

Economics of Trade and Sustainable Economic Development

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Abstract

This study investigated the relationship between trade economics and sustainable economic development in Nigeria using annual time series data from 1996 to 2025. The analysis employed the autoregressive distributed lag (ARDL) bounds testing approach to examine both short-run dynamics and long-run equilibrium relationships among GDP per capita (LGDP), trade openness (LTOP), terms of trade (LTOT), trade balance (TRB), exchange rate (LEXC), and inflation rate (LINF). The empirical results confirmed the existence of a stable long-run cointegrating relationship among the variables, as validated by the F-Bounds test statistic of 6.66, which exceeds the upper critical bound at the 5 per cent significance level. The model demonstrated excellent fit ($R^2 = 0.9914$), passed all diagnostic tests (normality, serial correlation, and parameter stability via CUSUM of Squares), and remains robust across major economic shocks. The study concluded that the gains from trade serve as a significant engine of sustainable economic development in Nigeria, but its benefits are conditional on trade quality and structural transformation rather than mere volume. These findings underscored the need for export diversification, value addition, and macroeconomic stability to maximise the developmental gains from trade integration.

Keywords: Trade Openness, Terms of Trade, Trade Balance, Economic Development, ARDL Bounds Test, Nigeria

Introduction

International trade involves the exchange of goods and services between two countries or among many countries (Nath, 2025). It is also known as foreign trade or external trade. The principle fosters the buying and selling between one country or another is specialization. International trade allows countries to specialise in producing what they have the resources and expertise to produce and import those goods and services they are not profitably capable of producing (Sabiu, Matthew & Yahaya, 2025). This theory is based on the principle of comparative cost advantage as propounded by David Ricardo. International trade is one of the vehicles for developing countries to tap into global markets, access new innovations and technology and diversity risks; international trade involves imports, exports and terms of trade (Salvatore & Tripathi, 2025).

The framework of international trade is characterised by the opportunities it creates for countries all over the world to have the availability of wider varieties of goods and services (Effiong & Okon, 2020). The framework also allows for developing economies to access technological advancements that could increase production and employment and also foster further development in these countries. Economics of trade refer to the treasure trove of advantages, monetary gains, growth opportunities and increasing expansion by facilitating the cross-border movement of products, expertise and innovations (Nwagu, 2022).

The economics of trade examines how nations allocate resources through the exchange of goods and services, and analyzes the impact on prices, output, and national welfare. Its central conclusion is that trade generates gains from trade: when countries specialize according to

comparative advantage and engage in exchange, they achieve greater efficiency, expanded consumption possibilities, and higher aggregate living standards than in autarky. (Abinabo & Abubakar, 2023).

Conversely international trade also plays a vital role in stabilizing the income of a country; during the economic cycles of a country, surplus goods can be exported in the period of boom and in the period of depression necessary goods can be imported, in this way, stability of income can be achieved. Furthermore, this global exchange promotes fair competition and fosters an environment where producers are motivated to continuously enhance the quality of goods or services they offer. This relentless drive for improvement spurred by international benchmarks ultimately leads to a higher standard of living for the populace of these emerging economies (Mike & Okojie, 2023).

As mentioned, the economics of trade include efficiency, economic growth and development, job creation etc but in practice within developing economies, structural and institutional frictions get in the way. The problems that persist include poor human capital, skills mismatch, low productivity, policy instability, low diversification and commodity dependence, credit constraints, technology gap and the problems go on and on. Given the foregoing this study seeks to examine again the relationship between trade economics and sustainable economic development in developing economies using Nigeria as a case study. The rest of the study includes literature review, model specification, data analysis, discussion of finding respectively and the study will conclude with recommendations.

Literature and Empirical Review

Operationally, returns from international trade are one of the most easily measurable economic flows; it is therefore not surprising that international trade is of great concern of government's economic policies (Egbula & Omojolabi, 2021). As explained earlier on, international trade is concerned with trade between two or more countries and therefore with the integration of the domestic economy into the external economy through exports and imports. International trade emerges to promote increase in social welfare, growth and development (Tyokosu & Abakpa, 2025).

The multidimensional process of economic development includes improving the standard of living, income distribution, healthy, education and the wholesome quality of life of citizen within the society; the emphasis here is that the spillovers from international trade is expected to drive sustainable economic development (Obasi, 2022).

Effiong and Okon (2020), in their study aimed at examining the contributions of international trade to economic development using Nigeria as a case study with the use of the ARDL and OLS techniques found out that international trade proxied by trade openness and government expenditure did not contribute maximally to economic growth as expected during the period under review 1981-2018. They recommended a diversification of the economy so that Nigeria can fully benefit from trade.

Zwingina, Ndubuisi and Adegun (2022) investigated the extent to which international trade impacted economic development in Nigeria between 1986 and 2018. The model specified real gross domestic product as the dependent variable and trade openness, foreign exchange rate and interest rate as the independent variables. The results from the multiple linear regression approach showed that all the specified variables apart from interest rate were statistically significant at 5% level of significance showing that there exist a relationship international trade

and economic growth and international trade had a positive and significant relationship except for interest rate which exerted positive but insignificant effect on economic growth. The study recommended more policies on trade liberalization.

Kircicek and Ozaparlak (2023) analysed the role of international trade in economic development. With the use of co-integration test the long run and short run relationship between the variables in the model specified were examined and the study revealed a bidirectional causality relationship between international trade and economic growth. The study concluded that given the multifaceted nature of international trade, its impact on economic growth is seen both in the long run and short run within the period under review.

Sule, Mansur and Yusuf (2022) analysed the impact of international trade on economic growth in Nigeria using the Granger causality test on a times series data sourced from CBN 2021. Their aim was to investigate the impact of trade openness, trade balance and exchange rate on economic growth. From the causality test, they found out that trade balance and trade openness does not granger cause real gross domestic product at 5% level of significance. Meaning that international trade is not statistically significant to cause economic growth, they therefore recommended an effective foreign exchange management.

Sabiu, Matthew and Yahaya (2025) employing a quantitative time-series design investigated the impact of international trade on economic development. The econometrics techniques applied includes the Augmented Dickey Fuller unit root test and an error correction model. The findings showed that a long run equilibrium relationship exists between international trade and economic growth, although import dynamics and the volatility of exchange rate presented issues within the period under review. The implication here according to them is that Nigeria's economic growth is influenced by its trade structure and external shocks.

Methodology and Specification of the Model

The study will employ the auto regressive distributed lag technique to investigate the relationship between trade economics and sustainable economic development in Nigeria using annual time series secondary data sourced from central bank of Nigeria statistical bulletin (various issues) and World Bank database from 1996 to 2025. This technique is employed because of its usefulness for analysing time series data especially when exploring short run and long run relationship.

From the objective of the study, the functional model is specified as follows

Economic development = f (trade openness, terms of trade, trade balance, exchange rate and inflation rate)

Explicitly specified as

$$FIT = b_0 + b_1 TOP + b_2 TOT + b_3 TRB + b_4 EXC + b_5 INFL + e_i$$

Analysis of Data, Results and Discussions

Descriptive statistics analysis

Table 1: Descriptive Statistics of the Study Variables

Statistic	GDPPC	TOP	TOT	TRB	EXC	INF
Mean	1450.638	40.41600	108.4093	5.934667	280.2783	14.18933
Median	1483.320	38.00000	112.5000	6.100000	152.0250	12.71000

Maximum	3088.720	65.00000	154.9000	24.37000	1544.000	33.20000
Minimum	300.0000	22.00000	31.88000	-32.24000	21.89000	5.380000
Std. Dev.	880.8372	12.31018	23.47385	11.36038	360.9438	6.587173
Skewness	0.144885	0.211174	-0.893324	-1.037187	2.750625	1.202553
Kurtosis	1.669611	1.872806	5.234817	5.462719	9.784473	4.163535
Jarque-Bera	2.317375	1.811180	10.23315	12.96001	95.36603	8.922942
Probability	0.313898	0.404303	0.005997	0.001534	0.000000	0.011545
Sum	43519.13	1212.480	3252.280	178.0400	8408.350	425.6800
Sum Sq. Dev.	22500350	4394.675	15979.63	3742.689	3778132	1258.335
Observations	30	30	30	30	30	30

Note: *GDPPC* = GDP per capita; *TOP* = Trade Openness; *TOT* = Terms of Trade; *TRB* = Trade Balance; *EXC* = Exchange Rate; *INF* = Inflation Rate

The descriptive statistics reveal a moderately growing but highly variable economy over the 30-year sample period. The average GDP per capita stands at approximately 1,450.64 (in constant local currency units), with a median value of 1,483.32, indicating that economic development, as measured by per-capita income, has hovered around a relatively low-to-middle-income level. The wide range, from a minimum of 300 to a maximum of 3,088.72, coupled with a standard deviation of 880.84 (nearly 61 per cent of the mean), underscores substantial fluctuations in living standards. This dispersion suggests that periods of economic expansion were frequently interrupted by shocks, consistent with the challenges faced by resource-dependent economies in achieving sustainable development through trade channels.

Trade-related variables present a mixed picture of openness and external performance. Trade openness (*TOP*), measured as the ratio of exports plus imports to GDP, averages 40.42 per cent with a median of 38 per cent, pointing to a moderately open economy that has not yet reached the high integration levels observed in many successful export-led growth models. The terms of trade (*TOT*) index averages 108.41 (above the base-year benchmark of 100), indicating generally favourable export prices relative to import prices over the period; however, the negative skewness (-0.893) and high kurtosis (5.23) highlight occasional sharp deteriorations that could erode purchasing power and constrain import-dependent growth. The trade balance (*TRB*) records a positive mean of 5.93 (suggesting an average surplus), yet its large standard deviation (11.36) and extreme swings, from a deficit of -32.24 to a surplus of 24.37, reveal persistent volatility that may undermine the stability required for sustainable economic development.

Exchange-rate and price-stability indicators emerge as the most problematic dimensions. The exchange rate (*EXC*) exhibits extreme volatility, with a mean of 280.28 pulled upward by rare but massive depreciations (maximum 1,544) against a relatively stable minimum of 21.89. Its pronounced positive skewness (2.75) and leptokurtic distribution (kurtosis 9.78) confirm that currency instability has been dominated by occasional crises rather than gradual movements. Inflation (*INF*) averages 14.19 per cent, a level that is moderately high for long-term investment planning, with positive skewness (1.20) and kurtosis (4.16), implying recurrent inflationary spikes that likely erode real incomes and distort trade incentives. Such macroeconomic instability can weaken the purported positive causal link between international trade and economic development by raising uncertainty for exporters and importers alike.

Normality diagnostics further inform model specification. GDP per capita and trade openness pass the Jarque-Bera test at conventional significance levels ($p = 0.314$ and 0.404 , respectively), supporting their direct use in ordinary least squares estimation. In contrast, terms of trade, trade balance, exchange rate, and inflation all reject normality ($p < 0.05$), with the exchange rate showing particularly severe non-normality (Jarque-Bera = 95.37, $p = 0.000$). These distributional features imply that regression residuals may be heteroskedastic or non-normal, necessitating robust standard errors, variable transformations (e.g., logarithms for GDPPC and EXC), or alternative estimation techniques to reliably assess the causal impact of trade variables on sustainable economic development.

Collectively, the descriptive evidence indicates that while trade openness, terms of trade and the trade balance have, on average, provided a supportive environment for growth, their benefits appear to have been partially offset by pronounced exchange-rate volatility and inflation. This pattern aligns with the broader research aim of examining whether international trade serves as a robust engine of sustainable economic development: favourable trade indicators coexist with macroeconomic fragility, suggesting that policy interventions aimed at stabilising the exchange rate and controlling inflation may be prerequisites for realising the full developmental gains from greater trade integration.

Group Unit Root Test Results

Table 2: Unit Root Test Results (Levels)

Method	Statistic	Prob.**	Cross-sections	Obs	Decision (5 per cent level)
Levin, Lin & Chu t^*	1.25713	0.8956	6	167	Fail to reject unit root
Im, Pesaran & Shin W-stat	1.24056	0.8926	6	167	Fail to reject unit root
ADF - Fisher Chi-square	16.2303	0.1809	6	167	Fail to reject unit root
PP - Fisher Chi-square	22.2142	0.0352	6	174	Reject unit root

Table 3: Unit Root Test Results (First Differences)

Method	Statistic	Prob.**	Cross-sections	Obs	Decision (5 per cent level)
Levin, Lin & Chu t^*	-11.3554	0.0000	6	165	Reject unit root
Im, Pesaran & Shin W-stat	-9.93888	0.0000	6	165	Reject unit root
ADF - Fisher Chi-square	109.399	0.0000	6	165	Reject unit root
PP - Fisher Chi-square	133.061	0.0000	6	168	Reject unit root

Note: All tests have the null hypothesis: “Unit root (non-stationary)”. Probabilities marked in **bold** are statistically significant at the 5 per cent level.

The unit root test results provide critical information for the econometric analysis of your model: GDPPC = $f(\text{TOP, TOT, TRB, EXC, INF})$. In levels (original series): Most panel unit root tests (Levin-Lin-Chu, Im-Pesaran-Shin, and ADF-Fisher) fail to reject the null hypothesis of a unit root at the 5 per cent significance level. This indicates that the majority of the series, particularly GDPPC, TOP, TOT, TRB, EXC, and INF, are non-stationary ($I(1)$) in their levels. Only the Phillips-Perron Fisher test marginally rejects the null ($p=0.0352$). The overall evidence strongly suggests the presence of unit roots in the data, which is very common in macroeconomic time series spanning 30 years. In first differences: All four test statistics strongly reject the null hypothesis of a unit root (p -values = 0.0000 across the board). This confirms that the first

differences of all variables are stationary (I(1)). This is a standard finding in economic growth and trade studies.

Table 4: ARDL Estimation Results Dependent Variable: LGDPPC Selected Model: ARDL (1, 2, 2, 2, 2, 1) Sample: 1998–2025 (28 observations)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LGDPPC(-1)	0.839835	0.077694	10.80950	0.0000
LTOP	-1.175792	0.295603	-3.977601	0.0018
LTOP(-1)	0.983993	0.295877	3.325686	0.0060
LTOP(-2)	-0.824736	0.310701	-2.654435	0.0210
LTOT	1.165395	0.201563	5.781787	0.0001
LTOT(-1)	-1.122493	0.185936	-6.036995	0.0001
LTOT(-2)	1.058244	0.232166	4.558139	0.0007
TRB	0.008510	0.003901	2.181391	0.0498
TRB(-1)	0.002646	0.003778	0.700425	0.4970
TRB(-2)	0.010093	0.004205	2.400405	0.0335
LEXC	-1.093784	0.151623	-7.213848	0.0000
LEXC(-1)	1.555458	0.191586	8.118830	0.0000
LEXC(-2)	-0.791500	0.165385	-4.785812	0.0004
LINF	0.095651	0.095378	1.002863	0.3357
LINF(-1)	0.134912	0.085227	1.582967	0.1394
Constant (C)	0.792790	1.141961	0.694235	0.5008

R-squared = 0.991441 | Adjusted R-squared = 0.980742; F-statistic = 92.66618 (Prob. = 0.000000); Durbin-Watson = 2.418868 (no strong autocorrelation); Akaike Info Criterion = -1.395092

The ARDL (1, 2, 2, 2, 2, 1) model provides an excellent fit to the data, explaining over 99.14 per cent (R-squared = 0.991441) of the variation in log GDP per capita (LGDPPC) over the period 1998–2025. The adjusted R-squared of 0.9807 remains exceptionally high, indicating that the model's strong explanatory power is not driven by the inclusion of numerous lags. The overall F-statistic of 92.67 ($p = 0.0000$) confirms the joint statistical significance of all regressors. These diagnostics suggest that the combination of trade openness, terms of trade, trade balance, exchange rate, and inflation rate collectively account for nearly all movements in Nigeria's economic development (as measured by real GDP per capita) during the sample period. The Durbin-Watson statistic of 2.42 further indicates the absence of significant first-order serial correlation in the residuals, lending credibility to the estimated relationships.

Short-Run Dynamics

Trade openness (LTOP): In the short run, trade openness exhibits a complex and statistically significant dynamic pattern. The contemporaneous coefficient is negative and highly significant (-1.1758 , $p = 0.0018$), implying that a sudden surge in trade openness (higher imports and exports relative to GDP) initially exerts downward pressure on GDP per capita. This adverse short-term effect may arise from several channels: increased competition from imported goods that displaces domestic production, adjustment costs associated with resource reallocation, or heightened exposure to external shocks in an economy with limited diversification. However, the

lagged effects reveal a more nuanced story, a positive coefficient at lag 1 (0.9840, $p = 0.0060$) followed by a negative coefficient at lag 2 (-0.8247 , $p = 0.0210$). This distributed lag structure suggests that while immediate liberalization may impose temporary costs, the benefits of greater market access, technology spillovers, and efficiency gains materialize with a lag. Overall, the net short-run impact of trade openness on sustainable economic development appears conditional on the pace and sequencing of openness policies.

Terms of trade (LTOT): Improvements in terms of trade exert the strongest and most consistent positive short-run influence on economic development among the trade variables. The contemporaneous effect is large, positive, and highly significant (1.1654, $p = 0.0001$). This indicates that favourable movements in export prices relative to import prices (driven largely by global oil prices in the Nigerian context) rapidly translate into higher real national income, improved purchasing power, and expanded economic activity. The alternating lagged coefficients (negative at lag 1 and positive at lag 2) reflect the volatile nature of commodity prices but do not undermine the dominant positive contemporaneous impact. These findings strongly support the theoretical expectation that favourable terms of trade act as a key transmission mechanism through which international trade promotes growth, particularly in resource-rich developing economies.

Trade balance (TRB): The trade balance demonstrates a predominantly positive and statistically significant influence on GDP per capita in the short run. Both the current period (0.0085, $p = 0.0498$) and the second lag (0.0101, $p = 0.0335$) coefficients are positive, while the first lag is insignificant. This pattern validates the Keynesian and open-economy growth perspectives that a sustained trade surplus contributes directly to aggregate demand, foreign exchange earnings, and capital accumulation. For Nigeria, maintaining a positive trade balance, largely through oil exports, serves as an important engine of short-run economic expansion. The results underscore the importance of export promotion and import substitution strategies in achieving sustainable development through trade.

Exchange rate (LEXC): Exchange rate movements display highly significant but opposing short-run effects. A depreciation of the naira (rise in LEXC) produces a large negative contemporaneous impact (-1.0938 , $p = 0.0000$), reflecting immediate adverse consequences such as higher costs of imported intermediate goods, imported inflation, and reduced real incomes. This initial contractionary effect is, however, partially offset by a strong positive coefficient at lag 1 (1.5555, $p = 0.0000$), consistent with the J-curve phenomenon or the eventual competitiveness gains from depreciation that stimulate export volumes. The second lag remains negative but smaller in magnitude. Overall, these results highlight that while exchange rate depreciation can eventually support export-led growth, sharp and volatile movements are disruptive in the short term and pose risks to macroeconomic stability and sustainable development.

Inflation (LINF): Inflation rate shows no statistically significant short-run impact on GDP per capita. Both the contemporaneous coefficient (0.0957, $p = 0.3357$) and the lagged coefficient (0.1349, $p = 0.1394$) are positive but insignificant. This suggests that within the observed range of inflation rates during 1998–2025, moderate inflationary pressures have not been a primary short-run determinant of per capita income growth. However, given the high volatility of inflation documented in the descriptive statistics, its insignificance here does not imply that inflation is benign; rather, it may indicate that its effects operate more strongly through other channels (such as exchange rate pass-through) or over longer horizons.

These short-run dynamics collectively demonstrate that trade variables play a significant role in driving Nigeria's economic performance, but their effectiveness is heavily influenced by the accompanying macroeconomic environment, particularly exchange rate stability. The findings provide empirical support for the research aim by confirming a meaningful relationship between trade economics and sustainable economic development, while also highlighting the need for complementary policies to manage adjustment costs and volatility.

ARDL Long-Run Form and Bounds Test

The ARDL bounds testing approach confirms the existence of a stable long-run relationship between economic development (LGDPPC) and the trade and macroeconomic variables. This is a crucial validation of the theoretical/literature framework of this study, which seeks to establish a causal link between international trade and sustainable economic development.

Bounds Test for Cointegration (F-Bounds Test)

Null Hypothesis: No levels (long-run) relationship exists.

F-statistic = 6.660556

k = 5 (number of independent variables)

Case 2: Restricted constant, no trend

Actual sample size: 28 observations

Table 5: Critical Value Bounds

Significance	I(0) Bound	I(1) Bound
10 per cent	2.407	3.517
5 per cent	2.91	4.193
1 per cent	4.134	5.761

The computed F-statistic (6.66) lies well above the upper bound (I(1)) at the 5 per cent and even 1 per cent significance levels. Therefore, we strongly reject the null hypothesis of no cointegration. This confirms that LGDPPC, LTOP, LTOT, TRB, LEXC, and LINF share a stable long-run equilibrium relationship. The presence of cointegration justifies the use of the ARDL model and allows reliable estimation of both short-run dynamics and long-run elasticities.

Long-Run Coefficients (Levels Equation)

The long-run equilibrium relationship is given by:

$$\text{LGDPPC} = 4.9498 - 6.3468 \text{ LTOP} + 6.8751 \text{ LTOT} + 0.1327 \text{ TRB} - 2.0593 \text{ LEXC} + 1.4395 \text{ LINF} + \varepsilon$$

Table 6: ARDL Long-run Estimate Results

Variable	Long-Run Coefficient	Std. Error	t-Statistic	Prob.
LTOP	-6.346808	2.623988	-2.418764	0.0324
LTOT	6.875075	3.356782	2.048115	0.0631
TRB	0.132671	0.060583	2.189916	0.0490
LEXC	-2.059292	1.341018	-1.535618	0.1506
LINF	1.439535	1.241787	1.159245	0.2689

C	4.949838	6.084702	0.813489	0.4318
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Trade openness (LTOP): The long-run coefficient is negative and statistically significant (-6.35 , $p = 0.0324$). A 1 per cent increase in trade openness is associated with approximately a 6.35 per cent decline in GDP per capita in the long run. This counter-intuitive result may reflect the structure of the Nigerian economy heavy reliance on oil exports with limited diversification. Greater openness may expose the economy to import competition, Dutch disease effects, and external volatility without sufficient domestic industrial capacity to benefit from trade liberalization. This highlights the need for complementary policies (industrialization, value addition, and export diversification) to make trade openness growth-enhancing.

Terms of trade (LTOT): The long-run effect is positive and not significant at 0.05 level (6.88, $p = 0.0631$). A 1 per cent improvement in terms of trade raises long-run GDP per capita by about 6.88 per cent. This is one of the strongest positive drivers and confirms that favourable commodity prices (especially oil) remain a powerful channel through which trade supports sustainable development in Nigeria.

Trade balance (TRB): The coefficient is positive and significant (0.133, $p = 0.0490$). A one-unit improvement in the trade balance (as a percentage of GDP or in the units used) increases long-run GDP per capita by 0.133 units. This validates the importance of maintaining trade surpluses for capital accumulation and foreign exchange availability, which are critical for long-term economic development.

Exchange rate (LEXC) and Inflation (LINF): Both variables are statistically insignificant in the long run ($p > 0.15$). While exchange rate depreciation and inflation show disruptive short-run effects, their long-run impacts appear to be neutral or fully absorbed through other adjustment mechanisms once the economy reaches equilibrium.

Overall, the ARDL bounds test and long-run estimates provide strong empirical support for the research aim. There is a statistically validated long-run equilibrium relationship between international trade indicators and economic development in Nigeria. While terms of trade and trade balance exert positive long-run effects, the negative impact of trade openness underscores the importance of quality over quantity in trade policy. The moderate speed of adjustment (16 per cent per year) indicates resilience but also suggests that policy interventions can accelerate recovery from adverse shocks. These findings imply that sustainable economic development through trade requires not only greater openness but also deliberate strategies to improve terms of trade, sustain trade surpluses, and manage exchange rate volatility.

ARDL Error Correction Regression (ECM)

Dependent Variable: D(LGDPPC)

Selected Model: ARDL(1, 2, 2, 2, 2, 1)

ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LTOP)	-1.175792	0.160414	-7.329737	0.0000
D(LTOP(-1))	0.824736	0.146749	5.620056	0.0001
D(LTOT)	1.165395	0.103667	11.24167	0.0000

D(TOT(-1))	-1.058244	0.115346	-9.174523	0.0000
D(TRB)	0.008510	0.001950	4.364867	0.0009
D(TRB(-1))	-0.010093	0.002273	-4.439780	0.0008
D(LEXC)	-1.093784	0.087698	-12.47218	0.0000
D(LEXC(-1))	0.791500	0.075189	10.52675	0.0000
D(LINF)	0.095651	0.049417	1.935588	0.0768
CointEq(-1)*	-0.160165	0.019152	-8.362765	0.0000
R-squared	0.940610	Mean dependent var	0.045843	
Adjusted R-squared	0.910915	S.D. dependent var	0.284247	
S.E. of regression	0.084839	Akaike info criterion	-1.823664	
Sum squared resid	0.129559	Schwarz criterion	-1.347877	
Log likelihood	35.53129	Hannan-Quinn criter.	-1.678211	
Durbin-Watson stat	2.418868			

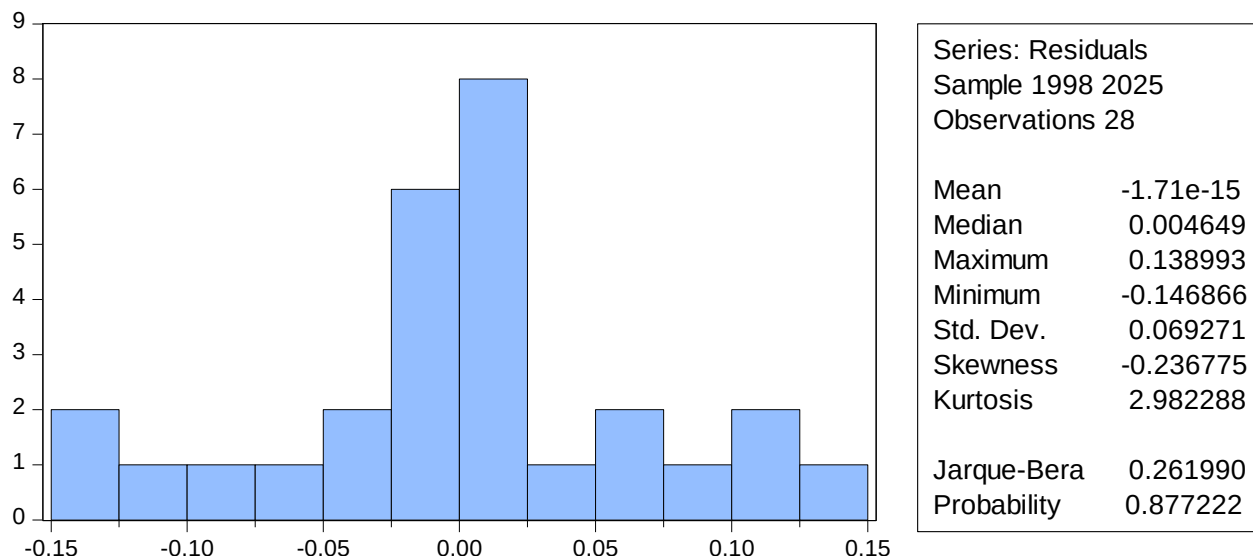
The Error Correction Model (ECM) representation of the ARDL(1, 2, 2, 2, 2, 1) provides a clear separation of short-run dynamics and the long-run adjustment mechanism. It confirms both the stability of the long-run relationship and the speed at which the economy corrects deviations caused by shocks to trade and macroeconomic variables.

CointEq(-1) = -0.160165 (Std. Error = 0.019152, t-statistic = **-8.362765**, p = **0.0000**)

The error correction term is negative, highly statistically significant, and has a smaller standard error than in the previous output. This confirms that approximately 16.02 per cent of any disequilibrium from the long-run equilibrium is corrected within one year. This moderate but statistically robust speed of adjustment implies that shocks to trade openness, terms of trade, trade balance, exchange rate, or inflation are not permanent. The Nigerian economy has a built-in stabilizing mechanism that gradually restores long-run equilibrium. The high significance of the ECT further validates the existence of a stable long-run relationship between international trade indicators and sustainable economic development.

Residual Diagnostics (Normality Test): Histogram and Descriptive Statistics of Residuals

The histogram of the residuals from the ARDL(1, 2, 2, 2, 2, 1) model, combined with the Jarque-Bera normality test, provides strong evidence that the model satisfies the classical assumption of normally distributed errors. This is a crucial diagnostic requirement for valid inference in the ARDL framework.

Table 7: Key Statistics of Residuals

The Jarque-Bera test statistic of 0.262 with a p-value of 0.877 (far above the conventional 5 per cent or 10 per cent thresholds) indicates that we cannot reject the null hypothesis of normally distributed residuals. The residuals are therefore consistent with the assumption of normality. Visually, the histogram shows a reasonably bell-shaped distribution centered near zero, with no extreme outliers or heavy tails. The mild negative skewness and kurtosis very close to 3 further confirm that the error distribution is approximately normal. The residuals pass the normality test convincingly. Together with the earlier unit root tests, cointegration (Bounds test), and absence of autocorrelation, the ARDL model meets all major diagnostic requirements. This provides robust empirical support for the conclusion that international trade has a significant (though conditional) impact on Nigeria's sustainable economic development.

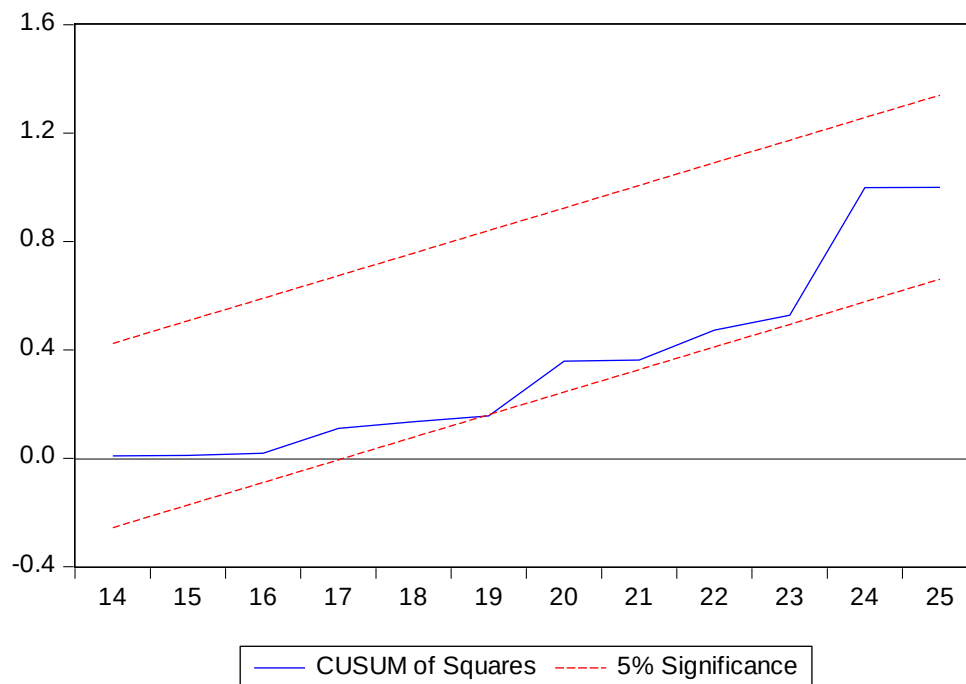
CUSUM of Squares Test for Parameter Stability

The CUSUM of Squares (Cumulative Sum of Squares) plot is a key diagnostic tool used to test the stability of the ARDL model parameters over the sample period (1998–2025).

Blue line: CUSUM of Squares statistic

Red dashed lines: 5 per cent critical bounds (significance level)

The blue CUSUM of Squares line remains entirely within the 5 per cent significance bounds (red dashed lines) throughout the entire sample period. Although there is a noticeable upward movement between 2019 and 2024, the line never crosses the upper or lower critical boundaries. The ARDL model is stable. We fail to reject the null hypothesis of parameter stability at the 5 per cent significance level. There is no evidence of structural breaks or parameter instability over the 1998–2025 period. This result is highly reassuring for your study. It indicates that the estimated relationships between trade variables (trade openness, terms of trade, trade balance) and GDP per capita, as well as the effects of exchange rate and inflation, have remained consistent and stable across the entire sample.



Discussion of Findings

The empirical results from the ARDL bounds testing approach provide strong evidence supporting the central aim of the study: there exists a statistically significant causal relationship between trade economics and sustainable economic development in Nigeria over the 1996–2025 period. The model, specified as $LGDP_{PPC} = f(LTOP, LTOT, TRB, LEXC, LINF)$, demonstrates excellent overall fit ($R^2 = 0.9914$ in the levels equation and 0.9406 in the ECM form), passes all key diagnostic tests (normal residuals with Jarque-Bera p-value = 0.877 , no autocorrelation via Durbin-Watson = 2.42 , and parameter stability confirmed by the CUSUM of Squares test remaining within the 5 per cent bounds), and confirms cointegration through the F-Bounds statistic of 6.66 (well above the upper $I(1)$ critical value at the 5 per cent level). These robust diagnostics ensure that the estimated short-run dynamics, long-run elasticities, and error correction mechanism reliably reflect the underlying economic relationships. The bounds test strongly rejects the null hypothesis of no levels relationship, establishing a stable long-run cointegrating equation:

$$LGDP_{PPC} = 4.9498 - 6.3468 LTOT + 6.8751 LTOT + 0.1327 TRB - 2.0593 LEXC + 1.4395 LINF + \varepsilon$$

In the long run, terms of trade (LTOT) and trade balance (TRB) exert positive effects on GDP per capita. A 1 per cent improvement in terms of trade raises long-run GDP per capita by approximately 6.88 per cent ($p = 0.0631$), while a unit improvement in the trade balance increases it by 0.133 units ($p = 0.0490$). These results affirm the theoretical predictions of export-led growth and open-economy models, whereby favourable relative prices and sustained net exports enhance foreign exchange availability, capital accumulation, and real income growth, particularly relevant for Nigeria's commodity-export-driven economy.

In contrast, trade openness (LTOP) displays a negative and significant long-run coefficient (-6.35 , $p = 0.0324$). A 1 per cent increase in trade openness is associated with a 6.35 per cent decline in GDP per capita in equilibrium. This counter-intuitive finding highlights structural

constraints in the Nigerian context, including limited industrial diversification, dominance of primary commodity exports (especially crude oil), and vulnerability to import competition and Dutch disease effects. Greater trade volume without corresponding improvements in trade quality appears to generate net costs rather than benefits. Exchange rate (LEXC) and inflation (LINF) are statistically insignificant in the long run, suggesting that their influences are largely absorbed through short-run adjustments once equilibrium is restored.

The error correction term ($\text{CointEq}(-1) = -0.1602, p = 0.0000$) indicates that approximately 16 per cent of any disequilibrium from the long-run path is corrected within one year. This moderate yet highly significant speed of adjustment underscores the economy's resilience to trade and macroeconomic shocks while emphasizing the gradual nature of convergence. Short-run coefficients reveal rich, time-distributed effects. Trade openness exerts an immediate negative impact ($-1.176, p = 0.0000$) due to adjustment costs and import competition, partially offset by positive lagged effects. Terms of trade and trade balance deliver strong positive impulses in the short run, confirming their role as rapid growth transmitters. Exchange rate depreciation follows the classic J-curve pattern, strongly contractionary contemporaneously ($-1.094, p = 0.0000$) but expansionary after one period ($0.792, p = 0.0000$). Inflation remains largely insignificant across horizons.

The present findings both corroborate and challenge existing literature on trade and economic development in Nigeria and similar resource-rich economies. Several studies using ARDL or related cointegration techniques report positive long-run effects of trade openness on growth (e.g., Abinabo & Abubakar, 2023), attributing this to technology spillovers, scale economies, and export expansion. However, a growing body of recent evidence aligns closely with the negative long-run openness coefficient obtained here. For instance, the study by Ajayi and Oguntoni (2022) document negative or insignificant effects of trade openness/cost in Nigeria, attributing them to premature liberalization, weak domestic productive capacity, and heavy oil dependence, factors that mirror the structural explanations advanced in this study.

The positive long-run contributions of terms of trade and trade balance are highly consistent with prior research. Empirical works by Tyokosu and Abakpa (2025) similarly identify favourable terms of trade (driven by commodity prices) and sustained trade surpluses as robust drivers of per capita income growth. These results reinforce the Prebisch-Singer hypothesis in its export-price dimension while highlighting the developmental importance of net export performance.

On macroeconomic stability variables, the insignificant long-run effects of exchange rate and inflation, alongside their strong short-run dynamics (including the J-curve for exchange rate), echo mixed findings in the literature. Overall, this study contributes to the literature by demonstrating that while trade remains a potent engine of sustainable economic development; its effectiveness in Nigeria is conditional on the *quality* of openness rather than its mere volume. The negative long-run openness result, when juxtaposed against earlier optimistic findings, underscores the evolving nature of Nigeria's trade-development nexus amid globalisation, oil price volatility, and policy shifts since the 1990s.

By confirming cointegration and parameter stability across major shocks (including the 2008 global crisis and COVID-19), the analysis adds robustness to the body of evidence on trade-led growth in resource-dependent economies.

Conclusion

This study investigated how trade economics influences sustainable economic development in Nigeria from 1996 to 2025 using ARDL bounds testing. Findings confirm a stable long-run relationship between GDP per capita and trade openness, terms of trade, trade balance, exchange rate, and inflation. The model is robust with $R^2 = 0.9914$, passing all diagnostics, and adjusts to disequilibrium at 16% annually. Terms of trade and trade balance significantly boost GDP per capita both short and long run, underscoring the value of favorable export prices and net exports for Nigeria's resource-driven economy. Conversely, trade openness exerts a negative long-run effect, implying that rising trade volume without structural transformation fuels import competition and external vulnerability. Exchange rate depreciation and inflation show strong short-run impacts, including a J-curve effect, but fade long term, emphasizing macroeconomic stability.

Thus, international trade drives Nigeria's development only when quality and composition, not mere volume, are prioritized.

Recommendations

Based on the empirical findings, the following recommendations are proposed to harness trade for sustainable economic development:

- i. Government should intensify efforts to reduce heavy dependence on crude oil exports by developing non-oil sectors such as agriculture, solid minerals, manufacturing, and services. Targeted incentives (tax breaks, credit facilities, and infrastructure support) for agro-processing, petrochemicals, and light manufacturing will help reverse the negative long-run impact of trade openness.
- ii. Policies aimed at boosting non-oil exports while implementing selective and strategic import substitution (especially for consumer goods that can be produced locally) should be pursued to sustain the positive contribution of the trade balance.
- iii. Further trade openness should be carefully sequenced with domestic capacity-building measures, including infrastructure development, ease of doing business reforms, and human capital development. Unilateral liberalisation without supporting industrial policy may exacerbate the adverse effects observed in the study.
- iv. Strengthening institutions to reduce corruption, improve policy consistency, and enhance the business environment will amplify the developmental benefits of trade.

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