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EFFECT OF INDUSTRIAL DEVELOPMENT ON ECONOMIC GROWTH IN NIGERIA

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ABSTRACTS

Industrial development remains a critical factor in Nigeria's economic growth, with the potential to drive economic growth, create jobs, and enhance technological innovation. However, persistent challenges such as inflationary pressures, exchange rate fluctuations, and the economy's overdependence on crude oil exports may dampen the sector's performance. This study, therefore, examines the effect of industrial development on economic growth in Nigeria, using annual data from 1970 to 2023. The results from the Fully Modified Ordinary Least Squares (FMOLS) technique revealed that Industrial value added (INVA) negatively and significantly impacts GDP growth, suggesting inefficiencies in Nigeria's industrial sector, poor infrastructure, and low productivity. Similarly, the total labour force (LLF) has a negative but statistically insignificant effect, indicating potential issues such as skill mismatches and labour market inefficiencies. Gross fixed capital formation (LGFCF) has a positive but insignificant impact on economic growth, suggesting that capital investment alone does not drive short-term economic growth. Trade openness (TOP) statistically fosters GDP growth, highlighting the importance of global integration in enhancing economic performance. The findings suggest that policy measures should focus on improving industrial productivity, enhancing labour market efficiency, optimizing capital investments, and promoting trade liberalization for sustainable economic growth in Nigeria.

Keywords: Economic growth, Industrial development, capital formation, industrial value added.

JEL Classification: O47, O14, C22.

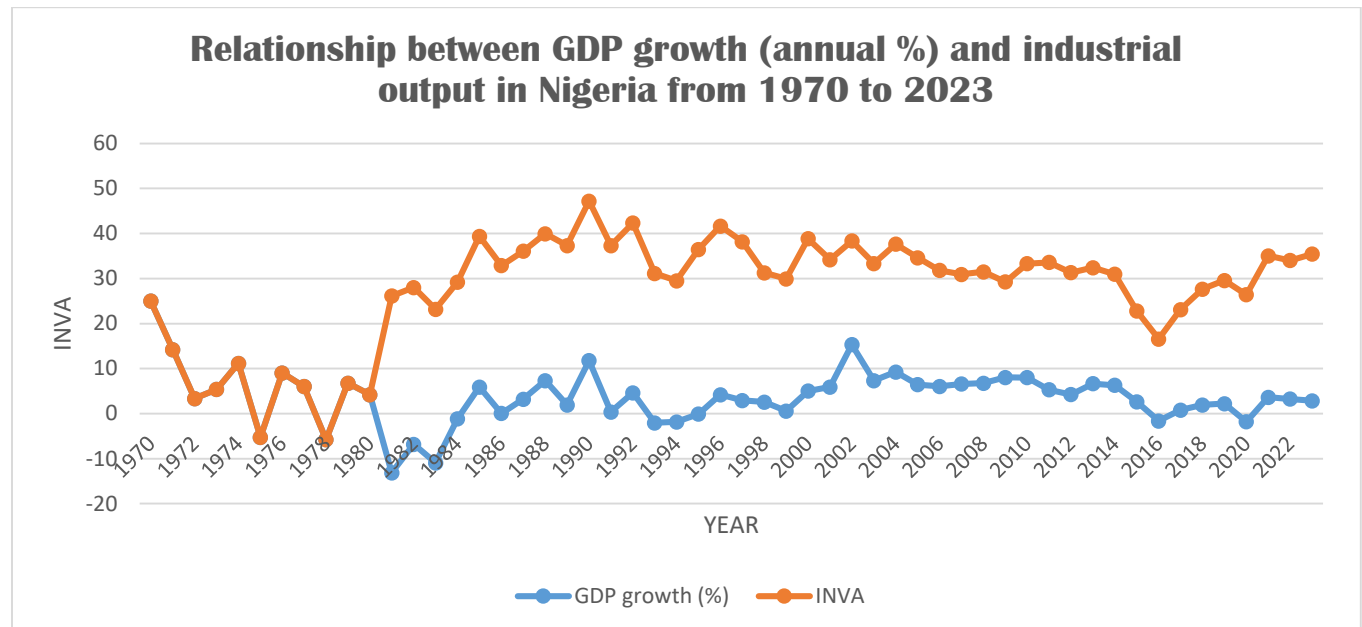
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1. Introduction

Industrialization has long been recognized as a fundamental driver of economic growth, playing a transformative role in shaping modern economies. The shift from an agrarian-based economy to an industry-driven economy enhances productivity, innovation, and wealth creation. Industrialization fosters large-scale production, leveraging advanced machinery, modern infrastructure, and specialized labour to optimize efficiency (Tunio et al., 2024). As a result, the process significantly impacts employment by creating jobs across multiple sectors, thereby improving income levels and enhancing overall economic well-being (Buyukyazici et al., 2024). Many developed economies attribute their sustained economic expansion to robust industrialisation, which has driven technological advancements and improved the quality of life for their populations (Lenort et al., 2023).

In Nigeria, industrial development has played a pivotal role in economic growth, albeit with varying degrees of success across different periods. The country's industrialisation efforts began in the 1960s with import substitution strategies aimed at reducing dependence on foreign goods. Subsequent phases of industrial growth saw increased investment in manufacturing, oil refining, and steel production. According to the National Bureau of Statistics (NBS, 2024), the manufacturing sector contributed approximately 13% to Nigeria's Gross Domestic Product (GDP) in 2022, highlighting its significance in economic development. Additionally, industrial zones such as the Lekki Free Trade Zone and Agbara Industrial Estate have been instrumental in boosting local production, enhancing export opportunities, and attracting foreign direct investment (IFC, 2025). Nigeria's industrial landscape encompasses several key sectors, including oil and gas, manufacturing, construction, and telecommunications. The petroleum industry remains a dominant player, contributing over 6.33% to the country's Gross Domestic Product and over 90% to foreign earnings (NBS, 2023). However, the government has made efforts to diversify the economy through initiatives like the Economic Recovery and Growth Plan (ERGP), which focuses on boosting industrial output in agriculture, textiles, and automobile manufacturing. Moreover, the Central Bank of Nigeria's (CBN) interventions, such as the Manufacturing Sector Support Fund, have been crucial in fostering industrial expansion and employment generation (Ichime et al., 2024). The figure below illustrates the fluctuating trend in Nigeria's GDP growth (annual %) and industrial output (INVA) over the years, demonstrating periods of both positive and negative growth. From the early 1970s to 1980, GDP growth exhibited significant volatility, with peaks such as 25.01% in 1970 and 14.24% in 1971, before declining sharply into negative growth in 1975 (-5.23%) and 1978 (-5.76%) (NBS, 2024). However, industrial output data from 1981 onwards suggests that despite GDP contractions in the early 1980s, industrial output remained relatively high, peaking at 39.25 in 1981 before declining over the next decade. The persistent drop in GDP growth during economic downturns, such as in 1981 (-13.13%) and 1983 (-10.92%), coincided with a decrease in industrial output, indicating the sector's vulnerability to macroeconomic shocks. However,

during economic recovery periods, such as 1985 (5.91% GDP growth) and 1990 (11.78%), industrial output also stabilised around 33–35, suggesting a strong link between industrial performance and overall economic expansion (NBS, 2024).



Source: Researcher's compilation, 2025

Fig.1: Graphical Representation of the Relationship between GDP Growth (Annual %) and Industrial Output

Despite its progress, Nigeria's industrial sector faces significant challenges, including inadequate infrastructure, inconsistent policies, and power supply shortages. The World Bank (2022) reports that Nigeria's manufacturing sector operates below capacity due to an unreliable electricity supply, which increases production costs and reduces competitiveness. Additionally, high import dependency for raw materials and machinery limits the potential for local value addition. To address these issues, the government has prioritised infrastructure development through projects like the Ajaokuta-Kaduna-Kano (AKK) gas pipeline and increased investment in renewable energy to support industrial activities (Esitikit et al., 2025). Despite the implementation of various industrial policies and economic reforms, Nigeria's industrial sector appears to contribute a relatively small share to the nation's Gross Domestic Product (GDP) when compared with dominant sectors such as oil and services (Abid et al., 2024). This raises the question of whether Nigeria's industrialisation efforts have been effective in promoting sustained economic growth, particularly given the country's vast natural and human resource endowments. It is unclear to what extent industrial value-added directly influences real GDP, although this relationship remains central to policy discussions on inclusive and sustainable economic growth (Udoh et al., 2024).

While some studies suggest that industrialisation contributes positively to economic growth, others argue that structural weaknesses hinder the sector's potential (Okechukwu et al., 2023). For example, although Nigeria recorded a GDP growth of 15.33% in 2002, industrial output fell to 23.04%, suggesting a possible disconnect between output growth and industrial performance. Similarly, between 2015 and 2020, GDP growth declined and even turned negative in 2016 (-1.62%) and 2020 (-1.79%), while industrial output exhibited inconsistent patterns, fluctuating between 18.17 and 28.22. These patterns raise doubts about the linearity or strength of the causal relationship between industrial output and economic growth. Could other factors, such as trade openness, investment climate, and macroeconomic volatility, be playing more significant roles than industrial development? Given these uncertainties, it becomes necessary to investigate empirically whether industrial development significantly influences economic growth in Nigeria. While government-led policy reforms and institutional interventions have attempted to revitalise the industrial sector, persistent challenges such as inflationary pressures and the economy's overdependence on crude oil exports may continue to dampen the sector's performance and its potential contribution to long-term growth (UNIDO, 2021).

This study, therefore, seeks to answer four questions:

Research Questions

- a) What is the effect of industrial value-added on economic growth in Nigeria?
- b) How does the total labour force affect economic growth in Nigeria?
- c) What is the impact of gross fixed capital formation on economic growth in Nigeria?
- d) To what extent does trade openness impact economic growth in Nigeria?

Objectives of the Study

The general objective of this study is to examine the impact of industrial development and key macroeconomic variables on economic growth in Nigeria.

The specific objectives are to:

- a) Examine the effect of industrial value-added on economic growth in Nigeria.
- b) Assess the effect of the total labour force on economic growth in Nigeria.
- c) Determine the impact of gross fixed capital formation on economic growth in Nigeria.
- d) Evaluate the extent to which trade openness influences economic growth in Nigeria.

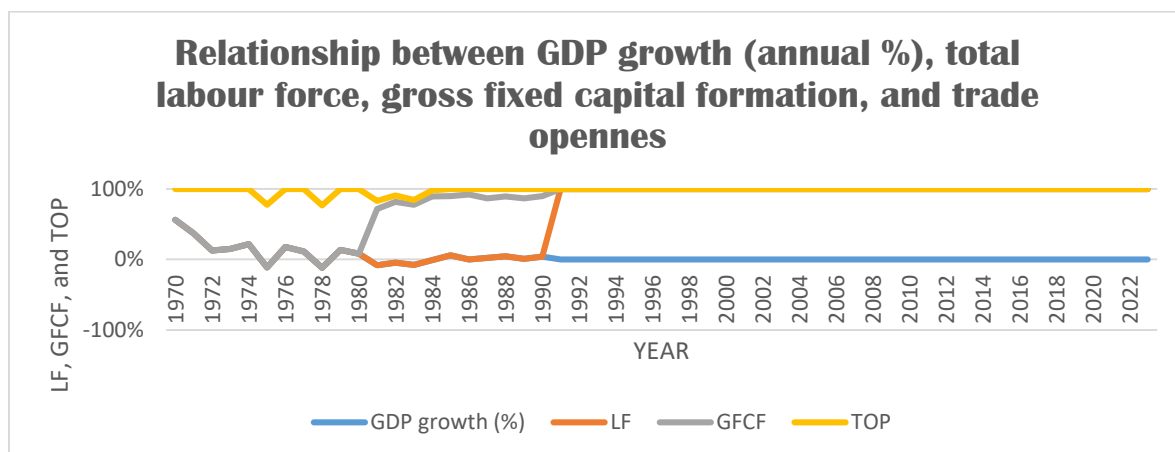
2.0. Literature Review

2.1. The Conceptual Literature

This concept collectively offers a comprehensive insight into the impact of industrial development on economic growth in Nigeria.

Concept of Industrial Output on Economic Growth in Nigeria

Industrial development is pivotal to the economic growth of nations, catalysing job creation, technological advancement, and improved standards of living. In Nigeria, the journey toward industrialisation has been marked by both challenges and opportunities. Despite being rich in natural resources, particularly oil and gas, the country's industrial sector has historically contributed a modest share to the Gross Domestic Product (GDP). For instance, according to available data, between 2022 and 2023, the industrial and manufacturing sector in Nigeria contributed around 13-16% to the country's GDP, with the manufacturing sector alone contributing a larger share in 2023 compared to 2022, reaching up to 16.18% in the third quarter of 2023 (NBS, 2024). Recent studies have highlighted the significant impact of industrial output on Nigeria's economic performance. Research indicates that industrial output has a direct and substantial effect on real GDP, with an aggregate impact of 86% (Ibitoye et al., 2022). This underscores the potential of industrial development to drive economic growth. However, challenges such as inadequate infrastructure, inconsistent policies, and limited access to finance continue to hinder the full realisation of Nigeria's industrial potential. Addressing these issues is crucial for the country to harness the benefits of industrialisation and achieve its economic growth objectives.



Source: Researcher's compilation, 2025

Figure 2: Relationship between GDP growth (annual %), total labour force, gross fixed capital formation, and trade openness

Figure 2 above provides a comprehensive dataset showing the relationship between GDP growth rate, total labour force (LF), gross fixed capital formation (GFCF), and trade openness (TOP) in Nigeria from 1970 to 2023. Observing the data, there is a visible correlation between these variables. For instance, GDP growth exhibits high volatility, with noticeable declines in the early 1980s, which coincides with economic downturns and reduced capital formation. The labour force data, although missing in earlier years, shows a steady increase over time, suggesting that population growth and workforce expansion are ongoing trends. Gross fixed capital formation, which reflects investment in infrastructure and capital goods, also shows an upward trajectory, although its relationship with GDP growth appears non-linear. Periods of increasing capital formation do not always correspond to higher GDP growth, implying that other factors, such as economic policies, external shocks, and productivity levels, influence growth outcomes.

Trade openness (TOP), which measures the level of integration with global markets, fluctuates significantly over the years. For instance, the early 1980s saw a sharp decline in GDP growth, accompanied by reduced trade openness, likely due to economic policies and external shocks such as oil price volatility. In contrast, in the early 2000s, when trade openness improved, GDP growth also showed a significant recovery. However, in recent years, the decline in trade openness, particularly after 2015, coincided with sluggish GDP growth, suggesting that reduced integration with global markets may be limiting economic expansion. Meanwhile, the labour force continued to expand, but the rate of GDP growth did not match this expansion, indicating that job creation and productivity improvements are critical factors beyond mere workforce expansion.

Overall, the data suggest a complex interaction among these variables. While an increasing labour force and higher capital formation contribute to economic growth, they do not guarantee consistent growth unless supported by favourable economic policies, stable macroeconomic conditions, and a conducive trade environment. The fluctuations in GDP growth highlight the vulnerability of Nigeria's economy to both internal and external shocks. The decline in trade openness in recent years, despite increasing capital formation, indicates potential structural challenges that need to be addressed to enhance economic stability and long-term growth.

2.2 Theoretical Review

Classical Growth Theory

The Classical Growth Theory, developed by Adam Smith (1776), David Ricardo (1817), and Thomas Malthus (1798), provides one of the earliest explanations of economic development. The theory emphasises the role of capital accumulation, labour productivity, land availability, and diminishing returns in driving economic growth. Classical economists argued that industrialisation facilitates structural transformation by

shifting economic activity from low-productivity sectors such as agriculture to high-productivity sectors like manufacturing and industry (Smith, 1776). This shift leads to increased output, employment, and economic diversification.

In the context of Nigeria, the Classical Growth Theory is relevant because industrialisation serves as a catalyst for economic diversification and productivity improvement. Capital investment in infrastructure, such as power, transport, and technology, plays a crucial role in sustaining industrial growth. Additionally, Ricardo's (1817) principle of comparative advantage highlights the benefits of trade openness, allowing Nigeria's industrial sector to integrate into the global economy. However, a key limitation of the theory is its assumption that diminishing returns to labour and capital are inevitable, which does not always hold in modern economies where technological advancements and innovation mitigate such effects.

Endogenous Growth Theory

The Endogenous Growth Theory, developed by Paul Romer (1986) and Robert Lucas (1988), challenges the classical notion of diminishing returns by emphasising the role of human capital, technological innovation, and knowledge spillovers in sustaining long-term economic growth. Unlike classical economists, proponents of this theory argue that investment in research, education, and industrial technology enhances productivity and generates sustained economic expansion (Romer, 1986). This theory is particularly relevant in explaining why some economies experience continuous growth without experiencing diminishing returns to capital accumulation.

In the Nigerian industrial context, Endogenous Growth Theory highlights the importance of investing in human capital and industrial research to foster long-term economic development. The theory suggests that technological innovation in the industrial sector can lead to higher labour productivity and competitiveness in global markets. Government policies supporting industrial research, training, and innovation are critical for sustaining industrial growth. However, the assumption that government policies and private-sector investments will always lead to positive spillovers may not hold in Nigeria, where weak institutions, corruption, and inadequate infrastructure can hinder industrial progress.

Industrial Location Theory

Industrial Location Theory, proposed by Alfred Weber (1909), explains how industries select their locations based on factors such as transportation costs, labour availability, and agglomeration economies. The theory argues that industries tend to cluster in regions where production costs are minimised, and access to markets and resources is optimised. This framework is essential in understanding the spatial distribution of industries and the role of infrastructure in industrial development (Weber, 1909). In Nigeria, Industrial Location Theory is relevant in explaining why major industrial hubs such as Lagos, Kano, and Aba have

emerged as key manufacturing centres. These regions have better access to transportation networks, skilled labour, and markets, making them attractive locations for industrial investment. The theory also highlights the importance of policies that promote industrial clusters and export processing zones to enhance Nigeria's industrial growth. However, it does not fully account for modern challenges such as globalisation, digital transformation, and policy inconsistencies that influence industrial location decisions in the contemporary era.

2.3 Empirical Literature Review

Abid et al. (2024) investigated the role of industrial growth on economic development through a comparative analysis of developed and developing countries. The study used GDP per capita as the dependent variable, while industry value added, labour force participation, gross fixed capital formation, preprimary school enrollment, and institutional quality were the independent variables. Panel Quantile Regression (PQR) through the Method of Movement-Quantile Regression (MM-QR) approach was employed as the estimation technique. The empirical results found a U-shaped relationship between industrialisation and economic development in both samples. The labour force significantly increased economic development in developed countries, but declined in developing countries. Institutional quality enhanced economic development in developed countries while decreasing it in developing countries.

Ibeaja et al. (2024) examined the restructuring of the industrial sector and its impact on economic growth in Nigeria. Real Gross Domestic Product (RGDP) was employed as the dependent variable, while manufacturing output, crude petroleum and natural gas, and solid mineral mining were the independent variables. The study adopted the Error Correction Model (ECM) and the Auto-Regressive Distributed Lag (ARDL) model. The findings showed that manufacturing had a significant positive effect on economic growth, crude petroleum and natural gas had a positive and significant impact, while solid mineral mining had an insignificant positive impact on economic growth in Nigeria.

Udoh et al. (2024) analysed the effects of industrialisation on the business and economic climate in Nigeria using sectoral analysis. GDP served as the dependent variable, while private sector credit, net foreign direct investment, exchange rate volatility, and reliance on fossil fuels were the independent variables. The ARDL model was used as the estimation method. The findings revealed a positive and significant relationship between industrialisation and economic growth. Private sector credit geared towards business development and foreign direct investment played a crucial role in economic expansion. However, exchange rate volatility limited access to reliable energy sources and affected sectoral contributions.

Ibrahim et al. (2024) examined the impact of agriculture, industry, and the service sector on economic growth in Nigeria. GDP was used as the dependent variable, while the agricultural sector, industrial sector, and service sector were the independent variables. The study employed the Ordinary Least Squares (OLS)

regression method. Findings revealed that the industrial sector had a significant positive effect on GDP, emphasising its importance in driving economic growth. The agricultural sector contributed positively but modestly, indicating the need for modernisation and investment. Surprisingly, the service sector showed a statistically significant negative impact on GDP, highlighting potential structural weaknesses in the sector. Adeosun et al. (2023) investigated the relationship between industrial sector performance, human capital development, and economic growth in Nigeria. GDP per capita was used as the dependent variable, while the human capital index and industrial output were the independent variables. The ARDL model was employed as the estimation method. The study found no long-run relationship among the variables but highlighted a negligible short-term impact of human capital and industrial output, suggesting the need for government intervention.

Okechukwu et al. (2023) examined the impact of industrial sector growth on the Nigerian economy. GDP was the dependent variable, while industry value added, gross fixed capital formation, labour force participation rate, and trade openness were the independent variables. The OLS method was employed for analysis. Results indicated a positive impact of these variables on economic growth, with a long-run relationship among them.

Oyebanji et al. (2022) explored the impact of industrialisation on economic growth in Nigeria. Real GDP was the dependent variable, while industrial output, foreign direct investment, interest rate, and exchange rates were the independent variables. Johansen co-integration and Granger causality tests were used. Findings showed that industrial output had a significant direct effect and an 86% aggregate effect on real GDP. A unidirectional causal impact of industrial output on GDP was established.

Mutairu et al. (2022) examined the nexus between industrial development and economic growth in Nigeria. GDP was the dependent variable, while manufacturing, solid minerals, and crude petroleum and gas were the independent variables. The ARDL model was used. Findings revealed that all industrial subsectors had positive and significant influences on economic growth in both the short and long run, with the crude petroleum and gas sector being the highest driver of growth, indicating a lack of economic diversification. Lessor (2022) assessed Nigeria's manufacturing industry and its relationship with economic growth through factors affecting economic growth. GDP was the dependent variable, while financial accessibility, human capital development, government policy implementation, and infrastructural development were the independent variables. A Chi-Square test was employed. Findings showed significant relationships between manufacturing and all independent variables, suggesting that manufacturing plays a vital role in economic growth.

Stephen et al. (2021) investigated industrial output and economic growth in Nigeria. The growth rate of real GDP per capita was the dependent variable, while the industrial sector, capital expenditure, trade openness, and lending rate were the independent variables. Co-integration tests and the ECM were used.

Results showed a weak but positive relationship between industrial output and economic growth. Capital expenditure and lending rates had negative impacts, highlighting the need for appropriate policy interventions.

The previous empirical works extensively examined the relationship between industrial development and economic growth using various econometric methodologies, including OLS, ARDL, ECM, and co-integration techniques. However, a methodological gap persists, as limited studies have employed the Fully Modified Ordinary Least Squares (FMOLS) technique, which offers more efficient long-run estimations, particularly in addressing endogeneity and serial correlation. Additionally, most existing studies have analysed shorter timeframes, overlooking the long-term trends and structural changes that may have occurred in Nigeria's industrial sector. Covering the period from 1970 to 2023 provides a more comprehensive understanding of the sustained impact of industrial development on economic growth. Furthermore, many studies treat the industrial sector as a single entity without adequately distinguishing the contributions of manufacturing, solid minerals, and crude petroleum within a unified analytical framework. Additionally, the omission of key macroeconomic control variables, such as the exchange rate, limits the robustness of previous findings. This study aims to bridge these gaps by employing the FMOLS estimation technique to assess the long-term effect of industrial development on Nigeria's economic growth, while incorporating a more nuanced sectoral approach and essential macroeconomic controls.

3. Methodology

Model Specifications

This study adopts the classical growth model of Abid et al. (2024), who investigated the role of industrial growth on economic development as a working theoretical foundation. However, this study adapted some variables to align with the research on the effect of industrial development on economic growth in Nigeria.

$$GDP = F (INVA, LF, GFCF, TOP, EXR) \dots\dots\dots 1$$

Where;

GDP = GDP growth (annual %)

INVA = Industrial value added (% of GDP)

LF = Total labour force

GFCF = Gross fixed capital formation (% of GDP)

TOP = Trade openness (% of GDP)

EXR = Exchange rate

Expressing equation (1) in econometric terms, the linear regression model specification takes the following form:

$$GDP_t = \beta_0 + \beta_1 INVA_t + \beta_2 LF_t + \beta_3 GFCF_t + \beta_4 TOP_t + \beta_5 EXR_t + \epsilon_t \dots \dots \dots 2$$

Where;

GDP, INVA, LF, GFCF, TOP and EXR as previously defined

β_0 = Constant

β_1 to β_5 are the parameters

t = time variable

ϵ_t = Error term

Table 3.1: A summary table incorporating the descriptions, measurements, and sources of the variables

Variable	Description	Measurement	Expected Sign	Data Sources
GDP Growth (Annual %)	Year-over-year percentage increase in a country's total economic output, adjusted for inflation. Reflects overall economic performance and health.	Annual percentage change		World Development Indicators
Industrial Value Added (% of GDP)	Contribution of the industrial sector (manufacturing, mining, construction, etc.) to a country's total economic output, measured as a percentage of GDP.	Percentage of GDP	+	World Development Indicators
Total Labour Force	Total number of people employed or actively seeking employment within an economy, excluding those not seeking work (e.g., retirees, students).	Total number of individuals	+	World Development Indicators
Gross Fixed Capital Formation (% of GDP)	Share of total economic output invested in fixed assets (infrastructure, machinery, etc.) as a percentage of GDP. Indicates long-term investment levels crucial for growth.	Percentage of GDP	+	World Development Indicators
Trade Openness (% of GDP)	Measure of total trade activity (exports + imports) relative to GDP, reflecting a country's integration with the global economy.	Percentage of GDP	+ or -	World Development Indicators
Exchange Rate	Price at which one currency is exchanged for another, influencing trade, capital flows, and inflation. Can be fixed, floating, or managed.	Value of currency	+ or -	World Development Indicators

4. Result and Discussion

4.1 Result

Descriptive Statistics

Descriptive statistics provide a summary of key characteristics of a dataset, offering insights into its central tendency, dispersion, and distribution. Common measures include the mean, median, standard deviation, and range, which help in understanding the overall patterns and variations within the data. Table 4.1 shows a summary of the descriptive statistics of all variables of interest in this study.

Table 4.1: Computation of Summary Statistics

	GDPGR	INVA	LLF	LGFCF	TOP	EXR
Mean	4.093986	28.10966	17.68704	8.435182	37.08905	133.3673
Median	4.430627	27.79206	17.69133	8.757105	37.62450	128.9370
Maximum	15.32916	37.70961	18.04428	10.62749	53.27796	358.8108
Minimum	-2.035119	18.17313	17.30730	5.654557	20.72252	9.909492
Std. Dev.	3.907038	5.210248	0.224200	1.302286	8.751868	96.13916
Skewness	0.439651	0.339308	-0.061250	-0.401865	-0.053148	0.674914
Kurtosis	3.544369	2.426866	1.802762	2.392114	2.392347	2.851556
Jarque-Bera	1.336887	0.986253	1.810482	1.269383	0.475676	2.305086
Probability	0.512506	0.610714	0.404444	0.530099	0.788331	0.315833
Sum	122.8196	843.2899	530.6112	253.0555	1112.672	4001.019
Sum Sq. Dev.	442.6834	787.2538	1.457706	49.18252	2221.261	268039.4
Observations	30	30	30	30	30	30

Source: E-views

The summary statistics describe the distribution and characteristics of variables related to industrial development and economic growth in Nigeria over 30 years. The mean GDP growth rate is 4.09%, with a standard deviation of 3.91, indicating moderate fluctuations in economic performance. Industrial value added (INVA), a critical measure of industrial contribution to GDP, has a mean of 28.11% and a standard deviation of 5.21, suggesting relative stability in industrial output. The total labour force (LLF) exhibits minimal variation, with a mean of 17.69 million and a standard deviation of 0.22, reflecting a steady workforce. Gross fixed capital formation (GFCF), representing investment in infrastructure and productive assets, has a mean of 8.43% and a standard deviation of 1.30, indicating moderate variability. Trade openness (TOP), which measures Nigeria's engagement in global trade, has an average value of 37.08%, while the exchange rate (EXR) shows significant volatility, with a mean of 133.37 and a standard deviation

of 96.14, reflecting exchange rate fluctuations over the years. The skewness and kurtosis values suggest that most variables are fairly symmetric and normally distributed, except for the exchange rate, which is moderately skewed to the right. The Jarque-Bera test probabilities confirm that none of the variables exhibit significant departures from normality, as all p-values exceed 0.05, implying a normal distribution. The maximum and minimum values highlight the range of variations, with GDP growth fluctuating between -2.03% and 15.33%, while the exchange rate varies widely from 9.91 to 358.81, underscoring the impact of exchange rate instability on economic growth. The sum and sum of squared deviations further emphasise the cumulative contributions of each variable over time. These statistics provide a foundation for econometric analysis, assessing the long-run impact of industrial development on economic growth in Nigeria.

Unit Root Test

Table 4.2: Unit Root Test Determination

Variable	ADF t-Statistic	5% Critical Value	Integration Order
GDP	-8.911442	-2.919952	I(1)
INVA	-6.212578	-2.936942	I(1)
LLF	-3.176576	-2.960411	I(1)
GFCF	-4.267089	-2.935001	I(1)
TOP	-7.880965	-2.922449	I(1)
EXR	-4.547797	-2.919952	I(1)

Source: Researcher's Compilation

The Augmented Dickey-Fuller (ADF) unit root test results indicate that all the variables—GDP growth (GDP), Industrial Value Added (INVA), Labour Force (LLF), Gross Fixed Capital Formation (GFCF), Trade Openness (TOP), and Exchange Rate (EXR) are integrated of order one, I(1). This means that none of the variables are stationary at the level, but they become stationary after first differencing. The test statistics for all variables are significantly lower (in absolute terms) than the 5% critical value, leading to the rejection of the null hypothesis of a unit root at the first difference. This suggests that these economic variables follow a stochastic trend and require transformation to achieve stationarity before further econometric modelling, such as regression analysis, can be performed.

Result for Fully Modified Ordinary Least Squares (FMOLS) Model

The Fully Modified Ordinary Least Squares (FMOLS) is an econometric estimation technique developed by Phillips and Hansen (1990) to provide optimal estimates in the presence of co-integrated time series. It is particularly useful when dealing with long-run relationships between variables that exhibit endogeneity and serial correlation issues. FMOLS modifies the standard OLS estimator to correct for endogeneity and serial correlation by incorporating non-parametric adjustments to the long-run covariance matrix of the residuals. This ensures that the estimates are asymptotically unbiased and efficient, even when dealing with small sample sizes.

The results of the FMOLS model are reported in Table 4.3. The selected optimum lag length was based on the Akaike information criterion (AIC).

Table 4.3: Fully Modified Ordinary Least Squares (FMOLS) Estimation

Coefficient				
Variable	t	Std. Error	t-Statistic	Prob.
INVA	-0.613762	0.153651	-3.994530	0.0006
LLF	-23.69353	15.51439	-1.527197	0.1403
LGFCF	3.151856	2.478434	1.271713	0.2162
TOP	0.247232	0.067498	3.662802	0.0013
EXR	-0.002582	0.015000	-0.172111	0.8649
C	405.0042	257.0241	1.575744	0.1287
R-squared	0.428820	Mean dependent var	4.222801	
Adjusted R-squared	0.304651	S.D. dependent var	3.910824	
S.E. of regression	3.261142	Sum squared resid	244.6061	
Long-run variance	6.750066			

Source: E-views Result

The results of the Fully Modified Ordinary Least Squares (FMOLS) estimation reveal mixed effects of industrial development-related variables on economic growth (GDP growth) in Nigeria. Industrial Value Added (INVA) has a negative and statistically significant impact on GDP growth, with a coefficient of -0.613762 and a p-value of 0.0006, suggesting that an increase in industrial output, as measured by INVA, is associated with a decline in GDP growth. This counterintuitive result may be due to inefficiencies in Nigeria's industrial sector, poor infrastructure, or constraints in productivity. Total Labour Force (LLF) also

has a negative impact on GDP growth (-23.69353) but is not statistically significant at the 5% level ($p = 0.1403$). Similarly, Gross Fixed Capital Formation (LGFCF) has a positive coefficient (3.151856) but remains statistically insignificant ($p = 0.2162$), indicating that capital investment alone may not be a strong determinant of short-term growth, though it could have long-term benefits.

Among the variables examined, Trade Openness (TOP) stands out as having a positive and statistically significant impact on GDP growth, with a coefficient of 0.247232 and a p-value of 0.0013. This suggests that greater openness to trade enhances economic performance, likely through increased market access, foreign investments, and technological spillovers. This result aligns with the findings of Okechukwu, Florence, Ignatius, Nkechi, Chidinna, Chika, and Marycynthia (2023), who also established a positive long-run relationship between trade openness and economic growth in Nigeria. Their study emphasised that greater integration into the global economy supports industrial expansion and economic development. The R-squared value of 0.428820 indicates that about 42.88% of the variations in GDP growth are explained by the independent variables, suggesting a moderate explanatory power of the model.

Diagnostic Test analysis

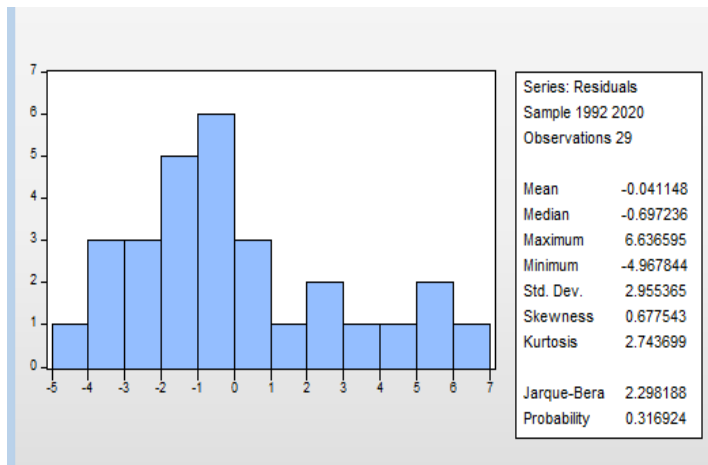


Fig. 1.1: Normality Test

The normality test results, as indicated by the Jarque-Bera statistic of 2.298188 and a p-value of 0.316924, suggest that the residuals follow a normal distribution. Since the p-value exceeds the 5% significance level (0.05), we fail to reject the null hypothesis of normality. Additionally, the histogram of residuals appears roughly bell-shaped, further supporting the assumption of normality. The skewness (0.677543) is slightly positive, indicating a mild rightward tilt, while the kurtosis (2.743699) is close to the normal distribution benchmark of 3, suggesting an approximately normal distribution. These results validate the use of FMOLS, as normality in residuals ensures reliable statistical inference.

Table 4.4: Correlogram of Residuals

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob*
. .	. .	1 -0.031	-0.031	0.0305	0.861
. .	. .	2 -0.010	-0.011	0.0340	0.983
.** .	.** .	3 -0.223	-0.224	1.7475	0.626
. .	. .	4 0.054	0.042	1.8542	0.763
. .	. .	5 -0.047	-0.053	1.9362	0.858
.* .	.* .	6 -0.071	-0.129	2.1359	0.907
.** .	.** .	7 -0.322	-0.332	6.3822	0.496
. * .	. .	8 0.119	0.071	6.9935	0.537
. .	. .	9 0.013	-0.047	7.0016	0.637
. * .	. .	10 0.170	0.033	8.3652	0.593
.* .	.* .	11 -0.101	-0.068	8.8796	0.633
. .	. .	12 0.040	-0.005	8.9653	0.706

*Probabilities may not be valid for this equation specification.

The correlogram of residuals indicates that there is no significant autocorrelation in the residuals of the estimated model. The autocorrelation (AC) and partial autocorrelation (PAC) coefficients are generally small, fluctuating around zero, with no clear pattern. Furthermore, the Q-statistics at different lags have high p-values, all well above the 5% significance level, meaning we fail to reject the null hypothesis of no serial correlation. This suggests that the residuals are randomly distributed and do not exhibit systematic patterns over time. The absence of significant autocorrelation validates the robustness of the FMOLS estimation, ensuring that the long-run relationships identified in the model are not distorted by serial correlation.

4.5: Gradients Summary

Variable	Sum	Mean	Weighted Grad.
INVA	2.03E-11	7.00E-13	-3.60E-18
LLF	4.46E-11	1.54E-12	-1.07E-17

LGFCF	7.44E-11	2.57E-12	3.07E-17
TOP	1.11E-10	3.82E-12	-1.84E-17
EXR	5.49E-10	1.89E-11	-9.92E-18
C	4.89E-12	1.69E-13	1.99E-15

The gradient summary provides an understanding of the sensitivity of the objective function with respect to the estimated parameters. The sum and mean of the gradients for each variable are extremely small, indicating that the optimisation process has converged effectively, with minimal changes in the objective function. The weighted gradients are also close to zero, suggesting that the estimated coefficients are stable and the model is well-specified. The near-zero values imply that further parameter adjustments would not significantly improve the model's objective function, confirming that the estimated long-run relationships are statistically reliable.

4.2 Discussion of Findings

The descriptive statistics summarized in Table 4.1 reveal key characteristics of the variables used to examine the relationship between industrial development and economic growth in Nigeria over the 30-year period. The average GDP growth rate of 4.09% indicates moderate economic performance, though the relatively high standard deviation reflects significant growth volatility. Industrial value added shows relative stability with a mean of 28.11%, while the labour force exhibits minimal variation, suggesting steady workforce expansion. Gross fixed capital formation and trade openness display moderate fluctuations, indicating changing investment patterns and varying degrees of integration into the global economy. In contrast, the exchange rate records substantial volatility, underscoring macroeconomic instability over the period. Normality tests confirm that all variables are approximately normally distributed, supporting their suitability for econometric analysis.

The Augmented Dickey-Fuller (ADF) unit root test results indicate that all variables are non-stationary at levels but become stationary after first differencing, implying integration of order one, $I(1)$. This confirms the presence of stochastic trends in the data and justifies the application of cointegration and error-correction-based econometric techniques to examine both the short-run and long-run effects of industrial development on economic growth in Nigeria.

The Fully Modified Ordinary Least Squares (FMOLS) technique, developed by Phillips and Hansen (1990), was employed to estimate the long-run relationship between industrial development indicators and economic growth, correcting for endogeneity and serial correlation in cointegrated time-series data. The

FMOLS results indicate mixed long-run effects of the explanatory variables on GDP growth. Industrial value added exerts a negative and statistically significant effect on economic growth, suggesting that inefficiencies, weak productivity, and structural constraints within Nigeria's industrial sector may limit its growth-enhancing role (Rodrik, 2016; Szirmai & Verspagen, 2015). The labour force and gross fixed capital formation exhibit statistically insignificant effects, implying that labour expansion and capital accumulation alone are insufficient to stimulate growth without improvements in human capital quality and investment efficiency (Lucas, 1988; Solow, 1956).

Trade openness emerges as the most robust determinant of economic growth, exerting a positive and significant long-run impact, consistent with trade-led growth theory and empirical evidence for Nigeria (Grossman & Helpman, 1991; Okechukwu et al., 2023). The exchange rate shows an insignificant effect, reflecting weak transmission of exchange rate movements to real sector performance in an import-dependent economy. The model explains about 43% of the variation in GDP growth, indicating moderate explanatory power. Diagnostic tests confirm the normality of residuals, validating the reliability of the FMOLS estimates and supporting their use for long-run inference (Phillips & Hansen, 1990).

The correlogram of residuals (Table 4.4) shows no evidence of serial correlation, as AC and PAC coefficients are small and the Ljung–Box Q-statistics have p-values above 0.05, indicating residuals are independently distributed. This validates the robustness of the FMOLS estimates (Box & Pierce, 1970; Phillips & Hansen, 1990). The gradient summary further confirms model stability, with sums, means, and weighted gradients near zero, indicating convergence and well-specified coefficients. Together, these diagnostics affirm that the long-run relationships estimated between industrial development variables and GDP growth in Nigeria are statistically reliable (Greene, 2018).

5. Conclusion and Recommendation

5.1 Conclusion

The study examined the impact of industrial development on economic growth in Nigeria using the Fully Modified Ordinary Least Squares (FMOLS) approach. The findings reveal mixed effects among the variables. Industrial Value Added has a negative and statistically significant impact on GDP growth, suggesting inefficiencies within the industrial sector. This result implies that despite industrial activities, constraints such as poor infrastructure, inadequate policy frameworks, and low productivity hinder expected economic gains. Additionally, Total Labour Force exhibits a negative impact on GDP growth, though it is statistically insignificant, indicating that labour force expansion alone is insufficient for economic growth without improved labour efficiency and skill enhancement. Gross Fixed Capital Formation (LGFCF) shows

a positive relationship with GDP growth, but its statistical insignificance suggests that capital investment alone does not guarantee economic expansion, possibly due to misallocation or inefficiencies in capital utilisation. However, Trade Openness (TOP) emerges as the only significant positive contributor to GDP growth, reinforcing the role of global market integration in economic performance. The model explains approximately 42.88% of the variations in GDP growth, indicating a moderate explanatory power. In line with the result obtained, the following recommendations are provided below:

5.2 Recommendation

- a) Address Industrial Inefficiencies: Given the negative impact of Industrial Value Added on GDP growth, policymakers should focus on improving infrastructure, enhancing technological advancements, and implementing policies that boost industrial productivity.
- b) Enhance Labour Market Efficiency: Since the Total Labor Force does not significantly contribute to GDP growth, government policies should emphasize skill development, education reforms, and labour market flexibility to improve workforce productivity.
- c) Optimize Capital Investments: Despite the positive but insignificant effect of Gross Fixed Capital Formation, efforts should be made to ensure that capital investments translate into tangible economic growth by improving investment efficiency and enhancing financial sector support for industries.
- d) Promote Trade Liberalisation: The positive and significant effect of Trade Openness on GDP growth suggests that further integration into global markets is beneficial. Policymakers should facilitate export competitiveness, reduce trade barriers, and attract foreign direct investment to strengthen Nigeria's global market position.

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