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Trade Openness and Macroeconomic Dynamics in Nigeria (2000–2023): Evidence from Autoregressive Distributed Lag (ARDL) Analysis

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Persistent macro-volatility has cast doubt on whether two decades of liberalization have actually strengthened Nigeria's economy. Trade-to-GDP fell from 41 percent in 2019 to 32 percent in 2021, GDP growth has swung from +6.3 percent (2014) to -1.9 percent (2020) and the naira has depreciated from ₦306/US$ (2019) to > ₦1,600/US$ (mid-2024). Against this backdrop the study asks: (i) how has trade openness evolved between 2000-2023; (ii) what is its effect on growth; and (iii) do inflation and exchange rate volatility condition that effect economic growth positively? Annual data on trade intensity, inflation, NGN/US$ rate and GDP-growth were extracted from World Bank, IMF and CBN sources. After ensuring stationarity (ADF $p < 0.01$ for all series), a two-stage strategy was adopted: an Ordinary Least Squares (OLS) model, testing the direct link (Model 1) and an Autoregressive Distributed Lag (ARDL)-bounds framework testing individual and joint effects with mediators (Model 2). Diagnostics (VIF < 7; BG-LM $p = 0.37$; BP-Godfrey $p = 0.82$; CUSUM within 5% bands) confirmed model adequacy. Results show trade intensity exerts a large positive impact on GDP growth ($\beta = 19.59$; $t = 7.77$; $p < 0.001$; $R^2 = 0.17$), supporting Endogenous-Growth predictions and leading to rejection of H_{01}. When inflation and the exchange rate are included, explanatory power rises ($R^2 = 0.41$; $F = 7.40$; $p < 0.01$). Exchange-rate depreciation carries a small but significant negative effect ($\beta = -0.016$; $p = 0.023$), prompting rejection of H_{03}, whereas inflation is statistically inert ($\beta = 0.14$; $p = 0.45$), so H_{02} is retained. The error-correction term (-0.93; $p < 0.01$) indicates a 93 percent annual convergence to long-run equilibrium, confirming a stable cointegrating relationship and rejection of H_{04}. Trade openness is a robust growth driver, but naira volatility materially erodes these gains while moderate inflation appears growth-neutral. the Federal Ministry of Industry, Trade and Investment—working with Nigerian Export Promotion Council (NEPC) should launch an export-diversification programme (tax incentives, credit lines and African Continental Free Trade Area (AfCFTA) value-chain facilitation for agro-processing, light manufacturing and information and communication technology (ICT) product) so that the documented benefits of openness translate into broad-based, shock-resilient growth.

Keywords: Trade openness, Economic Development, GDP Growth, Exchange Rate Volatility, Inflation, unemployment.

INTRODUCTION

Trade openness is often positioned as a vital pathway for stimulating economic development, particularly within emerging markets that seek to diversify production and access global markets. As globalization intensifies, the

integration of national economies through trade has garnered widespread attention from policymakers and scholars alike. Contemporary economic theories, especially the Endogenous Growth Theory, posit that trade liberalization fosters economic expansion by facilitating the diffusion of technology, enhancing knowledge spillovers, and improving allocative efficiency (Dosi and Tranchero, 2021; Mahony, 2023). For Nigeria, however, the practical outcomes of increased trade openness remain mixed. Despite ongoing liberalization efforts, the country's macroeconomic indicators such as GDP growth, inflation, and exchange rate stability continue to exhibit volatility. This raises important questions about the nature and depth of Nigeria's integration into the global trading system and its implications for sustainable economic growth.

Over the past two decades, Nigeria has pursued a range of liberalization policies, including its participation in the World Trade Organization and, more recently, the African Continental Free Trade Area (AfCFTA). Nevertheless, empirical data suggests that these measures have not consistently translated into robust economic growth. For instance, Nigeria's trade-to-GDP ratio declined from 41.3% in 2019 to 32.1% in 2021 (Trading Economics, 2025), indicating a contraction in the country's external trade activities. Additionally, the GDP growth rate has oscillated significantly from 6.3% in 2014 to -1.6% during the 2016 recession, followed by modest recoveries and another contraction of -1.9% in 2020 due to the COVID-19 pandemic (Worldometers, 2025). Exchange rate instability has further compounded these issues, with the Naira depreciating from ₦306/USD in early 2019 to over ₦1,600/USD by mid-2024 (Adebayo *et al.,* 2023). These macroeconomic fluctuations underscore the need to explore how Nigeria's trade openness has evolved from 2000 to 2023 and whether it has supported or hindered economic stability.

While a number of empirical studies have investigated the link between trade openness and economic growth in Nigeria, their conclusions remain inconclusive. Scholars such as Asamoah *et al.* (2019), Nguyen *et al.* (2023), and Zhuang *et al.* (2021) argue that trade openness positively influences GDP, but only in the presence of strong institutions and stable macroeconomic conditions. Others contend that liberalization exacerbates macroeconomic vulnerabilities, particularly in contexts characterized by over-reliance on primary exports, weak infrastructure, and policy inconsistency (Ereke *et al.,* 2024; Mansurov, 2023; Sare *et al.,* 2024). Moreover, inflation and exchange rate volatility are often cited as mediating variables that distort the expected benefits of trade openness (Demir and Razmi, 2022; Yabu and Kimolo, 2020). The Russian-Ukraine war, for example, disrupted Nigeria's importation of critical goods such as wheat and fertilizers, while external shocks in oil prices have consistently destabilized the country's fiscal position. These realities point to a crucial knowledge gap: although trade openness is frequently cited as a growth driver, there is insufficient evidence on its dynamic effects in Nigeria, especially when accounting for inflation and exchange rate fluctuations as mediators. Thus, this study seeks to fill this empirical void by analyzing the evolutionary trends of trade openness in Nigeria between 2000 and 2023 and its effects on macroeconomic outcomes using advanced econometric methods with particular emphasis on the mediating roles of inflation and exchange rate fluctuations.

To address this research problem, the study is guided by three interrelated questions. First, what are the evolutionary trends of Nigeria's trade openness from 2000 to 2023? This question aims to contextualize the country's historical trade performance relative to key policy and global events. Second, what is the effect of trade openness, measured as the ratio of exports and imports to Gross National Product (GNP), on Nigeria's economic growth, proxied by the GDP growth rate? Third, to what extent do exchange rate volatility and inflation mediate the relationship between trade openness and macroeconomic performance? These questions will be empirically tested using the Autoregressive Distributed Lag (ARDL) model and bounds cointegration framework, which are well-suited for examining short-run and long-run relationships in time-series data. The significance of this objective lies in its ability to offer a nuanced and policy-relevant understanding of trade dynamics in one of Africa's largest but structurally challenged economies.

This study is distinct in its originality and relevance for several reasons. First, it expands upon existing research by focusing on a recent and comprehensive timeframe that incorporates major economic shocks, such as the global pandemic and regional geopolitical conflicts. Second, it departs from aggregate analyses by explicitly disaggregating the trade-growth relationship, accounting for macroeconomic mediators such as inflation and exchange rates, which many past studies have neglected. Third, the research uses updated and reliable data from reputable sources such as the World Bank, the Central Bank of Nigeria, and the International Monetary Fund datasets that reflect the most current realities of Nigeria's economic environment. Finally, this study offers practical contributions for policymakers by identifying which macroeconomic variables moderate the benefits of trade openness. As Nigeria aspires to implement Vision 2050 and deepen its engagement in regional and global trade platforms, the findings of this study can inform more targeted and effective trade, industrial, and fiscal policies aligned with long-term economic development goals.

Literature review

Theoretical framework

This study investigates the relationship between trade openness and economic growth in Nigeria, with a particular focus on the mediating roles of exchange rate volatility and inflation. To underpin this inquiry, three major

economic theories are applied: the Endogenous Growth Theory, the Mundell-Fleming Model, and the Structuralist Theory of Trade. Each theory provides critical insights into the mechanisms linking openness, macroeconomic stability, and growth, especially in developing economies like Nigeria.

The Endogenous Growth Theory (Romer, 1994; Lucas, 1988) posits that long-run economic growth is driven by internal factors such as human capital, innovation, and technology diffusion. Trade openness facilitates these processes by expanding markets, increasing access to foreign direct investment, and enabling the transfer of knowledge and intermediate inputs (Akobir, 2024; Grossman and Helpman, 1991). Studies such as Oluwo (2025), Qi (2024), and Nkoro (2022) affirm this perspective, demonstrating that trade liberalization, when supported by appropriate institutions, can foster sustainable growth. Therefore, trade openness serves as an external catalyst for endogenous processes that elevate productivity and output, justifying its inclusion as an independent variable in this study.

The Mundell-Fleming Model (Fleming, 1962; Mundell, 1963) emphasizes the role of macroeconomic stability in open economies. It argues that exchange rate volatility and inflation are crucial determinants of output, especially under varying capital mobility conditions. For Nigeria, where the economy is sensitive to global commodity prices and exchange rate regimes, this model is highly relevant. Oyinlola *et al.* (2023) and Haryani *et al.* (2022) found that exchange rate instability and inflation distort trade outcomes and limit the benefits of openness. Similarly, Solomon and Tukur (2022) observed that Nigeria's reliance on oil exports, compounded by inflationary pressures, weakens the transmission of trade benefits to GDP growth. This supports the treatment of exchange rate volatility and inflation as mediating variables that condition the effectiveness of trade openness.

The Structuralist Theory, rooted in the Prebisch-Singer hypothesis, critiques trade liberalization in the Global South by highlighting dependency on primary exports, weak industrial bases, and persistent terms-of-trade shocks (Jahan, 2021). Scholars such as Afolabi (2022), Kaba *et al.* (2022) and Sunde (2025) argue that trade openness in structurally weak economies may lead to deindustrialize-tion, inflationary imports, and long-term trade deficits. The theory thus provides a contextual basis for analyzing Nigeria's macroeconomic vulnerabilities and justifies the inclusion of inflation and exchange rate variables as systemic constraints.

Integrating these theoretical strands, the conceptual framework for this study posits that trade openness (measured as export + import/GNP) influences economic growth (proxied by real GDP growth), but the strength and direction of this relationship are mediated by inflation and exchange rate volatility. The framework aligns with recent empirical evidence (Ajayi and Araoye, 2019; Ereke *et al.,* 2024; Mansurov, 2023; Sare *et al.,* 2024) and offers a comprehensive structure for testing both direct and indirect pathways using ARDL and mediation analysis. This multi-theoretical approach enhances the explanatory power of the study and ensures a nuanced understanding of how macroeconomic volatility conditions the trade-growth dynamic in Nigeria.

The conceptualization of trade openness, economic growth, inflation and exchange rates

The concepts of trade openness and economic growth have long generated debate in both theoretical and empirical literature. While many scholars agree that trade can stimulate economic expansion through resource allocation, specialization, and access to broader markets, there is no single consensus on how best to define or measure openness and growth. The controversy stems from the fact that trade openness is not only an economic flow variable but also a reflection of broader institutional, structural, and policy environments. Similarly, economic growth is frequently assessed through changes in GDP, but this often overlooks qualitative dimensions such as income distribution, structural transformation, and human development. These definitional ambiguities have contributed to inconsistent findings in the literature, especially in countries like Nigeria, where growth remains vulnerable to external shocks and domestic constraints.

Trade openness, in most empirical studies, is commonly measured as the ratio of the sum of exports and imports to GDP. Ajayi and Araoye (2019) support this measure, arguing that it captures a country's exposure to international trade. However, other scholars propose broader interpretations. Zhuang *et al.* (2021) suggest that trade openness also involves tariff regimes, capital flow liberalization, and regulatory institutions. Dosi and Tranchero (2021) add that the quality of trade-related policies and comparative advantage must be considered. These perspectives suggest that trade openness is not a one-dimensional metric but an integrated outcome of economic flows, policy stance, and institutional quality. In this study, trade openness is thus conceptualized as the extent of Nigeria's engagement in cross-border trade, relative to its economic size, and moderated by policy orientation and institutional strength.

Economic growth has often been equated with rising GDP, but recent perspectives emphasize its broader developmental implications. Nkoro and Uko (2022) define it as the sustained increase in real income per capita. Romer (1994) extend this by including capital formation, productivity improvements, and technological innovation. Ojo and Amassoma (2021), however, warn that GDP growth may obscure structural weaknesses, inequality, and environmental degradation. Therefore, for the purpose of this study, economic growth is defined as the sustained and inclusive increase in productive capacity that leads to improvements in income, employment, and innovation within the Nigerian context.

Inflation and exchange rate volatility are critical macro-economic variables that interact with trade openness and influence economic growth. As per the Mundell-Fleming model (Fleming, 1962; Mundell, 1963), unstable exchange rates distort trade prices, affect competitiveness, and undermine investment flows. High inflation erodes purchasing power and reduces export value. Studies such as those by Oyinlola *et al.* (2023) and Ss (2019) show that these variables often mediate the effectiveness of trade liberalization. Within this study's conceptual framework, trade openness is grounded in endogenous growth theory (Romer, 1994), explaining how openness drives growth through technology transfer. Inflation and exchange rates are embedded in the Mundell-Fleming model, serving as mediators. Structuralist theory adds context by highlighting Nigeria's dependence on primary exports (Jahan *et al.,* 2021). Together, these frame-works guide the examination of how trade openness influences economic growth under conditions of macroeconomic instability.

Existing empirical evidence and gap in literature

The relationship between trade openness and economic growth

The relationship between trade openness and economic growth in Nigeria has been widely debated in the literature, yet the results remain inconclusive and context-specific. Afolabi (2022), using disaggregated trade components, found that agricultural and oil exports positively affect short-run growth, while solid mineral exports had a negative impact and manufacturing exports remained insignificant. This sectoral analysis revealed that not all forms of trade openness contribute equally to economic performance. Baajike *et al.* (2022) confirmed a long-run positive relationship between aggre-gate trade openness and economic growth using ECM, although they noted that excessive imports weaken this benefit. Similarly, Sunde (2025) demonstrated that trade openness significantly drives GDP growth, suggesting that liberalization strategies can support broader development objectives when properly managed.

Comparative studies reinforce this mixed evidence. Nkoro and Uko (2022) and Kaba *et al.* (2022) found that trade openness exerts a significant influence on economic growth in both Nigeria and Ghana, although the strength of this relationship varies by country and period. Afolabi (2022) reported that trade openness alone may not yield substantial growth unless complemented by structural reforms. Solomon and Tukur (2022) emphasized the need for export diversification, showing that over-reliance on oil-based trade hampers inclusive and sustainable growth. Ikechi and Nwadiubu (2020) linked trade openness to energy use and growth, implying that production capacity plays a crucial role in realizing openness benefits. However, studies such as Ikechi and Nwadiubu (2020) and Ajayi and Araoye (2019) maintained that while openness can foster growth, its effects are neither automatic nor uniform across time.

Despite this extensive literature, a critical gap remains: few studies provide an updated, time-bound analysis covering the 2000–2023 period using a unified macro-economic dataset and the ARDL approach to empirically reassess whether trade openness, as conventionally measured, has had a sustained and measurable effect on Nigeria's economic growth. This study aims to fill that gap. Hence, the first hypothesis of this study which states that trade openness has no significant positive impact on economic growth in Nigeria between 2000 and 2023. This hypothesis was postulated considering the ravaging infrastructural decadence, political corruption and naira devaluation.

Inflation and Exchange rates as mediators of the relationship between Trade openness and economic growth

Trade openness is widely regarded as a driver of economic growth through increased market access, technology transfer, and competition. However, the actual gains from openness can be undermined by macroeconomic instability, particularly inflation and exchange rate volatility. Haryani *et al.* (2022), using ASEAN-5 data, showed that exchange rates significantly mediate the impact of trade openness on growth, suggesting that trade reforms yield better outcomes in stable monetary environments. Similarly, Oyinlola *et al.* (2023) found that foreign trade performance is highly sensitive to exchange rate volatility, which in turn affects economic output. In Nigeria, Ikechi and Nwadiubu (2020) emphasized that exchange rate fluctuations distort trade pricing and reduce competitive-ness, especially for non-oil sectors.

Inflation also plays a key role. Ss (2019) highlighted that inflation weakens the positive effect of openness on growth in Ghana, while Demir and Razmi (2022) found that both inflation and exchange rates mediate growth via the financial market. Ereke *et al.* (2024) affirmed that in sub-Saharan Africa, trade liberalization contributes to growth only when inflation is controlled. Nigerian studies by Ojo and Amassoma (2021) and Afolabi (2022) corroborate these findings, revealing that trade openness contributes positively to GDP, but its impact is often offset by high inflation and exchange rate volatility.

Despite these insights, a critical empirical gap remains. Most studies assess the direct relationship between trade openness and economic growth, while only a few explore how inflation and exchange rate volatility function as mediating variables, particularly in Nigeria's post-reform context. Furthermore, many prior studies do not employ integrated models that simultaneously test these com-bined effects over extended timeframes. This study addresses this gap by examining the extent to which inflation and exchange rate volatility in combination with trade intensity affects economic growth in Nigeria between

Table 1. Model variables and roles.

Variable	Role	Measurement Scale
GDP Growth Rate	Dependent	Interval
Trade Intensity	Independent	Interval
Inflation Rate	Independent	Interval
Exchange Rate	Independent	Interval

2000 and 2023, using robust ARDL and OLS regression analysis techniques.

Hypotheses

Following the gap in literature and the focus of this study, the following hypotheses were tested at 5% accuracy (Figure 1)

H_{01}: *There is no significant effect of Trade Intensity (TI) on Economic Growth in Nigeria.*

H_{02}: *There is no significant effect of Inflation Rate (IR) on Economic Growth in Nigeria.*

H_{03}: *There is no significant effect of Exchange Rate (EXR) on Economic Growth in Nigeria.*

H_{04}: *There is no joint significant effect of Trade Intensity (TI), Inflation Rate (IR), and Exchange Rate (EXR) on Economic Growth in Nigeria.*

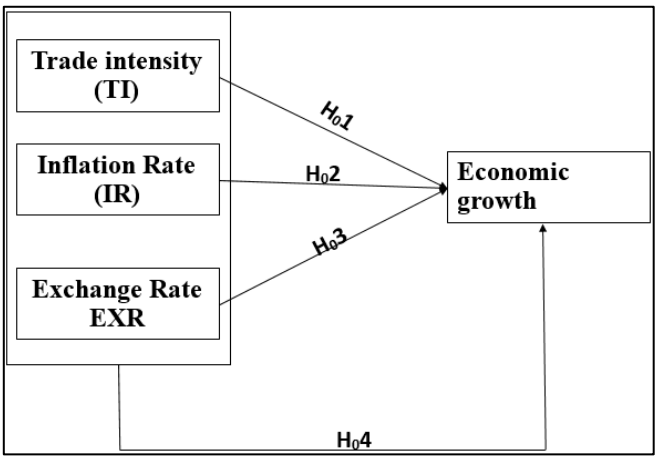

Figure 1. Operational framework and study hypotheses.

METHODOLOGY

Design

The study employs a quantitative time-series explanatory research design, which is appropriate for analyzing causal relationships among macroeconomic variables across multiple years. This design enables the investigation of both direct and combined effects of trade intensity, inflation rate, and exchange rate on economic growth using annual data from 2000 to 2023, aligning with longitudinal analysis practices (Lucas, 1988; Mansurov, 2023). By relying on secondary data sourced from reputable databases such as the World Bank (via Trading Economics) and Macrotrends, the study follows a deductive approach to test hypotheses derived from established economic theories (Jahan *et al.,* 2021). The use of time-series methods, particularly the Autoregressive Distributed Lag (ARDL) model and bounds testing (Pesaran *et al.,* 2001), ensures methodological rigour in detecting both short-run and long-run relationships, as supported in recent econometric applications (Oyinlola *et al.,* 2023; Nkoro and Uko, 2022). This design is justified by its capacity to uncover dynamic interactions between variables and assess the structural behavior of Nigeria's economy within the context of exogenous shocks and trade openness.

Study Model

The analytical framework is based on the Endogenous Growth Theory, which posits that external trade influences long-term productivity through capital inflows, technology transfer, and resource allocation efficiency. Trade openness, measured by trade intensity (the ratio of imports and exports to GDP), is the main independent variable, while GDP growth serves as the dependent variable. Exchange rate and inflation rate are included in extended models to capture their additional and joint effects on economic growth. Table 1 below outlines the variable functions.

The models estimated are:

- **Model 1**: Simple linear model
  $GDPgrt = \beta_0 + \beta_1 Ti_t + \mu_t$
- **Model 2**: Multiple regression model
  $GDPgr_t = \beta_0 + \beta_1 Ti_t + \beta_2 EXR_t + \beta_3 IR_t + \mu_t$

Expected signs are:

- $\beta_1 > 0$ (Trade Intensity)
- $\beta_2 < 0$ (Exchange Rate)
- $\beta_3 > 0$ (Inflation Rate)

Data Collection

The study used annual time series data from 2000 to 2023, sourced from the World Bank World Development Indicators (WDI) and Macrotrends. Variables include GDP growth rate, trade intensity (export + import as a percentage of GDP), exchange rate (NGN/USD), and inflation rate. The dataset was screened for accuracy, consistency, and completeness, and transformations (e.g., differencing and log conversions) were applied as appropriate for statistical testing.

Data Analysis and Estimation Techniques

A series of structured quantitative analysis were employed to analyse the time series data collected cleaned and validated. Descriptive statistics such as mean, standard deviation, skewness, and kurtosis were computed to assess the central tendencies and dispersion of the macroeconomic variables. This approach aligns with recent economic studies that emphasize understanding distributional properties prior to regression analysis (Afolabi, 2022). To complement the descriptive analysis, trend analysis charts were generated to visualize historical patterns in trade intensity, inflation, exchange rate, and GDP growth, following the approach used by Baajike *et al.* (2022) in similar macroeconomic evaluations.

Prior to model estimation, the time-series properties of each variable were examined using the Augmented Dickey-Fuller (ADF) test to confirm stationarity. The ADF test is widely recommended in empirical economic studies to avoid spurious regression, especially when working with macroeconomic time-series data (Pesaran *et al.,*

Table 2. Summary of variable descriptive statistics.

Statistics	Trade Intensity	Inflation Rate (%)	Exchange Rate (NGN/USD)	GDP Growth Rate (%)
Mean	0.262126625	13.12916667	217.9737917	5.05125
Standard Error	0.01193772	0.912662119	27.12186918	0.741055923
Median	0.2553625	12.7	154.974	5.615
Standard Deviation	0.058482644	4.471112999	132.8694807	3.630417766
Sample Variance	0.00342022	19.99085145	17654.2989	13.17993315
Kurtosis	0.242785211	0.542228424	2.397420733	1.900279602
Skewness	0.684025823	0.538547104	1.625013479	0.459401831
Range	0.229774	19.3	519.295	17.12
Minimum	0.172843	5.4	102.105	-1.79
Maximum	0.402617	24.7	621.4	15.33
Sum	6.291039	315.1	5231.371	121.23
Count	24	24	24	24

2001). Pearson's correlation test was applied to determine the direction and strength of the bivariate relationships among variables, while multicollinearity test was assessed using the Variance Inflation Factor (VIF), consistent with the best practices for multiple regression models (Solomon and Tukur, 2019).

Regression estimation was conducted in two stages using Ordinary Least Squares (OLS). Model 1 explored the bivariate relationship between trade intensity and economic growth, while Model 2 incorporated inflation and exchange rate as additional regressors. This stepwise modeling strategy is supported by longitudinal analyses that emphasize sequential inclusion of macroeconomic controls to isolate the primary effect of trade openness (Nkoro and Uko, 2022). Given the possibility of mixed integration levels (I(0)/I(1)), the Autoregressive Distributed Lag (ARDL) model was selected as the most appropriate technique, as advocated by Pesaran *et al.* (2001) and reaffirmed in recent applications (Oyinlola *et al.,* 2023).

Diagnostic and Stability Tests

To test for the existence of long-run relationships, the ARDL bounds testing approach was applied. Model robustness was ensured using post-estimation diagnostics including the Durbin-Watson statistic for serial correlation, the Breusch-Godfrey LM test, the Breusch-Pagan-Godfrey test for heteroskedasticity, and the CUSUM/CUSUMSQ tests for parameter stability, consistent with contemporary macroeconomic model validation procedures (Pesaran *et al.,* 2001; Oyinlola *et al.,* 2023). These steps ensured the reliability, accuracy, and internal validity of the study's empirical strategy.

RESULTS AND DISCUSSION

Descriptive statistics

The descriptive statistics in Table 2 provide insights into the distribution and characteristics of the key economic variables analyzed in this study. Over the 23-year period (2000–2023), trade intensity averaged 0.262, with a relatively low standard deviation of 0.058, indicating that Nigeria's trade openness remained fairly stable. Inflation rate had a mean of 13.13%, with fluctuations ranging from 5.4% to 24.7%, suggesting occasional periods of price instability. The exchange rate had an average value of 217.97 NGN/USD, but its high standard deviation (132.87) and wide range (102.1 to 621.4 NGN/USD) highlight significant currency volatility over the years. GDP growth rate averaged 5.05%, with variations ranging from -1.79% to 15.33%, indicating periods of both economic expansion and contraction. The skewness and kurtosis values for most variables suggest that while the data distribution is fairly normal, the exchange rate and GDP growth exhibit some degree of positive skewness and higher-than-normal kurtosis, implying the presence of extreme values or outliers. Overall, these statistics highlight economic volatility in Nigeria, particularly in terms of inflation and exchange rates, while trade openness remained relatively stable.

The trend analysis (Figure *2*) revealed significant economic fluctuations in Nigeria over the years, particularly after 2015, with notable declines in trade intensity, sharp depreciation of the Naira, and rising inflation. Trade intensity showed a downward trend until 2015, followed by a slow recovery, indicating fluctuating trade policies and economic instability. The exchange rate remained relatively stable until 2015 but surged dramatically post-2016, exceeding 600 NGN/USD by 2023, reflecting currency depreciation and external shocks. Inflation displayed volatility, with peaks around 2000 and 2005, followed by a steady rise after 2015, reaching its highest levels in 2022 and 2023, likely due to exchange rate instability and rising import costs. GDP growth was strong in the early 2000s but declined significantly in post-2015, expressing recessionary periods in 2016 and 2020, and showing only weak recovery in subsequent years. These trends suggest potential correlation between exchange rate volatility, inflation, and economic instability.

The effects of trade openness, inflation rate, and exchange rate on economic growth

The statistical diagnostics presented in Tables 3–5 affirm the robustness and reliability of the data and model used in this study. As shown in Table 2, the results of the panel unit root tests (Levin, Lin and Chu, Breitung, Im-Pesaran-

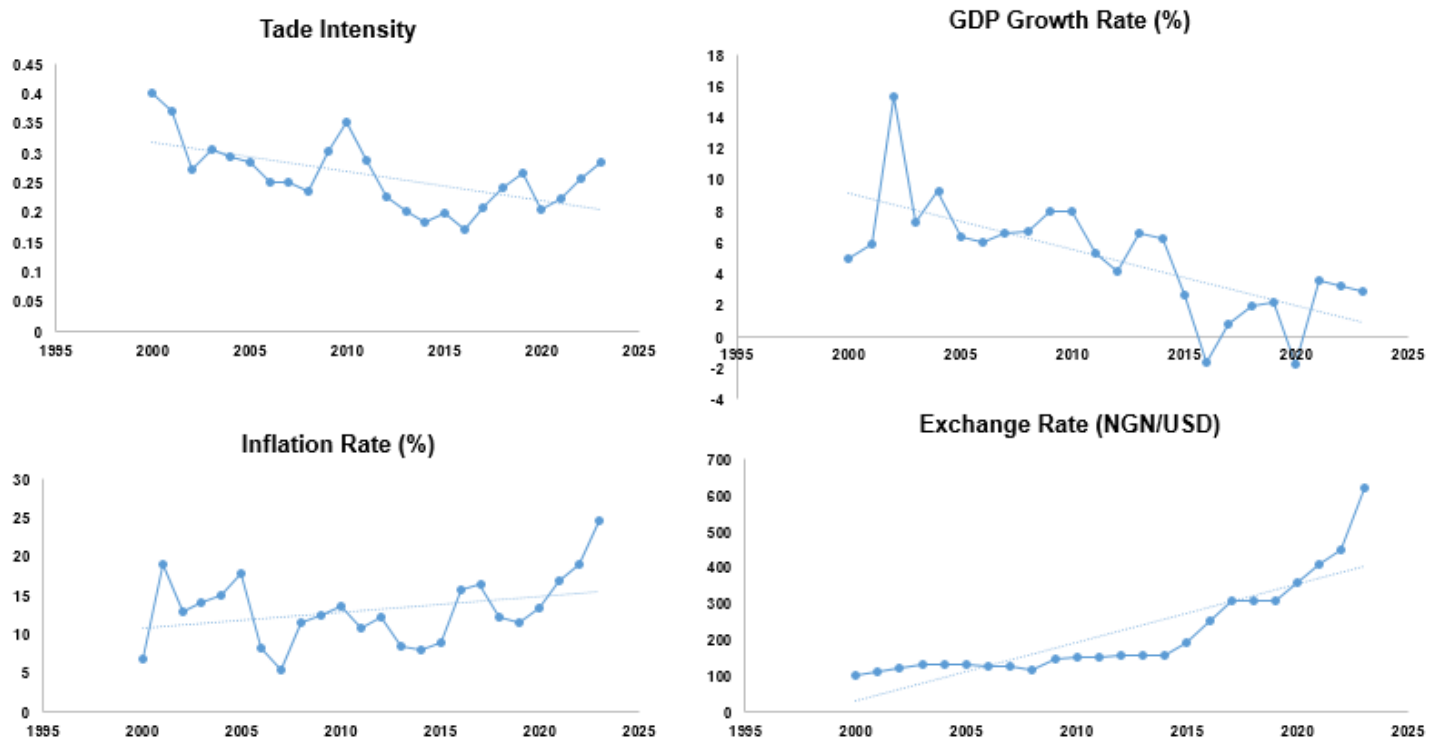

Figure 2. Trend analysis of Nigeria trade intensity, GDP growth rate, inflation rate, and exchange rate (2000-2023).

Table 3. Panel unit root test summary (2000–2023).

Method	Test Statistic	Probability (p-value)	Decision
Levin, Lin and Chu t	-5.804433	0.0000	Reject null (Stationary)
Breitung t-stat	-1.577703	0.0074	Reject null (Stationary)
Im, Pesaran and Shin W-stat	-5.983730	0.0000	Reject null (Stationary)
ADF - Fisher Chi-square	43.9132	0.0000	Reject null (Stationary)
PP - Fisher Chi-square	103.853	0.0000	Reject null (Stationary)

Table 4. Pearson correlation matrix.

Variable	GDP Growth Rate	Trade Intensity	Inflation Rate	Exchange Rate
GDP Growth Rate	1.000	0.422	-0.186	-0.625
Trade Intensity	0.422	1.000	0.126	-0.334
Inflation Rate	-0.186	0.126	1.000	0.571
Exchange Rate	-0.625	-0.334	0.571	1.000

Table 5. Variance inflation factors (VIF).

Variable	Coefficient Variance	Uncentered VIF
Trade Intensity	42.16810	4.51
Inflation Rate	0.033259	6.85
Exchange Rate	0.0000447	5.16

Shin, ADF-Fisher, and PP-Fisher) consistently reject the null hypothesis of a unit root ($p < 0.01$), indicating that all series are stationary and suitable for regression analysis.

Table 3 displays the Pearson correlation matrix, revealing a moderate positive correlation between Trade Intensity and GDP Growth Rate ($r = 0.422$), while Exchange Rate shows a strong negative correlation with GDP growth ($r = -0.625$), suggesting a potential adverse effect of exchange rate volatility on growth. Meanwhile, Inflation Rate shows a weak negative correlation with GDP growth ($r = -0.186$).

In Table 4, the Variance Inflation Factor (VIF) values are all below the conservative threshold of 10, indicating no serious multicollinearity among the predictors. This

Table 6a. ARDL long-run form and bounds test results.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant (C)	2.080733	3.927157	0.529382	0.6027
GDP growth rate (-1)	-0.925254	0.242689	-3.812830	0.0013
Trade intensity	24.70506	16.04781	1.539646	0.1411
Inflation rate	-0.131285	0.209867	-0.149714	0.8827
Exchange rate	-0.015359	0.009247	-1.660965	0.1140

Dependent Variable: D (GDP growth rate) Sample: 2000–2023 | Model: ARDL (1) | Case 2: Restricted Constant and No Trend a. Conditional Error Correction Regression F-statistics: 7.403640

Table 6b. Critical values (Case 2: restricted constant and no trend).

Significance Level	I(0) Bound	I(1) Bound
10%	3.38	4.02
5%	3.87	4.85
2.5%	4.19	5.39
1%	4.68	6.44

Decision: Since F-statistic (7.403640) > I(1) bound at all levels, we reject the null hypothesis of no long-run relationship.

Table 7. Model 1 OLS regression coefficient of the effect of trade intensity on GDP growth rate.

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Trade intensity	19.586	2.522	7.766	0.000

* R^2 = 0.166; Adj R^2 = 0.166; S.E. of regression = 3.315; Durbin-Watson Stat = 2.174.

confirms that the explanatory variables can be used together in the regression model without distortion from collinearity effects.

Furthermore, The ARDL bounds test results in Tables 6a and 6b confirm the existence of a long-run relationship between trade intensity, inflation rate, exchange rate, and GDP growth rate in Nigeria from 2000 to 2023. The computed F-statistic of 7.40 exceeds the upper bound critical values at all conventional significance levels (e.g., 4.85 at 5%), leading to the rejection of the null hypothesis of no long-run relationship. Although the individual coefficients for trade intensity, inflation, and exchange rate are statistically insignificant at the 5% level, the high magnitude of the lagged GDP growth rate coefficient (-0.925) with a significant p-value (0.0013) suggests a strong error correction mechanism. This means that deviations from long-run equilibrium are corrected by approximately 92.5% in the following period, implying high speed of adjustment and reinforcing the model's reliability in capturing long-run dynamics.

Effect of trade openness on GDP growth rate

Table 7 presents the results of Model 1, which examines the direct effect of trade intensity on GDP growth rate in Nigeria. The regression coefficient of 19.586 indicates that a one-unit increase in trade intensity is associated with a 19.59% increase in GDP growth, holding other factors constant. This effect is statistically significant (p = 0.000), as supported by the high t-statistic (7.77). The model explains 16.6% of the variance in GDP growth (R^2 = 0.166), and although modest, the result demonstrates a meaningful positive relationship between trade openness and economic growth. The Durbin-Watson statistic of 2.174 suggests no serious autocorrelation in the residuals, supporting the statistical soundness of the model. Overall, this model confirms that trade openness is a key driver of economic growth in Nigeria.

Individual and combined effects of trade openness, inflation and exchange on GDP growth rate

Table 8 presents the Model 2 multiple linear regression, assessing the combined effects of Trade Intensity, Inflation Rate, and Exchange Rate on Nigeria's GDP Growth Rate. The results show that Trade Intensity has a strong, positive, and statistically significant effect (β = 24.95, p = 0.0009), reinforcing its role in economic expansion. Exchange Rate exhibits a significant negative impact (β = -0.0164, p = 0.0229), suggesting that exchange rate depreciation hampers growth. However, Inflation Rate does not significantly affect GDP growth (β = 0.140, p = 0.4502).

Table 8. Model 2 OLS multiple linear regression of the effects of Trade Intensity, Inflation Rate, and Exchange Rate on GDP Growth Rate.

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Trade Intensity	24.95034	6.493697	3.842240	0.0009
Inflation Rate	0.140313	0.182369	0.769392	0.4502
Exchange Rate (NGN/USD)	-0.016405	0.006685	-2.454093	0.0229

R^2 = 0.407; Adjusted R^2 = 0.350; standard error of regression = 2.927; sum of squared residuals = 179.885; log likelihood = -58.226; Akaike information criterion = 5.102; Schwarz criterion = 5.249; Hannan-Quinn criterion = 5.141; Durbin-Watson statistic = 1.903.

Table 9. Residual Diagnostic Tests Summary.

Test	Statistic	p-value	Conclusion
Serial correlation (BG LM test)	F-statistic = 1.0488	0.3739	No autocorrelation
	Obs*R^2 = 2.6614	0.2643	
Heteroskedasticity (BP-Godfrey)	F-statistic = 0.3822	0.8185	No heteroskedasticity
	Obs*R^2 = 1.8003	0.7724	
	Scaled ESS = 2.6698	0.6145	

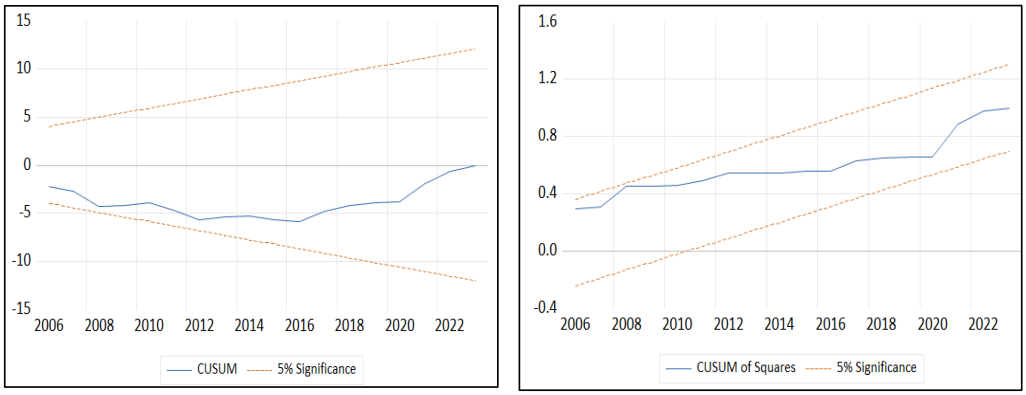

Figure 3. Stability diagnostics using CUSUM and CUSUM of squares tests.

The model explains 40.7% of the variance in GDP growth (R^2 = 0.407) with an adjusted R^2 of 0.350, indicating moderate explanatory power. The standard error of regression (2.927) and Durbin-Watson statistic (1.903) suggest good model fit and no significant autocorrelation. Information criteria values (AIC = 5.102, SC = 5.249, HQ = 5.141) further support the model's statistical validity. Overall, the results highlight that while trade openness enhances economic growth, exchange rate volatility poses a constraint, and inflation has a limited role within this context.

Models Residual Diagnostics Tests

The residual diagnostic tests (Table 9) confirm the reliability of the regression model. The Breusch-Godfrey LM test indicates no serial correlation, as all p-values exceed 0.05. Similarly, the Breusch-Pagan-Godfrey test shows no evidence of heteroskedasticity, confirming that the residuals have constant variance. These results validate that the model satisfies the key OLS assumptions of error independence and homoskedasticity, supporting the robustness of the estimated coefficients and the overall model specification. Furthermore, Figure 3 which showed the CUSUM and CUSUM of squares (CUSUMSQ) for the model residual plots indicate that the regression model is stable over time, as the CUSUM and CUSUMSQ lines lie within the 5% significance bounds. This suggests that the model parameters do not experience structural breaks or instability from 2006 to 2023. Hence, the estimated coefficients can be considered consistent and reliable for inference throughout the period of analysis.

DISCUSSION

The heuristic model (Figure 4) provides a visual and empirical summary of the key relationships explored in this study. It highlights the varied impacts of trade intensity,

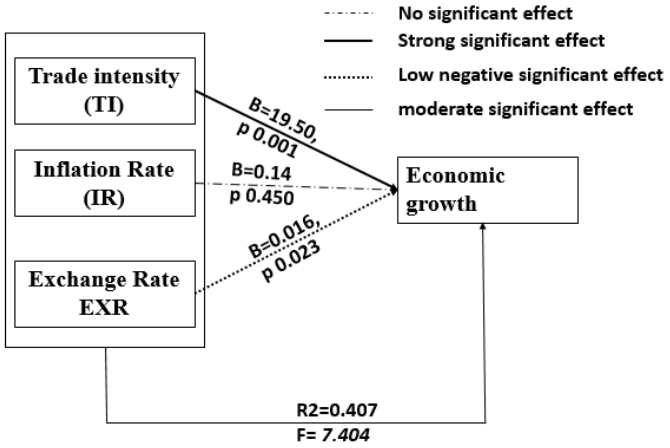

Figure 4. Study heuristic model.

inflation rate, and exchange rate on economic growth in Nigeria over the period 2000–2023. These relationships correspond to four hypotheses: H_{01} (impact of trade intensity), H_{02} (impact of inflation), H_{03} (impact of exchange rate), and H_{04} (combined effect of all three variables). The model demonstrates that trade intensity (TI) has a strong, statistically significant positive effect on GDP growth (B = 19.50, p = 0.001), hence H_{01} is rejected, supporting the alternative hypothesis that trade intensity significantly influences economic growth. Conversely, the exchange rate (EXR) had a low but statistically significant negative effect on GDP growth (B = -0.016, p = 0.023), leading to rejection of H_{03}, indicating that exchange rate fluctuations significantly affect economic growth. In contrast, the inflation rate (IR) exerts no statistically significant influence on GDP growth (B = 0.14, p = 0.450), so H_{02} was not rejected, suggesting that inflation does not have a significant direct effect on economic growth within the observed period. The combined explanatory power of the model (R^2 = 0.407; F = 7.404) confirms that the joint influence of TI, IR, and EXR is statistically significant, as such H_{04} was rejected, affirming that the combined macroeconomic variables significantly explain variations in Nigeria's economic growth.

The significant and positive relationship between trade intensity and economic growth (H_{01}) reinforces the theoretical predictions of Romer's (1994) Endogenous Growth Theory, which argues that openness facilitates access to foreign knowledge and markets, thereby enhancing productivity and long-term growth. This relationship is widely supported in recent empirical literature. Afolabi (2022) provide country-specific evidence that liberalized trade policies have contributed to Nigeria's industrial output, especially during periods of stable commodity prices. Similarly, Asamoah *et al.* (2019) and Qi (2024) confirm that trade openness enhances economic growth across several African economies, particularly when trade infrastructure and institutional capacity are moderately strong. However, the literature also reveals counter-evidence. For example, Dosi and Tranchero (2021) argue that Nigeria's structural weaknesses—such as poor infrastructure, high import dependency, and oil monoculture—limit the growth-enhancing benefits of trade openness. Mahony (2023) further caution that without adequate domestic production capacity and value-chain development, increased trade intensity can widen trade deficits and exacerbate macroeconomic volatility. These criticisms suggest that while H_{01} is supported, the growth effects of trade openness are conditional and depend on complementary factors such as export diversification and policy consistency.

The finding that inflation rate has no statistically significant impact on economic growth (H_{02}) may appear to contradict classical monetary theories, yet it is increasingly acknowledged in modern empirical studies. Demir and Razmi (2022) attribute these results to Nigeria's historically weak monetary transmission mechanisms, noting that price changes often result from cost-push factors (e.g., energy costs, exchange rate pass-through) rather than demand-driven inflation. This interpretation is echoed by Ss (2019), who contend that Nigeria's inflation dynamics are largely supply-side in nature and episodic, thus diminishing their persistent effect on growth. Nonetheless, Lucas (1988) warn of a threshold effect, noting that inflation becomes harmful only beyond a certain level (estimated at 13% in their study). Given that inflation hovered near this threshold during the study period, the null finding may reflect a marginal zone where inflation neither spurs nor harms economic activity. Other scholars like Qi (2024) also highlight that the inflation-growth nexus varies across regimes—where inflation persistence and policy credibility are weak, its effect on investment and consumption remains muted. This calls for deeper structural modeling to detect possible non-linearities or interactions that H_{02} in its current linear form may have missed.

The rejection of H_{03}, confirming a significant negative effect of exchange rate volatility on growth, is consistent with findings from Ikechi and Nwadiubu (2020), who found that exchange rate instability discourages foreign direct investment and raises production costs in Nigeria's import-dependent economy. This resonates with the Mundell-Fleming model (Fleming, 1962; Mundell, 1963), which predicts adverse growth effects of currency depreciation in small open economies with limited export substitution. However, evidence from Mansurov (2023) suggests that countries with diversified and competitive export bases may benefit from moderate depreciation, as it enhances export competitiveness. Nigeria, however, lacks this structural resilience; its heavy reliance on oil exports and foreign-denominated debt implies that depreciation leads to inflationary pressure, reduces purchasing power, and hampers capital formation. The model's combined R^2 of 0.407 and significant F-statistic affirms H_{04}, showing that macroeconomic variables collectively explain a moderate portion of growth variation. Still, this leaves room for other

influential variables—such as government spending, institutional quality, political risk, or innovation capacity—which future studies should incorporate. As Ereke *et al.* (2024) and Sare *et al.* (2024) argue, macroeconomic fundamentals matter, but they interact with broader socio-political factors in shaping long-term growth, especially in developing economies like Nigeria.

The findings offer important policy recommendations for enhancing Nigeria's economic growth through strategic trade and macroeconomic management. The significant positive effect of trade intensity (H_{01}) highlights the potential of trade openness as a catalyst for economic development, but this must be underpinned by structural transformation. According to Afolabi (2022), trade openness yields positive outcomes only when supported by strong local industrial capacity and export diversification. Merely increasing trade flows without enhancing domestic production risks deepening dependency on imports and external shocks. The negative and significant effect of exchange rate volatility (H_{03}) reinforces the need for stable currency management. Nkoro and Uko (2022) argue that volatile exchange rates in Nigeria deter foreign investment and complicate trade financing. To mitigate this, Nigeria must adopt a managed float regime with credible market-based interventions, supported by consistent fiscal coordination. The non-significance of inflation (H_{02}) aligns with recent studies by Adebayo *et al.* (2023), who found that inflation's effect on growth in Nigeria is often overshadowed by structural rigidities. Thus, efforts to boost growth should extend beyond monetary tightening to include infrastructure investments, food system resilience, and governance reforms that address inflation drivers at the root.

Conclusion

This study examined the impact of trade openness measured through trade intensity on Nigeria's economic growth from 2000 to 2023, while accounting for the influence of macroeconomic variables such as inflation rate and exchange rate. Grounded in the Endogenous Growth Theory and informed by Structuralist and Mundell-Fleming models, the research developed four hypotheses (H_{01}–H_{04}) to test both individual and combined effects of these variables on GDP growth. The analysis revealed that trade intensity had a statistically significant and positive influence on economic growth (H_{01}), reinforcing the argument that increased global economic integration can drive domestic expansion through technology diffusion and productivity gains. In contrast, the inflation rate (H_{02}) showed no significant effect on GDP growth, suggesting that inflation within moderate bounds may not directly impede growth in Nigeria's context. The exchange rate (H_{03}), however, had a significant negative impact, indicating that currency volatility can erode economic performance. Finally, the collective model (H_{04}) demonstrated moderate explanatory power ($R^2 = 0.407$), affirming that while trade openness and macroeconomic factors are important, other structural elements also play a role in shaping Nigeria's growth outcomes.

Theoretically, this study advances the literature by contextualizing classical economic models within Nigeria's evolving macroeconomic environment. It confirms the centrality of trade integration while highlighting the nuanced roles of inflation and currency stability in a resource-dependent, import-reliant economy. Practically, the findings call for policies that deepen trade engagement, stabilize exchange rates, and support export diversification. These can foster a more resilient economic base capable of leveraging the benefits of trade liberalization.

However, the study is limited by its exclusion of institutional quality, foreign direct investment, and potential structural breaks. Future research should employ panel data across African economies, incorporate governance indicators, and explore the effects of recent trade agreements like AfCFTA. Longitudinal analyses using dynamic techniques such as GMM and SVAR could also offer deeper insights into the causal mechanisms linking trade, stability, and development in Nigeria.

Recommendations

The findings of this study necessitated the following recommendations:

1. The Federal Ministry of Industry, Trade and Investment should implement export diversification policies such as incentives for non-oil sectors and AfCFTA integration to maximize the growth-enhancing effects of trade intensity.
2. The Central Bank of Nigeria should adopt a unified and transparent exchange rate policy with strengthened monetary frameworks to curb exchange rate volatility that negatively affect economic growth.
3. The Ministry of Finance should invest in infrastructure and supply chain efficiency to reduce structural inflation pressures, addressing price instability through sustainable, supply-side reforms.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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