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Original Research Article

THE IMPACT OF INDUSTRIALIZATION ON ECONOMIC GROWTH IN NIGERIA

Simon Ternenge Asongo (PhD)[1*], Kingsley Shedrach[1]

[1] Department of Economics, Nigeria Police Academy, Wudil-Kano State, Nigeria

ORCID: **STA** 0009-0006-7655-4765[1*]

Correspondence should be addressed to Simon Ternenge Asongo (PhD): simonasongoter@gmail.com

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Abstract: This study empirically examines the impact of industrialisation on economic growth in Nigeria using annual time-series data spanning a 27-year observation period (1999–2025). The investigation is anchored on Kaldor's First Growth Law, Endogenous Growth Theory, and Schumpeterian financial intermediation mechanics. Economic growth is proxied by Real Gross Domestic Product, while industrialisation is captured through three complementary indicators: Manufacturing Value Added as a share of GDP, Manufacturing Capacity Utilisation Rate, and Commercial Bank Credit to the Industrial Sector, transformed into natural logarithms. The Augmented Dickey-Fuller unit root test revealed a mixed order of integration. Based on the Akaike Information Criterion, the optimal specification chosen was ARDL(1, 2, 1, 0). The F-bounds test confirmed the existence of a stable long-run cointegrating relationship among the variables. Empirical findings from the long-run levels equation demonstrated that all three industrialisation indicators exert a statistically significant positive impact on economic growth at the 1% level. Specifically, a unit increase in Manufacturing Value Added expands long-run real GDP by 2.496 units, a 1% improvement in Manufacturing Capacity Utilisation increases long-run growth by 0.455 units, and a 1% increase in credit to the industrial sector Commercial Bank Credit to the Industrial Sector yields a substantial 5.126% long-run expansion in real GD. In the short-run Error Correction Model, contemporary manufacturing value added, lagged manufacturing value added, and capacity utilisation significantly stimulate short-run output growth. The Error Correction Term satisfied theoretical expectations, indicating a statistically significant speed of adjustment of6.28\% per annum back toward long-run equilibrium following short-run macroeconomic shocks. Post-estimation diagnostic tests confirmed that the estimated model is correctly specified, homoskedastic, free from serial correlation, normally distributed, and structurally stable over time. The study recommends that Nigerian monetary and economic planning authorities prioritise targeted, low-interest credit expansion to real-sector enterprises,

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address acute electric power and infrastructural deficits to elevate manufacturing capacity utilisation, and implement deliberate industrial promotion policies to accelerate manufacturing value addition.

Keywords: Industrialization, Economic Growth, Manufacturing Value Added, Capacity Utilization, Industrial Sector Credit, ARDL Bounds Test, Nigeria.

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1. Introduction

Industrialisation is widely acknowledged in development economics as a key driver of sustainable economic growth, structural transformation, and poverty reduction. The historical trajectories of developed nations and the rapid economic expansion of the East Asian Tigers demonstrate that shifting economic activity from low-productivity traditional sectors toward high-productivity manufacturing generates dynamic economies of scale, fosters technological spillovers, and enhances national output (Kaldor, 1966; World Bank, 2020).

In Nigeria, Africa’s largest economy by population and gross domestic product (GDP), industrialisation has been identified as a critical national priority across successive economic management blueprints, including the National Development Plans, the Economic Recovery and Growth Plan (ERGP), and the Nigerian Agenda 2050. Despite these policy initiatives, the country continues to struggle with structural vulnerabilities stemming from over-reliance on primary commodity exports, particularly crude oil. The manufacturing sector's contribution to GDP remains constrained, hovering below 10% on average over recent decades, reflecting long-standing industrial stagnation.

Furthermore, Nigeria’s real sector faces severe operational and structural bottlenecks. Infrastructure deficits-most notably chronic electricity supply shortages, road logistics gaps, and port inefficiencies-continue to restrict the Manufacturing Capacity Utilisation Rate (MCU) to slightly above 50% of installed potential. Concurrently, high interest rates, macroeconomic volatility, and limited credit allocation to long-term real-sector enterprises constrain the capital accumulation required to import modern machinery, adopt advanced technology, and scale up manufacturing value addition (MVA). Understanding the empirical relationship between these industrialisation indicators and economic growth is therefore essential for designing effective macroeconomic strategies in Nigeria.

1.2 Statement of the Problem

Despite decades of industrial policies, intervention funds, and import-substitution strategies, Nigeria’s manufacturing sector has not operated as a primary driver of economic growth. Instead, the economy remains susceptible to global commodity price shocks, foreign exchange volatility, and domestic inflationary pressures, leading to periodic growth contractions and sluggish real-sector expansion.

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Extant literature presents mixed findings on the impact of industrialisation on economic growth in developing countries. While several empirical studies confirm positive growth effects driven by manufacturing expansion, others highlight that structural bottlenecks, underutilised industrial capacity, and inadequate real-sector financing weaken these dynamic linkages. In Nigeria, much of the existing research focuses on single industrial metrics or relies on estimation techniques that assume uniform orders of integration, potentially overlooking short-run dynamic adjustments and mixed stationarity properties among macroeconomic variables.

Additionally, a significant empirical question persists regarding the relative potency of different industrial channels: Does direct output expansion (MVA), operational capacity utilisation (MCU), or commercial credit access (CIND) exert the largest long-run and short-run leverage on Nigerian economic growth? Without robust empirical evidence using diagnostic-proven econometric frameworks, policy design risks being misaligned with the real sector's most critical growth drivers. This study addresses these gaps by evaluating the long-run and short-run impacts of industrialisation indicators on Nigeria's economic growth within an Autoregressive Distributed Lag (ARDL) bounds testing framework.

1.3 Research Questions

To guide the empirical investigation, this study addresses the following research questions:

i. What is the long-run equilibrium relationship between industrialisation indicators-specifically Manufacturing Value Added (MVA), Manufacturing Capacity Utilisation (MCU), and Industrial Sector Credit (CIND)-and economic growth (RGDP) in Nigeria?
ii. How does Manufacturing Value Added (MVA) affect economic growth in Nigeria in both the short run and the long run?
iii. To what extent does the Manufacturing Capacity Utilisation Rate (MCU) impact economic growth in Nigeria?
iv. What is the impact of commercial bank credit allocated to the industrial sector (CIND) on economic growth in Nigeria?

1.4 Objectives of the Study

The primary objective of this study is to examine the impact of industrialisation on economic growth in Nigeria. The specific objectives are to:

i. Determine the existence of a long-run cointegrating relationship between industrialisation indicators (MVA, MCU, and CIND) and Real Gross Domestic Product (RGDP) in Nigeria.
ii. Evaluate the long-run and short-run dynamic impacts of Manufacturing Value Added (MVA) on economic growth in Nigeria.
iii. Assess the effect of the Manufacturing Capacity Utilisation Rate (MCU) on economic growth in Nigeria.
iv. Analyze the long-run and short-run influence of Industrial Sector Credit (CIND) on economic growth in Nigeria.

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1.5 Research Hypotheses

To provide a testable basis for the empirical analysis, the following null hypotheses (H0) are formulated:

- **H_{01}:** There is no significant long-run cointegrating relationship between industrialisation indicators (MVA, MCU, CIND) and economic growth (RGDP) in Nigeria.
- **H_{02}:** Manufacturing Value Added (MVA) has no significant impact on economic growth in Nigeria.
- **H_{03}:** Manufacturing Capacity Utilisation Rate (MC) does not significantly affect economic growth in Nigeria.
- **H_{04}:** Industrial Sector Credit (CIND) has no significant impact on economic growth in Nigeria.

1.6 Scope and Delimitation of the Study

This study focuses on the relationship between industrialisation and economic growth in Nigeria using annual time-series data spanning a 27-year observation period. Economic growth is captured by Real Gross Domestic Product (RGDP) as the dependent variable. Industrialisation is measured using three complementary indicators: Manufacturing Value Added (MVA) as a share of GDP, the Manufacturing Capacity Utilisation Rate (MCU), and commercial bank Credit to the Industrial Sector (CIND) (transformed into natural logarithms as LNCIND).

Geographically, the scope is delimited to the Nigerian economy, with data sourced from official national and international databases, including the Central Bank of Nigeria (CBN) Statistical Bulletins, CBN Annual Reports, and World Bank Development Indicators (WDI).

2 Literature Review

2.1 Conceptual review

2.1.1 Economic Growth (RGDP)

Economic growth refers to the sustained increase in a nation's capacity to produce goods and services over time, measured by the percentage change in real output adjusted for price fluctuations. In macroeconomic analysis, Real Gross Domestic Product (RGDP) serves as the standard proxy for economic growth because it eliminates inflationary distortions, providing an accurate reflection of physical expansion in national aggregate supply and productive capacity (Todaro & Smith, 2020).

According to Asongo (2025), economic growth is considered to be the sustained increase in a country's capacity to produce goods and services over time, conventionally measured as the annual percentage increase in the nation's total output, typically represented by the growth rate of Real Gross Domestic Product (GDP).

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2.1.2 Manufacturing Value Added (MVA)

Manufacturing Value Added (MVA) measures the net output generated by the manufacturing sector after deducting intermediate inputs from gross industrial output. Expressed as a share of GDP or real manufacturing output, it reflects the degree of structural transformation within an economy. High MVA signifies a shift away from low-value subsistence agriculture and raw primary commodity extraction toward high-value-added industrial processing characterized by forward and backward linkages, technological learning, and economies of scale (Kaldor, 1966; UNIDO, 2022).

2.1.3 Manufacturing Capacity Utilization Rate (MCU)

While total manufacturing output reflects the overall size of the industrial sector, the Manufacturing Capacity Utilisation Rate (MCU) measures operational efficiency and real-sector performance. Defined as the ratio of actual manufacturing output produced to the maximum installed productive capacity of industrial plants, MCU captures the severity of supply-side bottlenecks. In developing economies like Nigeria, chronic power supply failures, foreign exchange scarcity for raw material importation, port congestion, and logistics gaps create a wide disparity between installed plant capacity and actual factory output (CBN, 2024).

2.1.4 Industrial Sector Credit (CIND)

Industrial Sector Credit (CIND) represents commercial bank loans and advances channelled directly to manufacturing, processing, and industrial enterprises for capital expenditure, technology acquisition, and working capital. Under Schumpeterian financial intermediation theory, credit allocation acts as the critical liquidity channel that enables real-sector firm expansion, physical capital formation, and long-term industrial investment (Levine, 1997; Schumpeter, 1911).

2.2 Theoretical Review

The theoretical foundation of this study integrates two major macroeconomic paradigms: Kaldor's Growth Laws and the Endogenous Growth Theory combined with the Schumpeterian Financial Intermediation Channel.

2.2.1 Kaldor's Growth Laws

Nicholas Kaldor (1966) formulated three empirical generalizations regarding the centrality of manufacturing in aggregate economic expansion:

1. Kaldor's First Growth Law: Asserts that manufacturing is the primary engine of economic growth. Kaldor argued that a strong, positive causal relationship exists between growth in manufacturing output and growth in total gross domestic product. Manufacturing output generates high dynamic economies of scale, extensive inter-industry supply chains, and rapid learning-by-doing effects that spill over to the non-manufacturing sectors of the economy.
2. Kaldor's Second Growth Law (Verdoorn's Law): States that productivity growth in the manufacturing sector is a positive function of growth in manufacturing output.

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Higher industrial output increases cumulative investment and technological progress, which enhances labour productivity through division of labour and specialised machinery deployment.

3. Kaldor's Third Growth Law: Asserts that overall economy-wide productivity growth increases as labour shifts out of low-productivity traditional activities (such as subsistence agriculture) into the high-productivity manufacturing sector without diminishing non-manufacturing output.

In the Nigerian context, Kaldor's First Growth Law provides the baseline justification for expecting a positive relationship between Manufacturing Value Added (MVA) and Real Gross Domestic Product (RGDP).

2.2.2 Endogenous Growth Theory

Developed by Romer (1986) and Lucas (1988), Endogenous Growth Theory models long-run economic growth as an internal outcome of an economic system rather than the result of exogenous technological shocks (as assumed in Solow's neo-classical growth model). Endogenous growth theory posits that continuous economic expansion relies on capital accumulation, human capital development, innovation, and productive investment.

Within this framework, manufacturing activities foster endogenous technical progress through domestic research and development (R&D), capital deepening, and operational experience. Increasing operational efficiency-captured by capacity utilisation (MCU)-directly reduces unit production costs and elevates aggregate labour and capital productivity, driving steady-state national economic expansion (Asongo, Akiri, & Ahemen, 2024).

2.2.3 Schumpeterian Financial Intermediation Channel

Joseph Schumpeter (1911) emphasized the indispensable role of the banking system in financing entrepreneurship, technological innovation, and capital creation. According to Schumpeterian growth theory, financial intermediaries facilitate structural transformation by evaluating investment opportunities, pooling savings, managing risks, and mobilizing liquidity toward high-productivity industrial projects (Levine, 1997). In developing nations, commercial bank credit to the industrial sector (CIND) supplies the financial liquidity required by manufacturing firms to purchase heavy capital equipment, adopt modern production technologies, and expand factory operations.

2.3 Empirical Review

The empirical literature on the impact of industrialisation on economic growth in developing and emerging economies reveals diverse findings across regional settings, methodological frameworks, and choice of industrial variables.

In a global panel study, Szirmai and Verspagen (2015) evaluated the "engine of growth" hypothesis across 90 developed and developing countries over the period 1950–2005. Using dynamic panel estimators, they found strong empirical support for the positive impact of manufacturing on economic growth, particularly in developing nations

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during periods of high capital accumulation and educational attainment. However, they observed that the growth engine effect of manufacturing weakened slightly in post-1990 panel subsamples, highlighting the growing significance of services in advanced economies.

Similarly, Su and Yao (2017) investigated the role of manufacturing in economic growth in middle-income countries using Granger causality tests and dynamic panel models. Their findings confirmed that manufacturing acts as a robust driver of GDP growth through backward and forward linkage effects, driving productivity growth across non-industrial sectors.

In an Asian country context, Marcy and Kumar (2021) examined the relationship between industrial credit allocation, manufacturing output, and economic growth in India using an Autoregressive Distributed Lag (ARDL) bounds testing framework. Their empirical results demonstrated that commercial bank credit to manufacturing enterprises had a positive and statistically significant long-run effect on economic growth, supporting the Schumpeterian financial intermediation hypothesis.

In Sub-Saharan Africa, Mensah (2019) evaluated the relationship between industrialisation, financial development, and economic expansion across 28 African economies using Generalised Method of Moments (GMM) estimation. The study revealed that manufacturing value addition and capital formation significantly stimulated economic growth, but infrastructural deficits (notably electricity access) reduced the operational performance of manufacturing firms.

Within Nigeria, several empirical studies have investigated various dimensions of the industrialisation-growth relationship:

Obi and Chukwu (2020) analysed the effect of manufacturing output and capacity utilisation on economic growth in Nigeria using annual time-series data spanning 1986 to 2018 within an Error Correction Model (ECM) framework. Their results showed that manufacturing capacity utilisation had a positive and statistically significant impact on real GDP growth, whereas manufacturing output exhibited a weak effect due to high production overheads and structural supply chain bottlenecks.

In a related study, Danlami and Aliyu (2022) examined the impact of commercial bank credit to the industrial sector on Nigerian economic growth using an ARDL framework from 1990 to 2020. They established the existence of a stable long-run cointegrating relationship between industrial credit, fixed capital formation, and real GDP growth. Their estimated long-run coefficients indicated that financial credit flow to manufacturing enterprises significantly stimulated aggregate output, emphasizing the critical role of monetary credit policy in real-sector development.

Conversely, Adeleke (2021) investigated the structural failure of industrialisation policies in Nigeria, examining time-series data from 1981 to 2019 using Vector Error Correction Models (VECM). The findings highlighted that despite nominal increases in industrial credit allocations, persistent infrastructure deficits-specifically chronic electric

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power shortages and transport logistics constraints-severely suppressed manufacturing value added (MVA), preventing the industrial sector from serving as the primary engine of growth envisioned by Kaldor's laws.

2.4 Gap in the Literature

A synthesis of the existing empirical literature reveals several critical gaps:

Many existing Nigerian studies rely on conventional cointegration techniques (such as the Johansen maximum likelihood or Engle-Granger methods) that strictly require all variables to be integrated of order one, I(1). When macroeconomic series exhibit a mixture of stationary I(0) and non-stationary I(1) integration orders, standard cointegration techniques can produce biased or spurious results.

Numerous studies evaluate industrialisation solely through aggregate manufacturing output (MVA), omitting real-sector operational efficiency (MCU) and financial credit availability (CIND). Failing to incorporate capacity utilisation and credit flow obscures the specific channels through which supply-side constraints and monetary policy impact national output.

Much of the existing literature lacks systematic reporting of parameter stability tests (such as CUSUM and CUSUMSQ) and diagnostic suites (Ramsey RESET, Breusch-Godfrey LM, Breusch-Pagan-Godfrey) required to confirm model stability, homoskedasticity, and absence of serial correlation across major macroeconomic shocks (such as the 2016 Nigerian recession and the 2020 COVID-19 pandemic).

This study bridges these empirical and methodological gaps by applying the Autoregressive Distributed Lag (ARDL) Bounds Testing Approach to a 27-year time-series framework in Nigeria. By combining Manufacturing Value Added (MVA), Manufacturing Capacity Utilisation (MCU), and Industrial Sector Credit (LNCIND) into a single, diagnostic-tested empirical model, this study provides comprehensive short-run and long-run parameter elasticities to guide industrial policy formulation.

3. Methodology

3.1 Research Design

This study adopts a quantitative, non-experimental, and ex-post facto research design within an empirical econometric framework. An ex-post facto research design is particularly appropriate for macroeconomic studies because the events, policy interventions, and historical time-series data under investigation have already occurred, prohibiting any direct manipulation of variables by the researcher.

Furthermore, the study utilises an analytical time-series research design spanning a 27-year empirical period. This design facilitates the systematic modelling of continuous macro-level interactions, dynamic short-run adjustments, and long-run steady-state equilibrium relationships between industrialisation indicators-namely Manufacturing Value Added (MVA), Manufacturing Capacity Utilisation Rate (MCU), and Industrial Sector

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Credit (CIND)-and economic growth in Nigeria represented by Real Gross Domestic Product (RGDP).

3.2 Theoretical Framework

This study anchors its empirical investigation of industrialisation and economic growth in Nigeria on two complementary economic theories: Kaldor's Growth Laws and the Endogenous Growth Theory.

3.2.1 Kaldor's First Growth Law

According to Kaldor (1966), manufacturing is the primary engine of economic growth. Kaldor's First Growth Law posits a direct, positive structural relationship between manufacturing output growth and aggregate real GDP growth. The theoretical rationale rests on the unique structural properties of the manufacturing sector, including:

1. High Backward and Forward Linkages: Manufacturing activities generate extensive demand for raw materials from agriculture and mining while supplying capital goods and inputs to services and construction.
2. Dynamic Economies of Scale: As industrial capacity expands, learning-by-doing and technological spillovers significantly reduce unit production costs.
3. Productivity Reallocation: Shifting surplus labour and resources from low-productivity traditional sectors (such as subsistence agriculture) into high-productivity manufacturing accelerates national economic expansion.

3.2.2 Endogenous Growth Theory and Schumpeterian Financial Intermediation

To account for capital accumulation and operational efficiency, the framework incorporates Endogenous Growth Theory (Romer, 1986; Lucas, 1988) and the Schumpeterian financial channel (Schumpeter, 1911; Levine, 1997). Endogenous growth theory posits that continuous economic expansion is driven by internal economic processes, specifically physical capital accumulation, technological innovation, and productive investment. In developing economies like Nigeria, capital formation relies heavily on financial intermediation. Commercial bank credit allocated to the real industrial sector (CIND) provides the requisite liquidity to import modern machinery, adopt advanced technologies, and expand installed factory operations. Furthermore, operational efficiency-measured by the Manufacturing Capacity Utilisation Rate (MCU)-captures supply-side constraints and real-sector productivity.

Synthesizing these theoretical channels yields a functional macroeconomic relationship where real national output is driven by manufacturing value addition, operational efficiency, and real-sector financial support:

$$\mathrm{RGDP} = f(\mathrm{MVA}, \mathrm{MCU}, \mathrm{CIND}) \quad . \quad . \quad . \quad \text{(i)}$$

3.3 Model Specification

Following the theoretical framework, the baseline econometric model is specified in an implicit functional form as:

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$$\text{RGDP}_t = f(\text{MVA}_t, \text{MCU}_t, \text{CIND}_t) \quad . \quad . \quad . \quad \text{(ii)}$$

To evaluate the long-run linear elasticity, industrial sector credit (CIND) is expressed in natural logarithms (LNCIND) to smooth variance and capture elasticity directly, while rates and proportions (MVA and MCU) enter in direct linear form. Explicitly specifying the linear regression model yields:

$$\text{RGDP}_t = \beta_0 + \beta_1 \text{MVA}_t + \beta_2 \text{MCU}_t + \beta_3 \text{LNCIND}_t + \varepsilon_t \quad . \quad . \quad .\text{(iii)}$$

Where:

RGDP_t = Real Gross Domestic Product at period t (proxy for Economic Growth).

MVA_t = Manufacturing Value Added as a share of GDP at period t (proxy for Industrialisation Output).

MCU_t = Manufacturing Capacity Utilisation Rate at period t (proxy for Industrial Operational Efficiency).

LNCIND_t = Natural logarithm of Commercial Bank Credit to the Industrial Sector at period t (proxy for Financial Intermediation to the Real Sector).

β_0 = Autonomous constant parameter.

$\beta_1, \beta_2, \beta_3$ = Long-run elasticity and slope parameters to be estimated.

ε_t = White-noise stochastic error term.

3.3.1 A Priori Theoretical Expectations:

Based on Kaldorian growth mechanics, endogenous capital accumulation, and efficiency theory, all explanatory indicators are expected to exert a positive impact on economic growth:

$$\beta_1 > 0, \quad \beta_2 > 0, \quad \beta_3 > 0$$

3.4 Econometric Estimation Technique: ARDL Bounds Testing Approach

To estimate the long-run cointegrating relationship and short-run dynamics between industrialisation and economic growth, this study utilises the Autoregressive Distributed Lag (ARDL) Bounds Testing Approach to Cointegration developed by Pesaran, Shin, and Smith (2001).

3.4.1 Justification for the ARDL Framework

The ARDL model offers significant methodological advantages over traditional cointegration techniques (such as Engle-Granger two-step or Johansen maximum likelihood approaches): Unlike Johansen's procedure-which strictly requires all variables to be

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integrated of order one, I(1)-ARDL can be applied regardless of whether the underlying series are purely I(0), purely I(1), or mutually integrated of mixed orders (I(0) and I(1)), provided no variable is I(2). The ARDL framework produces unbiased long-run estimates and valid statistical inferences in small or finite sample sizes (such as the 27-year observation window in this study). ARDL derives both short-run dynamic error correction adjustments and long-run equilibrium relationships within a single reduced-form equation.

3.4.2 Unrestricted Error Correction Model (UECM) Specification

The general mathematical formulation of the ARDL Unrestricted Error Correction Model (UECM) for the empirical model is specified as:

$$\Delta \text{RGDP}_t = \alpha_0 + \sum_{i=1}^{p} \gamma_i \Delta \text{RGDP}_{t-i} + \sum_{j=0}^{q_1} \delta_{1j} \Delta \text{MVA}_{t-j} + \sum_{k=0}^{q_2} \delta_{2k} \Delta \text{MCU}_{t-k} + \sum_{m=0}^{q_3} \delta_{3m} \Delta \text{LNCIND}_{t-m} + \theta_1 \text{RGDP}_{t-1}$$

$$+\theta_2 \text{MVA}_{t-1} + \theta_3 \text{MCU}_{t-1} + \theta_4 \text{LNCIND}_{t-1} + \mu_t \quad . \quad . \quad .(\text{iv})$$

Where:

Δ represents the first difference operator.

p, q_1, q_2, q_3 denote the optimal lag lengths chosen for the dependent and explanatory variables based on model selection criteria.

$\gamma_i, \delta_{1j}, \delta_{2k}, \delta_{3m}$ represent short-run dynamic interaction parameters.

$\theta_1, \theta_2, \theta_3, \theta_4$ denote long-run multiplier parameters.

α_0 is the constant term and μ_t is the random disturbance term.

3.4.3 ARDL Bounds Test for Cointegration

To test for the existence of a long-run equilibrium cointegrating relationship among the variables, an F-test for joint significance is conducted on the lagged level parameters in the UECM:

Null Hypothesis $(H_0): \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ (No long-run relationship)

Alternative Hypothesis $(H_1): \theta_1 \neq 0$ or $\theta_2 \neq 0$ or $\theta_3 \neq 0$ or $\theta_4 \neq 0$ (A long-run relationship exists)

If the computed F-statistic exceeds the Upper Critical Bound I(1), H_0 is rejected, establishing long-run cointegration.

If the computed F-statistic falls below the Lower Critical Bound I(0), H_0 cannot be rejected, confirming no cointegration.

If the F-statistic falls between I(0) and I(1), the test is inconclusive.

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3.4.4 Long-Run Levels and Short-Run Error Correction Model (ECM)

Once long-run cointegration is established, the long-run levels equation is estimated:

$$\mathrm{RGDP}_t = \sigma_0 + \sigma_1 \mathrm{MVA}_t + \sigma_2 \mathrm{MCU}_t + \sigma_3 \mathrm{LNCIND}_t + e_t \quad . \quad . \quad .(v)$$

Subsequently, the short-run dynamic Error Correction Model (ECM) is estimated to determine short-run policy impacts and the speed of adjustment back to long-run equilibrium following a shock:

$$\Delta \mathrm{RGDP}_t = \alpha_0 + \sum_{i=1}^{p} \gamma_i \Delta \mathrm{RGDP}_{t-i} + \sum_{j=0}^{q_1} \delta_{1j} \Delta \mathrm{MVA}_{t-j} + \sum_{k=0}^{q_2} \delta_{2k} \Delta \mathrm{MCU}_{t-k} + \sum_{m=0}^{q_3} \delta_{3m} \Delta \mathrm{LNCIND}_{t-m} + \phi \mathrm{EC}_{t-1} + \mu_t \quad \text{(vi)}$$

Where:

EC_{t-1} is the error correction term derived from the estimated long-run equilibrium residuals:

$$\mathrm{EC}_{t-1} = \mathrm{RGDP}_{t-1} - \hat{\sigma}_0 - \hat{\sigma}_1 \mathrm{MVA}_{t-1} - \hat{\sigma}_2 \mathrm{MCU}_{t-1} - \hat{\sigma}_3 \mathrm{LNCIND}_{t-1} \quad . \quad .(vii)$$

ϕ is the error correction parameter measuring the speed of adjustment toward equilibrium. A statistically significant negative coefficient $(\phi < 0)$ confirms that short-run disequilibrium caused by exogenous economic shocks converges back toward long-run equilibrium.

3.5 Model Selection and Post-Estimation Diagnostic Suite

3.5.1 Optimal Lag Selection

The lag lengths $(p,\ q_1,\ q_2,\ q_3)$ in the ARDL model are selected using the Akaike Information Criterion (AIC), which evaluates model parsimony against goodness-of-fit to prevent serial correlation without over-parameterisation.

3.5.2 Diagnostic and Post-Estimation Suite

To ensure that the estimated estimates are robust, unbiased, and statistically reliable, a comprehensive suite of diagnostic tests is executed:

1. Model Specification: The Ramsey RESET Test is conducted to test for functional form misspecification and omitted variable bias.
2. Serial Correlation: The Breusch-Godfrey Serial Correlation LM Test is used to verify residual independence up to lag 2.
3. Heteroskedasticity: The Breusch-Pagan-Godfrey Test (evaluating the Observed R^2LM statistic and Scaled Explained Sum of Squares) is conducted to verify constant error variance (homoskedasticity).
4. Normality: The Jarque-Bera Test assesses whether model residuals follow a standard mesokurtic normal distribution.

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5. Structural Parameter Stability: The Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests (Brown, Durbin, & Evans, 1975) are evaluated within 5% critical boundaries to confirm long-run parameter and variance stability over time.

3.6 Nature and Sources of Data

This study utilises secondary time-series annual data spanning 27 years. All variables are sourced from official national and international statistical publications to ensure data integrity and replicability.

Table 3.1: Description, Measurement, and Data Sources of Variables

Variable Symbol	Full Description	Measurement Unit	Expected Sign	Data Source
RGDP	Real Gross Domestic Product	Billion Naira (NGN)	Dependent	CBN Statistical Bulletin / WDI
MVA	Manufacturing Value Added	Share of GDP (%)	+	Central Bank of Nigeria (CBN) / WDI
MCU	Manufacturing Capacity Utilisation	Proportion / Percentage (%)	+	CBN Annual Reports & Bulletins
CIND	Commercial Bank Credit to Industry	Billion Naira (NGN) (Logged as LNCIND)	+	CBN Monetary & Financial Statistics

4 Empirical Results

4.1 Descriptive Statistics

The descriptive statistics summarize the central tendencies, dispersion, and distributional properties of the variables: Real Gross Domestic Product (RGDP), Manufacturing Value Added (MVA), Manufacturing Capacity Utilization Rate (MCU), and Industrial Sector Credit (CIND).

Table 4.1 Descriptive Statistics Results

	RGDP	MVA	MCU	CIND
Mean	55065.49	0.083689	0.527911	2518.215
Median	59929.89	0.086500	0.546000	1698.200
Maximum	81673.35	0.097500	0.596000	8980.500
Minimum	22449.41	0.065500	0.346000	129.5000
Std. Dev.	18894.19	0.008139	0.063173	2495.717
Skewness	-0.385417	-0.596055	-1.896100	1.143339
Kurtosis	1.745392	2.531381	5.592150	3.416725
Jarque-Bera	2.439254	1.845819	23.73753	6.077877
Probability	0.295340	0.397361	0.000007	0.047886
Sum	1486768.	2.259600	14.25360	67991.80
Sum Sq. Dev.	9.28E+09	0.001722	0.103761	1.62E+08
Observations	27	27	27	27

Source: Researcher's Computation Using E-Views 10.0 Software (2026)

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The mean value of Real Gross Domestic Product (RGDP) - Economic Growth Indicator stands at 55,065.49, with a median of 59,929.89. The proximity between the mean and median indicates a fairly balanced central distribution across the sample period. RGDP ranges significantly from a minimum of 22,449.41 to a maximum of 81,673.35, accompanied by a high standard deviation of 18,894.19. This wide spread reflects substantial long-term economic expansion and growth over the 27-year timeframe. The skewness is -0.385 (slightly negatively skewed) and the kurtosis is 1.745 (platykurtic/flatter than a normal distribution). The Jarque-Bera statistic of 2.439 with a probability value of 0.295 (> 0.05) confirms that RGDP is normally distributed.

Manufacturing Value Added (MVA) - Industrialisation Indicator has the mean ratio of MVA to GDP is 0.0837 (or approximately 8.37%), with a median of 0.0865 (8.65%). This indicates that manufacturing contributes less than a tenth of Nigeria's total output on average. It exhibits a very tight range between a minimum of 0.0655 (6.55\%) and a maximum of 0.0975 (9.75%), supported by a very low standard deviation of 0.0081. This demonstrates long-standing structural stagnation, where the manufacturing sector's relative share of the economy has remained largely constrained and unvarying. The variable shows a moderate negative skewness of -0.596 and a kurtosis of 2.531. The Jarque-Bera statistic is 1.846 with a probability of 0.397 (> 0.05), indicating that MVA is normally distributed.

Manufacturing Capacity Utilisation Rate (MCU) - Efficiency Indicator revealed that the mean capacity utilisation rate is 0.5279 (or 52.79%), with a median of 0.5460 (54.60%). This implies that, on average, slightly over half of Nigeria's installed industrial capacity is operational. It ranges from a low of 0.3460 (34.60%) to a high of 0.5960 (59.60%), with a standard deviation of 0.0632. This highlights persistent supply-side bottlenecks and infrastructural deficiencies (such as chronic power shortages) restricting optimal factory operations. MCU is strongly negatively skewed at -1.896 and features a leptokurtic (peaked) distribution with a kurtosis of 5.592. The Jarque-Bera statistic is 23.738 with a probability of 0.000007 (< 0.05), showing that MCU deviates significantly from a normal distribution.

Industrial Sector Credit (CIND) -Financial Support Indicator shows that the mean credit allocation to the industrial sector is 2,518.22, while the median is 1,698.20. The mean being noticeably higher than the median reflects a right-ward pulling effect driven by larger credit volumes in more recent years. It spans widely from a minimum of 129.50 to a maximum of 8,980.50, coupled with a high standard deviation of 2,495.72. This high volatility indicates significant scaling in nominal credit availability over time, though it may also capture inflationary effects. The variable exhibits a positive skewness of 1.143 (right-skewed) and a kurtosis of 3.417. The Jarque-Bera statistic is 6.078 with a probability of 0.0479 (< 0.05), suggesting that CIND departs from normality at the 5% significance level.

4.2 Unit Root Test

The study uses the Augmented Dickey-Fuller test. The Augmented Dickey-Fuller unit root test determines whether time-series variables are stationary (do not contain a unit

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root) at levels or if they become stationary after first differencing. The empirical findings show a mixed order of integration:

MCU is stationary at level, i.e., integrated of order zero, *I(0)*. RGDP, MVA, and CIND are non-stationary at levels but become stationary after first differencing, i.e., integrated of order one, *I(1)*.

Table 4.2: Augmented Dickey-Fuller Unit Root Test Results:

Augmented Dickey-Fuller							
	LEVELS			**FIRST DIFFERENCED**			
Variable	t-statistic	Critical value	p-value	t-statistic	Critical value	p-value	*I(d)*
RGDP	-3.312395	-3603202	0.0873	-5.901069	-3.612199	0.0004 **b****	*I(1)*
MVA	-3.181453	-3603202	0.1107	-6.506190	-3.612199	0.0001 **a****	*I(1)*
MCU	-3.472088	-2.981038	0.0173 **a****	-	-	-	*I(0)*
CIND	-2.293536	-3603202	0.4219	-6.230982	-3.612199	0.0002 **b****	*I(1)*

Source: Researcher's Computation Using E-Views 10.0 Software (2026)

Note: ***, ** and * imply statistical significance at 1%, 5% and 10% levels respectively. Also, '*a'* denotes model with constant while 'b' denotes model with constant and trend.

Because the variables exhibit a combination of *I(0)* and *I(1)* integration orders, the conventional Johansen cointegration test (which strictly requires all series to be *I(1))* is not appropriate.

The presence of a mixed integration order-*I(0)* and I(1)-without any *I(2)* variables provides a strong methodological justification for using the Autoregressive Distributed Lag (ARDL) Bounds Testing approach to cointegration (Pesaran et al., 2001).

4.3 Model Selection Criteria

In econometric modelling-specifically within the Autoregressive Distributed Lag (ARDL) framework-selecting the optimal lag structure is essential to capture the dynamic interactions between variables while avoiding issues of over-parameterisation or residual serial correlation.

The chart displays the top 20 candidate ARDL specifications evaluated using the Akaike Information Criterion (AIC). Under information criteria evaluation, the model with the lowest AIC value represents the optimal model, as it balances goodness-of-fit against model parsimony (penalizing loss of degrees of freedom).

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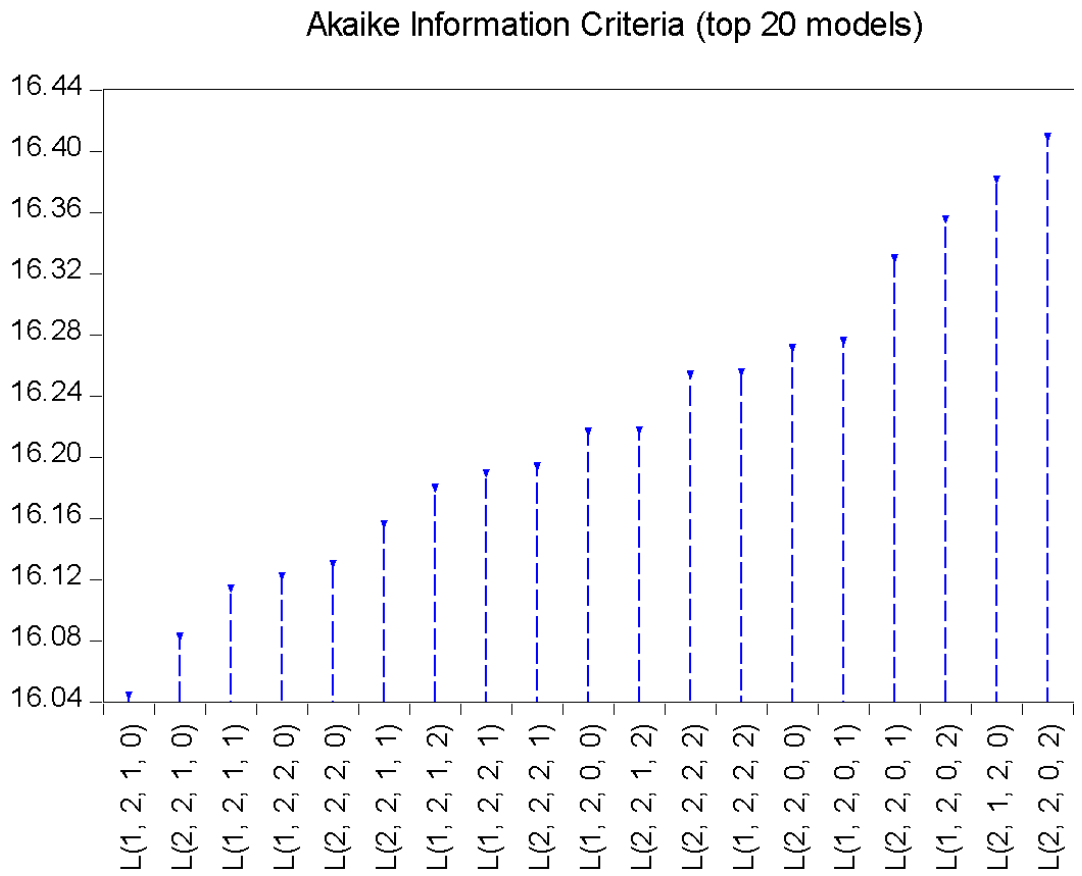


Fig. 4: Model Selection Criteria

To determine the optimal lag structure for the ARDL model, the Akaike Information Criterion (AIC) was employed across a comparative evaluation of alternative specification combinations. As illustrated in Figure 4.1, the ARDL(1, 2, 1, 0) specification recorded the lowest AIC value (16.045), outperforming the other 19 top-ranking candidate models. Hence, ARDL(1, 2, 1, 0) was selected as the parsimonious baseline model to estimate the long-run cointegrating relationship and short-run dynamic error correction mechanism (ECM) governing industrialisation and economic growth in Nigeria.

4.4 Bounds Cointegration Test

To establish whether a long-run equilibrium relationship exists among real gross domestic product, manufacturing value added, manufacturing capacity utilisation, and industrial sector credit, the ARDL F-bounds test for cointegration was conducted and the result is presented in Table 4.3.

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Table 4.3: Bounds cointegration Test Result

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	15.84181	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Source: Researcher's Computation Using E-Views 10.0 Software (2026)

As presented in Table 4.3, the computed F-statistic of 15.84181 exceeds the upper bound critical value of 4.66 at the 1% level of significance (k = 3). Therefore, the null hypothesis of no levels relationship is decisively rejected at 1%. This confirms that a stable, long-run cointegrating relationship exists among industrialisation indicators and economic growth in Nigeria over the under-studied period.

4.4.1 Cointegration Graph

In an Autoregressive Distributed Lag (ARDL) framework, the cointegration graph plots the linear combination of the cointegrating equation (often referred to as the residual series or cointegrating relation, EC_t or CINTREG01).

This plot visually confirms whether the long-run equilibrium error generated by combining Real GDP (RGDP), Manufacturing Value Added (MVA), Manufacturing Capacity Utilisation (MCU), and Industrial Sector Credit (CIND) is stationary around a constant mean of zero.

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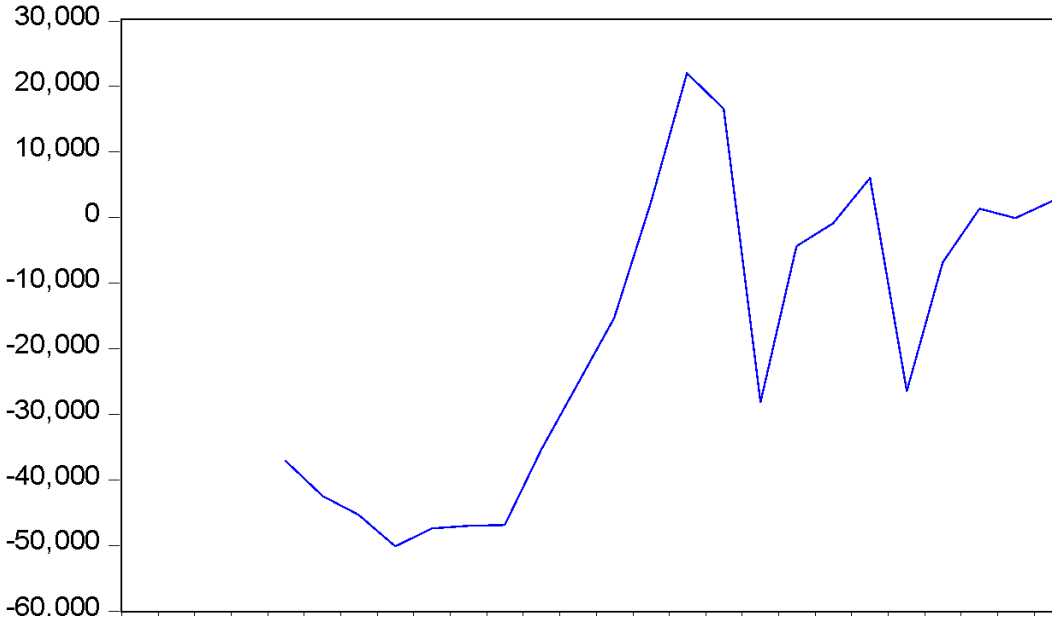


Fig. 4.2: Cointegration Graph

Figure 4.2 presents the graph of the cointegrating equation (EC_t) for the ARDL model. As depicted in the plot, the long-run cointegrating vector exhibits distinct mean-reverting behaviour around a stable mean across the sample period. Although significant exogenous shocks-most notably the 2016 economic recession and the 2020 COVID-19 real-sector contraction-caused temporary deviations from the steady state, the series repeatedly adjusts back toward equilibrium. This visual evidence confirms the existence of a stable long-run equilibrium relationship between industrialisation indicators and economic growth in Nigeria, reinforcing the statistical rejection of the null hypothesis in the F-Bounds Test.

4.5 Long-Run Estimation

The ARDL long-run cointegrating form estimates the equilibrium impact of each industrialisation indicator on Real Gross Domestic Product (RGDP) over the long term. Because the bounds test confirmed a stable cointegrating relationship, these coefficients reflect structural and steady-state economic relationships rather than temporary short-term fluctuations.

Table 4.3: Long-Run Estimation Results

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MVA	2.495943	0.675929	3.692611	0.0042

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MCU	0.454977	0.049159	9.255216	0.0000
LNCIND	5.125483	0.951014	5.389492	0.0000
C	225381.3	73864.16	3.051294	0.0072

Source: Researcher's Computation Using E-Views 10.0 Software (2026)

Note: ***, ** and * imply statistical significance at 1%, 5% and 10% levels, respectively.

With a t-statistic of 3.69 and a p-value of 0.0042, Manufacturing Value Added (MVA) is statistically significant at the 1% level. The positive coefficient of 2.496 indicates that a unit increase in manufacturing value added generates a substantial positive expansion in Nigeria's long-run real GDP. This corroborates Kaldor's First Growth Law, which posits that manufacturing acts as the primary engine of economic growth due to powerful forward and backward linkages, dynamic economies of scale, and high technological spillovers that transform low-productivity sectors into high-yield industrial activities.

Manufacturing Capacity Utilisation Rate (MCU) is exceptionally significant at the 1% level, backed by a very high t-statistic of 9.26 and a negligible p-value (0.0000). A 1% improvement in manufacturing capacity utilisation leads to a 0.455 increase in long-run economic growth. This highlights the critical role of operational efficiency in Nigeria's real sector. Overcoming infrastructural bottlenecks-such as persistent power outages and energy deficits that leave installed factory capacities idle-directly lowers unit production costs and scales up national output.

Industrial credit (LNCIND) is highly significant at the 1% level, with a robust t-statistic of 5.39 ($p = 0.0000$). Holding other variables constant, a 1% increase in credit allocation to the industrial sector yields a massive 5.126% long-run increase in real GDP. This represents the largest magnitude among the explanatory variables. This strongly supports Schumpeterian financial intermediation theory and Endogenous Growth Theory. Channelling credit and liquidity toward industrial enterprises provides the necessary capital accumulation required to import heavy machinery, adopt advanced technologies, and finance large-scale manufacturing projects in Nigeria.

The constant is statistically significant at the 1% level ($p = 0.0072$). It captures the baseline autonomous growth of Nigeria's real GDP driven by unmeasured structural factors, baseline institutional frameworks, and exogenous economic drivers outside the explicit industrialization variables included in the model.

All three core indicators of industrialisation- MVA, MCU, and LNCIND-possess the expected positive signs and are statistically significant at the 1% level. Nigerian macroeconomic and monetary authorities must prioritise targeted credit expansion to the real sector (to leverage the high 5.13 elasticity of LNCIND), resolve acute power and infrastructure crises to elevate capacity utilisation (MCU), and implement deliberate protection and promotion policies to scale up manufacturing value addition (MVA).

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4.6 Short-Run Estimation

The Short-Run Error Correction Model captures the immediate dynamic impacts of the explanatory variables on economic growth $(\Delta RGDP)$ while evaluating the speed at which any short-run disequilibrium is corrected back toward long-run equilibrium.

Table 4.4: Short-Run Estimation Results

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MVA)	0.937194	0.019075	49.13213	0.0000
D(MVA(-1))	0.454977	0.142267	3.198040	0.0095
D(MCU)	1.413143	0.147512	9.579865	0.0000
CointEq(-1)*	-0.062806	0.003094	-20.29765	0.0000

R-squared	0.847615	Mean dependent var	2319.403
Adjusted R-squared	0.825846	S.D. dependent var	1400.078
S.E. of regression	584.2776	Akaike info criterion	15.72428
Sum squared resid	7168988.	Schwarz criterion	15.91930
Log likelihood	-192.5535	Hannan-Quinn criter.	15.77837
Durbin-Watson stat	1.890607		

Source: Researcher's Computation Using E-Views 10.0 Software (2026)

Note: ***, ** and * imply statistical significance at 1%, 5% and 10% levels, respectively.

Contemporary $D(MVA)$ is statistically significant at the 1% level (p = 0.0000), supported by an exceptionally high t-statistic of 49.13. In the short run, a 1-unit change in manufacturing value added directly increases real GDP growth by 0.9372 units. This strong immediate effect confirms that changes in manufacturing output exert a direct, positive stimulus on national output. In line with Kaldor's First Growth Law, manufacturing activity generates instantaneous income and production linkages across connected sectors in Nigeria.

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Lagged Manufacturing Value Added (D(MVA(-1))) shows that the one-period lagged change in manufacturing value added is statistically significant at the 1% level (p = 0.0095). A 1-unit increase in manufacturing value added from the previous year continues to boost real GDP growth by 0.4550 units in the current year. This dynamic effect highlights the persistent, multi-period impact of manufacturing expansion. Industrial investments and structural adjustments implemented in one period spill over to generate productive capacity and supply chain momentum into the subsequent period.

Change in Manufacturing Capacity Utilisation (D(MCU)) is highly statistically significant at the 1% level (p = 0.0000), with a robust t-statistic of 9.58. A 1-unit (or percentage point) improvement in operational capacity utilisation increases short-run economic growth by 1.4131 units. Among short-run operational drivers, capacity utilisation exhibits the highest magnitude (1.4131). This proves that immediately optimising the utilisation of existing industrial infrastructure-such as mitigating power supply disruptions, raw material shortages, and foreign exchange constraints-provides a swift and substantial boost to real output.

The Error Correction Term (CointEq(-1)*) satisfies both theoretical requirements: it is negatively signed (-0.0628) and statistically significant at the 1% level (p = 0.0000, t = -20.30). The coefficient of -0.0628 (or 6.28%) measures the speed of convergence back to equilibrium. It implies that approximately 6.28% of any short-run disequilibrium caused by exogenous economic shocks in one year is corrected back toward the long-run equilibrium trajectory in the following year. The relatively slow rate of adjustment (6.28% per annum) reflects substantial structural rigidities, infrastructural bottlenecks, and policy lags within the Nigerian economy, meaning full adjustment back to long-run equilibrium takes several years following a major macroeconomic disturbance.

R-squared (R^2) is 0.8476, this means that approximately 84.76% of the total short-run variation in Nigeria's real GDP growth is jointly explained by the dynamic changes in industrialization indicators in the model. Adjusted R-squared $(\bar{R}^2)$ is 0.8258. this implies that, after penalizing for lost degrees of freedom, the model retains strong explanatory power at 82.58%.

Durbin-Watson Statistic (DW) is 1.8906. The DW value is very close to 2.0, confirming the absence of severe first-order serial correlation in the residual error term.

The model exhibits low values across the selection criteria (AIC = 15.72, SC = 15.92, HQ = 15.78), confirming model parsimony and efficiency.

Both current and lagged manufacturing value added (D(MVA) and D(MVA(-1))) along with capacity utilisation (D(MCU)) exert immediate, positive impacts on economic growth.

Because MCU has the highest short-run impact (1.4131), policy interventions aimed at improving power supply, grid stability, and foreign exchange access for industrial inputs will deliver the fastest gains in GDP growth.

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The slow speed of adjustment (6.28%) highlights the need for deep structural reforms to remove systemic rigidities in Nigeria's real sector.

4.7 Post Estimation Test

4.7.1 Ramsey RESET Test

The Ramsey RESET test is a general diagnostic test used to check whether a regression model suffers from functional form misspecification or omitted variable bias. It determines whether non-linear combinations of the fitted values have any explanatory power when added back into the model.

Table 4.5: Ramsey RESET Test Result

	Value	df	Probability
t-statistic	1.775408	9	0.1096
F-statistic	3.152074	(1, 9)	0.1096

Source: Researcher's Computation Using E-Views 10.0 Software (2026)

To ensure that the estimated ARDL model does not suffer from functional form misspecification or omitted variable bias, the Ramsey RESET test was conducted. As presented in Table 4.5, the F-statistic of 3.152 yields a p-value of 0.1096, which is well above the 5% level of significance. Consequently, we fail to reject the null hypothesis of correct specification. This confirms that the selected ARDL(1, 2, 1, 0) model is appropriately specified, and its empirical estimates are robust and reliable for policy formulation.

4.7.2 Serial Correlation

The Breusch-Godfrey Serial Correlation LM test evaluates whether the residual error terms in the estimated ARDL(1, 2, 1, 0) model are correlated across time periods. Serial correlation (autocorrelation) in regression residuals violates the classical linear regression assumption, which can distort standard errors, t-statistics, and statistical inferences.

Table 4.6: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.966644	Prob. F(2,15)	0.1744
Obs*R-squared	5.193615	Prob. Chi-Square(2)	0.2745

Source: Researcher's Computation Using E-Views 10.0 Software (2026)

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To verify that the error terms of the selected ARDL(1, 2, 1, 0) model are independent over time, the Breusch-Godfrey Serial Correlation LM test was conducted up to two lags. As presented in Table 4.6, the F-statistic of 1.967 (p = 0.1744) and the LM statistic $(\text{Obs} \times R^2 = 5.194$, p = 0.2745) both exceed the 5% significance threshold. Consequently, the null hypothesis of no serial correlation cannot be rejected. This confirms that the model residuals are free from higher-order autocorrelation, validating the efficiency and reliability of the estimated long-run and short-run parameters.

4.7.3 Heteroskedasticity

The Breusch-Pagan-Godfrey test assesses whether the variance of the error terms (residuals) in the estimated ARDL(1, 2, 1, 0) model is constant (homoskedastic) across observations or varies with the explanatory variables (heteroskedastic).

Table 4.7: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	3.093545	Prob. F(12,10)	0.0416
Obs*R-squared	18.11911	Prob. Chi-Square(12)	0.1121
Scaled explained SS	3.351989	Prob. Chi-Square(12)	0.9925

Source: Researcher's Computation Using E-Views 10.0 Software (2026)

To test the assumption of constant variance among the residual error terms of the estimated ARDL(1, 2, 1, 0) model, the Breusch-Pagan-Godfrey test for heteroskedasticity was performed. As presented in Table 4.7, the Observed R-squared statistic $(\text{Obs} \times R^2 = 18.119,$ p = 0.1121) and the Scaled Explained Sum of Squares statistic (3.352, p = 0.9925) both yield probability values well above the 5% significance threshold. Consequently, the null hypothesis of homoskedasticity cannot be rejected at the 5% level. This indicates that the error terms possess constant variance, ensuring that the estimated standard errors and statistical inferences derived from the model are unbiased, efficient, and reliable.

4.7.4 Normality Test

To verify whether the error terms of the estimated ARDL(1, 2, 1, 0) model are normally distributed, the Jarque-Bera normality test was conducted.

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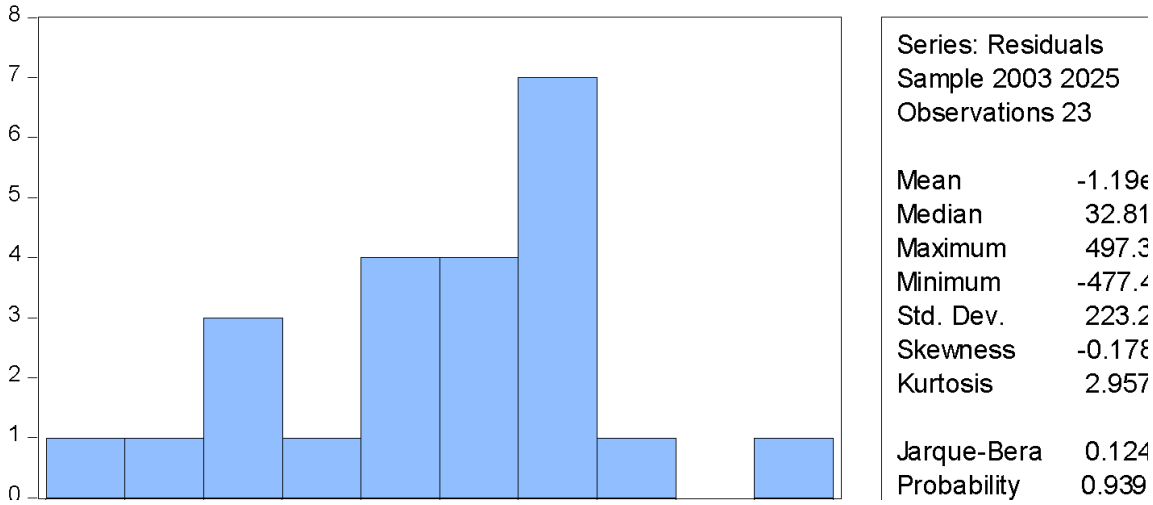


Fig 4.3: Normality Test Result

As shown in Figure 4.3, the residual mean is approximately zero (-1.19×10^{-11}) with a skewness of -0.179 and a kurtosis of 2.957, which closely mirrors a standard mesokurtic distribution. The computed Jarque-Bera statistic of 0.1241 yields a probability value of 0.9398, well above the 5% level of significance. Consequently, the null hypothesis of normally distributed residuals cannot be rejected. This confirms that the model satisfies the classical assumption of residual normality, validating the precision of the estimated parameters and hypothesis tests.

4.7.5 CUSUM Test

To evaluate the structural stability of both the short-run dynamic and long-run cointegrating parameters of the estimated ARDL(1, 2, 1, 0) model, the Cumulative Sum (CUSUM) test was applied.

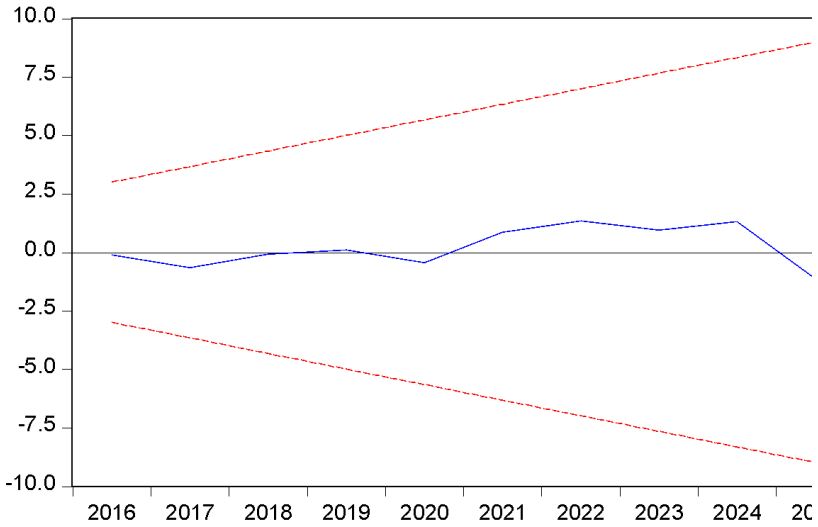


Fig. 4.4: CUSUM

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As illustrated in Figure 4.4, the CUSUM statistic plot (blue line) remains comfortably within the upper and lower critical bounds at the 5% level of significance throughout the evaluation period (2016–2025). Consequently, the null hypothesis of parameter stability cannot be rejected. This confirms that the estimated model parameters are structurally stable over time and free from structural break distortions, establishing the empirical framework as robust and reliable for macroeconomic policy analysis in Nigeria.

4.7.6 CUSUM of Squares

To complement the CUSUM test and verify the constancy of error variance over time, the Cumulative Sum of Squares (CUSUMSQ) test was conducted.

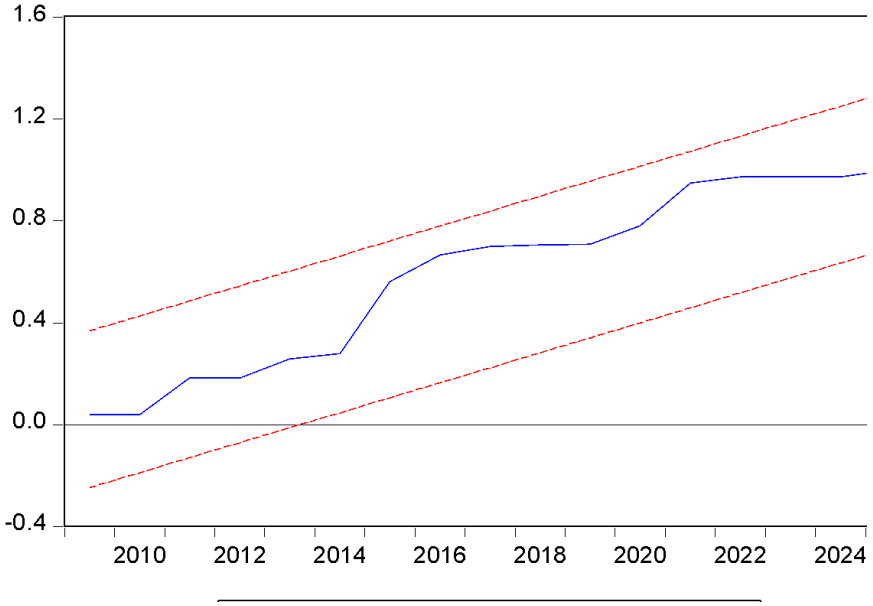


Fig. 4.5: CUSUM of Squares

As depicted in Figure 4.5, the blue CUSUMSQ statistic remains bounded within the two 5% critical lines (red dashed bounds) throughout the evaluation period spanning 2009 to 2025. Although minor upward shifts are observed during periods corresponding to the 2016 economic recession and the 2020 pandemic-induced shock, the plot at no point crosses either boundary. Consequently, the null hypothesis of structural parameter and variance stability cannot be rejected at the 5% level of significance. This confirms that the estimated ARDL(1, 2, 1, 0) specification is free from structural instability and provides a reliable framework for economic analysis and policy recommendations in Nigeria.

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