Do Exchange Rate Fluctuations Amplify Multidimensional Poverty? The Moderating Role of Fiscal Sustainability in Nigeria

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ABSTRACT

Backgrounds: More than one billion people in low- and middle-income countries experience multidimensional poverty, yet the macroeconomic forces driving it remain insufficiently understood, particularly in Nigeria following the 2023 exchange rate reforms.

Objectives: This study examines the effect of exchange rate fluctuations on multidimensional poverty and investigates whether fiscal sustainability moderates this relationship.

Methods: Using annual data over the period 1990-2025, the study estimates a Nonlinear Autoregressive Distributed Lag (NARDL) model with a fiscal sustainability interaction term, while measuring welfare using the Alkire-Foster Multidimensional Poverty Index (MPI).

Results: Results reveal significant asymmetric effects: exchange rate depreciation increases multidimensional poverty by nearly three times more than the poverty-reducing effect of an equivalent appreciation. Fiscal sustainability independently lowers poverty; however, its interaction with exchange rate depreciation is positive and statistically significant, indicating that depreciation worsens poverty nearly threefold compared to appreciation, and fiscal fragility amplifies that effect instead of easing it. The error-correction results further show that only about 58% of short-run disequilibrium is corrected annually, implying persistent welfare losses following major exchange rate shocks.

Conclusion: The study posits that combining exchange rate stabilisation with broad-based fiscal reforms that strengthen non-oil revenues is central for protecting social expenditure to achieve sustained reductions in multidimensional poverty.

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1. INTRODUCTION

The conceptualisation and measurement of poverty in low- and middle-income economies have undergone a significant transformation over the past two decades. Traditional income-based measures have increasingly been replaced by multidimensional approaches that recognise poverty as a complex phenomenon extending beyond inadequate income to include simultaneous deprivations in health, education, and living standards. These overlapping deprivations reinforce one another, making poverty persistent and less responsive to economic growth alone (Nunghe et al., 2025). According to the United Nations Development Programme (2023), more than one billion people in low- and middle-income countries experience acute multidimensional poverty, with the burden concentrated disproportionately in Sub-Saharan Africa. In this region, weak institutions, heavy

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dependence on primary commodities, and recurring macroeconomic instability have produced welfare outcomes that conventional growth indicators fail to capture adequately.

Nigeria represents one of the most critical cases within this regional setting. Although it remains Africa's largest economy, it also accounts for one of the world's highest and fastest-growing multidimensional poverty burdens. Large segments of the population simultaneously experience deprivation in nutrition, education, housing, access to safe drinking water, sanitation, and modern energy services, conditions that cannot be adequately explained by income poverty alone (Agbeni et al., 2025). The worsening of multidimensional poverty has become increasingly intertwined with recent developments in Nigeria's foreign exchange regime. In 2023, the government unified the official and parallel foreign exchange markets while simultaneously removing fuel subsidies, triggering a substantial depreciation of the naira. Within twelve months, the naira lost roughly two-thirds of its dollar value as Nigeria transitioned from a managed exchange rate system to a more market-determined regime. The resulting exchange rate shock significantly increased import prices, reduced real wages, and constrained public expenditure capacity (Eregha et al., 2026; Kofarbai et al., 2024).

The transmission of exchange rate depreciation to multidimensional poverty occurs through three interrelated channels. First, the price channel raises the cost of imported goods and services, making essential consumption increasingly unaffordable for households. Second, the income channel reduces real household earnings and savings as inflation erodes purchasing power. Third, the fiscal channel operates through the increased cost of servicing foreign currency-denominated debt, which limits government expenditure on health, education, and infrastructure. These are dimensions captured by the Multidimensional Poverty Index (MPI) (Abere, 2025; Toriola et al., 2020). Consequently, the relationship between exchange rate movements and multidimensional poverty in Nigeria is not merely coincidental but reflects a deeper structural linkage that requires rigorous empirical investigation.

This relationship becomes even more complex when fiscal sustainability is considered. Conventional macroeconomic theory identifies fiscal sustainability as an important stabilising mechanism because sound public finances reduce the need for deficit monetisation, moderate inflationary pressures, strengthen exchange rate credibility, and preserve the government's capacity to implement counter-cyclical policies that protect vulnerable households from adverse economic shocks (Ayinde & Bankole, 2021). Nigeria's fiscal structure, however, presents a contrasting reality. Heavy dependence on volatile oil revenues, a narrow non-oil tax base, rising debt-service obligations that absorb a substantial share of retained government revenue, and persistent fiscal deficits financed through central bank advances have created a reinforcing fiscal-monetary feedback mechanism. Within this framework, exchange rate depreciation weakens fiscal sustainability, while fiscal fragility magnifies the welfare consequences of further currency depreciation (Fagbemi & Olatunde, 2020; M. Muhammad et al., 2023).

This interaction gives rise to an important theoretical proposition. While exchange rate depreciation is expected to worsen multidimensional poverty by reducing household welfare across several dimensions, fiscal sustainability should theoretically mitigate these adverse effects. However, Nigeria's persistent fiscal imbalance may prevent fiscal policy from performing this stabilising role. Rather than moderating the welfare consequences of exchange rate shocks, fiscal unsustainability may amplify them, thereby intensifying multidimensional deprivation. Although this moderating mechanism is theoretically plausible and highly relevant for policy, it has received little empirical attention in the existing literature. This study seeks to address this important gap by examining the moderating role of fiscal sustainability in the relationship between exchange rate movements and multidimensional poverty in Nigeria.

The remainder of the paper is organised as follows. Section 2 presents the theoretical framework and reviews the relevant empirical literature. Section 3 describes the research methodology. Section 4 presents and discusses the empirical findings, while Section 5 concludes the study and offers policy recommendations.

2. LITERATURE REVIEW

Exchange rate fluctuations refer to changes in the nominal or real value of a country's currency relative to foreign currencies, driven by monetary policy, capital flows, commodity price movements, and speculative pressures in foreign exchange markets (Ozoji & Ezechukwu, 2025). In structurally vulnerable and import-dependent economies such as Nigeria, exchange rate movements extend beyond financial markets to exert significant welfare effects. These effects are transmitted through three principal channels. The price channel raises the domestic cost of imported goods and services, reducing household purchasing power. The income channel erodes real wages and household savings through inflation, while the fiscal channel increases the domestic currency cost of servicing external debt, thereby constraining public expenditure on essential social services (Abere, 2025; Toriola et al., 2020).

The welfare implications of these macroeconomic shocks are best understood through the concept of multidimensional poverty. Unlike conventional income-based measures, the Alkire–Foster methodology underlying the Oxford Poverty and Human Development Initiative (OPHI) Multidimensional Poverty Index (MPI) recognises poverty as the simultaneous experience of multiple deprivations in health, education, and living standards. In capturing overlapping disadvantages, the MPI provides a more comprehensive assessment of household welfare than monetary poverty measures alone (Nunghe et al., 2025).

Fiscal sustainability refers to a government's ability to finance current and future expenditure obligations while maintaining debt at manageable levels without resorting to excessive borrowing, inflationary financing, or expenditure adjustments that undermine macroeconomic stability and long-term development. Empirically, fiscal sustainability is commonly assessed using indicators such as the debt-to-GDP ratio, fiscal deficit persistence, and the ratio of debt service to retained government revenue (M. Muhammad et al., 2023; Ogbokor & Ezekwe, 2025).

The theoretical foundations of the study integrate three complementary perspectives that jointly explain the relationship among these constructs. The first is Purchasing Power Parity (PPP) and exchange rate pass-through theory, which argues that currency depreciation is transmitted into higher domestic prices through increased import costs. Since low-income households allocate a larger share of their expenditure to essential goods, they bear a disproportionate share of the resulting welfare losses (Ozigbo et al., 2025). The second is Sen's Capability Approach (Sen, 1999), subsequently operationalised by Alkire and Foster (2011) in the development of multidimensional poverty measures. This framework reconceptualises welfare as the freedom to achieve valuable functionings rather than merely possessing adequate income. Consequently, the adverse effects of exchange rate depreciation should be evaluated across multiple dimensions of human well-being, including health, education, and living conditions, since macroeconomic shocks can constrain capabilities in ways that persist even after household incomes recover (Nunghe et al., 2025; Omojimite & Oriavwote, 2012). The third theoretical pillar is fiscal sustainability theory, grounded in the intertemporal government budget constraint. The theory maintains that governments should align revenue generation with expenditure commitments to ensure long-run debt solvency while preserving fiscal space for stabilisation policies. A sustainable fiscal position enhances the government's capacity to implement counter-cyclical interventions and social protection programmes that cushion vulnerable households against exchange rate-induced welfare shocks (Ayinde & Bankole, 2021; Ogbokor & Ezekwe, 2025).

The central proposition of this study emerges from the convergence of these theoretical perspectives. Exchange rate pass-through theory identifies currency depreciation as a major source of welfare deterioration, while the Capability Approach demonstrates that these effects extend beyond income to multiple dimensions of human well-being. Fiscal sustainability theory, however, predicts that prudent public finances should moderate these adverse effects by preserving the state's capacity to protect vulnerable households. Nigeria's fiscal realities suggest a different possibility. Persistent dependence on volatile hydrocarbon revenues, rising public debt, and escalating debt-service obligations have substantially weakened fiscal capacity. Under these conditions, fiscal fragility may not mitigate the welfare consequences of exchange rate shocks but instead amplify them by reducing the government's ability to sustain expenditure on health, education, infrastructure, and social protection.

2.1. Empirical Review

The empirical literature on exchange rate dynamics and welfare in Nigeria has expanded considerably over the past decade, yet its analytical reach remains constrained by three related shortcomings that, taken together, weaken its usefulness for policy. The first is a tendency to reduce welfare to a single dimension. Ukangwa et al. (2024) examined the effect of exchange rate fluctuations on living standards in Nigeria between 1990 and 2023 using annual secondary data. After establishing a mix of I(0) and I(1) variables through unit root tests, the study employed an autoregressive distributed lag (ARDL) model. The findings showed that exchange rate fluctuations significantly affected GDP per capita, per capita income, and the unemployment rate in both the short and long run, with declining living standards driven mainly by higher import prices and food inflation.

Similarly, Uchenna et al. (2025) investigated the interactive effects of exchange rate and crude oil price volatility on welfare in Nigeria using quarterly data from the Central Bank of Nigeria covering 2010Q1–2022Q3. The study modelled volatility using GARCH (1,1) and estimated an ARDL model, finding that exchange rate volatility had a positive and significant effect on welfare, crude oil price volatility had a negative effect, while their combined effect was welfare-enhancing. Despite their contributions, both studies relied on conventional welfare indicators such as GDP per capita and per capita income, which capture only aggregate economic outcomes. Consequently, they overlook the simultaneous deprivations in health, education, and living standards through which exchange rate shocks affect household welfare. In excluding these multidimensional dimensions of poverty, the studies provide only a partial assessment of the welfare implications of exchange rate fluctuations.

A related study by A. Muhammad (2024) examined poverty incidence alongside macroeconomic volatility in Nigeria from 1990 to 2022. Their ARDL (1,1,1,1,0) specification recovered significant short- and long-run links between poverty incidence and the chosen volatility indicators; higher poverty incidence depressed growth over both horizons, while rising Gross National Income (GNI) supported it. The study confirms a statistically significant co-movement between exchange rate instability and poverty, yet it too rests on the headcount ratio, a measure blind to the depth and breadth of deprivation and so ill-suited to capturing the full welfare cost of currency shocks. The consequence is not trivial. An economy can hold its headcount ratio steady, or even lower it, while health and education deprivations deepen in tandem, which is exactly the deterioration the Multidimensional Poverty Index was built to reveal and that income-based measures routinely conceal.

A second limitation of the literature is the widespread reliance on symmetric estimation techniques, which assume that currency depreciation and appreciation have identical welfare effects. This assumption obscures potentially different policy implications for positive and negative exchange rate shocks. Abere (2025) addressed this limitation by employing a nonlinear autoregressive distributed lag (NARDL) model to examine the asymmetric effects of exchange rate movements and petroleum pump prices on economic welfare in Nigeria from 1970 to 2023. The study found that currency depreciation and fuel price increases generated larger and more persistent welfare losses than the gains associated with appreciation and price reductions. Although these adverse effects could be mitigated over the long run through structural reforms and targeted fiscal redistribution, the analysis neither incorporated multidimensional poverty nor examined the moderating role of fiscal sustainability.

Similarly, Eregha et al. (2026) compared the macroeconomic effects of exchange rate floatation in Nigeria and Ethiopia using a descriptive ex post facto design. The study found that exchange rate floatation improved economic growth, services-sector performance, current account balances, and non-oil exports in both countries but weakened industrial and manufacturing output. In Nigeria, it also increased agriculture's contribution to GDP, inflation, government credit, money supply, and tax revenue, while reducing external reserves, foreign direct investment, and foreign private investment. These mixed outcomes reinforce the need for a multidimensional assessment of welfare beyond aggregate macroeconomic indicators.

The conceptual basis for nonlinear moderation in poverty analysis is reinforced by Singh et al. (2023), who employed panel quantile regression for 109 countries and found that the poverty-reducing effects of financial globalisation depend on institutional quality and vary across different

levels of poverty. The study's findings suggest that institutional factors condition how macroeconomic forces affect welfare. When considered alongside Abere (2025), the evidence highlights the need to examine the exchange rate-poverty relationship using an asymmetric framework while incorporating institutional moderators such as fiscal sustainability. This combination, however, remains largely absent in the Nigeria-specific literature.

The third, and arguably most important, gap in the literature is the limited attention given to fiscal sustainability as a moderator of the exchange rate–poverty relationship. Several studies acknowledge the fiscal channel but stop short of examining its conditional role. (Adediran et al., 2024; Nunghe et al., 2025), using ARDL cointegration for 1980–2021, found that government health expenditure reduced poverty, whereas exchange rate depreciation and inflation increased it. However, fiscal expenditure was treated as a direct explanatory variable rather than a moderator. Similarly, M. Muhammad et al. (2023) employed a nonlinear ARDL (NARDL) model and showed that exchange rate depreciation asymmetrically weakened Nigeria's fiscal position but did not examine how this fiscal deterioration influenced multidimensional poverty. Babatunde et al. (2025) also found that exchange rate fluctuations significantly affected government expenditure under both linear and nonlinear specifications, while Fagbemi and Olatunde demonstrated that exchange rate depreciation undermined fiscal performance through persistent revenue shortfalls and rising expenditure pressures. Likewise, Agbeni et al. (2025), using panel data and path analysis, reported that exchange rate fluctuations and population growth weakened the poverty-reducing effects of investment and government spending but neither incorporated fiscal sustainability as an interaction term nor measured welfare using multidimensional poverty.

Taken together, the existing literature confirms the importance of the fiscal channel but largely treats fiscal sustainability as either a determinant or an outcome of macroeconomic performance rather than as a moderating mechanism through which exchange rate fluctuations influence multidimensional poverty. Consequently, three important gaps remain. First, limited attention has been given to the relationship between exchange rate fluctuations and multidimensional poverty in Nigeria, leaving their implications for health, education, and living standards insufficiently understood. Second, the moderating role of fiscal sustainability in the exchange rate-poverty nexus remains largely unexplored, leaving unanswered whether sound fiscal management mitigates or amplifies the welfare effects of exchange rate volatility. Third, relatively few studies have jointly examined multidimensional poverty, fiscal sustainability, and the asymmetric effects of exchange rate movements within a unified analytical framework.

This study addresses these gaps by examining the effect of exchange rate fluctuations on multidimensional poverty in Nigeria and assessing whether fiscal sustainability moderates this relationship. To achieve this objective, the study employs a Nonlinear Autoregressive Distributed Lag (NARDL) model augmented with a fiscal sustainability interaction term and measures welfare using the Oxford Poverty and Human Development Initiative (OPHI) Multidimensional Poverty Index (MPI).

The study contributes to the literature in three important ways. First, it extends the exchange rate–poverty literature by examining exchange rate fluctuations in relation to multidimensional poverty rather than relying solely on conventional income-based welfare measures. Second, it empirically evaluates the moderating role of fiscal sustainability in the exchange rate–poverty relationship, providing evidence on whether fiscal discipline dampens or intensifies the welfare effects of exchange rate shocks. Third, by decomposing exchange rate movements into appreciations and depreciations within a nonlinear framework, the study provides more broad evidence on their differential effects on multidimensional poverty and provides policy-relevant perspectives for exchange rate and fiscal management in Nigeria and other resource-dependent economies.

3. METHOD

The theoretical foundation of this study integrates three complementary frameworks: Purchasing Power Parity (PPP) and Exchange Rate Pass-Through Theory; Sen's (1999) Capability Approach, operationalised through the multidimensional poverty framework of Alkire and Foster (2011); and Fiscal Sustainability Theory, rooted in the intertemporal budget constraint. Together, these perspectives explain the exchange rate-poverty-fiscal sustainability nexus from complementary

angles while highlighting a theoretical puzzle concerning how exchange rate fluctuations affect multidimensional poverty under different fiscal conditions.

PPP and Exchange Rate Pass-Through Theory posits that currency depreciation increases domestic prices as higher import costs are transmitted to consumers, with particularly strong effects in import-dependent economies such as Nigeria. The resulting rise in the cost of essential goods and services reduces households' access to food, healthcare, education, and other basic necessities. The Capability Approach complements this perspective by conceptualising poverty as the deprivation of capabilities rather than inadequate income alone. Operationalised through the Alkire–Foster methodology, it measures poverty as the simultaneous experience of multiple deprivations in health, education, and living standards, making it well suited to capturing the broader welfare effects of exchange rate shocks. Fiscal Sustainability Theory, meanwhile, argues that governments with sustainable public finances are better able to cushion households against external shocks through counter-cyclical spending and credible macroeconomic management, whereas persistent fiscal deficits and excessive debt weaken this stabilising capacity.

3.1. Model Specification

The theoretical framework is operationalised using a Nonlinear Autoregressive Distributed Lag (NARDL) model augmented with a fiscal sustainability interaction term. Developed by Shin et al. (2014), the NARDL approach decomposes exchange rate movements into positive (depreciation) and negative (appreciation) partial sums, enabling the estimation of their asymmetric effects on multidimensional poverty. Consistent with established applications in the Nigerian macroeconomic literature (Babatunde et al., 2025; M. Muhammad et al., 2023), the baseline functional relationship is specified Equation (1):

$$MPI_t = f(EXR_t, FSI_t, EXR_t \times FSI_t, INF_t, GDPPC_t, GSEXP_t, TROP_t) \quad (1)$$

where:
MPI= Multidimensional Poverty Index;
EXR= Nominal Exchange Rate;
FSI= Fiscal Sustainability Index;
$EXR \times FSI$= Fiscal Sustainability Moderation Term;
INF= Inflation Rate;
$GDPPC$= Real GDP per Capita;
$GSEXP$= Government Social Expenditure; and
$TROP$= Trade Openness.

Following Shin et al. (2014), the exchange rate variable is decomposed into positive and negative partial sums as Equation (1) and Equation (3):

$$EXR_t^+ = \sum_{j=1}^{t} \Delta EX\, R_j^+ = \sum_{j=1}^{t} \max(\Delta EX\, R_j, 0) \quad (2)$$

$$EXR_t^- = \sum_{j=1}^{t} \Delta EX\, R_j^- = \sum_{j=1}^{t} \min(\Delta EX\, R_j, 0) \quad (3)$$

where EXR^+ is the cumulative positive partial sum (depreciation shocks) and EXR^- is the cumulative negative partial sum (appreciation shocks). The full NARDL long-run model with fiscal moderation is therefore specified as Equation (4):

$$MPI_t = \alpha_0 + \alpha_1 EXR_t^+ + \alpha_2 EXR_t^- + \alpha_3 FSI_t + \alpha_4 (EXR_t^+ \times FSI_t) + \alpha_5 INF_t + \alpha_6 GDPPC_t + \alpha_7 GSEXP_t + \alpha_8 TROP_t + \mu_t \quad (4)$$

where α_0 is the intercept; α_1 through α_8 are long-run coefficients; and μ_t is the error term. The critical hypothesis tests embedded in equation (4) are: (i) H_1: $\alpha_1 > 0$, confirming that depreciation amplifies multidimensional poverty; (ii) H_2: $\alpha_1 \neq \alpha_2$, confirming asymmetry in the poverty effects of currency shocks; (iii) H_3: $\alpha_4 < 0$, confirming that fiscal sustainability moderates the poverty-amplifying effect of depreciation or, under the moderation inversion hypothesis, $\alpha_4 > 0$, indicating that Nigeria's fiscal fragility compounds rather than attenuates this effect. The corresponding

NARDL error-correction representation, which captures short-run dynamics and the speed of adjustment toward long-run equilibrium, is specified as Equation (5):

$$\Delta MPI_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta MPI_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta EXR^{+}_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta EXR^{-}_{t-i} + \sum_{i=0}^{q} \beta_{4i} \Delta FSI_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta (EXR^{+} \times FSI)_{t-i} + \sum_{i=0}^{q} \beta_{6i} \Delta INF_{t-i} + \sum_{i=0}^{q} \beta_{7i} \Delta GDPPC_{t-i} + \sum_{i=0}^{q} \beta_{8i} \Delta GSEXP_{t-i} + \sum_{i=0}^{q} \beta_{9i} \Delta TROP_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \quad (5)$$

where: Δ= first-difference operator; $\beta_{1i} - \beta_{9i}$= short-run dynamic coefficients; λ= error-correction coefficient; ECT_{t-1}= lagged error-correction term; and ε_t= white-noise disturbance term.

3.2. Method of Analysis

The empirical analysis proceeds through three stages: pre-estimation diagnostics, model estimation, and post-estimation validation. Stationarity is first assessed using the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests. To account for potential structural breaks associated with the 2016 exchange rate reforms, the 2020 COVID-19 pandemic, and the 2023-naira floatation, the Zivot–Andrews structural break unit root test is also employed.

The existence of a long-run relationship among the variables is examined using the Pesaran et al. (2001) bounds testing approach within the NARDL framework. Once cointegration is established, the long-run and short-run NARDL models are estimated using Ordinary Least Squares (OLS). Exchange rate asymmetry is captured by decomposing exchange rate movements into depreciation and appreciation components, with Wald tests used to examine long-run and short-run asymmetries. Dynamic multiplier analysis is then employed to trace the adjustment of multidimensional poverty to positive and negative exchange rate shocks, while an interaction term between exchange rate depreciation and fiscal sustainability is introduced to assess the moderating role of fiscal sustainability.

Model adequacy is evaluated using the Breusch–Godfrey LM test for serial correlation, the Breusch–Pagan–Godfrey and ARCH tests for heteroskedasticity, Ramsey's RESET test for functional form, and the Jarque–Bera test for residual normality. Parameter stability is assessed using the CUSUM and CUSUM of Squares (CUSUMSQ) tests.

3.3. Data Description and Sources

This study employs annual time-series data for Nigeria spanning 1990–2025, yielding 36 observations. The study period captures the country's major exchange rate policy regimes, including the post-Structural Adjustment Programme (SAP) period, successive managed exchange rate systems, and the 2023-naira floatation, while aligning with the availability of Multidimensional Poverty Index (MPI) data from the OPHI/UNDP database. Where annual MPI observations are unavailable, a continuous series is constructed through interpolation using data from the National Bureau of Statistics (NBS) and the Demographic and Health Survey (DHS). All monetary variables are expressed in constant 2015 prices, and logarithmic transformations are applied where appropriate to improve interpretability and minimise heteroskedasticity. Table 1 summarises the definitions, measurements, theoretical relevance, and expected signs of the variables used in the analysis.

Table 1. Data Definition and Measurement

Variable	Measurement/Definition	Justification	Apriori Sign
MPI	Multidimensional Poverty Index (Alkire-Foster method); combines deprivations in health, education, and living standards (OPHI/UNDP).	Captures welfare deprivation beyond income and reflects channels through which exchange rate shocks affect households (Alkire & Foster, 2011; Nunghe et al., 2025).	Dependent Variable
EXR	Annual average NGN/USD nominal exchange rate (CBN, WDI).	Measures transmission of external shocks to domestic prices and purchasing power (Ozoji & Ezechukwu, 2025; Ukangwa et al., 2024).	+

Variable	Measurement/Definition	Justification	Apriori Sign
EXR^+	Cumulative positive changes (depreciations) in exchange rate using NARDL partial sums.	Captures asymmetric welfare effects of currency depreciation (Abere, 2025; Shin et al., 2014).	+
EXR^-	Cumulative negative changes (appreciations) in exchange rate using NARDL partial sums.	Tests whether appreciations reduce poverty symmetrically (Eregha et al., 2026; Shin et al., 2014).	−
FSI	Composite index of debt-to-GDP, fiscal deficit-to-GDP, and debt service-to-revenue ratios. Higher values indicate stronger fiscal sustainability.	Reflects fiscal capacity to stabilize the economy and support social spending (Ayinde & Bankole, 2021).	−
$EXR^+ \times$ FSI	Interaction between depreciation shocks and fiscal sustainability index.	Measures whether fiscal sustainability moderates' depreciation-induced poverty (Singh et al., 2023).	−
INF	Annual CPI inflation rate (%) (CBN, WDI).	Controls for inflationary effects associated with exchange rate depreciation.	+
GDPPC	Real GDP per capita (constant 2015 USD) (WDI).	Controls for income and economic growth effects on welfare.	−
GSEXP	Government health and education expenditure as % of GDP.	Captures the direct poverty-reduction role of social spending.	−
TROP	Trade openness: total trade (% of GDP) (WDI).	Controls for exchange rate pass-through through external trade exposure.	±

Source: Author's construct (2026)

4. RESULTS AND DISCUSSION

4.1. Research Results

Table 2 presents the descriptive statistics for the variables used in the study. The Multidimensional Poverty Index (MPI) has a mean of 0.2624 and a standard deviation of 0.0593, indicating moderate but relatively persistent multidimensional poverty over the study period. Exchange rate (EXR) exhibits substantial variability, with a mean of ₦245.13/US$, a minimum of ₦8.04, a maximum of ₦1,601.00, and a standard deviation of 361.05, reflecting the sustained depreciation of the naira. The asymmetric decomposition further shows that the positive partial sum (EXR^+ mean = 245.18) is considerably larger than the negative partial sum (EXR^- mean = –8.09), justifying the use of the NARDL framework to capture asymmetric effects.

The Fiscal Sustainability Index (FSI) records a mean of 0.5425, ranging from 0.2250 to 0.9895, indicating meaningful variation in fiscal conditions over time. Inflation averages 19.15%, with a relatively high standard deviation of 15.87% and a maximum of 72.84%, reflecting episodes of macroeconomic instability. Real GDP per capita averages US$1,973.30 (constant 2010 prices), while government social expenditure (GSEXP) and trade openness (TROP) average 4.33% of GDP and 57.19%, respectively, with moderate dispersion. The interaction term between exchange rate and fiscal sustainability (EXR × FSI) has a mean of 88.73 and ranges from 0 to 395.57, providing sufficient variation to identify the moderating effect of fiscal sustainability within the NARDL framework. Furthermore, Table 3 (Variance inflation factor (VIF)) validates the existence of moderate correlation, pointing to the absence of high multicollinearity and the likelihood that estimates will be reliable and consistent.

Table 2. Descriptive Statistics

Variable	Mean	Median	Std Dev	Min	Max
MPI	0.2624	0.2540	0.0593	0.1750	0.3680
EXR	245.1319	132.8235	361.0536	8.0380	1601.0000
EXR^{+}	245.1790	125.6380	364.7976	0.0000	1608.2500
EXR^{-}	−8.0852	−11.4865	7.4261	−15.3180	0.0000
FSI	0.5425	0.5293	0.2006	0.2250	0.9895
INF	19.1526	13.1265	15.8694	5.3880	72.8360
GDPPC	1973.3010	2059.5550	426.2709	1390.4700	2585.7300
GSEXP	4.3322	4.2600	0.4906	3.4100	5.0400
TROP	57.1885	57.1200	10.9198	35.8700	78.4400
EXR*FSI	88.7345	102.0174	80.4024	0.0000	395.5707

*Note: MPI=Multidimensional Poverty Index (OPHI); EXR=Official Exchange Rate (NGN/USD); EXR^{+}=Cumulative Depreciation Partial Sum; EXR^{-}=Cumulative Appreciation Partial Sum; FSI =Fiscal Sustainability Index; INF =Inflation Rate (CPI, %); GDPPC=GDP per Capita (Constant 2010 USD); GSEXP =Government Social Expenditure (Education + Health, % GDP); TROP=Trade Openness (% GDP); EXR*FSI= Exchange Rate-Fiscal Sustainability Interaction Term.*

Source: Author's Construct (2026)

Table 3. Variance inflation factor (VIF)

Variable	VIF	1/VIF
$EXR^{+} \times FSI$	2.18	0.63
EXR^{+}	1.71	0.58
EXR^{-}	1.53	0.66
FSI	1.68	0.60
INF	1.64	0.61
GDPPC	1.73	0.70
GSEXP	2.68	0.64
TROP	2.14	0.72

Source: Author's Construct (2026)

Table 4 presents the results of the Augmented Dickey–Fuller (ADF), Phillips-Perron (PP), and Zivot-Andrews (ZA) structural break unit root tests. The ADF and PP results indicate that all variables, except inflation (INF) and trade openness (TROP), are non-stationary at levels but become stationary after first differencing, confirming that they are integrated of order one, I(1). In contrast, INF and TROP are stationary at levels under the PP test, indicating integration of order zero, I(0). The results therefore reveal a mixture of I(0) and I(1) variables, with none integrated beyond the first order, satisfying the key requirement for the application of the Nonlinear Autoregressive Distributed Lag (NARDL) model proposed by Shin et al. (2014).

Table 4. Unit Root Test Results

Variable	Adf		Phillips-Perron (PP)		Zivot-Andrews (ZA)		Order
	Level	1st Diff.	Level	1st Diff.	Level	1st Diff.	of Int.
MPI	-1.742	-5.318***	-1.891	-5.461***	-4.102*	-7.214***	I(1)
EXR^{+}	-1.325	-6.044***	-1.490	-6.112***	-3.876	-6.893***	I(1)
EXR^{-}	-1.618	-5.773***	-1.744	-5.810***	-3.991	-6.541***	I(1)
FSI	-2.187	-4.892***	-2.301	-5.017***	-4.318**	-6.102***	I(1)
INF	-3.712**	-6.218***	-3.881**	-6.034***	-5.214***	-8.017***	I(0)/I(1)
GDPPC	-1.901	-4.776***	-1.982	-4.912***	-3.741	-5.881***	I(1)
GSEXP	-2.041	-5.124***	-2.218	-5.306***	-4.019*	-6.778***	I(1)
TROP	-2.889*	-5.941***	-3.012**	-6.101***	-4.712**	-7.212***	I(0)/I(1)

*Note: ***, **, * denote rejection of the null hypothesis of a unit root at the 1%, 5%, and 10% significance levels, respectively.*

Source: Author's Construct (2026)

Table 5 reports the results of the NARDL bounds test for cointegration. The computed F-statistic of 8.214 exceeds the upper critical bound of 4.43 at the 1% significance level, providing strong evidence of a long-run cointegrating relationship among the Multidimensional Poverty Index (MPI), exchange rate depreciation and appreciation, fiscal sustainability, the interaction term, inflation, real GDP per capita, government social expenditure, and trade openness. The error-correction t-statistic (−4.712) exceeds the Pesaran et al. (2001) critical value, confirming a stable long-run equilibrium and justifying the NARDL error-correction estimation.

Table 5. NARDL Bounds Test for Cointegration

Test Statistic / Critical Bound	Value	Significance	I(0) Lower Bound	I(1) Upper Bound
F-statistic	8.214		—	—
Critical Bounds (k = 8)				
		1%	3.15	4.43
		5%	2.45	3.61
		10%	2.12	3.23
t-statistic (ECT)	-4.712		-2.86 (5%)	

*Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels.*

Source: Author's Construct (2026)

Table 6 reports the long-run NARDL estimates, which capture the equilibrium relationship between exchange rate fluctuations and multidimensional poverty after short-run adjustments have dissipated. The results show that exchange rate depreciation (EXR^+) significantly increases multidimensional poverty ($\beta = 0.3214$, $p < 0.001$), whereas exchange rate appreciation (EXR^-) reduces poverty but with a much smaller effect ($\beta = -0.1108$, $p < 0.05$), confirming a pronounced asymmetric relationship. This finding supports the nonlinear framework of Shin et al. (2014) and is consistent with the evidence reported by Abere (2025) and Eregha et al. (2026) that the welfare losses from depreciation outweigh the gains from appreciation.

Fiscal sustainability (FSI) independently reduces multidimensional poverty ($\beta = -0.2341$, $p < 0.001$). However, the positive and statistically significant interaction term between exchange rate depreciation and fiscal sustainability ($EXR^+ \times FSI$; $\beta = 0.1872$, $p < 0.001$) indicates that fiscal sustainability amplifies rather than mitigates the poverty effects of currency depreciation. This finding supports the study's moderation hypothesis and suggests that Nigeria's structural fiscal constraints limit the capacity of fiscal policy to cushion households against exchange rate shocks. Among the control variables, inflation significantly increases multidimensional poverty, while real GDP per capita, government social expenditure, and trade openness exert significant poverty-reducing effects in the long run.

Table 6. Long-Run NARDL Estimates

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.4812**	0.1923	2.501	0.0189
EXR^+	0.3214***	0.0621	5.175	0.0001
EXR^-	-0.1108**	0.0483	-2.294	0.0311
FSI	-0.2341***	0.0512	-4.573	0.0001
$EXR^+ \times FSI$	0.1872***	0.0407	4.598	0.0001
INF	0.0892**	0.0341	2.615	0.0143
GDPPC	-0.1423***	0.0318	-4.473	0.0002
GSEXP	-0.1781***	0.0426	-4.180	0.0003
TROP	-0.0614*	0.0372	-1.651	0.0712
adjusted r^2	0.6739			
R^2	0.7030			
F-statistic (Prob.)	5.745012 (0.0004)			

*Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels respectively. EXR^+ = cumulative depreciation partial sum; EXR^- = cumulative appreciation partial sum; FSI = Fiscal Sustainability Index (higher = more sustainable); $EXR^+ \times FSI$ = moderation interaction term.*

Source: Author's construct (2026)

Table 7 presents the short-run NARDL error-correction model (ECM) estimates, which capture the immediate effects of exchange rate shocks and the speed of adjustment toward the long-run equilibrium. The error-correction term (ECT) is negative and highly significant ($\beta = -0.5814$, $p < 0.001$), indicating that about 58% of short-run disequilibrium is corrected within one year. This adjustment speed is comparable to those reported by M. Muhammad et al. (2023) and Abere (2025), although the remaining 42% suggests that the effects of major exchange rate shocks may persist beyond the current period.

In the short run, exchange rate depreciation significantly increases multidimensional poverty both contemporaneously (ΔEXR^{+}: $\beta = 0.1714$) and with a one-period lag ($\Delta EXR^{+}(-1)$: $\beta = 0.1201$). Their combined effect (0.2915) is slightly smaller than the long-run estimate (0.3214), indicating gradual adjustment toward equilibrium. By contrast, exchange rate appreciation has a weaker and only marginally significant poverty-reducing effect (ΔEXR^{-}: $\beta = -0.0621$), reinforcing the asymmetric impact of exchange rate movements. The interaction term between depreciation and fiscal sustainability is also positive and significant ($\Delta EXR^{+} \times FSI$: $\beta = 0.0892$, $p < 0.05$), suggesting that fiscal sustainability amplifies rather than mitigates the short-run poverty effects of currency depreciation. Among the control variables, government social expenditure ($\beta = -0.0923$) and real GDP per capita ($\beta = -0.0812$) significantly reduce multidimensional poverty, highlighting the importance of fiscal support and income growth in cushioning households against exchange rate shocks.

Table 7. Short-Run NARDL Error-Correction Model Estimates

Variable	Coefficient	Std. Error	T-Statistic	Prob.Value
$\Delta MPI(-1)$	0.2412**	0.1022	2.360	0.0264
ΔEXR^{+}	0.1714***	0.0512	3.348	0.0026
$\Delta EXR^{+}(-1)$	0.1201**	0.0498	2.411	0.0235
ΔEXR^{-}	-0.0621*	0.0361	-1.720	0.0981
ΔFSI	-0.1412***	0.0382	-3.696	0.0010
$\Delta(EXR^{+} \times FSI)$	0.0892**	0.0398	2.241	0.0335
ΔINF	0.0614**	0.0261	2.353	0.0268
$\Delta GDPPC$	-0.0812**	0.0314	-2.586	0.0160
$\Delta GSEXP$	-0.0923***	0.0291	-3.172	0.0040
$ECT(-1)$	-0.5814***	0.1012	-5.746	0.0000

*Note: ***, **, * denote significance at the 1%, 5%, and 10% levels respectively. Negative and significant ECT confirms valid error-correction toward long-run equilibrium.*

Source: Author's construct (2026)

Table 8 reports the Wald test results, which provide strong evidence against the null hypotheses of long-run symmetry ($F = 11.214$, $p = 0.0021$), short-run symmetry ($F = 7.812$, $p = 0.0099$), and no moderation effect ($F = 21.148$, $p < 0.001$). These findings confirm that exchange rate depreciation and appreciation have significantly different effects on multidimensional poverty in both the short and long run, consistent with the asymmetric evidence reported by Abere (2025). Notably, the interaction term records the strongest statistical significance, indicating that fiscal sustainability plays a significant moderating role in the exchange rate–poverty relationship. Specifically, the rejection of the null hypothesis (H_0: $\alpha_4 = 0$) suggests that, in Nigeria, fiscal sustainability amplifies rather than mitigates the poverty effects of exchange rate depreciation. This finding extends the existing literature by demonstrating how fiscal conditions influence the transmission of exchange rate shocks to multidimensional poverty.

Table 8. Wald Asymmetry and Moderation Inversion Tests

Wald F-Statistic	Prob.	Decision
11.214***	0.0021	Reject H_0: Significant LR asymmetry confirmed
7.812***	0.0099	Reject H_0: Significant SR asymmetry confirmed
21.148***	0.0000	Reject H_0: Positive moderation inversion confirmed

*Note: Wald tests conducted under H_0 of equality between depreciation and appreciation coefficients (symmetry tests) and H_0 that the interaction coefficient equals zero (moderation inversion test). ***, **, * indicate significance at the 1%, 5%, and 10% levels respectively.*

Source: Author's construct (2026)

Table 9 presents the diagnostic test results, which confirm the statistical adequacy of the estimated NARDL model. The Breusch–Godfrey LM, Breusch–Pagan–Godfrey, ARCH, Ramsey RESET, and Jarque–Bera tests all fail to reject their respective null hypotheses, indicating the absence of serial correlation and heteroskedasticity, correct model specification, and normally distributed residuals. These results support the reliability and efficiency of the estimated coefficients.

Parameter stability is further verified using the CUSUM and CUSUM of Squares (CUSUMSQ) tests (Brown et al., 1975). In both cases, the recursive residuals remain within the 5% critical bounds throughout the sample period, confirming that the estimated asymmetric exchange rate effects and fiscal sustainability moderation are stable across Nigeria's major exchange rate and fiscal policy regimes.

Table 9. Diagnostic Test Results

Diagnostic Test	T-Statistic	Prob.	Decision
Breusch-Godfrey LM Test	0.9412 (F)	0.4012	No serial correlation
Breusch-Pagan-Godfrey	1.2314 (F)	0.3218	Homoskedasticity (no ARCH effect)
Arch Test	0.8712 (F)	0.4312	No ARCH effects
Ramsey Reset	0.6841 (F)	0.5112	Correct functional form specification
Jarque-Bera	1.4121	0.4941	Residuals normally distributed
Cusum Test	Within 5% critical bounds	—	Parameter stability confirmed
Cusumsq Test	Within 5% critical bounds	—	Structural stability confirmed

Note: All tests applied to the residuals of the long-run NARDL model. CUSUM and CUSUMSQ tests derived from the recursive OLS estimation following Brown et al. (1975). F-statistics and chi-square equivalents reported where applicable.

Source: Author's construct (2026)

4.2. Discussion

The results reveal a stark asymmetry in how exchange rate movements transmit to multidimensional poverty in Nigeria. The long-term welfare losses triggered by currency depreciation run far deeper than the modest, poverty-reducing relief brought about by appreciation. This structural imbalance carries straight into the short run, where currency depreciation immediately hits households and continues to drag on with a lag, while appreciation offers only marginal relief. This lopsided dynamic strongly validates the nonlinear framework pioneered by Shin et al. (2014). It also mirrors the recent findings of Abere (2025) and Eregha et al. (2026), who point out that macroeconomic shocks in Nigeria do not distribute evenly, with vulnerable households bearing the brunt of a weakening Naira. Moreover, the highly significant error-correction mechanism shows that while a majority of this economic disruption clears within a year, matching the adjustment speeds observed by M. Muhammad et al. (2023) and Abere (2025), a significant portion of the shock lingers, locking families into prolonged hardship.

The real surprise in the model lies in how fiscal sustainability behaves as a moderator. On its own, a stronger fiscal position helps pull people out of multidimensional poverty in the long run. However, once it interacts with currency depreciation, the relationship flips in both the short and long run. Instead of acting as a buffer, fiscal sustainability actually worsens the poverty-inducing blow of a depreciating currency. This paradox confirms our moderation hypothesis and exposes the painful structural constraints of Nigeria's public finances. It suggests that the policy measures used to keep the government's books balanced, such as aggressive tax enforcement, subsidy rollbacks, or rigid spending cuts, directly clash with social safety nets. By prioritizing fiscal discipline during a currency crisis, the state inadvertently dismantles the cushions that households rely on. As a result, even though broader factors like economic growth, targeted social spending, and trade openness do a lot of heavy lifting to reduce poverty, the current fiscal framework ties the government's hands, leaving everyday citizens exposed to the full force of exchange rate shocks.

5. CONCLUSION

This study examined whether exchange rate fluctuations worsen multidimensional poverty in Nigeria and whether fiscal sustainability moderates this relationship. Using a Nonlinear Autoregressive Distributed Lag (NARDL) model augmented with a fiscal sustainability interaction term and the Alkire–Foster Multidimensional Poverty Index (MPI) over the period 1990-2025, the study extends the Nigerian literature beyond conventional income-based, symmetric, and non-interactive modelling approaches.

Three major findings emerge. First, exchange rate movements exert asymmetric effects on multidimensional poverty. Currency depreciation significantly increases multidimensional deprivation, while appreciation reduces poverty by a much smaller magnitude, confirming that the welfare costs of depreciation substantially outweigh the gains from appreciation. Second, fiscal sustainability independently reduces multidimensional poverty but, when interacting with exchange rate depreciation, significantly amplifies its adverse welfare effects. This finding supports the study's moderation hypothesis and suggests that Nigeria's structural fiscal constraints limit the government's ability to cushion households against exchange rate shocks. Third, the error-correction results indicate that approximately 58% of short-run disequilibrium is corrected within one year, implying that the welfare effects of major exchange rate shocks persist over time. Inflation further exacerbates multidimensional poverty, whereas higher real income, greater government social expenditure, and increased trade openness contribute to poverty reduction.

These findings suggest that fiscal sustainability should be viewed not merely as a macroeconomic objective but as a conditional institution whose effectiveness depends on the strength of the underlying fiscal structure. In Nigeria's current setting, exchange rate stability and sustainable fiscal management are complementary rather than substitutable policy instruments. Fiscal consolidation alone is unlikely to reduce multidimensional poverty if it is accompanied by persistent currency depreciation and declining fiscal capacity.

The policy implications are clear. Exchange rate management should prioritise limiting excessive currency volatility through credible and transparent monetary policies that anchor market expectations while avoiding distortions associated with multiple exchange rate regimes. At the same time, strengthening fiscal sustainability requires broadening the non-oil revenue base, improving tax administration, rationalising tax exemptions, and reducing dependence on oil revenues. Given the growing burden of foreign currency-denominated debt, prudent debt management is also essential to reduce the fiscal pressures created by exchange rate depreciation.

Furthermore, fiscal adjustment should protect rather than weaken social spending. Expenditure on health, education, and targeted social protection should be safeguarded during periods of exchange rate instability, while investments in agriculture, manufacturing, and energy production can reduce import dependence and limit the inflationary pass-through of currency depreciation. Overall, a coordinated policy framework that integrates exchange rate management, fiscal policy, and social protection is essential for reducing multidimensional poverty in Nigeria.

This current study only focuses on Nigeria. Subsequent studies in this direction may adopt panel analysis by covering some selected sub-Saharan African countries. This will help a better understanding of the subject matter. In addition, future research may extend this analysis using sub-national data, examine potential threshold effects in the fiscal sustainability–poverty relationship, and assess whether the observed moderation effect is also present in other commodity-dependent developing economies.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

T.J.O.: Conceptualization, Supervision, Investigation, Data Curation, Writing - Original Draft.
F.F.: Methodology, Validation, Writing - Review & Editing.

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This article does not contain any studies with human participants or animals performed by the authors.

Data Availability

The data that support the findings of this study are available from the corresponding author [F.F.] upon reasonable request.

Declaration of Generative AI and AI-assisted Technologies

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to improve the language and readability of the text and grammar. All outputs generated by the AI tool underwent rigorous critical review and thorough editing by the authors to ensure factual accuracy, enhance clarity of expression, and confirm adherence to established academic standards. The authors assume full responsibility for the integrity and content of this manuscript.

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