows:

$$\Delta \text{In}MANU_t = \beta_{01} + \sum_{i=1}^{n1} \beta_{11}\, \Delta\text{InMANU}_{i-t} + \sum_{i=1}^{n2} \beta_{12}\, \Delta\text{In}RGDP_{i-t} + \sum_{i=1}^{n3} \beta_{13}\, \Delta\text{InEXC}_{t-i} + \sum_{i=1}^{n4} \beta_{14}\, \Delta\text{INF}_{t-t} + \sum_{i=1}^{n5} \beta_{15}\, \Delta\text{In}INT_{i-t} + \sum_{i=1}^{n6} \beta_{16}\, \Delta\text{InMSS}_{t-i} + \sum_{i=1}^{n7} \beta_{17} \Delta SER_{t-t} + \sum_{i=1}^{n8} \beta_{18}\, \Delta\text{In}FD_{i-t} + \sum_{i=1}^{n9} \beta_{19}\, \Delta\text{In}ENG_{t-i} + \sum_{i=1}^{n10} \beta_{110} \Delta TECH_{t-t} + \sum_{i=1}^{n11} \beta_{111} \Delta EDU_{t-t} + \phi_{11}\text{InMANU}_{i-t} + \alpha ECM_{t-1} \quad (3)$$

4. Result and discussion

4.1. Descriptive statistics

We begin our analysis by presenting the descriptive characteristics of the data generating set as presented in Table 1. From the table, it can be deduced that RGDP has the largest mean while the FD has the lowest mean. The Jarque-Bera test statistic was employed to test whether the variables employed followed a normal probability distribution. The JB test is an asymptotic or sizeable sample test and is useful in determining the Skewness and Kurtosis of the data generating set. The JB test reveals that the test is not normally distributed.

Our result suggests that all the variables except exchange rate and service are not normally distributed

4.1.1. Unit root test

In Table 2, we present the results of the unit root test for variables employed in the study. We understand that the period under investigation witnessed some financed crises and economic downturn which distorts the generated time series, we employed unit root techniques that can accommodate structural break. We followed (Stoian & Iorgulescu, 2020; Bekun et al., 2020; Adedoyin Isola Adedoyin Isola Lawal et al., 2022; Lawal et al., 2016) to employ Clemente-Motanes and Reyes (1998)[1] test that allows for either one or two structural breaks, advantageous for searching for unknown breakpoints, verifies both the existence of an additive outlier (AO) that accounts for transitionary shocks and the existence of innovative outliers (IO) that suggest the existence of a persistent shock with long-term effects. The IO model applies to both gradual changes in intercepts (IO1) and gradual changes in both the intercepts and trend (IO2). To determine the relevance of the IO model, we first conduct its least restrictive form (IO2). If the result shows that the t-statistic is not significant at 5%, we then apply the (IO1). The result as

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Table 1. Descriptive statistics and test for variables normality

	MANF	RGDP	EXC	INF	INT	MSS	SER	FD	ENG	TECH	EDU
MEAN	14.801	1.212	11.116	11.822	4.117	5.111	6.561	2.233	3.223	3.343	
MAXIMUM	167.1474	20.67773	15.900000	28.802	37.88033	884.24597	569.23228	165.122	123.431	211.349	233.09
MINIMUM	127.5786	−97.38988	6.0025400	4.105	−99.77880	−69.36985	−87.25477	1.012	1.099	1.944	3.980
STD.DEV	12.807	21.62044	3.173003	4.564793	17.95676	6.235542	4.236588	3.096	2.091	2.112	2.118
SKEWNESS	0.007186	−2.587353	−0.083287	0.846133	−4.20541	−3.200154	−3.002547	1.092	2.193	2.88	2.095
KURTOSIS	1.488403	12.47718	1.904886	3.649962	26.58801	12.32651	13.225778	11.091	9.098	7.155	4.091
JARQUE-BERA	4.17759	224.6640	2.857628	6.024590	1257.147	5.36524	8.365222	5.211	4.221	3.109	2.671
PROBABILITY	0.00087	0.000042	0.00046	0.00017	0.00440	0.000211	0.000009	0.0001	0.001	0.000	0.002
OBSERVATIONS	384	384	384	384	384	384	384	384	384	384	384

Source: **Author Computation (2022) Using E-Views 7** presented in Table 2 shows that the null hypothesis is rejected in favour of the alternative hypothesis given that the t-statistic is greater than the critical value. It is clear from the CMR test that RGDP and INT are stationary in log level while EXC, TECH, and EDU are stationary in the first difference. Moreso, our CMR result, identity existence of various significant breaks around the years 2008, 2015, and 2016, suggesting the impact of the global financial crisis, global economic meltdown and economic recession, respectively. Hence, it is important to account for the presence of disruptions in the time series when we estimate the model.

In Table 3, we presented the result of the estimated long-run and short-run coefficients of the ARDL model and the result of the bound tests. From the table, it is evidence that the f-statistic of the test is greater than the 1% upper bound critical value; hence, the null hypothesis is rejected suggesting that the model exhibits a long term equilibrium relationship between its variables.

The diagnostic test result shows that the residuals of the equilibrium are not affected by serial correlation and heteroscedasticity. The results of the Jargue-Bera test suggest that the series tends towards normal distribution. The plots of both the CUSUM and CUSUMQ curves lie between the 5% critical bounds suggesting that the estimated coefficients are stable.

Having established the validity and reliability of the ARDL model, we present a discussion of the long-run relationship between the manufacturing and the explanatory variables. The long-run relationship as presented on the left side of Table 3 suggests the existence of a possible impact of the lagged RGDP on manufacturing. This implies that an increase in RGDP will lead to an increase in the manufacturing sector. It is assumed that an increase in growth will stimulate demand, which will stir up manufacturers' desire for more profits. The result of the nexus between manufacturing and RGDP is in line with the propositions of the endogenous growth theory.

On the impact of the dynamic socio-political factors on the manufacturing sector, the result suggests that a positive and statistically significant relationship exists between financial debt and manufacturing. This suggests that the manufacturing sector's capacity to produce is enhanced with an increase in financial development. With a growth rate of financial development, more financial options are available to service the manufacturing sector, banks' capacity to extend credit facilities is enhanced, and the possibility of having syndicated loans or joint financing is enhanced thus increasing the manufacturing capacity of the economy. In a related development, the result of the energy coefficient is negative, suggesting an inverse relationship between energy and the manufacturing sector. This suggests that as energy prices increase, production is negatively affected, as it is almost impossible to transfer the burden to the end-users immediately or in the short run given regulations and the fear of competition. Hence, to enhance the productivity base in the manufacturing sector, it is advisable that policy measures should be put in place to reduce energy prices. This could be by the way of liberalisation or a purposeful subsidy regime that focus on the manufacturing sector of the economy.

The lagged of technology transfer is positively related to manufacturing and its coefficient is statistically significant at 5%. Technology transfer is key to manufacturing as it provides better ways of producing, reduces the cost of production, and increases competitiveness.

Therefore, an increase in the volume of technology transfer will put in place policies that will support the backward integration of technology into the economy. Our result is in line with the findings of those who intend that technology support growth for the economies of scale but contradicts the findings of (Pulicherla et al., 2022).

In the service sector, the result suggests that though a positive relation exists between manufacturing and the service sector the relationship is not statistically strong. The implication is that the impact on the service sector and manufacturing sector is at best weak. This could be based on

Table 2. CMR unit root test results

Variable	Lags	Breakpoints	t-statistic	Critical value
MANU	0	2008:Q3	−2.012	−3.16
		2015:Q4		
D_MANU	0	2016:Q1***	−6.093	−3.46
		2016:Q3***		
RGDP	2	2008:Q1***	−3.023	−1.08
		2015:Q1***		
D_RGDP	3	2015Q:Q2***	−4.129	−2.03
		2016:Q3		
EXC	2	2014:Q4	−6.023	−4.11
		2015:Q3		
D_EXC	0	2016:Q3***	−4.026	−3.91
		2017:Q2***		
INF	0	1989:Q4	−5.099	−2.18
		1995:Q2		
D_INF	0	2016:Q4***	−6.022	−3.17
		2017:Q2		
INT	0	1991:Q3***	−4.108	−2.15
		2002:Q1**		
D_INT	1	2007:Q3***	−5.029	−5.42
		2008:Q1		
MSS	0	1989:Q4*	−4.073	−5.33
		1995:Q2*		
D_MSS	2	2016:Q4***	−5.056	−2.19
D_MSS	2	2017:Q2***	−3.424	−1.44
DD_MSS	1	2018:Q1	−6.074	−3.29
SER	0	2014:Q2***	−7.022	−2.87
		2016:Q1**		
D_SER	0	2017:Q1***	−5.092	−3.07
		2018:Q2		
FD	1	2002:Q1***	−4.017	−2.28
		2011:Q2***		
D_FD	1	2015:Q2***	−5.021	−3.61
		2016:Q3		
ENG	0	2000:Q1***	−6.049	−3.19
		2005:Q2***		
D_ENG	2	2012:Q4	−3.221	−1.22
	4	2014:Q2***		
TECH	2	2013:Q3	−6.922	−3.82
		2015:Q2		
D_TECH	0	2017:Q1***	−4.032	−2.91
		1989:Q4***		
EDU	3	1995:Q2	−5.026	−3.17
		2011:Q4		
D_EDU	2	2014:Q2***	−5.022	−2.19
		2017:Q2		

Note: *, **, and *** represent significance level at 10%, 5%, and 1% respectively; D_; DD_ denote first difference and second difference respectively.

the fact the economy is still emerging. The result obtained here is similar to that of (Doytch & Narayan, 2021).

On inflation rate and exchange rates, the results of the coefficient of these variables suggest that they are negatively related in the manufacturing sector, with statistically significant coefficients. The implication is that increase in any of these variables will have a negative consequence on the manufacturing sector, for instance, an increase in the consumer price index will reduce the purchase of power of the people, halting demand for manufactured goods. Furthermore, the result of the exchange rate implies that worse exchange rate regimes will have a negative impact on production in Nigeria. This is largely dependent on the fact that Nigeria is majorly an import-oriented economy, besides the manufacturers depend on foreign market to source equipment, plants, and machinery necessary for production. Our result is in line with the contradicts (Zhenhui & Pal, 2022). This difference could be largely induced by the methodological gap/issues.

The result of interest rate and money supply shows that the interest rate coefficient is negative and significant at 5% while that of the money supply is positive but not significant. The implication of a negative and significant link between interest rate and manufacturing suggests that a rise in interest rate will impact the manufacturing sector, as the sector's capacity to borrow is halted. Theoretically, increase in interest rate implies an increase in the cost of borrowing, increase in the cost of borrowing, on the other hand, implies an increase in the cost of production. Our result is in line with the findings of (Zhenhui & Pal, 2022) for India.

The result of the error correction model, a measure of the speed of adjustment back to equilibrium presents negative and highly significant estimates at a 1% level of significance, this suggests the existence of a strong correction mechanism whenever there is a deviation from the long-run equilibrium. The coefficient of the error correction model is implied at 80%

4.1.1.1. Short-run estimates. Having tested the cointegration relationship between the variables, and finding the long-run coefficient, we proceed by examining the short-run coefficient to examine the validity of the theoretical models (Solow and endogenous growth). The results of the short-run estimates are presented on the right-hand side of Table 3. The results show the impact of contemporary changes in economic growth mirrored by RGDP on the manufacturing sector. The results noted that a 1% change in RGDP will induce an increase of 0.029 percentage points (PP) on the manufacturing sector. This supports the theoretical notes of both the Solow growth model and the endogenous growth model that stresses that a functional relationship exists between economic growth and the manufacturing sector. The result of the other macroeconomic variables like inflation, exchange rate, and interest rates are not too far from the long run estimates as the revealed that negative and significant relationship exist between each of these variables and the manufacturing sector. For instance, the result of the relationship between inflation and the manufacturing sector suggests that a 1% increase in inflation will lead to a 0.05% fall in manufacturing output. The exchange rate result shows that an increase in exchange rate by 1% will lead to a 0.05% fall in manufacturing while an increase in interest rate by 1% will lead to a 0.048% fall in the manufacturing output.

The short-run estimate of the link between manufacturing and the socio-political variables suggests that financial development exerts a positive and significant relationship in manufacturing such that a 1% increase in financial development will provoke a 3.5% increase in manufacturing. The result of technology transfer is like that of financial development, as a 1% increase in technology transfer will provoke an increase in the manufacturing sector by 3.1%. For the energy, service and education the results differ from that of financial and technological transfer as they reported negative and significant relationships. The results of energy suggest that a 1% increase in energy price will induce a 9% fall in the manufacturing sector output. This is based on the fact that the nation, though an oil-producing economy, is largely dependent on the global oil market for its

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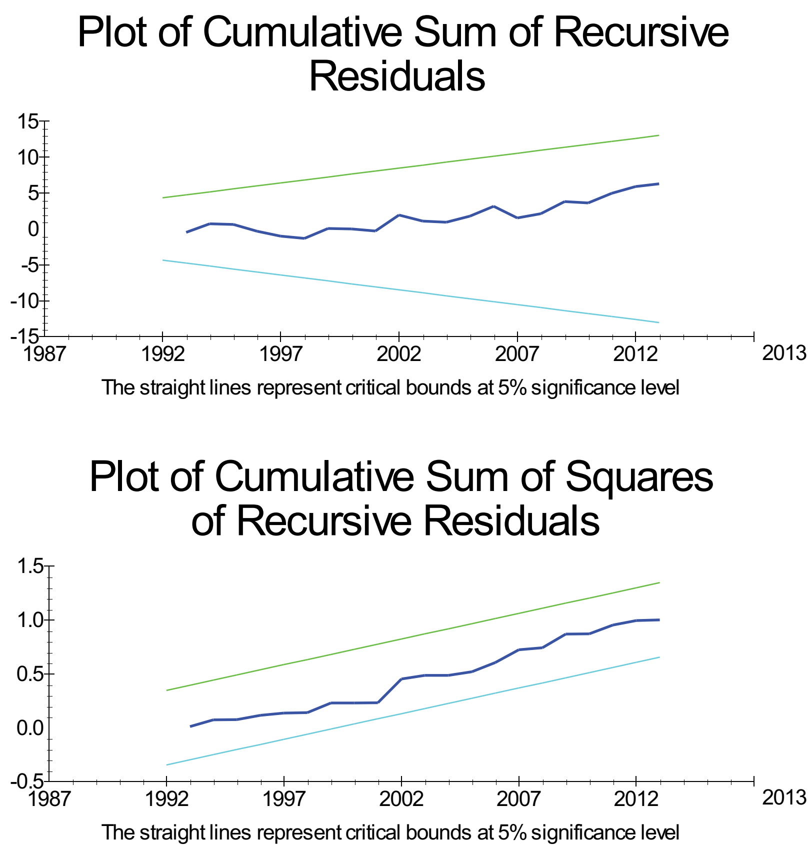
Table 3. The ARDL bounds testing model estimates

Long run coefficients				Short run coefficients			
Variables	**Coefficients**	**Std. Error**	**t-Statistic**	**Variables**	**Coefficients**	**Std. Error**	**t-Statistic**
RGDP	0.018	0.081	5.077	MANU(−1)	0.111***	0.034	3.099
EXC	−0.031*	0.089	3.101	RGDP	0.029***	0.044	1.122
INF	−0.042	2.091	4.111	RGDP(−1)	0.112***	0.054	1.117
INT	−0.033	0.071	2.098	EXC	−0.0511***	0.034	2.112
MSS	0.067	0.009	5.102	EXC(−1)	−0.116**	0.045	2.110
SER	0.028	0.008	2.111	INF	−0.0512**	0.034	1.117
FD	0.028	1.045	3.133	INF(−1)	−0.111***	0.045	1.102
ENG	−0.021	0.076	2.122	INT	−0.048**	0.054	3.115
TECH	0.027***	0.089	3.121	INT(−1)	−0.118**	0.048	4.111
EDU	0.029	0.090	2.090	MSS	0.112	0.039	3.115
Constant	1.051	0.566	0.588	MSS(−1)	0.114	0.037	3.119
				SER	0.132	0.038	5.167
				SER(−1)	0.161	0.045	5.109
				FD	0.035***	0.055	6.114
				FD(−1)	0.113***	0.034	2.112
				ENG	−0.091***	0.049	3.109
				ENG(−1)	−0.122**	0.037	4.112
				TECH	0.031***	0.038	4.119
				TECH(−1)	0.112**	0.045	3.166
				EDU	0.116	0.027	3.112
				EDU(−1)	0.114	0.064	4.114
				Constant	−2.322	−1.521	0.000
				ECT_{t-1}	−0.8003	−6.906	0.000
				R-Square	0.87		
				DW	2.411		

Note: *, **, *** represent 10%, 5%, and 1% respectively

Figure 1. Plots of CUMUQ and CUSUM Curves



energy sources because it is a net importer of oil. The result of education though positive is not significant and similarly, the result of the service sector is positive but not significant.

To test the stability of the coefficient of our estimate ARDL model on the relationship between manufacturing and the explanatory variables, we employed the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of square (CUSUMQ). The rule of thumbs says, if the plot lies within the 5% range of significance level, we cannot reject the null hypothesis, as it implies that the coefficients in the error correlation model (ECM) are stable. If otherwise, we reject the consistency of the coefficients. Figure 1(a, b) suggest that both the plots of CUSUM and CUSUMQ lie within the central boundaries hence, we cannot reject the null hypothesis.

5. Conclusion

This study examines the validity of both endogenous growth theory and Solow growth theory on Nigeria's economy with a focus on the determinant of manufacturing sector growth. To achieve our objectives, we employed the ARDL model to examine the nexus between the manufacturing sector output and some selected macroeconomic variables like RGDP, Inflation rate, Interest rate, and Exchange rate. We noted the impact of some dynamic factors like level of education, technology transfer, energy service and financial development that can influence the behaviour of our dependent variable, and calibrated them into our model. The data employed in the model spanned from 1986 to 2019, and are in annual frequencies. Our results suggest that both the Solow growth theory and endogenous growth model are valid in the short run for the studied economy, but the result is not the same in the long run, as only the endogenous growth model was valid in the long run. Our result noted that technology transfer and financial development contribute substantially to the growth of the manufacturing sector, as technology transfer helps in the backward integration of the sector. The result of energy is negative and suggests that an increase in energy prices reduces the productive capacity of the manufacturing sector. The result of energy is based on the fact that though Nigeria is an oil-producing economy, it is largely a net oil import, and Nigeria's energy consumption is dominated by fossil fuels, especially in the manufacturing sector of the national economy, any innovation in the oil sector affect the economy. The study, therefore, suggests a rapid transition from fossil fuel usage to renewable energy sources in Nigeria.

Based on the evidence obtained from this study, we suggest that policymakers put an eye on inflation rate, exchange rate and interest rate to help the manufacturing sector. Lowering the exchange rate will impact the manufacturing sector positively, as it will help the sector easily import plants and machinery to support production. The need to watch the behaviour of interest rate was important for its role in the manufacturing sector's access to capital for expansion, higher interest rate will reduce the manufacturing sector's capacity to borrow, as a consequence of expansion.

The debate on the role of the manufacturing sector in advancing economic growth is inexhaustible; hence, the study suggests that further studies should look at other macroeconomic variables not discussed here, employ other methodologies, and extends the study to other economies.

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Endnotes
1. Traditional unit root tests like ADF, PP, and KPSS do not account for structural breaks of the data generation set, hence their results are not presented in this study though they are available upon demand.

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