Responsiveness of Industrial Growth to External Debt Question in Nigeria

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Abstract: *A high level of industrial growth is associated with higher economic growth and development. Still the argument remains whether this mechanism is sustainable in Nigeria, given the low level of access to external capital flows and low domestic capital investment. The study, therefore, employed Autoregressive Distributed Lag Model (ARDL), variance decompositions, and impulse response functions to examine the long-run effect of external debt on industrial growth in Nigeria. The study used time series data from 1985 to 2019, and the findings reveal that external debt has a negative and significant effect on industrial growth in the long run. The evidence from the sensitivity analysis also indicated a negative response of industrial growth to external debt. Consequently, policymakers in Nigeria must ensure effective management of external borrowing through evidence-based policies on external debt and domestic capital formation that can create enabling business environment and stimulate investors' confidence to accelerate real industrial growth in Nigeria.*

Keywords: ARDL, external debt, debt servicing, investment, industrial growth

1. Introduction

External Debt refers to money borrowed from a source outside the country that must be paid back in the currency it is borrowed. It could also mean the liabilities owed to non-residents by residents, measuring an economy's obligations to make future payments and, therefore, is an indicator of a country's vulnerability to solvency and liquidity problems (https://economictimes.indiatimes.com). Meanwhile, the significance of foreign capital inflows in the development of the industrial sector cannot be overemphasized. It is regarded as the ardent booster of industrial productivity through the importation of capital goods that aids maximum production (Ugwu, Asogwa, and Ugwuanyi, 2017). External borrowing is preferable in terms of interest charged compared to what is obtainable in the domestic financial market. Abdullahi, Abubakar and Hassan (2016) argue that external borrowing is an integral part of both developing and developed economies, as the government in most cases experienced deficit budget financing to bridge infrastructural gaps and stimulate economic activities for investment and output growth.

Hunt (2007) emphasized one of the discoveries of Harrod-Domar growth model that external financing play a significant role in the growth of industrial sector and the economy at large. Empirical studies have also shown that one of the reasons some economies are not industrialized is the lack of capital for investment. It has proven beyond doubt that less developed countries need more savings to bridge the investment gaps (Hunt, 2007). Thus, there is a need for external borrowing in Nigeria. The danger of overdependence on oil and gas has also necessitated the country's need

for diversification. The Industrial sector is regarded as the engine and heartbeat of any nation, as sustainable economic growth and development cannot be attained without the development of the sector. This argument is supported by many theories such as List (1841) and Rostow (1960), stages of development. In an attempt to develop the industrial sector, various empirical studies have been conducted to determine the challenges of the sector in Nigeria. Evidence from various findings identified lack of capital, infrastructural decay and inadequate modern technologies as major challenges of the manufacturing sector in Nigeria (Abdu and Anam, 2018; Eze and Ogiji, 2013). In order to proffer solution to these challenges, efforts have been put in place to mobilize domestic savings and foreign capital. However, insufficient domestic savings has necessitated incessant foreign borrowing in Nigeria. Consequently, the country's fiscal position seems to be worsened as the cost of repaying debt surpassed the government's revenue in the first quarter of 2022. According to details of the 2022 fiscal performance report from January through April; Nigeria's total revenue stood at ₦1.63 trillion while debt servicing stood at ₦1.94 trillion, showing a variance of ₦300 billion. The Debt Management Office (DMO) also posted Nigeria's external debt stock as at March 31, 2022, as $39,969.19 billion. It comprised debts for multilateral and bilateral creditors as well as commercial loans.

Various authors have also developed different econometric strategies to address research issues related to time series data. Some of these methodologies are fully Modified Ordinary Least Square (FMOL), Ordinary Least Square (OLS), Johansen Maximum Likelihood (JML), Johansen Multivariate Co-integration tests (JMC), Engel-Granger test for co-integration (EG), Autoregressive Distributed Model (ARDL) among others. However, most of these estimation methods would only yield robust results when series in the model are integrated of the same order with a large sample size and where only one variable is assumed to be the predictor of the dependent variable (Gujarati, Porter, and Gunasekar, 2012; Mamun and Kabir, 2022; Menegaki, 2019;Narayan, 2005 and Narayan, 2004). Moreover, extant studies have established that where series in the model are fractionally integrated, the autoregressive distributed lag(ARDL) model will constitute the most appropriate econometric methodology to apply in estimating the long-run and short-term effect of the predictors (external debt and other control variables) on the dependent variable (Narayan, 2005; Pesaran *et al,* 2001). This further implies that the methodology is more appropriate for reporting a robust and unbiased estimate of the coefficient and also can address the potential of endogeneity and serial correlation problem especially when the sample size is small (Pesaran *et al,* 2001; Narayan, 2004; Narayan, 2005). The main objective of this study is to estimate the long-term effect of external debt on industrial growth in Nigeria, and the determination of the rate of convergence from any economic shock in the long run (ARDL). Therefore, the study is more robust compared to existing studies that applied panel econometric strategies where the level of industrial development across the panel (countries, regions, firms, etc) are not the same, hence, the assumption of homogeneity across the panel especially in African region does not hold in realty (Odhiambo, 2009 and Menegaki, 2019). Therefore, addressing the issue of how industrial growth responds to any change in external debt stock using country-specific time series data will yield robust estimates with higher reliability in policy implications and formulation processes.

The nation's past experiences have shown that the inability of the Debt Management Office (DMO) to embark on debt management strategies that can bring sustainable

growth has posed a lot of imbalances in the real sector of the economy especially industries that rely heavily on foreign inputs for production. Hence, this study seeks to examine the long-run effect of external debt on Nigeria's industrial growth. The study is further structured as follows: Section 2 reviews some literature on external debt theories and their effect on industrial growth. Section 3 describes the methodology used while Section 4 presents the results and discussion. Section 5 summarizes and concludes the study with policy implications.

2. Literature Review

The undeveloped economies usually experience low investment and economic growth because of a weak financial market that cannot supply loanable funds to both the private and public sectors for investment (Hunt, 2007). Also, growth in capital and investment is enhanced with foreign capital loans, which as a result of the increase in savings over time will stimulate sustainable industrial and economic growth.

Debt overhang theory and crowding out effect emphasized that high indebtedness will negatively impact industrial growth through servicing existing debt (Krugman, 1988; Claessens, Detragiache, Kanbur, and Wickham, 1996). The philosophy of crowding out effect is assumed when only government and its agencies can borrow because of high-interest charges. The entrepreneurs and firms are thus unable to compete and crowded out the market. Consequently, industrial growth is affected due to the inability of the economies to generate sufficient capital for investment (Abdullahi, Abubakar, and Hassan, 2016). But it was observed that during the period of the great depression in the 1930s when the debt growth declined, the industrial sector output also declined. Therefore, some neoclassical growth models suggested a positive relationship between external debt and industrial growth. The Dual gap theory also states that government could use external debt to bridge the gap between domestic savings and investment if adequately utilized. Also, it was established that industrial growth depends on the level of external borrowings, savings and investment. However, the inability of investors to service her external debt will result in a debt burden and overhang which will disallow investors from contracting new loans for capital investment. For the industrial sector to experience growth, the return from investment in which the loan is contracted must be higher than the marginal cost of servicing debt (Egbetunde, 2012).

While examining the impact of external debt and gross capital formation on industrial growth in Nigeria, Abubakar (2019) applied the Great Big Push theory and Kaldor's first law alongside time series data to discover a positive and significant relationship between external debt and industrial growth. Also, the study revealed that the mechanisms of positive relationship are through introduction of modern technologies and knowledge spill-over with innovation that aids industrial productivity. This implies that proper utilization of external debt to bridge the gap between domestic savings and investments facilitates industrial growth. But contrary to the study of Cowan and Raddatz (2011) that industries that rely more on external borrowing will experience declining growth in the long run in terms of the high cost of servicing debt and if not properly managed, will result in debt overhang.

Matelis (2014) using Generalized Method of Moments (GMM), found that external debt negatively and significantly affect the manufacturing sector. The finding

indicated that higher external debt increased tax rate due to liquidity constraints to service the debt, and consequently decline in industrial growth through the crowding out effect. Matelis further explained that the mechanism of the negative effect is not directly through decreased investment but rather through resources used by the sector. In a similar study by Ugwu *et al.* (2017), the relative impact of external debt on manufacturing output in Nigeria was investigated using time series data spanning 1982 and 2013. The study adopted ordinary least squares (OLS), and evidence from the finding showed that external debt has a negative and significant impact on manufacturing output in Nigeria. This implies that external borrowing was not directly invested in the manufacturing sector but rather channeled to unproductive projects. This was also in line with the argument of Abdullahi *et al.* (2016) who documented that accumulation of debt and debt service arrears will reduce foreign reserves, depreciation in the domestic currency and reduction in domestic capital formation, which negatively affect industrial growth in Nigeria. The study also established that macroeconomic instability resulting from a high stock of debt tends to discourage foreign investors with a negative externality on the real sector of the economy.

Another study on the nexus between external financing and industrialization in Nigeria was conducted by Abubakar (2017) using the Johansen co-integration and error correction model (ECM), with data spanning 1985 and 2016. The result of the study showed that an accumulation of debt in the long run has a negative impact on industrial growth. Specifically, increased external debt led to a high cost of servicing the debt, depreciating the external reserve and international value of the domestic currency thus, increased price of industrial inputs. The study also found that increased external borrowing led to an increase in tax rates which discourages private investments and reduction of industrial output.

A cross-country study to examine the determinants of industrialization among 35 African Countries was conducted by Samouel and Aram (2016) using cross-sectional data. The study revealed that industries that have access to external loans grow disproportionately faster. This explained the possibility of external borrowings to enhance the efficient allocation of resources through investment in capital goods and the real sector of the economy if properly managed but its mismanagement is capable of generating a negative impact on the industrial sector. In another related study on the determinants of industrial growth from the globalization perspective, Wilson (2010) identified a close relationship between industrial growth and capital inflows through foreign direct investment and external borrowing. The study revealed that international capital market acts as a facilitator of financial intermediation, and thus provide loans for industrial growth. Furthermore, capital inflows augment domestic savings, transfer much-needed technology and increase the investment level for sustainable industrial growth. Wilson and David (2019) also studied external debt and industrial growth through agricultural production in Nigeria, using the Johansen co-integration and error correction model (ECM). The study discovered an inverse relationship between external debt and industrial growth with low agricultural production in Nigeria.

Going by the review of extant literature on the possible effects of external debt on the various economies including Nigeria, most of the studies reviewed succeeded in paying more attention to the impact of external debt on economic growth but none

was able to link it to industrial sector and also failed to examine the mechanism of transmission and degree of responsiveness of industrial growth to a change in external debt. Therefore, the novelty in this study relies on the proper identification of econometrics tools, and by extension the consideration of impulse-response function and variance decomposition in the model of the relationship between external debt and industrial growth in Nigeria.

3. Methodology

3.1 Theoretical framework and Model Specification

The theoretical framework of this study hinges on the dual gap theory which states that investments as a purpose of savings needed external loans to augment insufficient domestic savings that will sustain industrial growth and economic development. In line with the broad objective of this study to examine the effect of external debt on industrial growth in Nigeria spanning 1985-2019, the Metelis (2014) model was adopted and modified as follows:

INDO = f (EXTD) (3.1)
Where;
INDO = Real Industrial Growth
EXTD = External Debt Stock (% of GDP)

External debt can further be specified thus:
EXTD = f (TDS, REXR) (3.2)
Where;
TDS = Total Debt Service (% of exports of goods, services and primary income) to proxy crowding out effect.

REXR = Real Exchange Rate (₦/USD)
Equation 3.1 and 3.2 can be combined as stated thus;

$$INDO_t = \beta_0 + \beta_1 EXTD_t + \beta_2 TDS_t + \beta_3 EXR_t\ \varepsilon_t \quad (3.3)$$

The study also included financial development, trade openness and investment as control variables in order to strengthen eq.3.3 in determining the significant effect of external debt on real industrial growth, such that;

$$INDO_t = \beta_0 + \beta_1 EXTD_t + \beta_2 TDS_t + \beta_3 EXR_t + \beta_4 FID_t + \beta_5 TRADE_t + \beta_6 GCF_t + \varepsilon_t \quad (3.4)$$

Where;
FID = Financial development proxy by Credit to Private Sectors (%GDP)
TRADE = Trade Openness proxy by the sum of Exports and Imports (%GDP)
GCF = Investment proxy by Gross Capital Formation (% of GDP)
ε_t = Stochastic Error term, and it is assumed to be normally distributed with constant variance, meaning $\varepsilon_t \sim N(0,1)$
β_0 $= constant\ parameter$
$\beta_1 - \beta_6$ $= are\ paremeters\ to\ be\ estimated$
Equation 3.4 was considered to estimate the relationship between external debt and industrial growth in Nigeria. It captures the effect of Total Debt Service, Gross Capital Formation, Financial Development, Real Exchange Rate and Trade Openness on Industrial Growth in Nigeria.

3.1.1 A priori Expectations

$\frac{\Delta INDO}{\Delta EXTD} > 0\ (\beta_1 > 0)$

$\frac{\Delta INDO}{\Delta TDS} > 0\ (\beta_2 < 0)$

$\frac{\Delta INDO}{\Delta EXR} > 0\ (\beta_3 < 0)$

$\frac{\Delta INDO}{\Delta FID} > 0\ (\beta_4 > 0)$

$\frac{\Delta INDO}{\Delta TRADE} > 0\ (\beta_5 > 0)$

$\frac{\Delta INDO}{\Delta GCF} > 0\ (\beta_6 > 0)$

Following the dual gap theory, an increase in external debt will lead to the introduction of new technology from advanced countries and supplement domestic capital by bridging the gap between domestic savings and investments. This will also boost industrial productivity by expanding production capacity. It is therefore expected to bear a positive sign such that;
$(\beta_1 > 0)$.

Total Debt Service $(\beta_2 < 0)$ is expected to bear a negative sign because high external debt service will crowd out private investment and thus reduces foreign exchange earnings.

The exchange rate is expected to bear a negative sign because it is highly volatile and its devaluation will lead to a high cost of industrial inputs, thus retard industrial growth such that; $(\beta_3 < 0)$.

Financial development $(\beta_4 > 0)$ is expected to have a positive effect on industrial growth because a sound financial system ensures efficient allocation of financial resources, stimulate entrepreneurial activities, engender high returns on investment and then spur industrial growth.

Trade openness $(\beta_5 > 0)$ is expected to have a positive sign because openness helps in regional integration and diversification of the economy, and countries with such economic policy would enjoy benefits of trade in general and comparative advantages in particular. Secondly, trade openness accelerates the adoption of new technologies from advanced countries and allows free flow of economic resources leading to a reduction in the per-unit cost of raw materials thus, leading to industrial growth.

Gross capital formation $(\beta_6 > 0)$ is expected to show a positive sign because an increase in capital formation enhances capital accumulation and the development of infrastructure that can boost industrial productivity.

3.2 Estimation Techniques

3.2.1. Autoregressive Distributed Lag (ARDL)

This study adopts Autoregressive Distributed lag (ARDL**)** bounds tests as analytical approach. It was postulated by Pesaran *et al.* (2001) based on unrestricted error correction.

The ARDL model shows both the long-run and short-run adjustment without losing the previous information. It can also be applied to correct the residual serial correlation and endogeneity problems. However, to know the nature of the trend and to avoid spurious results, the Augmented Dickey-Fuller and Phillip-Perron unit root tests were applied to check the stationarity of the variables. The estimation strategy is most appropriate whether the series are purely integrated of the same order or not*:* *I*(0) and/or *I*(1) except for the presence of *I*(2) (Narayan, 2005; Pesaran, *et al*. 2001). From equation (3.4), the specific ARDL framework is captured as follows:

$$\begin{aligned} INDO_t = \beta_0 + \sum_{i=1}^{q} \emptyset_i \Delta IND_{t-i} + \sum_{i=0}^{p} \gamma_i \Delta EXTD_{t-0} + \sum_{i=0}^{p} \delta_i \Delta TDS_{t-0} \\ + \sum_{i=0}^{p} \vartheta_i \Delta REXR_{t-0} + \sum_{i=0}^{p} \theta_i \Delta FID_{t-0} + \sum_{i=0}^{p} \pi_i \Delta TRADE_{i-0} \\ + \sum_{i=0}^{p} \sigma_i \Delta GCF_{t-0} + \omega_1 INDO_{t-1} + \omega_2 EXTD_{t-1} + \omega_3 TDS_{t-1} \\ + \omega_4 REXR_{t-1} + \omega_5 FID_{t-1} + \omega_6 TRADE_{t-1} + \omega_7 GCF_{t-1} \\ + \varepsilon_t \qquad (3.5) \end{aligned}$$

Δ is the difference operator, while q and p are the optimal lags length of the dependent and the independent variables determined by using SIC and AIC criteria. Error term and independent variables are assumed to be uncorrelated. With this model, the reaction to $INDO_t$ after the changes in any of the independent variables is distributed over a number of periods. The effects are captured by the parameter in the model denoted by $\emptyset, \gamma, \delta, \vartheta, \theta, \pi, \sigma, and \sum_{i=1}^{6} \omega_i$ while ε_t is the white noise error term. The error correction model can be obtained from the ARDL equation as follows:

$$\begin{aligned} \Delta INDO_t = \beta_0 + \sum_{i=1}^{q} \emptyset_i \Delta INDO_{t-i} + \sum_{i=0}^{p} \gamma_i \Delta EXTD_{t-0} + \sum_{i=0}^{p} \delta_i \Delta TDS_{t-0} \\ + \sum_{i=0}^{p} \vartheta_i \Delta REXR_{t-0} + \sum_{i=0}^{p} \theta_i \Delta FID_{t-0} + \sum_{i=0}^{p} \pi_i \Delta TRADE_{i-0} \\ + \sum_{i=0}^{p} \sigma_i \Delta GCF_{t-0} + \lambda ECT_{t-1} + \varepsilon_t \qquad (3.6) \end{aligned}$$

Where $\emptyset_i, \gamma_i, \delta_i, \vartheta_i, \theta_i, \pi_i \; and \; \sigma_i$ denote the short-run coefficients and λ is the speed of adjustment. The appropriate optimal lag length for the model was chosen using the Akaike and Schwarz-Bayesian Information Criteria. This choice enables the consistent selection of a parsimonious model among a finite set of models. The choice of this methodology was based on its numerous advantages such as the ability to address the problems of endogeneity, autocorrelation and advantages of yielding a robust estimate especially when the sample size is considered, the ability to yield both the long-run and the short-run effect, the elasticity of showing how industrial growth response to a change in input (external debt and control variables used in this study). It also shows the existence of a small sample size and fractional integration among the series. All the strengths of this estimation strategy have been clearly argued in the

extant literature (see Gujarati, Porter, and Gunasekar, 2012; Mamun and Kabir, 2022; Menegaki, 2019; Narayan, 2005; Narayan, 2004).

3.2.2 Vector Auto regression (VAR)

The study also utilized unrestricted Vector Auto-Regression to examine the degree of responsiveness of industrial growth to changes in external debt. The sensitivity tests include the stationarity test, variance decomposition and the impulse-response function. The variance decomposition and impulse-response function were used because of the difficulties in interpreting the VAR results. Also, these methodologies have the strength of showing the speed of responsiveness of industrial growth to any shock measured by innovation and independent variables in the model. Moreover, the question of how much of industrial growth is explained by each of the independent variables can be answered with variance decomposition (Gujarati, Porter and Gunasekar, 2012).

3.3 Data Identification and Source

The study employed secondary data sourced from the Debt Management Office (DMO), Central Bank of Nigeria Statistical Bulletin and World Development Indicator (WDI, 2019). Annual Time Series data spanning 1985 and 2019 were identified and processed to reflect the period of the Structural Adjustment Programme which marks the major economic and financial reforms in Nigeria.

4. Results and Discussion

This section presents the econometrics analysis of the effect of external debt on industrial growth in Nigeria. Pre-econometric tests were carried out using descriptive statistics and stationarity tests, followed by the ARDL long-run and short-run dynamics while the last part of this section considered the sensitivity analysis using impulse-response function and factor decomposition obtained from VAR.

4.1 Descriptive Statistics

Descriptive statistics is one of the important pre-tests for any empirical analysis, as it helps to determine the features of each series' distribution. This test helps to determine the measure of central tendency, variation of series from their average and normality (Narayan, 2005).

Table 4.1: Results of Descriptive Statistics

	INDO	EXTD	TDS	FID	GCF	REXR	TRADE
Mean	0.985234	36.22486	12.68022	16.06848	35.22806	144.7648	32.6387
Median	1.761326	31.53299	10.98078	13.39988	34.10954	100	34.18262
Maximum	18.05893	120.8353	38.03883	27.37879	85.9339	536.7732	53.27796
Minimum	-18.9746	4.078808	0.494173	9.063329	14.90391	49.73375	9.135846
Std. Dev.	6.791979	31.21834	10.14271	5.719423	17.347	118.2679	12.51378
Skewness	-0.44981	0.767389	0.797721	0.688277	0.885457	2.003573	-0.42036
Kurtosis	4.425153	2.897809	2.833751	1.88434	3.608998	6.188356	2.291292

Jarque-Bera	4.378933	3.647566	3.966827	4.840216	5.406651	40.42687	1.863983
Probability	0.111976	0.161414	0.137599	0.088912	0.066982	0.0000	0.393769
Observations	37	37	37	37	37	37	37

Source: Authors' Computation, 2021 from EVIEW 10

The results of descriptive statistics presented in Table 4.1 show that the average annual growth rate of the industrial sector in Nigeria is less than one percent within the scope of the study. This is why Nigeria is classified among developing countries. The average of external debt as a percentage of gross domestic products (GDP) was 36.22 percent. This means that the average annual external debt incurred over the years was big enough to stimulate investment through both physical and human capital formation that can translate into industrial growth, but corruption and inefficient utilization of external borrowing on profitable projects has thrown the Nigerian economy into the cobweb of debt. The other series used in this analysis reveal high level of consistency as their mean and median values fell within their minimum and maximum values. The study further estimated the kurtosis that measures the flatness of the curve while skewness measures the asymmetry of the series irrespective of the closeness of their values e to 3 and 0 respectively. The standard deviation that measures the volatility of data also shows very low value for all the series except the exchange rate with volatility within the considered period. A formal test of normality was conducted using Jargue-Bera statistics; the results show rejection of the alternative hypothesis of non-normality of the series and uphold the decision that all the series used in the analysis except exchange rates were normally distributed at 5% significance level.

4.2 Unit Root Test

The study used the Augmented Dickey-Fuller and Philip-Perron tests of stationarity to examine the nature of the series. The study was conducted using equation intercept with no trend to determine the true behaviour of each series. Although the adoption of the ARDL bounds tests for co-integration does not require a unit root test, as the extant literature has shown that it is applicable whether series are integrated of the same or different order (Pesaran, Shin and Smith, 2001).

Table 4.2: Stationarity Test at the level and first difference

Variables	**ADF-Stat.@level**	**ADF-Stat.@1st Diff.**	**Decision**	**PP-Stat.@level**	**PP-Stat.@1st diff.**	**Decision**
INDO	**--5.336*** **	**-10.018*** **	**I(0)**	**-5.336*** **	**-10.189*** **	**I(0)**
EXTD	**-1.281**	**-5.655*** **	**I(1)**	**-1.281**	**-5.652** **	**I(1)**
TDS	**1.903**	**-9.199*** **	**I(1)**	**-1.711**	**-13.041*** **	**I(1)**

GCF	**-1.074**	**6.172*** **	**I(0)**	**-3.715*** **	**-4.886*** **	**I(0)**
FID	**-0.821**	**-4.789*** **	**I(1)**	**-0.509**	**-5.269*** **	**I(1)**
TRADE	**-2.436**	**-7.310*** **	**I(1)**	**-2.351**	**-7.847*** **	**I(1)**
REXR	**-3.460** **	**-4.198*** **	**I(0)**	**-1.882**	**-4.005*** **	**I(1)**

Source: Authors' Computation, 2021 from EVIEW 10
*Note: 1%, 5% and 10% level of significance were denoted with ***, ** and * respectively*

Having established that all the variables except exchange rates were normally distributed from the descriptive analysis, it is necessary to estimate the stationarity of the series to avoid spurious results. The results of ADF stationarity presented in Table 4.2 show that only two variables (INDO and REXR) were stationary at level. The study further differenced all the series once to exhibit stationarity, showing that the mean, covariance and variance of the time series were independent of time and they were all stationary. The results from the Phillip-Perron unit root test on the other hand further confirm that the series were integrated into different orders. It is therefore inferred that the study sample is a mixture of I(0) and I(1), meaning that the series were fractionally integrated.

4.3 ARDL Bounds Tests for Co-integration

The fact that all series were integrated of different orders, which is a mixture of I (1) and I (0) necessitated the use of Pesaran *et al.* (2001) bounds tests for co-integration. The decision was to compare the value of the F-statistic with the upper bound critical value; if the F-statistic value is greater than I(1), the null hypothesis of no long-run relationship among the variables is rejected otherwise we cannot reject the null hypothesis of no co-integration.

Table4.3: Co-integration Bounds Tests

F-Bounds Test		**Null Hypothesis: No. levels relationship**		
T- Stat.	**Value**	**Signif.**	**I(0)**	**I(1)**
F-stat.	**14.884*** **	**10%**	**2.12**	**3.23**
K	**6**	**5%**	**2.45**	**3.61**
		1%	**3.15**	**4.43**

Sources: Authors' Computation, 2021 from EVIEW 10
Notes: Critical values are from Pesaran, Shin and Smith (2001), Table CI (iii) case III, when the number of the independent variables (k) equal six and the significance level is 1%.

The results of the bounds tests presented in Table 4.3 show that the F-statistic value of 14.88396 was greater than the upper bound critical value of 4.43 at 1 % level of significance. Therefore, the null hypothesis of no long-run relationship between external debt, other control variables and industrial growth in Nigeria was rejected. This implies that there exists evidence of a strong and long-run relationship

among all the estimated variables in the model (i.e. EXTD, TDS, GCF, FID, TRADE, REXR, and INDO). The co-integration among the series justifies the estimation of both the long-run and the short-run coefficients using ARDL and the unrestricted error correction model (ECM) approach.

4.4 Long-run Effect of External debt on Industrial Growth in Nigeria

The existence of co-integrating equation from the ARDL bounds tests was the reason for examining the long-run effect of external debt on industrial growth

Table 4.4 Results of Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXTD	**-0.162094**	**0.03916**	**-4.139335**	**0.0005*** **
TDS	**0.274752**	**0.241403**	**1.138146**	**0.2679**
GCF	**0.410525**	**0.196231**	**2.092052**	**0.0488** **
FID	**0.514603**	**0.224924**	**2.287901**	**0.0326** **
REXR	**-0.012598**	**0.008291**	**-1.519488**	**0.1436**
TRADE	**0.385083**	**0.100932**	**3.815256**	**0.0010*** **

Source: Authors' Computation, 2021 from EVIEW 10
*Note: 1%, 5% and 10% level of significance were denoted with ***, ** and * respectively*

The results of long-run dynamics of ARDL presented in Table 4.4 clearly reveal that the totality of external debt (with debt service) has a negative and statistical significant effect on industrial growth in Nigeria. This implies that a unit increase in external debt will lead to a decrease of about 0.162 units in the level of industrial growth holding all other variables constant. The finding further corroborates the debt overhang theory and crowding out effects that excessive debts caused liquidity restraints due to reduction in governments' expenditure which arising from incessant servicing of outstanding debt stocks beyond economic potential (Abdullahi *et al*., 2016; Ugwu *et al.,* 2017; Abubakar,2017). However, the finding negates the submission of Abubakar (2019) who found a positive and significant relationship between the external loan and industrial growth, which also states that inflows of funds from the external economies to augment the supply of funds for domestic investment stimulate economic activities for industrial growth. The investment measured by the gross capital formation coefficient indicates a positive and statistical significant relationship between investment and industrial growth. This suggests that a unit increase in investment will lead to about 0.411 unit increase in industrial growth, holding all other exogenous variables constant. Also, financial development returned a positive relationship with industrial growth. A unit increase in financial development will increase industrial growth by 0.515. This result agrees with the economic theory of investment and the finding of McKinnon (1973) which also established that a strong and sophisticated financial ecosystem motivates the surplus sectors (Savers) to convert some of their unproductive real assets to financial assets, and by so doing interest rates fall and the supply of credits increase in the economy. Therefore, increase in demand for credits will further help investors to implement their investment ideas and consequently boosts industrial productivity (McKinnon,

1973). Trade openness also reveals positive relationship with industrial growth. For example, a unit increase in trade openness will induce industrial growth by 0.385.The result supports the finding of Adamu and Doğan (2016) that discovered positive relationship between trade openness and industrial growth. The study also lends credence to the removal of trade barriers in order to open the economy for transfer of needed modern technologies and knowledge for industrial growth. The exchange rate (REXR) from the results only conforms to the established economic theory by showing a negative relationship with industrial growth. Based on the presented results in Table 4.4, exchange rate reveals negative and insignificant response to the country's industrial growth. A unit increase in the exchange rate will result in 0.012 units' decrease in industrial growth in Nigeria.

4.5 Analysis of Error Correction Model

The study employed the error correction model extracted from the ARDL to examine the short-run effect of external debt on industrial growth. This helps to show the speed of adjustment in which disequilibrium in the long run can be restored to equilibrium. The coefficient of the error term is expected to be negative and statistically significant to indicate convergence to equilibrium (Adamu and Doğan, 2016).

Table 4.5: Error Correction Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-33.9026	2.953479	-11.4789	0.0000***
D(TDS)	0.01047	0.105872	0.098896	0.9222
D(TDS(-1))	-0.53371	0.110511	-4.82948	0.0001***
D(GCF)	0.262875	0.149697	1.756055	0.0937*
D(FID)	-1.00026	0.282659	-3.53877	0.0019***
D(FID(-1))	-0.80343	0.268727	-2.98975	0.007***
D(TRADE)	0.277034	0.073977	3.744887	0.0012***
ECT(-1)*	-1.20063	0.103736	-11.5739	0.0000***
R-squared	0.871872	Mean dependent var		0.597485
Adjusted R-squared	0.838654	Durbin-Watson stat		2.364482
F-statistic	26.24672	Prob(F-statistic)	0.0000***	

Source: Authors' Computation, 2021 from EVIEW 10
*Note: 1%, 5% and 10% level of significance were denoted with ***, ** and * respectively*

The results of the error correction model presented in Table 4.5 reveal that debt servicing coefficient in the lagged period of one year has a negative and significant effect on industrial growth in the short run. This implies that a unit increase in debt servicing during this period decreased industrial growth by 0.533, which implies that continuing servicing of outstanding debt will crowd out investment and thus affect

industrial growth in the short run. The coefficient of financial development in the current period and one year-lagged period reveal negative and significant effect on industrial growth at 1% significance level. This suggests that a unit increase in financial development in both periods decreased industrial growth by 1.00 and 0.803 units respectively. The finding contradicts the apriori expectation but agrees with the finding of Udoh and Ogbuagu (2012).

The coefficient of trade openness in the current period was positively signed and statistically significant. This agrees with apriori expectation. A unit increase in trade openness in the current period increases the level of industrial growth in the short run by 0.277 units. The finding also agrees with the submission of Adamu and Doğan (2016). While the error correction term [ECT (-1)] was correctly signed and statistically significant, its coefficient of -1.20 implies that the disequilibrium of the previous year shock is restored to the long-run equilibrium at the speed of 120% in the current period. This also shows that the rate of adjustment to equilibrium is faster. Although the coefficient is slightly below -1, however, fell within the dynamically stable range since it is not lower than -2 (Pesaran, Shin, & Smith, 1999). The performances of the error correction term also confirm the convergence of industrial growth after a shock to the predictors in the long run as instantaneous (Narayan, 2005). The coefficient of determination (R^2) reveals that 84% variation in industrial growth is explained by the independent variables while the F-statistic value further shows the goodness of fit and the statistical significant of the model.

4.6 Analysis of Post Estimation Tests

The study also carried out post-estimation tests on the error correction model to determine the validity and reliability of the short-run coefficients. It also employed the Jarque-Bera test, Breusch-Pagan-Godfrey test, LM test and Ramsey RESET test to determine the normality; heteroscedasticity; serial correlation and specification of the estimated error correction model.

Table 4.6: Summary of Diagnostic Tests

	Breusch-Pagan-Godfrey	**Jarque-Bera**	**LM Test:**	**Ramsey RESET**
F-Statistics	**1.575786**	**0.3387**	**1.108834**	**0.906338**
Probability	**0.1712**	**0.8442**	**0.3504**	**0.3525**

Source: Authors' Computation, 2021 from EVIEW 10

The summary of results in Table 4.6 indicates no problem of heteroscedasticity, non-normality, serial correlation and misspecification. This further confirms the robustness and validity of the results for long-term decisions (Brown, Durbin, and Evans, 1975).

In the same vein, the Cumulative Sum (CUSUM) and the Cumulative Sum of Squares (CUSUMSQ) stability tests result presented in Figures 4.1a and 4.1 b indicate that the plot of CUSUM and CUSUMSQ were within the lower and upper bounds at 5% level. This implies that the coefficients of error correction model were stable within the period of the study.

Figure 4.1a: CUSUM and CUSUMSQ Stability Tests

CUSUM plot with 95% confidence level

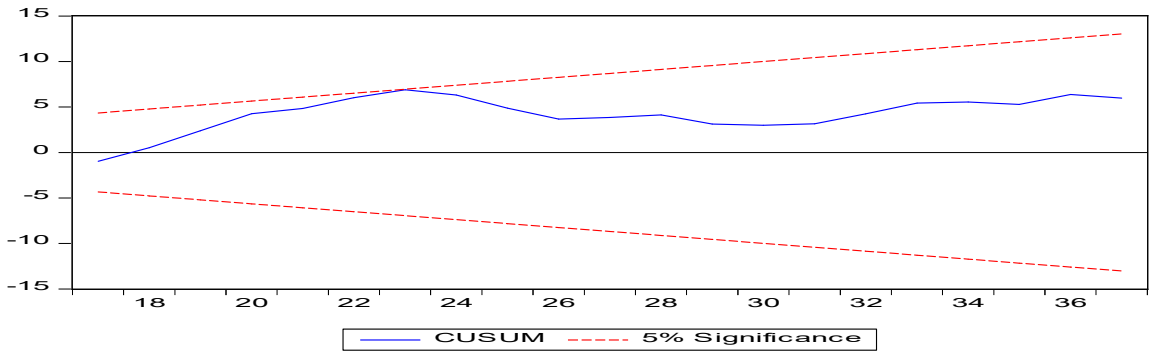
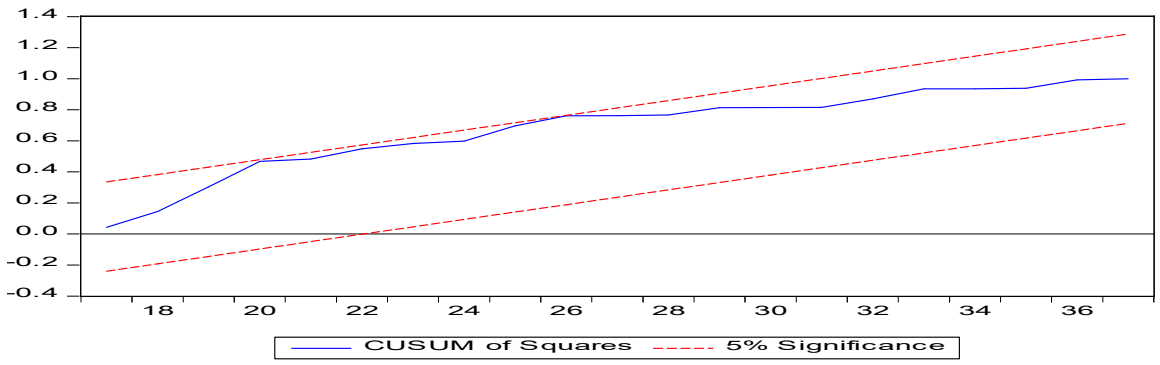


Figure4.1b: CUSUMSQ plot with 95% confidence level



4.7 Sensitivity Analysis

4.7.1 Impulse - Response Function

The impulse response function measures the degree of responsiveness of the dependent variable to shocks in each of the variables. This econometric technique was developed as a result of difficulties in interpreting VAR coefficients and it is expected to modelling the response of the dependent variable to a shock in error term. Therefore, the impulse response examines the responsiveness of industrial growth to itself and independent variables in a ten-year generalization.

Table 4.7: Response of Industrial Growth to a Change in Independent Variables

Period	INDO	EXTD	TDS	GCF	FID	REXR	TRADE
	(0.70405)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
2	1.152806	-0.695828	-0.149765	1.265329	-0.102027	-0.842761	1.382237
	(1.21060)	(1.22465)	(0.98872)	(1.03854)	(1.14123)	(0.97165)	(0.91275)

3	0.335097	-0.325278	1.057861	-0.065654	0.722301	-0.673296	-0.111376
	(1.21993)	(0.93431)	(0.77270)	(0.78665)	(0.96361)	(0.83580)	(0.85616)
4	-0.300818	0.620703	-1.325685	-0.424404	0.091228	0.598114	-0.317706
	(0.99803)	(0.81666)	(0.67794)	(0.66507)	(0.87972)	(0.64853)	(0.73813)
5	0.361872	-0.049638	0.766067	0.621772	0.160662	-0.187797	0.144726
	(0.80648)	(0.68494)	(0.58294)	(0.53079)	(0.79058)	(0.54259)	(0.56385)
6	-0.580454	-0.188581	-0.178713	-0.092042	0.458100	0.199835	0.283907
	(0.65253)	(0.56533)	(0.54713)	(0.38656)	(0.52057)	(0.35097)	(0.44925)
7	0.295556	-0.141340	-0.117027	-0.173718	-0.024315	0.064032	-0.387449
	(0.55056)	(0.50301)	(0.46482)	(0.35186)	(0.39086)	(0.30291)	(0.35477)
8	-0.250947	0.050526	-0.028022	0.250588	-0.069066	0.027543	0.029526
	(0.41935)	(0.41999)	(0.38646)	(0.29487)	(0.31860)	(0.26218)	(0.30974)
9	0.070529	-0.215033	0.219884	-0.048881	0.066828	-0.033149	-0.075158
	(0.31866)	(0.35880)	(0.33678)	(0.24589)	(0.25829)	(0.22856)	(0.27388)
10	0.030781	-0.082984	-0.246916	-0.136451	-0.121274	0.137405	-0.119112
	(0.26814)	(0.32157)	(0.28706)	(0.21469)	(0.24181)	(0.20804)	(0.23954)

Source: Authors' Computation, 2021 from EVIEW 10

The results of the impulse-response function presented in Table 4.7 reveal the negative response of industrial growth to external debt in almost all the periods except the period four and eight which indicate positive response. Also, total debt servicing indicates negative response in six out of the ten periods examined. This result corroborates the submission of Cowan and Raddatz (2011) that manufacturing output responds negatively to external loans. The study further confirms that the accumulation of portfolio debt will not only cause a decline in industrial output but also has an indirect effect on the price level, rising inflation and thus resulting in crowding out the investors.

4.7.2 Variance Decomposition

This technique also provides the results of the comparative position of every subjective impulse influencing the variables in VAR modelling. The variance decomposition examines the responsiveness of industrial growth to itself, external debts and other variables also in a ten-year generalization.

Period	S.E.	INDO	EXTD	TDS	GCF	FID	REXR	TRADE
1	5.890506	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

2	6.384819	88.37534	1.187700	0.055020	3.927440	0.025535	1.742253	4.686709
3	6.564666	83.85994	1.369033	2.648806	3.725196	1.234783	2.700029	4.462215
4	6.780499	78.80298	2.121265	6.305444	3.883588	1.175526	3.308991	4.402206
5	6.867610	77.09418	2.073017	7.390791	4.605384	1.200623	3.300355	4.335647
6	6.921514	76.60134	2.115086	7.342788	4.551614	1.620038	3.332507	4.436627
7	6.943585	76.29633	2.143096	7.324589	4.585317	1.610982	3.319859	4.719827
8	6.953336	76.21274	2.142370	7.305684	4.702344	1.616333	3.312124	4.708401
9	6.961469	76.04504	2.232781	7.388391	4.696293	1.621774	3.306657	4.709063
10	6.971172	75.83544	2.240739	7.493292	4.721541	1.647527	3.336308	4.725157

Table 4.8: External Debt- Industrial Growth: Variance Decomposition
Source: Authors' Computation, 2021 from EVIEW 10

The results of variance decomposition presented in Table 4.8 reveal that a hundred percent (100%) of the variation in industrial growth is explained by their shocks at the one-year horizon. Again, at the 10-year horizon, 75.84 % of the variation in industrial growth is explained by its shocks while the effect of external debt, total debt servicing, investment, financial development, real exchange rate and trade openness jointly explained the outstanding value of 24.16%. The results suggest that at the end of 10 years, fluctuations in industrial growth were partly explained by their shocks as well as external debt, debt servicing and other control variables in the model.

Conclusion and Recommendation

Given the Pesaran *et al.* (2001) model, the ARDL bounds tests, Impulse-response function and variance decomposition; the study examines the long-run effect of external debt on industrial growth in Nigeria from 1985 to 2019. The major findings show that average annual external debt stimulates investment through both physical and human capital formation that translates into industrial growth; there exists a long run relationship between industrial growth and external debt while the totality of external debt(with debt servicing) has a negative and statistical significant effect on industrial growth in the short run. Also, financial development, investment and trade openness were positively related to industrial growth in the long run. The findings also support the evidence from the crowding out theory and the submission of Ochalibe *et al.* (2017) and Joshua and Vladyslav (2011) that excessive debt beyond the economy's capacity leads to liquidity restraints; which as a result of reduction in government expenditure and removal of many of the earnings accruable from domestic investment. The policy direction of accumulating capital stocks, investment in physical infrastructure and importation of high-quality technologies with other industrial inputs tend to achieve maximum production especially in the state of inverse relationship between external debt and industrial growth. Financing industrial sector through domestic savings from taxation, mobilization of remittances, development of domestic financial sector and interest rate reduction should be prioritized; while public-private partnership framework should also be

considered in policy formulation and implementation. This will minimize the overdependence on external debt, minimize exchange rate volatility, lower the perceived investment risk and stimulate other economic activities with ripple effects on the economy. The Central Bank of Nigeria (CBN) with the support of the government is to ensure effective management of external borrowings through developmental-oriented research on both external debt management and domestic capital formation that can create enabling business environment and stimulate investors' confidence for further investment. Also, in the state of huge external debt servicing, a concerted policy effort should be put in place by the government to ensure macroeconomic stability in order to keep the interest rates at the barest minimum to encourage private investment. This will also reduce overdependence on external borrowings and encourages industrial growth in Nigeria.

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