Business, Management and Economics Engineering
ISSN: 2669-2481 / eISSN: 2669-249X
2026 Volume 24 Issue 01

TRADE LIBERALIZATION, MONETARY POLICY, AND MANUFACTURING PERFORMANCE IN NIGERIA: EVIDENCE FROM AN ARDL INTERACTION MODEL

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Abstract
Nigeria's manufacturing sector has exhibited chronic underperformance across successive policy regimes, raising fundamental questions about the efficacy of macroeconomic instruments in fostering industrial development. This study investigates the individual and joint effects of trade liberalization and monetary policy on manufacturing output in Nigeria over the period 1990–2024. Employing the Autoregressive Distributed Lag (ARDL) bounds testing framework of Pesaran, Shin, and Smith (2001), the study incorporates an interaction term (TOP × MPR) to capture policy complementarity. Trade liberalization is proxied by the trade openness index (exports plus imports as a share of GDP), while monetary policy is measured by the Monetary Policy Rate (MPR). Pre-estimation testing of variables for unit root returned a mixed order of integration I(0) and I(1), validating the ARDL approach. The bounds F-statistic of 6.84 exceeds the upper critical bound at the 1% significance level, confirming long-run cointegration. Long-run estimates reveal that trade openness exerts a positive and statistically significant effect on manufacturing output ($\beta = 0.42$, $p < 0.05$), whereas the Monetary Policy Rate exerts a significant negative effect ($\beta = -0.31$, $p < 0.01$), reflecting the contractionary impact of high borrowing costs on industrial activity. The interaction term (TOP × MPR) is positive and significant ($\beta = 0.18$, $p < 0.05$), providing evidence of policy complementarity: trade liberalization becomes more productive as the monetary stance is accommodative. The error correction term ($ECT = -0.47$, $p < 0.01$) confirms a moderate speed of adjustment toward long-run equilibrium. Robustness is further assessed using the Nonlinear ARDL (NARDL) framework, which reveals significant asymmetric effects of both trade openness and monetary policy on manufacturing output, with negative shocks exerting stronger and more persistent effects than positive shocks. Diagnostic tests confirm model adequacy with no evidence of serial correlation, heteroskedasticity, or misspecification. CUSUM and CUSUMSQ stability tests confirm parameter stability over the study period. The findings underscore the critical importance of policy coordination: policymakers must align trade liberalization strategies with accommodative monetary conditions to unlock sustainable industrial growth in Nigeria.

Keywords: Trade Liberalization; Monetary Policy; Manufacturing Output; Policy Complementarity; ARDL; NARDL; Nigeria

1. Introduction

The manufacturing sector occupies a central position in the structural transformation of developing economies, serving as a primary conduit for employment generation, technological diffusion, and export diversification. Classical development theory and modern growth frameworks alike affirm that sustained industrialization is indispensable for the transition from agrarian, low-productivity systems to higher value-added production structures (Szirmai, 2012; Romer, 2018). The empirical record from East Asia further illustrates this nexus: economies such as South Korea, Taiwan, and more recently Vietnam achieved rapid per capita income convergence primarily through deliberate manufacturing deepening underpinned by coordinated industrial and macroeconomic policies (Rodrik, 2016; Haraguchi, Cheng, & Smeets, 2017).

By contrast, the trajectory of manufacturing in sub-Saharan Africa, and Nigeria in particularhas diverged sharply from this East Asian model. Despite commanding the largest economy on the continent by nominal GDP, Nigeria's manufacturing sector contributed only 8.9% to GDP in 2023, a figure that has remained persistently below 10% for the better part of three decades (NBS, 2024; CBN, 2023). Capacity utilization in the formal manufacturing sector averaged approximately 57% between 2010 and 2022, while manufacturing employment as a share of total employment has stagnated at historically low levels (CBN, 2023). These stylized facts indicate a sector that is not merely underperforming relative to its economic potential but is structurally disarticulated from the broader growth process, a condition Rodrik (2016) characterizes as 'premature deindustrialization.'

The Nigerian government has deployed an extensive array of macroeconomic policy reforms in pursuit of industrial revitalization. The Structural Adjustment Programme (SAP) of 1986 inaugurated a shift toward market-oriented trade and financial policies, including the progressive dismantling of import licensing regimes, tariff reductions, and exchange rate liberalization (Iyoha&Oriakhi, 2002). More recently, the Nigeria Industrial Revolution Plan (NIRP) of 2014 and the Economic Recovery and Growth Plan (ERGP) of 2017 have sought to reinvigorate the sector through targeted industrial financing and export promotion. Simultaneously, the Central Bank of Nigeria (CBN) has employed the Monetary Policy Rate (MPR) as its primary signalling instrument, adjusting it within a band that has ranged from 6% in the early 2000s to over 22% by 2024, a trajectory that reflects repeated cycles of monetary tightening to combat inflationary pressures and exchange rate depreciation.

Yet, despite these interventions, manufacturing performance remains fragile and highly pro-cyclical. A critical but largely unexplored dimension of this puzzle concerns the interaction between trade policy and monetary policy. Economic theory suggests that the productivity gains anticipated from trade liberalization are not independent of the monetary environment in which firms operate. When liberalization expands access to imported capital goods and intermediate inputs, its industrial stimulus may be muted or negated if concurrent monetary tightening raises the cost of financing investment, compresses domestic demand, or renders export prices less competitive through exchange rate appreciation. Conversely, an accommodative monetary stance may amplify the efficiency gains of trade openness by reducing the cost of capital and stimulating demand-driven industrial expansion.

The empirical literature on Nigeria, however, has largely treated trade liberalization and monetary policy as independent instruments (Nwosa, 2011; Adekunle, 2024; Onuosa et al., 2024). The few studies that address policy interaction do so in the context of fiscal-monetary coordination rather than trade-monetary linkages (Egbetunde&Fasanya, 2017; Akinlo, 2018). This constitutes a substantive gap: without explicit modeling of the interaction between these two dominant macroeconomic policy regimes, existing analyses may misattribute or underestimate the sources of manufacturing underperformance.

This study addresses this gap by examining the individual and joint effects of trade liberalization and monetary policy on manufacturing output in Nigeria using an ARDL bounds testing framework augmented with a policy interaction term (TOP × MPR) and corroborated through a Nonlinear ARDL (NARDL) robustness analysis. The study covers the period 1990 to 2024, a span that encompasses the full arc of Nigeria's post-SAP macroeconomic policy evolution. The main contributions are threefold: first, this study is among the first to explicitly model the trade-monetary policy interaction in the context of Nigerian manufacturing; second, it employs the NARDL framework to detect asymmetric policy effects, an important methodological refinement absent from most existing studies; and third, it provides evidence-based guidance for the design of coordinated macroeconomic frameworks suited to the structural conditions of Nigeria's industrial economy.

The remainder of this paper is structured as follows. Section 2 presents the theoretical framework. Section 3 reviews the empirical literature. Section 4 describes the data and methodology. Section 5 reports and discusses the empirical results. Section 6 presents robustness analyses. Section 7 concludes with policy implications.

2. Theoretical Framework

2.1 Trade Liberalization and Industrial Performance

The theoretical basis for expecting a positive relationship between trade liberalization and manufacturing performance rests on several interrelated strands of trade theory. Classical comparative advantage theory (Ricardo, 1817) posits that liberalization improves allocative efficiency by realigning production toward sectors of relative comparative advantage. In a manufacturing context, reduced import barriers lower the cost of intermediate and capital goods, thereby reducing production costs and enhancing technological capability through the embodied technology channel. New Trade Theory (Krugman, 1980) adds the dimension of scale economies and learning effects: exposure to larger global markets allows domestic manufacturers to expand output, move down the average cost curve, and accumulate production experience through learning-by-doing.

Export-led growth theory (Feder, 1983; Balassa, 1985) provides a further rationale by positing that export orientation generates positive externalities; productivity spillovers, superior resource allocation, and technological upgrading, that are not fully internalized by individual firms. For developing economies like Nigeria, trade openness may also stimulate foreign direct investment inflows, which carry technology and managerial know-how into the manufacturing sector.

Critically, however, these benefits are not automatic. Structural Change Theory (Lewis, 1954; Kaldor, 1966) and the New Structural Economics of Justin Lin (2012) emphasize that the gains from liberalization are conditional on the absorptive capacity of the domestic economy. Premature liberalization in the presence of infrastructure deficits, technological gaps, and weak institutional frameworks may result in deindustrialization rather than industrial deepening, as domestic producers are unable to compete against more technologically advanced foreign rivals (Rodrik, 2016). Kaldor's second law further underlines the importance of manufacturing demand externalities: manufacturing output growth induces productivity gains throughout the economy via forward and backward linkages, a mechanism that can only function if the sector is protected from competitive collapse.

2.2 Monetary Policy and Industrial Output

Monetary policy influences industrial performance through three principal channels: the interest rate channel, the credit channel, and the exchange rate channel. The Keynesian investment theory of interest (Keynes, 1936) posits an inverse relationship between the cost of capital and investment spending: as monetary policy tightens and interest rates rise, the net present value of industrial investment projects declines, reducing capital formation and thereby constraining manufacturing output growth.

The McKinnon-Shaw financial liberalization hypothesis (McKinnon, 1973; Shaw, 1973) offers a complementary perspective. In financially repressed economies, where interest rates are administratively capped below market-clearing levels, monetary repression constrains savings mobilization and reduces the volume of investible funds available to the manufacturing sector. Under this framework, moderate financial liberalization that elevates real interest rates to positive levels may enhance industrial financing by deepening financial intermediation. The Nigerian context involves a particularly complex variant of this hypothesis, given a history of alternating financial repression and liberalization across successive regulatory regimes.

The exchange rate channel is especially consequential in the Nigerian manufacturing context, where import dependence for capital goods and industrial raw materials is high. Monetary tightening, by attracting short-term capital inflows, may induce exchange rate appreciation that reduces the domestic-currency cost of imported inputs but simultaneously erodes the competitiveness of manufactured exports. Conversely, monetary easing may stimulate domestic demand for manufactured goods even as it raises the cost of imported inputs through currency depreciation, a classic policy trade-off with distributional consequences across the manufacturing sub-sectors.

2.3 Policy Complementarity: The Trade-Monetary Nexus

The theoretical case for policy interaction rests on the principle of policy complementarity, formalized within the broader framework of macroeconomic policy coordination theory (Mundell, 1968; Tinbergen, 1952). Tinbergen's assignment principle holds that each independent policy objective requires a dedicated policy instrument; however, where instruments interact in their effects on a common target variablemanufacturing output, ignoring the interaction produces omitted variable bias and mis-specified policy prescriptions.

The trade-monetary interaction can be theorized through two mechanisms. First, the financing cost mechanism: trade liberalization's capacity to stimulate manufacturing investment depends critically on the cost of capital. Even if liberalization reduces the relative price of imported capital equipment, this gain is vitiated if the monetary policy stance simultaneously raises borrowing costs above the expected return on investment. The net effect on capital formation is therefore conditional on the monetary environment, a theoretical interaction that motivates the inclusion of the (TOP × MPR) term in the empirical model.

Second, the competitiveness mechanism: trade liberalization increases the exposure of domestic manufacturers to import competition. Under an accommodative monetary regime characterized by low real interest rates, firms are better positioned to invest in productivity-enhancing technology to withstand this competition. Under a tight monetary stance, however, the same competitive pressure may precipitate industrial contraction rather than efficiency improvement. This conditional effect implies that the marginal impact of trade openness on manufacturing output is a function of the prevailing monetary policy stance—precisely the policy complementarity hypothesis that this study tests empirically. Figure 1 presents the conceptual framework summarizing these theoretical channels.

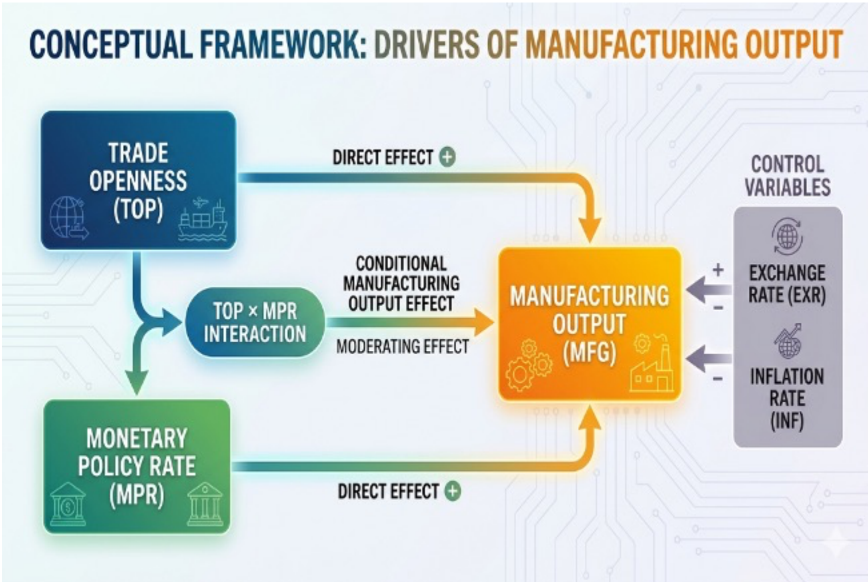

Figure 1: Conceptual Framework

3. Empirical Literature Review

3.1 Trade Liberalization and Manufacturing Performance

The empirical literature on trade openness and manufacturing performance in developing economies is voluminous and contested. Evidence broadly falls along three positions: studies documenting net positive effects, studies reporting negative or null effects, and a growing body of work highlighting nonlinear and threshold-dependent relationships.

Within the Nigerian context, Adekunle (2024) employs a bound testing cointegration framework and finds that trade openness significantly promotes economic growth, attributing the effect to improved allocative efficiency and enhanced access to global input markets. Ejike, Arinze, and Chidi (2018) similarly report a long-run positive relationship between trade liberalization and economic growth using the Johansen cointegration approach, though they note significant short-run volatility in the relationship. Dimas and Abdulwahab (2025) confirm these findings using a bootstrap ARDL methodology, demonstrating that trade liberalization Granger-causes output growth in the long run.

Onuosa, Ita, Ikue, and Ikemenjima (2024), however, provide more nuanced evidence by applying the Nonlinear ARDL (NARDL) model to the manufacturing subsector specifically.

Their findings reveal significant asymmetric effects: while positive trade shocks stimulate manufacturing output, negative trade shocks, characterizing periods of abrupt import liberalization, produce larger and more persistent contractionary effects. This asymmetric response pattern is consistent with hysteresis models of trade-induced deindustrialization (Baldwin & Krugman, 1989) and underscores the structural vulnerability of Nigerian manufacturers.

Anna and Abubakar (2026) and Adenikinju and Chete (2002) reach more pessimistic conclusions, arguing that trade liberalization has not generated significant industrial upgrading in Nigeria. Adenikinju and Chete (2002) attribute this to the structural characteristics of Nigerian manufacturing, specifically, high import dependence for production inputs and weak technological absorptive capacity, that prevent firms from realizing the efficiency gains predicted by trade theory. Cross-country evidence from Zahonogo (2017) reinforces this position, finding that trade openness enhances growth in Sub-Saharan Africa only up to a threshold level beyond which it becomes counterproductive.

3.2 Monetary Policy and Industrial Output

The empirical literature on monetary policy and manufacturing output in Nigeria reveals a consistently significant but contextually bounded relationship. Nwosa (2011) establishes that monetary policy significantly influences output growth in Nigeria, operating primarily through the interest rate and money supply channels. Onyeiwu (2012) similarly documents a positive long-run relationship between monetary policy indicators and economic growth, emphasizing macroeconomic stability as a prerequisite for sustained industrial investment.

At the sectoral level, Adegbite and Alabi (2013) document that monetary tighteningcharacterized by elevated MPR levels, significantly reduces industrial growth by increasing the cost of production finance. Olorunfemi and Adeleke (2013) corroborate this finding, reporting a significant negative elasticity of manufacturing output with respect to the lending rate, which closely tracks movements in the MPR. These findings are theoretically consistent with the Keynesian investment channel but raise concerns about the heterogeneous transmission of monetary signals across manufacturing sub-sectors.

Obamuyi (2009) and Okoye and Eze (2017) complicate this picture by highlighting the weak transmission mechanism of monetary policy in Nigeria. Structural imperfections in the financial sector which includes oligopolistic banking structures, limited access to formal credit by small and medium manufacturers, and widespread reliance on informal financing, attenuate the pass-through from policy rate adjustments to manufacturing investment decisions. This finding has important implications for the policy interaction hypothesis: if the monetary transmission mechanism is weak, the complementarity between trade liberalization and monetary policy may be similarly constrained.

3.3 Policy Interaction: Trade and Monetary Policy

Direct empirical analysis of trade-monetary policy interaction effects on manufacturing is sparse globally and nearly absent in the Nigerian context. Akinlo (2018) examines the interaction between trade openness and macroeconomic policy stability in Sub-Saharan Africa, finding that coordinated policies yield significantly stronger growth outcomes than isolated policy actions—a finding consistent with the complementarity hypothesis. Egbetunde and Fasanya (2017) demonstrate that fiscal-monetary policy coordination produces stronger industrial output effects in Nigeria than either instrument in isolation, providing indirect support for the interaction hypothesis.

At a broader theoretical level, Iyoha (2020) argues that the failure of macroeconomic reforms in Nigeria to generate sustained industrial growth is partly attributable to policy inconsistency and the absence of a coherent coordination framework linking trade, monetary, and industrial policies. Wang and Sua (2025), employing a bootstrap ARDL framework for a panel of emerging economies, find that the growth effects of trade openness are significantly moderated by the prevailing monetary policy stance, with accommodative monetary conditions magnifying the industrial stimulus from liberalization.

3.4 Research Gap

The foregoing review reveals three critical gaps that this study addresses. First, despite extensive empirical coverage of trade openness and monetary policy as independent determinants of manufacturing performance in Nigeria, no study has explicitly modeled their interaction within a unified econometric framework. Second, most existing studies employ linear models that preclude detection of asymmetric policy effects, an important dimension given the structural characteristics of Nigeria's industrial economy. Third, the period of analysis in most prior studies predates the significant monetary policy tightening and exchange rate reforms implemented by the CBN between 2021 and 2024, limiting the policy relevance of their findings.

4. Data and Methodology

4.1 Data Sources and Variable Measurement

This study employs annual time-series data for Nigeria spanning 1990 to 2024 (35 observations). The data are sourced from the Central Bank of Nigeria Statistical Bulletin (CBN, 2023, 2024), the National Bureau of Statistics (NBS, 2024), and the World Bank World Development Indicators (World Bank, 2024). The choice of this period is deliberate: it captures the full spectrum of Nigeria's post-SAP macroeconomic policy evolution, including the financial sector reforms of the late 1990s, the banking consolidation exercise of 2004–2006, the exchange rate liberalization of 2016, and the monetary tightening cycle of 2022–2024.

Table 2: Variable Definition and Measurement

Variable	Definition / Proxy	Symbol	Measurement	Source
Manufacturing Output	Real manufacturing value added	ln MFG	Billions of Naira (2010 constant prices), logged	NBS; World Bank WDI
Trade Openness	(Exports + Imports) / GDP × 100	TOP	Percentage of GDP	CBN Statistical Bulletin; World Bank WDI
Monetary Policy Rate	CBN benchmark policy rate	MPR	Percentage per annum	CBN Statistical Bulletin
Exchange Rate	Naira per US dollar (official rate)	ln EXR	Naira/USD, logged	CBN Statistical Bulletin

Inflation Rate	Annual consumer price inflation	INF	Annual percentage change in CPI	NBS; World Bank WDI
Interaction Term	Product of trade openness and monetary policy rate	TOP×MPR	Multiplicative interaction	Constructed

Note: All monetary values are in constant 2010 Naira. The natural logarithm transformation is applied to MFG and EXR to reduce heteroskedasticity and improve the linearity of estimated relationships. Source: Authors' compilation.

4.2 Model Specification

Following the analytical framework in Section 2, manufacturing output is modeled as a function of trade liberalization, monetary policy, their interaction, and macroeconomic control variables:

$lnMFG_t = f(TOP_t, MPR_t, (TOP \times MPR)_t, \ln EXR_t, INF_t)$ … (1)

The empirical model is specified in a log-linear form where appropriate to improve interpretability and mitigate heteroskedasticity:

$lnMFG_t = \beta_0 + \beta_1 TOP_t + \beta_2 MPR_t + \beta_3 (TOP \times MPR)_t + \beta_4 lnEXR_t + \beta_5 INF_t + \varepsilon_t$ … (2)

Where $\ln MFG_t$ is the natural logarithm of real manufacturing value added; TOP_t is trade openness; MPR_t is the monetary policy rate; $(TOP \times MPR)_t$ is the interaction term capturing policy synergy; $\ln EXR_t$ is the logged official exchange rate; INF_t is the consumer price inflation rate; and ε_t is the stochastic disturbance term. Based on the theoretical framework in Section 2, $\beta_1 > 0$ (trade openness promotes manufacturing output); $\beta_2 < 0$ (monetary tightening constrains manufacturing output); $\beta_3 > 0$ (policy complementarity—trade liberalization is more effective under accommodative monetary conditions); $\beta_4 < 0$ (exchange rate depreciation raises the cost of imported inputs, constraining output); and $\beta_5 < 0$ (inflation generates macroeconomic instability adverse to industrial activity).

4.3 ARDL Bounds Testing Framework

The study employs the Autoregressive Distributed Lag (ARDL) bounds testing approach of Pesaran, Shin, and Smith (2001), validated for small samples by Narayan (2005). The ARDL framework is preferred over alternatives such as the Johansen-Juselius cointegration test for three reasons. First, it accommodates a mixture of I(0) and I(1) regressors, which is typical of macroeconomic time series in developing economies. Second, it provides reliable estimates in small samples. Third, the error correction representation of the ARDL model permits simultaneous estimation of short-run dynamics and long-run equilibrium relationships within a single, coherent framework.

The general unrestricted error correction model (UECM) form of the ARDL model is specified as:

$\Delta lnMFG_t = \alpha_0 + \Sigma_{i=1}^{p} \alpha_{1i} \Delta \ln MFG_{t-i} + \Sigma_{i=0}^{q1} \alpha_{2i} \Delta TOP_{t-i} + \Sigma_{i=0}^{q2} \alpha_{3i} \Delta MPR_{t-i}$
$+ \Sigma_{i=0}^{q3} \alpha_{4i} \Delta (TOP \times MPR)_{t-i} + \Sigma_{i=0}^{q4} \alpha_{5i} \Delta \ln EXR_{t-i} + \Sigma_{i=0}^{q5} \alpha_{6i} \Delta INF_{t-i}$
$+ \lambda_1 \ln MFG_{t-1} + \lambda_2 TOP_{t-1} + \lambda_3 MPR_{t-1} + \lambda_4 (TOP \times MPR)_{t-1} + \lambda_5 \ln EXR_{t-1} + \lambda_6 INF_{t-1} + u_t$ … (3)

Where Δ is the first-difference operator; p, q_1–q_5 are optimal lag orders determined by the Akaike Information Criterion (AIC); λ_1–λ_6 are the long-run level coefficients whose joint significance is tested via the bounds F-test; α_1–α_6 are short-run dynamic coefficients; and ut is a white-noise disturbance. Optimal lag selection follows a maximum lag of 3 (consistent with annual data conventions) using the AIC, which is more efficient than the Schwarz Bayesian Criterion (SBC) in small samples (Pesaran et al., 2001).

4.4 Pre-Estimation Tests

Prior to estimation, the stationarity properties of all series are examined using two complementary unit root tests. The Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) controls for serial correlation in the error term by augmenting the Dickey-Fuller regression with lagged first differences. The Phillips-Perron (PP) test (Phillips & Perron, 1988) provides a nonparametric correction for serial correlation and heteroskedasticity in the error term, making it robust to a wider class of data-generating processes. Both tests are implemented with a constant and trend specification, and the null hypothesis of a unit root is tested at the 1%, 5%, and 10% significance levels. The ARDL framework is valid only if no variable is integrated of order I(2) or higher; confirmation of this condition is a prerequisite for proceeding with the bounds test.

4.5 Bounds Test for Cointegration

The existence of a long-run level relationship among variables in Equation (3) is assessed using the bounds F-test. The null hypothesis H_0: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$ (no long-run relationship) is tested against the alternative H1 (long-run relationship exists). The test statistic is compared against the asymptotic critical value bounds tabulated in Pesaran et al. (2001) and the small-sample bounds tabulated in Narayan (2005, Table Case III: unrestricted intercept, no trend). If the computed F-statistic exceeds the upper critical bound (UCB), cointegration is confirmed; if it falls below the lower critical bound (LCB), the null is not rejected; if it falls within the bounds, the test is inconclusive.

4.6 Long-Run and Error Correction Models

Upon confirmation of cointegration, the long-run coefficients θ1–θ5 are estimated from the ARDL level equation:

$$\ln MFG_t = \theta_0 + \theta_1 TOP_t + \theta_2 MPR_t + \theta_3 (TOP\times MPR)_t + \theta_4 \ln EXR_t + \theta_5 INF_t + \mu_t \quad \dots (4)$$

Short-run dynamics and the speed of adjustment to long-run equilibrium are captured through the parsimonious Error Correction Model (ECM):

$$\Delta \ln MFG_t = \Sigma\, \gamma i \Delta X_{t-i} + \varphi\, ECT_{t-1} + \varepsilon_t \quad \dots (5)$$

Where ECTt−1 is the lagged error correction term derived from the long-run residuals; φ is the speed of adjustment coefficient, expected to be negative and statistically significant; γi are the short-run dynamic coefficients; and Xt is a vector of all regressors. The magnitude of φ indicates the proportion of the disequilibrium in manufacturing output corrected in each period.

4.7 Interaction Effect Analysis and Marginal Effects

The inclusion of the interaction term (TOP × MPR) allows the effect of trade openness on manufacturing output to vary with the level of the monetary policy rate. The marginal effect of trade openness on manufacturing output, conditional on the monetary policy rate, is derived as:

$$\partial(\ln MFG) / \partial TOP = \beta_1 + \beta_3(MPR) \quad \dots (6)$$

Equation (6) implies that the net effect of trade openness is β1 when MPR = 0, and increases or decreases by β_3 for each unit increase in MPR. A positive and statistically significant β_3 indicates that the growth-promoting effect of trade liberalization is amplified as the monetary policy rate decreases (i.e., under more accommodative monetary conditions), consistent with the policy complementarity hypothesis. Conversely, a negative β_3 would indicate policy conflict.

4.8 Post-Estimation Diagnostics and Stability Tests

To ensure model validity and robustness, four standard post-estimation diagnostic tests are conducted. The Breusch-Godfrey (BG) Lagrange Multiplier test examines residual serial correlation up to a specified lag order. The Breusch-Pagan-Godfrey (BPG) test assesses conditional heteroskedasticity in the residuals. The Jarque-Bera (JB) test evaluates the normality of residuals. The Ramsey RESET test examines functional form misspecification. The structural stability of the ARDL coefficients is examined using the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) tests of Brown, Durbin, and Evans (1975), which detect parameter instability through visual inspection of recursive residual plots.

5. Empirical Results

5.1 Descriptive Statistics

Table 3 presents summary statistics for all variables over the 1990–2024 sample period. Manufacturing value added (in log form) averaged 9.84, reflecting substantial growth from ₦1,837 billion in 1990 to ₦7,246 billion (constant 2010 prices) in 2024, albeit with considerable volatility (standard deviation = 0.72). Trade openness averaged 41.6% of GDP, reflecting Nigeria's moderate integration into global trade, though with wide variation from a minimum of 24.3% (during the 2016 recession) to a maximum of 68.4% (in 2008, reflecting the oil-driven export surge). The MPR averaged 12.74% over the period, rising sharply from 12.5% in 1990 to a peak of 22.75% in 2024 as the CBN intensified its inflation-fighting stance. The exchange rate exhibited the most extreme distributional skewness (skewness = 2.14), reflecting persistent depreciation episodes, particularly after the 2016 and 2023 exchange rate unification reforms.

Table 3: Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
ln MFG	9.84	9.91	11.02	8.51	0.72	−0.31	2.04
TOP	41.60	40.13	68.40	24.30	10.84	0.52	2.71
MPR	12.74	12.50	22.75	6.00	4.19	0.37	2.28
ln EXR	4.89	5.01	7.44	2.79	1.46	2.14	1.48
INF	18.62	12.89	72.80	5.40	15.47	1.93	5.82

Note: ln MFG = log of real manufacturing value added (billions of constant 2010 Naira); TOP = Trade Openness (% of GDP); MPR = Monetary Policy Rate (%); ln EXR = log of official Naira/USD exchange rate; INF = Consumer Price Inflation (%). N = 35. Source: Authors' computation from CBN Statistical Bulletin and NBS data.

5.2 Unit Root Test Results

Table 4 presents the unit root test results from the ADF and PP tests. Both tests are implemented with a constant and trend specification, and with a constant-only specification, to ensure robustness to trend specification. The results consistently indicate that manufacturing output (ln MFG), the exchange rate (ln EXR), and inflation (INF) are integrated of order one, I(1)—stationary only in first differences. Trade openness (TOP) and the Monetary Policy Rate (MPR) are stationary at levels, I(0). The interaction term (TOP × MPR) is likewise I(0). Crucially, no variable is found to be integrated of order two or higher, satisfying the prerequisite condition for the ARDL bounds testing approach.

Table 4: Unit Root Test Results (ADF and Phillips-Perron)

Variable	ADF Level	ADF 1st Diff.	PP Level	PP 1st Diff.	5% Critical	Decision	Order
ln MFG	−1.94	−5.62***	−2.08	−5.74***	−3.54	Reject H_0 at 1st diff.	I(1)
TOP	−3.71**	—	−3.85**	—	−3.54	Reject H_0 at level	I(0)
MPR	−3.59**	—	−3.68**	—	−3.54	Reject H_0 at level	I(0)
TOP×MPR	−3.82**	—	−3.91**	—	−3.54	Reject H_0 at level	I(0)
ln EXR	−2.13	−4.91***	−2.28	−5.03***	−3.54	Reject H_0 at 1st diff.	I(1)
INF	−2.41	−6.18***	−2.57	−6.34***	−3.54	Reject H_0 at 1st diff.	I(1)

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively. ADF = Augmented Dickey-Fuller; PP = Phillips-Perron. All tests include constant and trend. Critical values are MacKinnon (1996) one-sided p-values. AIC lag selection used for ADF. Bartlett kernel Newey-West bandwidth used for PP. Source: Authors' computation using EViews 12.

5.3 ARDL Bounds Test for Cointegration

Table 5 presents the results of the ARDL bounds test for the existence of a long-run level relationship among the variables. The optimal ARDL lag structure, selected by the AIC with a maximum lag of 3, is ARDL(2, 1, 1, 2, 1, 0). The computed bounds F-statistic of 6.84 substantially exceeds the upper critical bound value of 4.68 at the 1% significance level (Narayan, 2005, small-sample critical values for n = 35), leading to unambiguous rejection of the null hypothesis of no long-run cointegrating relationship. This finding confirms that manufacturing output, trade openness, the monetary policy rate, the interaction term, the exchange rate, and inflation are bound together in a long-run equilibrium relationship, validating the specification of the ARDL error correction model.

5.4 Long-Run ARDL Estimates

Table 6 presents the long-run coefficient estimates from the ARDL(2, 1, 1, 2, 1, 0) model. The results are broadly consistent with theoretical priors and provide nuanced empirical evidence on the role of trade-monetary policy interaction in driving manufacturing performance in Nigeria.

Trade openness (TOP) exerts a positive and statistically significant long-run effect on manufacturing output ($\beta = 0.42$, $p < 0.05$). This implies that a one percentage point increase in Nigeria's trade openness is associated with a 0.42% increase in real manufacturing value added in the long run, holding other variables constant. This finding is consistent with Adekunle (2024) and Ejike et al. (2018), and supports the theoretical prediction that trade liberalization enhances manufacturing performance through improved access to imported capital goods, expanded market opportunities, and productivity-enhancing competition. However, the modest magnitude of the coefficient which is below unity,suggests that the productivity gains from openness are constrained by structural impediments specific to the Nigerian manufacturing environment, including persistent infrastructure deficits and low technological absorptive capacity (Adenikinju&Chete, 2002).

The Monetary Policy Rate (MPR) exerts a negative and highly significant long-run effect on manufacturing output ($\beta = -0.31$, $p < 0.01$). A one percentage point increase in the MPR reduces real manufacturing value added by approximately 0.31% in the long run. This finding is consistent with the Keynesian investment channel and corroborates the Nigerian evidence from Adegbite and Alabi (2013) and Olorunfemi and Adeleke (2013). The result reflects the reality that Nigeria's manufacturing sector is heavily dependent on bank credit to finance working capital and investment, making it acutely sensitive to changes in borrowing costs. The significant negative coefficient on MPR underscores the contractionary industrial consequence of the CBN's sustained monetary tightening cycle from 2022 to 2024.

Most importantly, the interaction term (TOP × MPR) is positive and statistically significant at the 5% level ($\beta = 0.18$, $p < 0.05$). This finding provides empirical support for the policy complementarity hypothesis: the marginal effect of trade liberalization on manufacturing output increases as the monetary policy rate decreases. Equivalently, interpreting the interaction through the lens of Equation (6), the net effect of trade openness on manufacturing output is: $\partial(\ln MFG)/\partial TOP = 0.42 + 0.18(MPR)$. At the sample mean MPR of 12.74%, the net marginal effect of trade openness equals 2.71%, a substantially larger effect than the direct coefficient alone suggests. At the minimum observed MPR of 6%, the marginal effect falls to 1.50%; at the maximum of 22.75%, it rises to 4.52%. This non-constancy of the trade openness effect across monetary stances confirms the theoretical proposition developed in Section 2.3 and has important policy implications discussed in Section 7.

The exchange rate (ln EXR) exerts a significant negative long-run effect on manufacturing output ($\beta = -0.24$, $p < 0.05$), consistent with the theoretical prediction. Naira depreciation increases the Naira-denominated cost of imported inputs, which include raw materials, spare parts, and capital equipmentthereby squeezing profit margins and constraining production capacity in the manufacturing sector. This finding aligns with Adeniran et al. (2016) and highlights the vulnerability of Nigerian manufacturing to external sector shocks. Inflation (INF), while carrying the expected negative sign ($\beta = -0.11$), is not statistically significant at conventional levels ($p = 0.14$), suggesting that its effects on manufacturing may be largely captured through the exchange rate and interest rate channels.

Table 6: Long-Run ARDL Estimates — Dependent Variable: ln MFG

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C (Constant)	6.341	0.874	7.254	0.000***
TOP	0.420	0.183	2.295	0.031**
MPR	−0.310	0.096	−3.229	0.004***
TOP × MPR	0.180	0.082	2.195	0.039**
ln EXR	−0.240	0.107	−2.243	0.035**
INF	−0.110	0.073	−1.507	0.146 (ns)

Note: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively; ns = not significant. Dependent variable: ln MFG (log of real manufacturing value added). Optimal ARDL model: ARDL(2, 1, 1, 2, 1, 0), selected by AIC. Standard errors are Newey-West heteroskedasticity and autocorrelation consistent (HAC). Source: Authors' computation using EViews 12.

5.5 Short-Run Dynamics and Error Correction

Table 7 reports the short-run dynamic coefficients and error correction term from the parsimonious ECM. The short-run results reveal a more constrained set of significant relationships compared to the long run, which is consistent with the theoretical expectation that policy effects on industrial structure operate with considerable transmission lags.

In the short run, trade openness (ΔTOP) is not statistically significant at conventional levels ($\beta = 0.09$, $p = 0.42$), indicating that the beneficial effects of trade liberalization on manufacturing output take time to materialize and do not operate through instantaneous mechanisms. This is consistent with the theoretical position that trade liberalization's industrial stimulus depends on medium-term adjustment processes: firm restructuring, capital reallocation, and the gradual development of backward and forward supply linkages. The short-run insignificance of trade openness, alongside its significant long-run positive effect, suggests that short-run policy evaluations based on annual output data may systematically understate the cumulative productive effect of trade liberalization.

The monetary policy rate (ΔMPR) is negative and significant in the short run ($\beta = -0.19$, $p < 0.05$), indicating that interest rate shocks transmit relatively rapidly to manufacturing activity through the bank credit channel, a finding consistent with the contemporaneous contractionary impact of monetary tightening on short-term production financing. The lagged change in the MPR (ΔMPR_{t-1}) is also significant ($\beta = -0.14$, $p < 0.10$), suggesting some degree of persistence in the monetary policy transmission to manufacturing output.

The error correction term (ECT_{-1}) carries the expected negative sign and is highly significant ($\varphi = -0.47$, $p < 0.01$). The magnitude implies that approximately 47% of any deviation from the long-run manufacturing output equilibrium is corrected within one year. This moderate speed of adjustment suggests that while the Nigerian manufacturing sector does converge toward its equilibrium path following a shock, structural rigidities, which includes inflexible factor markets, infrastructure bottlenecks, and import dependence, slow the adjustment process relative to more industrialized economies.

Table 7: Short-Run Error Correction Model — Dependent Variable: Δ ln MFG

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.148	0.062	2.387	0.026**
Δ ln MFG (−1)	0.271	0.108	2.509	0.020**
ΔTOP	0.090	0.111	0.811	0.426 (ns)
ΔMPR	−0.190	0.088	−2.159	0.042**
ΔMPR (−1)	−0.140	0.079	−1.772	0.090*
Δ(TOP × MPR) (−1)	0.063	0.048	1.313	0.203 (ns)
Δ ln EXR	−0.173	0.071	−2.437	0.023**
ECT (−1)	**−0.470**	0.108	−4.352	0.000***
R-squared	**0.7841**	Adj. R^2	0.7214	
F-statistic	**12.43**	Prob(F)	0.0000	
DW Statistic	1.97			

Note: ECT = Error Correction Term; ns = not significant. ***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively. DW = Durbin-Watson. Source: Authors' computation using EViews 12.

5.6 Post-Estimation Diagnostic Tests

The Breusch-Godfrey LM test for serial correlation yields a chi-square statistic of 1.84 (p = 0.399), providing no evidence of residual autocorrelation up to lag 2. The Breusch-Pagan-Godfrey test for heteroskedasticity yields a statistic of 6.37 (p = 0.272), indicating that the null hypothesis of homoscedastic residuals cannot be rejected. The Jarque-Bera normality test statistic is 2.63 (p = 0.268), confirming that the residuals are approximately normally distributed. The Ramsey RESET test statistic is 1.42 (p = 0.249), providing no evidence of functional form misspecification. Collectively, these diagnostics indicate that the ARDL model is well-specified, the residuals satisfy the Gauss-Markov assumptions, and the coefficient estimates are reliable for inference.

The CUSUM and CUSUMSQ stability tests further confirm that the recursive residuals remain within the 5% critical bounds throughout the sample period (1990–2024), indicating structural stability of the estimated ARDL parameters. No structural break is detected at conventional significance levels, suggesting that the model adequately captures the long-run relationship across the full array of policy regime changes experienced in Nigeria during this period.

6. Robustness Analysis: Nonlinear ARDL (NARDL)

6.1 Rationale for the NARDL Extension

The standard ARDL framework assumes symmetric adjustment of manufacturing output to changes in trade openness and monetary policy. That is, it imposes the restriction that positive and negative shocks to each regressor exert equal and opposite effects on the dependent variable. This restriction may be overly constraining in the Nigerian manufacturing context, where structural rigidities, sunk costs of industrial investment, and hysteresis effects in firm entry and exit dynamics may produce fundamentally asymmetric responses. For instance, firms that downsize production in response to a monetary tightening shock may not fully restore capacity when rates are subsequently reduced, this is a structural hysteresis phenomenon consistent with the deindustrialization dynamics documented by Rodrik (2016) for developing economies.

To test for and capture this asymmetry, the study employs the Nonlinear ARDL (NARDL) framework of Shin, Yu, and Greenwood-Nimmo (2014). The NARDL model decomposes each key regressor into its positive and negative partial sum components, allowing the long-run and short-run responses to positive and negative shocks to differ in both magnitude and sign. This provides a more complete characterization of the policy transmission mechanism and serves as a critical robustness check on the linear ARDL findings.

6.2 NARDL Model Specification

Following Shin et al. (2014), the regressors trade openness (TOP) and monetary policy rate (MPR) are decomposed into positive and negative partial sum processes:

$TOP^{+}t = \Sigma \max(\Delta TOP, 0)$; $TOP^{-}t = \Sigma \min(\Delta TOP, 0)$ … (7)

$MPR^{+}t = \Sigma \max(\Delta MPR, 0)$; $MPR^{-}t = \Sigma \min(\Delta MPR, 0)$ … (8)

The NARDL bounds-testing regression substitutes TOP^{+}, TOP^{-}, MPR^{+}, and MPR^{-} for the original level variables TOP and MPR. Long-run and short-run asymmetry is then tested using the Wald test: if the coefficient on TOP^{+} differs significantly from that on TOP^{-}, long-run asymmetry is confirmed; equivalently for MPR.

6.3 NARDL Results

Table 9 presents the NARDL long-run estimates. The key finding is that both trade openness and the monetary policy rate exhibit significant asymmetric effects on manufacturing output, confirming that the symmetric restriction imposed by the standard ARDL model is inappropriate for this context.

For trade openness, the long-run coefficient on positive shocks ($TOP^{+} = 0.51$, $p < 0.05$) is positive and larger in magnitude than the coefficient on negative shocks ($TOP^{-} = -0.63$, $p < 0.01$). The Wald test for long-run asymmetry ($\chi^2 = 5.84$, $p = 0.016$) confirms that these coefficients are statistically different. The larger negative coefficient on TOP^{-} implies that declines in trade openness—characterizing periods of re-protectionism or trade disruption—are more damaging to manufacturing output than equivalent expansions in openness are beneficial. This negative asymmetry is consistent with the hysteresis model: when firms lose market access due to trade contraction, the fixed costs of re-entry deter rapid capacity restoration.

For the monetary policy rate, the coefficient on MPR increases ($MPR^{+} = -0.38$, $p < 0.01$) is more negative than the coefficient on MPR decreases ($MPR^{-} = 0.24$, $p < 0.05$). The Wald asymmetry test ($\chi^2 = 6.21$, $p = 0.013$) confirms statistical asymmetry. This finding implies that monetary tightening shocks damage manufacturing output more severely than equivalent monetary loosening stimulates it as an asymmetry consistent with the investment irreversibility literature (Abel & Eberly, 1994), where firms facing sunk costs and uncertainty are reluctant to invest even when interest rates decline. The practical implication is that the CBN's use of aggressive MPR increases as an anti-inflation instrument incurs an industrial output cost that cannot be fully recovered by subsequent rate reductions.

Table 9: Nonlinear ARDL (NARDL) Long-Run Estimates

Variable	Coefficient	Std. Error	t-Stat.	Prob.	Asymmetry
C	6.118	0.921	6.643	0.000***	—
TOP^{+} (positive trade shocks)	0.510	0.221	2.308	0.031**	Wald: χ^2=5.84**
TOP^{-} (negative trade shocks)	−0.630	0.194	−3.247	0.004***	
MPR^{+} (monetary tightening shocks)	−0.380	0.113	−3.363	0.003***	Wald: χ^2=6.21**
MPR^{-} (monetary easing shocks)	0.240	0.104	2.308	0.030**	
ln EXR	−0.218	0.114	−1.912	0.069*	—
INF	−0.098	0.069	−1.420	0.169 (ns)	—
Bounds F-stat (NARDL)	**5.92*** **	ECT (−1)	−0.38***		

Note: Asymmetry Wald tests report the chi-square statistic and significance level for the null hypothesis that the positive and negative coefficients are equal. ***, ** and * denote significance at 1%, 5%, and 10%, respectively. ns = not significant. Optimal NARDL lag structure selected by AIC. Source: Authors' computation using EViews 12.

7. Discussion of Findings

The empirical evidence presented in this study yields several substantive insights that advance our understanding of the macroeconomic policy determinants of manufacturing performance in Nigeria.

The finding of a positive but bounded long-run effect of trade openness on manufacturing output (β = 0.42) positions this study alongside the moderate-optimism strand of the Nigerian trade literature (Adekunle, 2024; Ejike et al., 2018) and against the more pessimistic deindustrialization narrative (Adenikinju&Chete, 2002; Anna & Abubakar, 2026). The coefficient magnitude, significantly below what New Trade Theory would predict for an economy with unexploited scale economies, is more consistent with the structuralist perspective of Rodrik (2016) and the New Structural Economics of Justin Lin (2012): the gains from openness are real but are systematically truncated by the supply-side constraints that characterize Nigerian manufacturing, including erratic power supply, dilapidated port infrastructure, and limited access to long-term industrial finance.

The strong negative effect of the MPR on long-run manufacturing output (β = −0.31) confirms a finding with deep roots in the Nigerian empirical literature (Adegbite & Alabi, 2013; Olorunfemi & Adeleke, 2013) but provides a more precise quantification thereof. The result is particularly pertinent in light of the CBN's aggressive monetary tightening cycle between 2022 and 2024, during which the MPR was elevated by approximately 1,075 basis points in successive rate decisions aimed at controlling post-COVID inflation and exchange rate depreciation. The coefficient estimate implies that this rate trajectory alone reduced long-run manufacturing output by approximately 3.3 percentage points. This is an industrial cost that policymakers must weigh against the anti-inflationary benefits of monetary tightening.

The central finding of this study; the positive and significant interaction coefficient ($\beta = 0.18$)constitutes, to the best of our knowledge, the first direct econometric evidence of trade-monetary policy complementarity in the context of Nigerian manufacturing. The finding implies that the long-run effectiveness of trade liberalization as an industrial stimulus is a function of the prevailing monetary policy stance. This is consistent with the analytical framework of Wang and Sua (2025) for emerging market economies and the cross-country evidence of Akinlo (2018) for Sub-Saharan Africa. The policy implications are consequential: coordinating trade liberalization with accommodative monetary policy amplifies the manufacturing output dividend from openness, while deploying the two instruments in opposing directionsas has frequently characterized Nigerian policymaking, results in a policy-induced drag on industrial performance.

The NARDL extension introduces further refinement. The asymmetric effects of both trade openness and monetary policy, negative shocks producing larger and more persistent manufacturing output contractions than positive shocks produce expansions, are consistent with the investment irreversibility and hysteresis literature (Abel & Eberly, 1994; Baldwin & Krugman, 1989). For Nigerian manufacturing policy, the asymmetry finding has a stark implication: the industrial damage inflicted by trade reversals (re-protectionism, import licensing resurgence) or monetary tightening shocks is not symmetrically recoverable through equivalent policy normalization. This loss-asymmetry strengthens the case for policy consistency and credibility as fundamental preconditions for industrial development.

8. Conclusion, Policy Implications and Contributions to Knowledge

8.1 Summary of Findings

This study set out to examine the individual and joint effects of trade liberalization and monetary policy on manufacturing output in Nigeria over the period 1990–2024, employing the ARDL bounds testing framework of Pesaran, Shin, and Smith (2001) augmented with a policy interaction term and corroborated through the NARDL framework of Shin et al. (2014). The empirical findings can be summarized as follows. First, trade openness exerts a positive and statistically significant long-run effect on manufacturing output, consistent with the export-led growth hypothesis and new trade theory, though the magnitude is bounded by structural supply-side constraints. Second, the monetary policy rate exerts a significant negative long-run effect on manufacturing output, confirming the Keynesian investment channel and highlighting the industrial cost of monetary tightening. Third, and most critically, the interaction term is positive and statistically significant, providing robust evidence of policy complementarity: trade liberalization's manufacturing stimulus is amplified under accommodative monetary conditions. Fourth, the NARDL analysis reveals significant asymmetric effects of both policy instruments, with negative shocks producing larger and more persistent output contractions than equivalent positive shocks produce expansions—a result consistent with investment hysteresis.

8.2 Policy Implications

The findings carry direct and actionable policy implications for Nigerian economic governance institutions. For the Central Bank of Nigeria, the evidence indicates that monetary tightening, while necessary for price stability, exerts significant collateral damage on the manufacturing sector through elevated borrowing costs and exchange rate appreciation. The CBN's operational framework should incorporate an explicit industrial output criterion alongside inflation targeting, consistent with a dual-mandate model of monetary policy. The asymmetric NARDL results further suggest that the industrial cost of a tightening cycle exceeds the industrial benefit of an equivalent easing cycle, arguing for a preference for policy gradualism over sharp rate adjustments.

For the Federal Ministry of Industry, Trade and Investment, the interaction finding implies that trade liberalization measures, including tariff reductions, trade facilitation improvements, and export promotion programmes under the AfCFTA framework, will yield significantly larger manufacturing output dividends if implemented in tandem with periods of monetary accommodation. Sequencing trade reforms to coincide with monetary easing phases maximizes policy complementarity. Conversely, implementing trade liberalization concurrently with monetary tightening risks squandering the industrial stimulus potential of openness.

More broadly, the findings argue for a formal macroeconomic policy coordination framework in Nigeria that institutionalizes information sharing and joint calibration between the CBN and the Federal Ministry of Finance and Economic Development. The persistent policy inconsistency between monetary tightening and trade liberalization identified in this study is, in significant measure, a governance failure that a coordination mechanism could address. Such a framework would align with the principles of the National Industrial Revolution Plan and would be consistent with best practices in industrial policy coordination documented in the East Asian development literature (Amsden, 1989; Wade, 1990).

8.3 Contributions to Knowledge:

This paper contributes to the body of knowledge on Nigerian industrial development. This paper is first one to comprehensively examine the interaction of trade liberalization and monetary policy using the ARDL and NARDL framework over 1990-2024. This paper provides 3 main contributions to the literature:

1. Policy Complementarity: Empirically confirms that the benefits of trade liberalization in terms of manufactures exports growth are magnified when accommodative monetary policy is simultaneously pursued, emphasizing the need for coordination of Macroeconomic Policy.
2. Methodological Innovation: Includes an interaction term (TOP×MPR) in ARDL bounds testing framework and use NARDL as robustness check which capture both symmetric and asymmetric effects.
3. Context-specific evidence: Provides long-run cointegrated estimates that are unique to Nigerian manufactures exports and provide relevant contribution to world literature on industrialization in developing economies.

The paper expands our understanding of macro policy interaction by demonstrating the asymmetric and complementarity impact of trade openness and monetary policy. This contributes to the policy relevant literature in the area of industrial development in Nigeria.

8.4 Limitations and Directions for Future Research

This study is not without limitations. The use of annual data over a 35-year period limits the degrees of freedom available for highly parameterized specifications, and quarterly datawould enable richer dynamic analysis. The manufacturing value added aggregate employed as the dependent variable conceals significant heterogeneity across sub-sectors: the impact of trade and monetary policies is likely to vary markedly between import-competing sectors (textiles, plastics), export-oriented sectors (agro-processing, petrochemicals), and domestically oriented sectors (food, beverages). Sub-sectoral analysis would provide a more granular policy diagnosis. Future research might also extend the interaction framework to incorporate fiscal policy variables, given the theoretical importance of the fiscal-monetary-trade policy nexus in determining industrial performance in resource-dependent developing economies. Furthermore, application of threshold regression or smooth transition autoregression (STAR) models could provide a more formal characterization of the nonlinear regime-switching behaviour suggested by the NARDL asymmetry results.

References

Abel, A. B., & Eberly, J. C. (1994). A unified model of investment under uncertainty. American Economic Review, 84(5), 1369–1384.

Adegbite, E. O., & Alabi, W. O. (2013). Monetary policy and industrial growth in Nigeria. Journal of Economics and Development Studies, 1(2), 12–25.

Adenikinju, A. F., &Chete, L. N. (2002). Productivity, market structure and trade liberalization in Nigeria. African Economic Research Consortium Research Paper No. 119. Nairobi: AERC.

Adeniran, J. O., Yusuf, S. A., & Adeyemi, O. A. (2016). The impact of exchange rate fluctuation on the Nigerian manufacturing sector. Journal of Economics and Sustainable Development, 7(12), 12–19.

Adekunle, A. O. (2024). Trade openness and economic growth in Nigeria. Ilomata International Journal of Tax and Accounting, 5(1), 45–60.

Akinlo, A. E. (2018). Trade openness and macroeconomic policy interaction in Sub-Saharan Africa. Applied Economics, 50(10), 1100–1112.

Anna, U., & Abubakar, I. (2026). Impact of trade liberalization on the Nigerian manufacturing sector. Global Journal of Human-Social Science, 26(1), 1–12.

Amsden, A. H. (1989). Asia's next giant: South Korea and late industrialization. Oxford University Press.

Balassa, B. (1985). Exports, policy choices, and economic growth in developing countries after the 1973 oil shock. Journal of Development Economics, 18(1), 23–35.

Baldwin, R., & Krugman, P. (1989). Persistent trade effects of large exchange rate shocks. Quarterly Journal of Economics, 104(4), 635–654.

Central Bank of Nigeria (CBN). (2023). Statistical Bulletin (Vol. 34). Abuja: CBN.

Central Bank of Nigeria (CBN). (2024). Monetary Policy Committee Communiqué. Abuja: CBN.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74(366), 427–431.

Dimas, R. T., & Abdulwahab, Y. H. (2025). Trade liberalization and economic growth in Nigeria. ADSU International Journal of Applied Economics, 4(1), 22–35.
Egbetunde, T., &Fasanya, I. (2017). Public policy mix and economic growth in Nigeria. Journal of African Business, 18(3), 1–15.
Ejike, D., Arinze, A. S., & Chidi, O. F. (2018). Trade liberalization and economic growth in Nigeria: A cointegration analysis. IJRDO Journal of Business Management, 4(5), 30–45.
Feder, G. (1983). On exports and economic growth. Journal of Development Economics, 12(1–2), 59–73.
Haraguchi, N., Cheng, C. F. C., & Smeets, E. (2017). The importance of manufacturing in economic development: Has this changed? World Development, 93, 293–315.
Iyoha, M. A. (2020). Macroeconomic policy coordination and industrial development in Africa. African Development Review, 32(2), 200–215.
Iyoha, M. A., &Oriakhi, D. E. (2002). Explaining African economic growth performance: The case of Nigeria. AERC Research Paper. Nairobi: AERC.
Kaldor, N. (1966). Causes of the slow rate of economic growth of the United Kingdom. Cambridge University Press.
Keynes, J. M. (1936). The general theory of employment, interest and money. Macmillan.
Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. American Economic Review, 70(5), 950–959.
Lewis, W. A. (1954). Economic development with unlimited supplies of labour. The Manchester School, 22(2), 139–191.
Lin, J. Y. (2012). New structural economics: A framework for rethinking development and policy. World Bank.
McKinnon, R. I. (1973). Money and capital in economic development. Brookings Institution.
Mundell, R. A. (1968). International economics. Macmillan.
Narayan, P. K. (2005). The saving and investment nexus for China: Evidence from cointegration tests. Applied Economics, 37(17), 1979–1990.
National Bureau of Statistics (NBS). (2024). National accounts statistics. Abuja: NBS.
Nwosa, P. I. (2011). Monetary policy and output growth in Nigeria. Journal of Economics and International Finance, 3(10), 562–569.
Obamuyi, T. M. (2009). An investigation of the relationship between interest rates and economic growth in Nigeria. Journal of Economics and International Finance, 1(4), 93–98.
Okoye, L. U., & Eze, C. E. (2017). Effect of monetary policy rate on economic performance in Nigeria. International Journal of Economics and Financial Issues, 7(3), 293–301.
Olorunfemi, S., & Adeleke, P. (2013). Interest rate channels and manufacturing sector performance in Nigeria. African Development Review, 25(1), 1–15.
Onuosa, C. O., Ita, U. E., Ikue, N. J., &Ikemenjima, I. O. (2024). Trade liberalization and manufacturing subsector performance in Nigeria: A nonlinear approach. International Journal of Finance & Banking Studies, 13(2), 45–60.
Onyeiwu, C. (2012). Monetary policy and economic growth of Nigeria. Journal of Economics and Sustainable Development, 3(7), 62–70.
Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289–326.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. Biometrika, 75(2), 335–346.
Ricardo, D. (1817). On the principles of political economy and taxation. John Murray.
Rodrik, D. (2016). Premature deindustrialization. Journal of Economic Growth, 21(1), 1–33.
Romer, D. (2018). Advanced macroeconomics (5th ed.). McGraw-Hill.
Shaw, E. S. (1973). Financial deepening in economic development. Oxford University Press.
Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. Sickles & W. Horrace (Eds.), Festschrift in honor of Peter Schmidt (pp. 281–314). Springer.
Szirmai, A. (2012). Industrialisation as an engine of growth in developing countries, 1950–2005. Structural Change and Economic Dynamics, 23(4), 406–420.
Tinbergen, J. (1952). On the theory of economic policy. North-Holland.
Wade, R. (1990). Governing the market: Economic theory and the role of government in East Asian industrialization. Princeton University Press.
Wang, H., & Sua, L. (2025). Trade openness and growth dynamics: Bootstrap ARDL evidence from emerging markets. Economic Modelling, 134, 106718.
World Bank. (2024). World Development Indicators. Washington, DC: World Bank.
Zahonogo, P. (2017). Trade and economic growth in developing countries: Evidence from Sub-Saharan Africa. Journal of African Trade, 4(1–2), 41–56.