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Do Trade Imbalances Drive Inflation? A Nonlinear and Asymmetric Analysis of Nigeria's Economy (1981–2023)

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Abstract

The study examines the relationship between trade imbalances and inflation in Nigeria from 1981 to 2023, using the Nonlinear Autoregressive Distributed Lag (NARDL) model. It finds that positive trade imbalances (PTI) have a short-term deflationary effect on inflation, while negative trade imbalances (NTI) show delayed inflationary effects due to currency depreciation and increased import costs. The study highlights the asymmetric nature of trade imbalances' influence on Nigeria's economy. The study also reveals that macroeconomic variables like money supply, trade openness, foreign direct investment, and real GDP influence inflationary pressures. Increased money supply exacerbates inflation in the short and long run, while trade openness contributes to short-term inflation due to global price volatility. Foreign direct investment offsets short-term inflationary pressures with long-term economic benefits, and real GDP growth contributes to demand-pull inflation in the short term. Diagnostic tests confirm the model's robustness, despite residual autocorrelation. The findings also align with Balance of Payments theory, Monetary Theory of Inflation, and Structuralist perspectives. The study recommends policy measures to manage trade imbalances, stabilize inflation, and promote sustainable economic growth in developing economies, including diversifying exports, enhancing domestic production, and implementing effective monetary and fiscal policies.

Keywords: *Trade Imbalance, Inflation, Asymmetric Effects, NARDL Model, Monetary Policy*

1. Introduction

Trade imbalances, characterized by excess imports over exports, are crucial indicators of a country's macroeconomic health (FasterCapital, 2024). In developing economies like Nigeria, these imbalances impact inflation, exchange rate stability, and overall economic performance. Nigeria's heavily reliant economy on crude oil exports makes it vulnerable to external shocks, leading to widening trade deficits and rising inflation, posing significant challenges to macroeconomic stability.

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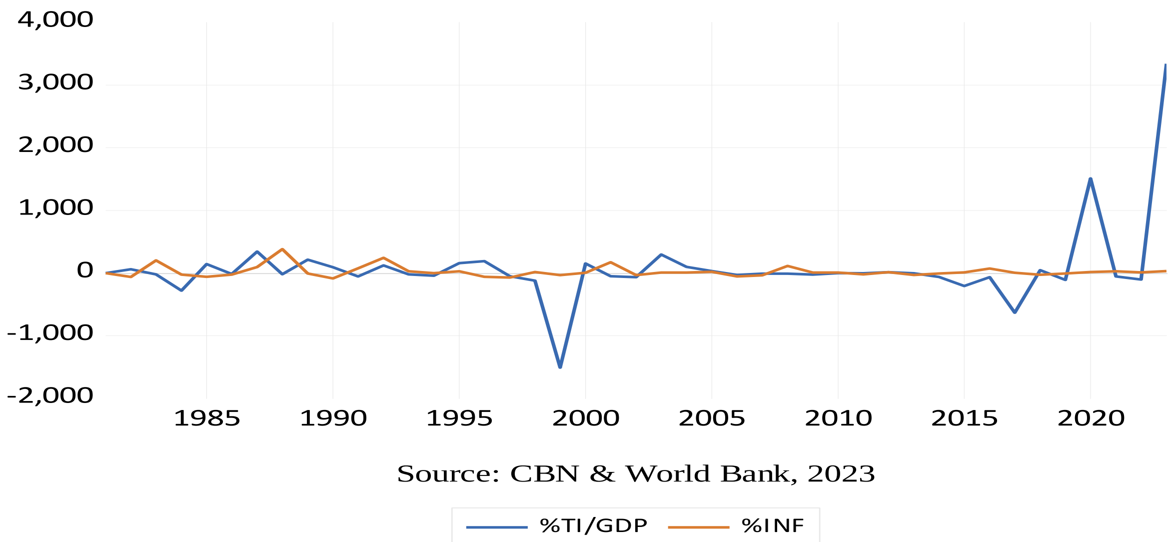
The relationship between trade imbalances and inflation is complex, often exhibiting nonlinear and asymmetric patterns. Moderate trade deficits can stimulate economic growth by facilitating capital imports and investment. However, persistent deficits deplete foreign reserves, weaken the domestic currency, and raise the cost of imports, fueling inflation. Conversely, trade surpluses can stabilize inflation by strengthening foreign exchange reserves, yet excessive reliance on exports may expose the economy to global shocks. This asymmetry suggests that trade imbalances may affect inflation differently depending on their direction and magnitude.

Figure 1: Trade Imbalance as a Percentage of GDP and Inflation (1981–2023)



Source: CBN & World Bank, 2023

Figure 1 above compares Nigeria's trade imbalance (TI) as a percentage of GDP and the inflation rate (INF) from 1981 to 2023. The graph shows that trade deficits often coincide with increased inflation, particularly in the 1980s to early 2000s. Notably, inflationary spikes are observed in the 2010s, with 2020 standing out as an exceptional year. This suggests a potential interaction between external trade dynamics and inflation, likely influenced by factors such as exchange rate volatility, external economic shocks, or domestic policy challenges. The post-2020 period, marked by global disruptions like the COVID-19 pandemic, further intensified these inflationary pressures, exacerbating the existing economic vulnerabilities.

1.2 Research Problem

Despite the significance of trade dynamics in shaping macroeconomic outcomes, existing empirical studies on Nigeria predominantly rely on linear models, thereby overlooking potential nonlinear and asymmetric relationships between trade imbalances and inflation. While prior research, such as Ihugba et al. (2024) and Shido-Ikwu et al. (2023), emphasizes the role of trade in economic growth, it often fails to differentiate the distinct inflationary impacts of trade deficits versus surpluses. This presents a critical gap in the literature, particularly in the context of Nigeria's persistent trade and inflation challenges.

Moreover, although several studies examine trade, exchange rates, and inflation, few directly investigate the specific influence of trade imbalances on inflation. Literature review evidence a gap on studies that have comprehensively addressed this relationship using models that capture potential nonlinearities and asymmetries, such as the Nonlinear Autoregressive Distributed Lag (NARDL) model, which may better reflect the complexity of Nigeria's economic environment. This methodological gap limits the formulation of evidence-based policies to manage inflation in the presence of external trade shocks.

1.3 Research Objectives

This study aims to fill that gap by:

a) Investigating the relationship between trade imbalances and inflation in Nigeria from 1981 to 2023.
b) Examining the nonlinear and asymmetric effects of trade imbalances (deficits and surpluses) on inflation using the Nonlinear Autoregressive Distributed Lag (NARDL) model.
c) Analysing both the short-run and long-run dynamics of this relationship.
d) Providing policy recommendations to address inflation and trade imbalances in Nigeria.

By applying the NARDL approach, this study seeks to uncover the true nature of the trade-inflation nexus, offering insights that can guide policymakers in designing effective, targeted strategies for economic stabilization and growth.

The remainder of this paper is structured as follows. Section 2 reviews the theoretical and empirical literature linking trade imbalances and inflation. Section 3 presents the methodology, including the NARDL model specification and data sources. Section 4 presents the empirical results, while Section 5 discusses the findings, provides the conclusion and policy recommendations.

2. Literature Review

2.1 Theoretical Framework

Monetary Theory of Inflation: The theory suggests that inflation occurs when there is excessive money supply growth relative to economic output. Trade imbalances, particularly deficits, can exacerbate inflation through exchange rate depreciation, leading to increased demand for foreign currency and higher import costs. This can feed into domestic inflation through imported goods and services (Dornbusch, Fischer, and Startz, 2014).

The Balance of Payments (BOP) theory suggests that trade deficits cause a decline in foreign exchange reserves, leading to monetary contractions or inflationary pressures. These deficits often indicate an imbalance in domestic savings and investment, causing currency depreciation and inflation (Vines, 2008).

Exchange Rate Pass-Through (ERPT) Theory: The ERPT theory explains how exchange rate changes lead to domestic inflation. Trade deficits cause currency depreciation, causing import prices to rise. Firms either absorb or pass these costs on, resulting in inflation. The degree of ERPT varies based on market structure and monetary policy (Taylor, 2000).

Cost-Push Inflation Theory: Cost-push inflation occurs when production costs increase, leading to higher prices. Trade imbalances worsen this effect by increasing input costs due to currency depreciation. In developing economies like Nigeria, where imports are a significant part of inputs, trade deficits directly lead to inflationary pressures (Blanchard, Cerutti, and Summers, 2015).

Structuralist Theory: The theory suggests that inflation in developing economies is a result of structural rigidities, such as import dependence and underdeveloped export sectors, leading to trade deficits and systemic consequences like depreciation and inflation (Bibi, 2024).

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2.2 Empirical Literature

2.2.1 Trade Imbalances and Inflation Dynamics

The study by Ihugba et al. (2024) examined the impact of international trade on Nigeria's economic stability. Using time-series data, the study found that higher inflation rates and exchange rate volatility negatively affect stability. It emphasizes the need for policies to promote domestic production and manage inflation to mitigate trade imbalances. Similarly, Shido-Ikwu et al. (2023) investigated Nigeria's economic growth from 1981 to 2019 using the ARDL approach. The results showed that import trade and exchange rate fluctuations negatively impact economic growth, while export trade significantly boosts it. These findings underscore the importance of managing inflation and encouraging exports to stabilize the economy.

In contrast, Etale and Ochuba (2019) analyzed exchange rate volatility and trade balances in Nigeria, with GDP as the proxy for economic growth. They found that while the exchange rate positively influences GDP, inflation has a negative but insignificant effect. However, Eke et al. (2015) identified a long-term relationship between trade balances, inflation, and exchange rates in Nigeria. The study highlighted the need to stabilize exchange rates to manage trade imbalances effectively.

2.2.2 Exchange Rates and Trade Balances

Thahara, Rinosha, and Shifaniya (2021) explored the relationship between exchange rates, inflation, and trade balance in Sri Lanka from 1977 to 2019. Using the ARDL model and Granger Causality tests, they found that inflation positively impacts the trade balance in the short run, while exchange rate depreciation and GDP negatively affect it in the long run. Similarly, Eke et al. (2015) emphasized that Nigeria's trade balance is highly sensitive to exchange rate fluctuations, advocating for policies to prevent continuous exchange rate declines. These studies collectively demonstrate that exchange rate volatility can destabilize trade balances, especially in developing economies.

2.2.3 Trade and Economic Growth

Okoro et al. (2020) analyzed the impact of regional and non-regional trade on economic growth in ECOWAS countries from 2007 to 2017. Results showed that regional trade positively predicts growth, while non-regional trade negatively affects it. Other macroeconomic variables like exchange rates, unemployment, and population growth had mixed effects. This supports the Krugman hypothesis that regional trade agreements are preferable to global trade. Oloyede, Osabuohien, and Ejemeyovwi (2021) examined trade openness and macroeconomic performance in Africa's regional economic communities (ECOWAS and SADC). They found a positive but insignificant correlation between trade openness and economic growth, suggesting the need for policies to ensure trade gains translate to economic development. Batrancea, Rathnaswamy, and Batrancea (2021) explored economic growth determinants in 34 African countries using panel data from 2001–2019. Results highlighted that imports, exports, capital formation, and domestic savings significantly influence GDP growth, while foreign direct investment plays a critical role in economic development.

2.2.4 Protectionism and Trade Imbalances

Delpeuch, Fize, and Martin (2024) studied the impact of trade imbalances on protectionist policies in G20 countries from 2009 to 2020. They found that bilateral trade imbalances strongly predict protectionist measures, particularly in countries with expansionary fiscal policies. This underscores the economic and political consequences of persistent trade deficits.

While these studies provide valuable insights into the relationship between trade, exchange rates, and inflation, significant gaps remain. To the best of our knowledge, no study explicitly analyzes the direct relationship between trade imbalances and inflation in Nigeria. Most existing research focuses on broader macroeconomic impacts. Furthermore, the literature lacks an exploration of the nonlinear or asymmetric effects of trade imbalances on inflation, which could more accurately reflect Nigeria's economic realities. In terms of methodology, while ARDL and cointegration tests are commonly used, there has been limited application of models that capture asymmetric effects, such as the NARDL approach.

3 Methodology

The study uses a quantitative research design to examine the impact of trade imbalances on Nigerian inflation, using annual time-series data from 1981 to 2023. The Nonlinear Autoregressive

Distributed Lag (NARDL) model is used to examine short-run and long-run relationships, identifying potential asymmetries.

3.1 Data Sources and Variables

The study uses secondary data from reliable sources like the Central Bank of Nigeria and the World Development Indicators to measure inflation. The dependent variable is inflation, measured as the annual percentage change in the Consumer Price Index (CPI), while the key independent variable is trade imbalance, calculated as a percentage of GDP. To account for other macroeconomic factors influencing inflation, the study includes control variables such as Trade Openness (TOP), Foreign Direct Investment (FDI), Gross Domestic Product (GDP), and Money Supply (M2). The study presents these variables, their measurements, expected signs, and data sources in Table 1.

Table 1: Measurement of Variables and Data Sources

Variables	Description	Measurement	Expected Sign	Source
INF	Annual inflation rate	Percentage (%)	Dependent	https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?subcat=11&locations=NG
TI	Trade imbalance as a % of GDP	(Exports - Imports)/GDP × 100	Positive/Negative	Computed from CBN data
PTI	Positive trade imbalance	Positive TI values	Negative	Derived from TI
NTI	Negative trade imbalance	Negative TI values	Positive	Derived from TI
RGDP	Real GDP (economic growth)	Log of real GDP (constant US$)	Positive/Negative	https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=NG
TOP	Trade openness	(Exports + Imports)/GDP × 100	Positive/Negative	Computed from CBN data
FDI	Capital inflows contributing to production and trade activities.	Annual FDI inflows (US$ million).	Negative	https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?locations=NG
M2	Broad money supply	Percentage change	Positive	CBN Statistical Bulletin, 2022 & 2023

3.2 Econometric Model

The Nonlinear ARDL model, developed by Shin et al. (2014), is used to analyse the impact of trade imbalances on inflation, dividing it into positive and negative components, allowing for asymmetric effects.

3.3 Model Specification

The general NARDL model is specified as:

$$INF_t = \alpha_0 + \sum_{i=1}^{\rho} \beta_i INF_{t-i} + \sum_{i=0}^{q} \theta_i PTI_{t-i} + \sum_{i=0}^{q} \phi_i NTI_{t-i} + \sum_{i=0}^{r} \delta_i Z_{t-i} + \varepsilon_t \qquad 1$$

Where:

INF_t : Inflation rate at time t (dependent variable).

PTI_t : Positive trade imbalance (trade surplus).

NTI_t : Negative trade imbalance (trade deficit).

Z_{t-i} : Vector of control variables (TOP, FDI, GDP, and M2).

ε_t : Error term.

$\alpha_0, \beta_i, \theta_i, \phi_i, \delta_i$: Parameters to be estimated.

3.3.1 Long-Run NARDL Model

The long-run NARDL model is used to estimate the equilibrium relationship between trade imbalances and inflation, the long-run NARDL model is expressed as:

$$INF_t = \alpha_0 + \sum_{j=0}^{q} \frac{\theta_j^+}{-\phi} PTI_t + \sum_{j=0}^{q} \frac{\theta_j^-}{-\phi} NTI_t + \sum_{j=0}^{r} \frac{\delta_j}{-\phi} Z_t + \varepsilon_t \qquad 2$$

The coefficients $\frac{\theta_j^+}{-\phi}$ and $\frac{\theta_j^-}{-\phi}$ represent the long-term effects of trade surpluses and deficits on inflation, while $\frac{\delta_j}{-\phi}$ reflects the long-term impacts of control variables.

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3.3.2 Short-Run NARDL Model

The short-run NARDL model is used to examine the immediate impact of trade imbalances and other macroeconomic factors on inflation. It is specified as:

$$\Delta INF_t = \alpha_0 + \sum_{i=1}^{\rho} \gamma_i \Delta INF_{t-i} + \sum_{i=0}^{q} \theta_i \Delta PTI_{t-i} + \sum_{i=0}^{q} \theta_i \Delta NTI_{t-i} + \sum_{i=0}^{r} \delta_i \Delta Z_{t-i} + \phi ECM_{t-1} + \varepsilon_t \qquad 3$$

Here, the first difference of inflation is represented by ΔINF_t while ΔPTI_t and ΔNTI_t represents positive and negative trade imbalances, respectively. The error correction term ϕECM_{t-1} measures the speed of adjustment back to long-run equilibrium.

3.4 Steps in the Analysis

Unit Root Testing: The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used to test the stationarity of variables, with NARDL allowing variables with mixed levels of integration ($I(0)\&I(1)$ but excluding those integrated at $I(2)$.

Bound Test for Cointegration: The ARDL bounds testing approach is applied to determine the existence of a long-run relationship among the variables. If the calculated F-statistic exceeds the upper critical bound, cointegration is established.

NARDL Estimation: The NARDL Estimation method decomposes the trade imbalance variable into positive and negative changes to capture potential asymmetries and estimates short-run and long-run coefficients to determine the direction and magnitude of effects.

Diagnostic tests are conducted to ensure model robustness, including Breusch-Godfrey LM test for serial correlation, ARCH test for heteroskedasticity, Jarque-Bera test for normality, Ramsey RESET test for model specification, and CUSUM and CUSUMSQ tests for stability.

3.5 Justification for NARDL Approach

The NARDL approach is justified for its asymmetric analysis, which captures the differential effects of positive and negative trade imbalances on inflation. It offers flexibility in integration orders, accommodating a mix of stationary and first-difference stationary variables. NARDL estimates both short- and long-run dynamics, making it ideal for analyzing time-series data like trade imbalances and inflation.

3.6 Expected Results

Trade deficits and trade surpluses are expected to have different impacts on inflation in Nigeria. Trade deficits are expected to have a positive effect due to increased import costs and exchange rate depreciation, while trade surpluses may have a negative effect by stabilizing foreign reserves and reducing inflationary pressures. Control variables, including GDP growth, FDI, and TOP, are expected to exert varying effects on inflation, contingent upon their function within Nigeria's macroeconomic context.

4 Results

4.1 Unit Root Tests

The NARDL model was evaluated using the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests to ensure variable stationarity. The results showed a mix of integration orders $I(0) \& I(1)$, confirming the model's suitability. However, none of the variables were integrated of order $I(2)$., ensuring no violation of NARDL assumptions.

Table 2: Unit Root Tests Result

Variables	ADF Test Statistic		PP Test Statistic		KPSS Test Statistic	
	Level	1st Diff	Level	1st Diff	Level	1st Diff
INF	-3.08*	5.96*	-2.94*	-10.80*	0.28*	0.50
TI	-4.08*	-7.60*	-4.58*	-7.48*	0.27*	0.30*
LRGDP	0.87	-5.24*	-1.06	-5.23*	0.66	0.16*
LFDI	-1.95	-10.13*	-1.64	-10.12*	0.56	0.08*
LTOP	-1.09	-7.38*	-0.79	-7.34*	0.78	0.15*
PTI	-2.12	-1.37	-2.38	-8.19*	0.48	0.50
NTI	12.1	4.12	-4.10*	-14.8*	0.47	0.32*
M2	-6.63*	-6.61*	-3.31*	-11.9*	0.13*	0.50

Source: Authors computation using Eviews 12, 2024

Notes (ADF): Test critical values at 5% (At level: constant = -2.94, while at First difference = -2.92); *signifies stationarity.
Notes (PP): Test critical values at 5% (At level: constant = -2.94, while at First difference = -2.92); *signifies stationarity.
Notes (KPSS): If the p-value at 5% is small ($p < 0.46$), reject the null hypothesis and conclude the series is non-stationary, while if it's large ($p > 0.46$), fail to reject the null hypothesis and conclude the series is stationary, *signifies stationarity.

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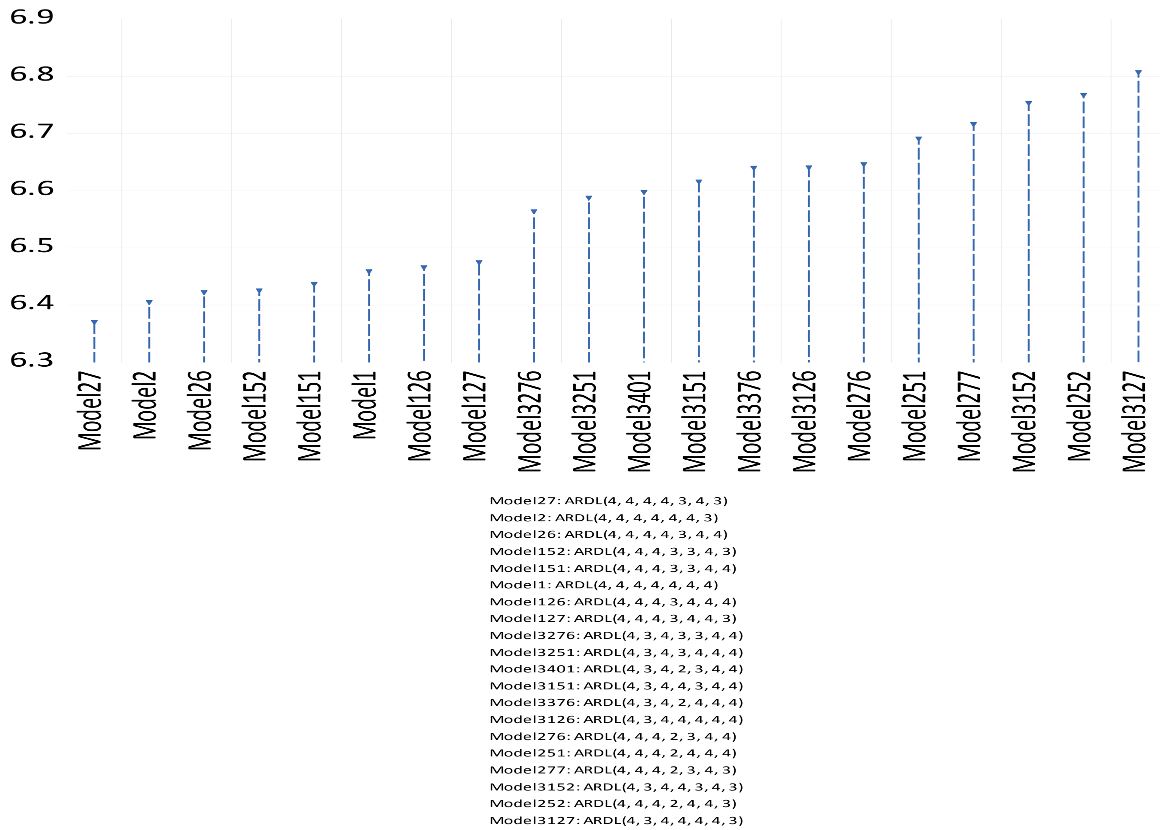
4.2 Model Selection Process

The summary of the top-ranked models based on AIC is presented in Figure 2.

Figure 2: Akaike Information Criteria (top 20 models)



The model selected, ARDL (4, 4, 4, 4, 3, 4, 3) with the lowest AIC value of 6.369917, efficiently captures variable relationships without overfitting. The model will be utilized for further analysis, estimating both short-term and long-term relationships.

4.3 Bounds Test for Cointegration

Table 3 presents the ARDL Bounds Test results, showing an F-statistic exceeding the 5% significance level, indicating a long-term relationship between inflation, trade imbalance, and control variables.

Table 3: F-Bounds Test results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.973296	10%	1.99	2.94
k	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99
Actual Sample Size	37		Finite Sample: n=40	

The F-Bounds Test is used to determine if a long-run relationship exists among variables in a model. The null hypothesis suggests no levels relationship, indicating no cointegration. The F-statistic is 4.973296, with significance levels and critical bounds for 10%, 5%, 2.5%, and 1%. k: Represents the number of explanatory variables in the model (k = 6 here). The sample size is 37 observations, with finite critical values for n=40.

The asymptotic critical bounds (n = 1000) were set at 10%, 5%, and 1% levels. At the 10% level, the results showed I(0) = 1.99 and I(1) = 2.94, rejecting the null hypothesis. At the 5% level, the results showed I(0) = 2.27 and I(1) = 3.28, rejecting the null hypothesis. At the 1% level, the results showed I(0) = 2.88 and I(1) = 3.99, rejecting the null hypothesis. The null hypothesis is rejected as the value of 4.973296 is greater than 2.94, 3.28, and 3.99 allowing for the estimation of long-run and short-run relationships using the ARDL/NARDL framework.

4.4 Long-run Results

Table 4 presents the long-run estimates of the NARDL model. Significant lagged values (INF(-2) and INF(-4)) indicate past inflation helps reduce current inflation, possibly due to tighter monetary policies or reduced purchasing power. Positive trade imbalance (PTI) has a negative contemporary effect (-1.55E-05, p = 0.0112), suggesting that an increase in trade surplus reduces inflation in the short term. This suggests that trade surpluses help stabilize prices by strengthening foreign exchange reserves or reducing import costs. Lagged effects, such as PTI(-2) and PTI(-3), confirm a persistent deflationary effect of trade surpluses on inflation over time. The effect diminishes at longer lags, indicating that the influence of trade surpluses on inflation is more immediate.

Table 4: NARDL Long Run Estimate (4, 4, 4, 4, 3, 4,3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
INF(-1)	0.153877	0.231510	0.664669	0.5426
INF(-2)	-1.587461	0.254149	-6.246175	0.0033
INF(-3)	-0.566727	0.305420	-1.855569	0.1371
INF(-4)	-1.902592	0.535432	-3.553378	0.0237
PTI	-1.55E-05	3.49E-06	-4.457828	0.0112
PTI(-1)	5.23E-06	5.45E-06	0.959239	0.3918
PTI(-2)	-2.16E-05	6.68E-06	-3.225933	0.0321
PTI(-3)	-3.57E-05	7.38E-06	-4.841967	0.0084
PTI(-4)	-1.02E-05	6.90E-06	-1.481745	0.2125
NTI	8.50E-06	4.86E-06	1.748957	0.1552
NTI(-1)	-1.20E-06	4.04E-06	-0.296168	0.7818
NTI(-2)	-3.76E-05	8.45E-06	-4.444672	0.0113
NTI(-3)	-5.98E-05	1.48E-05	-4.046160	0.0155
NTI(-4)	-8.60E-05	1.92E-05	-4.469959	0.0111
LRGDP	-6.829687	14.92528	-0.457592	0.6710
LRGDP(-1)	86.22862	22.00779	3.918096	0.0173
LRGDP(-2)	59.30862	16.73300	3.544410	0.0239
LRGDP(-3)	16.45605	10.86754	1.514239	0.2045
LRGDP(-4)	-5.149874	7.571901	-0.680130	0.5337
LFDI	-9.415854	8.640114	-1.089784	0.3371
LFDI(-1)	-0.923510	13.60141	-0.067898	0.9491
LFDI(-2)	21.15911	7.506190	2.818889	0.0479
LFDI(-3)	27.09064	7.151888	3.787901	0.0193
LTOP	32.88369	7.663470	4.290966	0.0127
LTOP(-1)	-3.499715	7.559755	-0.462940	0.6675
LTOP(-2)	2.217521	9.910972	0.223744	0.8339
LTOP(-3)	-18.97488	11.02662	-1.720825	0.1604
LTOP(-4)	-31.24266	12.30501	-2.539019	0.0640
M2	0.685268	0.254758	2.689874	0.0547
M2(-1)	0.851673	0.174556	4.879087	0.0082
M2(-2)	0.146203	0.162501	0.899702	0.4191
M2(-3)	0.756289	0.245348	3.082520	0.0368
C	-1161.386	462.1508	-2.513003	0.0658

R-squared= 0.980591; Adjusted R-squared=0.825319

The coefficient for (NTI) negative trade imbalance (trade deficit) is positive (8.50E-06) but statistically insignificant (p = 0.1552). This suggests that NTI has no immediate inflationary impact, but its lag effects, NTI(-2), NTI(-3), and NTI(-4), are significant and negatively signed, suggesting a delayed deflationary effect. This suggests a nonlinear and asymmetric relationship between NTI and inflation, possibly due to demand suppression caused by higher import costs or currency depreciation.

Significant lags in Real GDP (LRGDP) can positively impact inflation, suggesting that economic growth can increase demand and drive inflation. Higher FDI inflows may contribute to inflationary pressures through increased domestic spending or infrastructure demand, as indicated by positive coefficients for LFDI(-2) and LFDI(-3). The positive contemporaneous coefficient (LTOP) indicates that increased trade openness leads to short-term inflation, possibly due to higher import costs or exposure to global price fluctuations. The positive coefficients (M2, M2(-1), M2(-3)) confirm the inflationary impact of money supply expansion, aligning with monetary theory. The model explains 98.0% of the dependent variable's variance, with an adjusted R-squared of 0.82531, indicating a strong fit.

4.5 Short-Run Results

Equation (3) outlines the dynamic relationship between inflation and its key determinants in the short term, from which we derive the short-run results. The equation includes lagged changes in inflation, positive trade imbalance, and negative trade imbalance, along with other control variables like real GDP, foreign direct investment, trade openness, and money supply. The short-run coefficients for ΔPTI and ΔNTI are particularly insightful as they capture the asymmetric impact of trade imbalances on inflation dynamics. Positive trade imbalances are expected to stabilize inflation, while negative trade imbalances may have destabilizing implications, depending on the magnitude and significance of their respective coefficients. The findings will also highlight the persistence of inflationary pressures in the short term, as evidenced by the significance of lagged inflation coefficients. The control variables guarantee the adequate capture of other macroeconomic factors influencing inflation, thereby enabling robust conclusions about the short-run dynamics of inflation. The short-run result is presented in Table 5.

The ECM results show a negative and statistically significant (p-value < 0.01), error correction term (ECM (-1)) with a t-statistic of -10.46004, indicating a long-run relationship among variables. The coefficient's magnitude of -4.9029 indicates a fast adjustment toward equilibrium, with deviations from long-run equilibrium corrected by almost 490.29% in one period, possibly reflecting model-specific dynamics. The model explains 97.38% of the dependent variable's variance, with an adjusted R-squared of 0.9141, indicating a strong fit.

The study reveals that lagged inflation has a significant short-term positive impact on the dependent variable, with a slightly weaker effect on the dependent variable. However, the impact diminishes over time, as indicated by the weaker lags. In the short run, positive trade imbalance

(PTI) has a small but significant negative effect on inflation (D(PTI(-1)): 6.75E-05 ($p < 0.01$))), while delayed PTI has a positive and significant effect. Higher lags (PTI(-2), PTI(-3)) show that delayed effects are beneficial in the short run. (NTI) Negative Trade Imbalance (D(NTI(-1)): 0.000183 ($p < 0.01$))) has a small positive effect on contemporary markets, with a stronger short-run influence in the first lag. Higher lags (NTI(-2), NTI(-3)) remain significant and positive, though their magnitudes decrease over time.

Table 5: NARDL Short-run Result

ECM Regression Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	4.056781	0.389640	10.41160	0.0005
D(INF(-2))	2.469319	0.310706	7.947452	0.0014
D(INF(-3))	1.902592	0.225778	8.426828	0.0011
D(PTI)	-1.55E-05	1.70E-06	-9.162989	0.0008
D(PTI(-1))	6.75E-05	7.07E-06	9.548403	0.0007
D(PTI(-2))	4.59E-05	5.05E-06	9.101057	0.0008
D(PTI(-3))	1.02E-05	2.26E-06	4.526154	0.0106
D(NTI)	8.50E-06	1.68E-06	5.062881	0.0072
D(NTI(-1))	0.000183	1.76E-05	10.40521	0.0005
D(NTI(-2))	0.000146	1.55E-05	9.386892	0.0007
D(NTI(-3))	8.60E-05	9.48E-06	9.070097	0.0008
D(LRGDP)	-6.829687	5.425609	-1.258787	0.2766
D(LRGDP(-1))	-70.61479	8.923310	-7.913520	0.0014
D(LRGDP(-2))	-11.30617	3.907440	-2.893499	0.0444
D(LRGDP(-3))	5.149874	3.512172	1.466293	0.2165
D(LFDI)	-9.415854	2.798902	-3.364125	0.0282
D(LFDI(-1))	-48.24975	6.375936	-7.567478	0.0016
D(LFDI(-2))	-27.09064	3.517377	-7.701944	0.0015
D(LTOP)	32.88369	3.065811	10.72594	0.0004
D(LTOP(-1))	48.00002	5.417032	8.860946	0.0009
D(LTOP(-2))	50.21754	6.167706	8.142013	0.0012
D(LTOP(-3))	31.24266	5.469101	5.712577	0.0046
D(M2)	0.685268	0.085516	8.013310	0.0013
D(M2(-1))	-0.902492	0.122800	-7.349269	0.0018
D(M2(-2))	-0.756289	0.102175	-7.401896	0.0018
ECM(-1)*	-4.902903	0.468727	-10.46004	0.0005

R-squared= 0.9738; Adjusted R-squared= 0.9141

The short-run asymmetry in the coefficients for Positive Trade Imbalance (PTI) and Negative Trade Imbalance (NTI) indicates that the economy responds differently to these imbalances. Negative trade imbalances may stimulate short-term economic adjustments or investments, while positive trade imbalances may initially constrain the economy but contribute positively with a lag, possibly reflecting delayed benefits of surplus-driven resource allocation.

Table 5 reveals varying degrees of negative short-term impact of lagged real GDP, with D(LRGDP) values ranging from -6.8297 to 5.1499, indicating varying degrees of statistical significance. The short-term negative impact of Foreign Direct Investment (D(LFDI)) is significant, with lagged values showing stronger negative impacts. Trade openness significantly impacts short-run economic growth, with higher lags indicating sustained positive effects over time. The Broad Money Supply (D(M2)) showed a positive and significant impact, while the negative and significant D(M2(-1)) and D(M2(-2)) indicated a reversal of the initial positive impact.

4.6 Diagnostic Tests

The regression model's validity and robustness were evaluated through diagnostic tests, focusing on key assumptions like residual autocorrelation, heteroskedasticity, normality, model specification, and coefficient stability. Table 6 summarizes the results, including statistical measures, p-values, and conclusions.

Table 6: Summary of Diagnostic Test Results

Test	Test Statistic	Critical Value/ Threshold	p-Value	Decision	Remark
Breusch-Godfrey LM Test	F = 35.912	N/A	0.0271	Reject null hypothesis of no autocorrelation	Indicates residual autocorrelation.
Ljung-Box Q-Test	Q = 7.8079 (lag 1)	N/A	0.005	Reject null hypothesis of no autocorrelation	Suggests autocorrelation at lag 1.
Ramsey RESET Test	F = 3.871192	N/A	0.1438	Fail to reject null hypothesis	No evidence of model misspecification.
Heteroskedasticity Test (Breusch-Pagan-Godfrey)	F = 0.385451	N/A	0.9450	Fail to reject null hypothesis of homoscedasticity	No heteroskedasticity detected.
Normality Test (Jarque-Bera)	JB= 3.426754	N/A	0.180256	Fail to reject null hypothesis	Residuals are normally distributed.
Stability (CUSUM)	Within bounds	N/A	N/A	Model is stable	No structural instability detected.
CUSUM of Squares Test	Within bounds	N/A	N/A	Model is stable	No structural instability detected.

While the Breusch-Godfrey LM test and Ljung-Box Q-statistic show residual autocorrelation, but the model's robustness in diagnostic tests like heteroscedasticity, normality, and stability supports the validity of long-run estimates. ARDL models remain reliable for long-run inference, even with short-run residuals exhibiting autocorrelation, provided the model is correctly specified (Pesaran, Shin, and Smith, 2001).

The Ramsey RESET Test validates the robustness of the model, as the F-statistic (3.871192, p = 0.1438) and t-statistic (1.967534, p = 0.1438) show that conventional significance levels cannot reject the null hypothesis. Despite a significant likelihood ratio test, no evidence of omitted variable bias or functional form misspecification was found. This finding, along with other diagnostic tests, supports the model's overall robustness.

The exchange rate was initially considered as an explanatory variable for the relationship between trade imbalances and inflation. However, stationarity tests using ADF, PP, and KPSS revealed it was non-stationary at all levels, making it unsuitable for inclusion in the model. Instead, the inflation rate was modeled as the dependent variable, with trade imbalances, disaggregated into positive (PTI) and negative (NTI) trade imbalances, as the primary explanatory variables. Inflation is a suitable dependent variable, reflecting the macroeconomic effects of trade imbalances.

The substitution of the exchange rate with trade imbalances as the core focus allows for a more nuanced exploration of inflationary dynamics in the Nigerian context. Despite the presence of residual autocorrelation, the model's robustness in other diagnostic tests supports the reliability of the findings, particularly for long-term relationships. Future research could address serial correlation through alternative lag structures or advanced estimation techniques, such as robust standard errors or GARCH models, to refine the analysis of inflationary dynamics driven by trade imbalances.

The section following the references presents the results of all diagnostic tests and a summary of the data used in the analysis.

5 Discussion of Findings

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Based on Theoretical Framework: The Balance of Payments (BOP) theory confirms the deflationary impact of positive trade imbalances on inflation, which strengthens foreign reserves and stabilizes the exchange rate. However, negative trade imbalances erode foreign reserves and depreciate the currency, leading to higher import costs and inflation Vines (2008). The Exchange Rate Pass-Through (ERPT) theory, which suggests that currency depreciation increases import costs through NTI, which are then passed on to domestic consumers, drives inflation. This highlights the importance of stabilizing exchange rates to mitigate imported inflation, despite the exclusion of the exchange rate variable in the model. This underscores the significance of stabilizing exchange rates to mitigate imported inflation (Taylor, 2000). The findings support the monetary theory of inflation by demonstrating that money supply expansion significantly influences inflation in both short and long run. The positive coefficients for M2 indicate that excessive money supply growth contributes to inflationary pressures, highlighting the need for monetary policy interventions to stabilize prices and address the imbalance between money supply and economic output. This is consistent with the theory's emphasis on the imbalance between money supply and economic output (Dornbusch et al., 2014). The result also suggests that trade openness (LTOP) can lead to inflation in Nigeria due to increased import costs, driven by currency depreciation and trade deficits, which in turn raise production costs, thereby fuelling inflation, especially in countries like Nigeria. This is particularly relevant for Nigeria, where imported goods are critical to production processes (Blanchard et al., 2015). The finding reveals Nigeria's economic vulnerabilities, including reliance on imports and underdeveloped export sectors, as significant contributors to trade imbalances and inflation, aligning with the structuralist theory, which emphasizes the systemic nature of inflation in developing economies as stated by Bibi (2024).

Based on Empirical Literature: The significant impact of PTI and NTI on inflation supports the works of Ihugba et al. (2024) and Shido-Ikwu et al. (2023), who stressed the importance of managing trade imbalance to stabilize Nigeria's economy. However, this study extends the literature by revealing the asymmetric and nonlinear effects of these imbalances on inflation dynamics. Although exchange rate data was excluded, the inflationary effects of NTI indirectly influence exchange rates, as highlighted by Thahara et al. (2021) and Eke et al. (2015), emphasizing the destabilizing effects of exchange rate volatility on trade balances and inflation.

The findings supports Okoro et al. (2020) and Oloyede et al. (2021) by highlighting the dual effects of trade openness, highlighting short-term inflationary pressures due to global price volatility and long-term benefits of balancing openness with domestic economic resilience. The findings suggests that addressing trade imbalances through trade policies and domestic production could mitigate protectionist responses and enhance economic stability, as suggested by Delpeuch et al. (2024).

This study explores in a significant way, the link between trade imbalances and inflation in Nigeria, using the NARDL approach unlike previous studies to understand nonlinear and asymmetric effects. It provides actionable insights for policymakers to effectively address Nigeria's macroeconomic challenges, offering a nuanced understanding of inflationary dynamics.

5.1 Conclusion

The study analyses the relationship between trade imbalances and inflation in Nigeria from 1981-2023 using the Nonlinear Autoregressive Distributed Lag NARDL framework. It reveals significant asymmetric effects of positive trade imbalance (PTI) and negative trade imbalance (NTI) on inflation in the short and long run. Positive trade imbalances stabilize prices through foreign reserves and reduced import costs in the long run, while negative imbalances delay deflation due to rising import costs and currency depreciation. Short-run results show PTI stabilizes inflation, while NTI's impact diminishes with higher lags.

The study reveals mixed effects of other determinants like real GDP, FDI, trade openness, and M2, with trade openness positively impacting inflation in the short term and monetary expansion promoting inflation, emphasizing the need for cautious monetary policy. Overall, the study highlights the nonlinear and asymmetric dynamics between trade imbalances and inflation, providing valuable insights for policymakers to tackle Nigeria's persistent macroeconomic challenges.

Future research should explore advanced techniques like GARCH models or alternative lag structures to improve understanding of inflationary dynamics in response to trade imbalances.

5.2 Policy Recommendations

a) Policymakers should devise strategies to reduce trade deficits and boost surpluses by diversifying exports, promoting non-oil exports, and enhancing domestic production to decrease import dependency.
b) The Central Bank of Nigeria should focus on inflation control through monetary and fiscal policies, controlling broad money supply expansion, and targeting inflation through interest rate adjustments and policy coordination.
c) FDI can have short-term inflationary effects, but long-term benefits can be achieved through infrastructure improvements, reduced bureaucratic inefficiencies, and enhanced human capital development.
d) Trade policies should balance domestic industries with global market opportunities, using targeted tariffs, subsidies, and trade agreements to mitigate inflation risks and boost long-term growth.
e) Policymakers should utilize positive trade imbalances to strengthen foreign exchange reserves, stabilize the currency, and invest in infrastructure and productivity-enhancing initiatives to sustain deflationary impacts in the long term.

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ANNEX

Table 7: Summary of Data

Year	RGDP	TI	FDI	TOP	INF	NTI	PTI
1981	164.48	-1,816.30	542327289.1	12895.99	20.81	1816.3	0
1982	142.77	-2,564.10	430611256.5	10815.54	7.70	2564.1	0
1983	97.09	-1,401.20	364434580.2	8949.93	23.21	1401.2	0
1984	73.48	1,909.70	189164784.9	7234.929	17.82	0	1909.7
1985	73.75	4,658.20	485581320.9	7131.556	7.44	0	4658.2
1986	54.81	2,937.00	193214907.5	6036.05	5.72	0	2937
1987	52.68	12,498.90	610552091.5	18034.67	11.29	0	12498.9
1988	49.65	9,747.10	378667097.7	21611.27	54.51	0	9747.1
1989	44	27,111.00	1884249739	31162.12	50.47	0	27111
1990	54.04	64,168.20	587882970.6	46229.89	7.36	0	64168.2
1991	59.53	32,047.20	712373362.5	90052.44	13.01	0	32047.2
1992	52.06	62,460.50	896641282.5	144063.5	44.59	0	62460.5
1993	56.72	53,140.70	1345368587	166620.3	57.17	0	53140.7
1994	80.4	43,270.40	1959219858	163739.4	57.03	0	43270.4
1995	140.92	195,533.70	335842165	759516.6	72.84	0	195533.7

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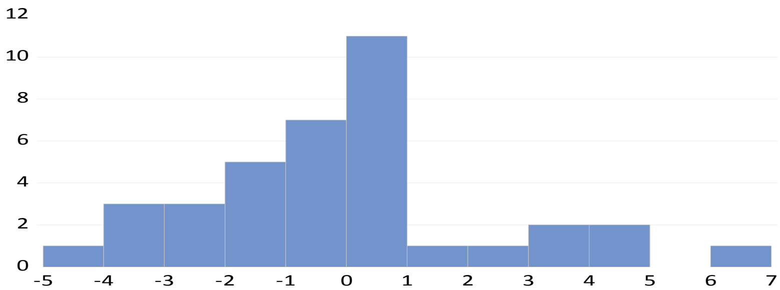
1996	185.73	746,916.80	499276809.5	568429	29.27	0	746916.8
1997	200.85	395,946.10	469577019.8	851061.4	8.53	0	395946.1
1998	218.42	-85,562.00	299566658.3	840573.8	10.00	85562	0
1999	59.15	326,454.10	1004915631	867476.4	6.62	0	326454.1
2000	69.17	960,700.91	1140167556	992752.9	6.93	0	960700.9
2001	73.56	509,773.52	1190618644	1365187	18.87	0	509773.5
2002	95.05	231,482.35	1874070753	1518368	12.88	0	231482.4
2003	104.74	1,007,651.12	2005353563	2089591	14.03	0	1007651
2004	135.76	2,615,736.27	1874060887	1999810	15.00	0	2615736
2005	175.67	4,445,678.47	4982533930	2819738	17.86	0	4445678
2006	238.45	4,216,161.31	4854353979	3126514	8.23	0	4216161
2007	278.26	4,397,805.69	6036021405	3931106	5.39	0	4397806
2008	339.48	4,794,513.17	8194071895	5615606	11.58	0	4794513
2009	295.01	3,125,663.59	8555990007	5497854	12.54	0	3125664
2010	366.99	3,847,501.30	6026253091	8185969	13.74	0	3847501
2011	414.47	4,240,802.36	8841062051	11022357	10.83	0	4240802
2012	463.97	5,372,769.40	7069908428	9791818	12.22	0	5372769
2013	520.12	5,822,588.90	5562857987	9463566	8.50	0	5822589
2014	574.18	2,423,112.33	4693828632	10558217	8.05	0	2423112
2015	493.03	-2,230,909.53	3064168904	11088883	9.01	2230910	0
2016	404.65	-644,754.96	3453258408	9493374	15.70	644755	0
2017	375.75	3,183,297.35	2412974916	10825269	16.50	0	3183297
2018	421.74	5,262,214.68	775247400	13471914	12.10	0	5262215
2019	474.52	-539,434.58	2305099812	20477859	11.40	539434.6	0
2020	432.2	-7,905,599.45	2385277666	20537208	13.25	7905599	0
2021	440.84	-3,750,664.65	3313210000	22981363	16.95	3750665	0
2022	472.62	136,463.81	-186792428.9	27151620	18.85	0	136463.8
2023	362.81	3,605,122.18	1872520530	32689935	24.7	0	3605122

Source: As stated in Table 1

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	35.91200	Prob. F(2,2)	0.0271
Obs*R-squared	35.99762	Prob. Chi-Square(2)	0.0000



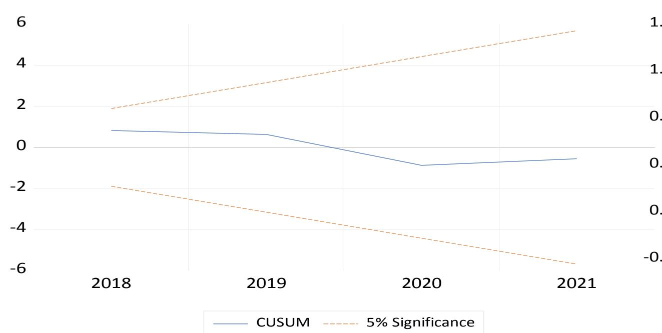
Series: Residuals	
Sample 1985 2021	
Observations 37	
Mean	7.98e-14
Median	-0.032028
Maximum	6.750076
Minimum	-4.554232
Std. Dev.	2.429846
Skewness	0.683946
Kurtosis	3.592983
Jarque-Bera	3.426754
Probability	0.180256

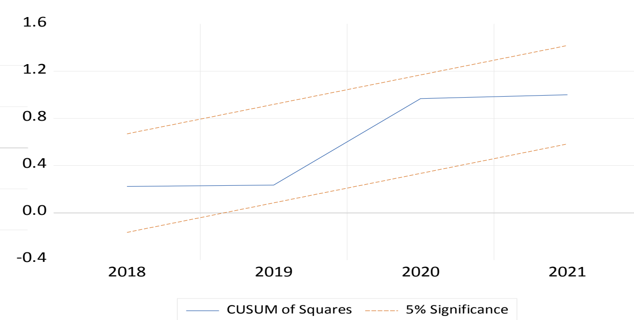
Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.385451	Prob. F(32,4)	0.9450
Obs*R-squared	27.93939	Prob. Chi-Square(32)	0.6724
Scaled explained SS	0.423353	Prob. Chi-Square(32)	1.0000

Ramsey RESET Test

	Value	df	Probability
t-statistic	1.967534	3	0.1438
F-statistic	3.871192	(1, 3)	0.1438
Likelihood ratio	30.66283	1	0.0000





Q-statistic probabilities adjusted for 4 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.441	-0.441	7.8079	0.005
		2	0.016	-0.222	7.8188	0.020
		3	-0.052	-0.185	7.9350	0.047
		4	-0.008	-0.155	7.9378	0.094
		5	-0.062	-0.208	8.1087	0.150
		6	0.155	0.010	9.2271	0.161
		7	-0.121	-0.084	9.9325	0.192
		8	0.246	0.238	12.944	0.114
		9	-0.346	-0.164	19.120	0.024
		10	0.025	-0.246	19.154	0.038
		11	0.213	0.117	21.677	0.027
		12	-0.149	-0.079	22.962	0.028
		13	-0.011	-0.133	22.969	0.042
		14	0.087	-0.080	23.447	0.053
		15	-0.137	-0.123	24.670	0.055
		16	-0.043	-0.303	24.796	0.074

*Probabilities may not be valid for this equation specification.