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PETROLEUM PRODUCT PRICING AND PREMIUM MOTOR SPIRIT (PMS) CONSUMPTION IN NIGERIA: EVIDENCE FROM AN ARDL APPROACH

[1] Elizabeth Oluwabunmi Taiwo *, [2] Salihu Ayodeji, & [3] Peter Adamu
***Corresponding authors' email**: elizabeth.bunmi.taiwo@gmail.com

[1&2] Department of Economics, Nigerian Defence Academy, Kaduna – Nigeria
[3] Department of Economics, Kaduna State University, Kaduna – Nigeria

ABSTRACT

This study investigates the effect of petroleum product pricing on Premium Motor Spirit (PMS) consumption in Nigeria from 1990 to 2025.An Autoregressive Distributed Lag (ARDL) model framework is utilized to examine the long run and short run dynamics between PMS consumption (LNPMSCON), domestic premium motor spirit pump prices (LN PMSP), Real Gross Domestic Product(LN RGDP) and Total Population (LNTPOP).The analysis is undertaken in explicit recognition of the transition from a regulated regime to the post-2021 Petroleum Industry Act (PIA) and the 2023 subsidy removal era. The empirical result shows that PMS consumption is characterized by significant structural rigidity, as a non-discretionary energy source due to persistent national grid instability. Long - run drivers are demographics and economic output, with consumption remaining highly inelastic to price changes. Mathematically, the long run coefficients are verified as LNPMSP = -0.1360 (p = 0.0005),LNRGDP = 0.3050 (p = 0.0465), and LN TPOP = -20.6862 (p = 0.0051).In the short run, the income effect remains positive at LNRGDP = 0.1928 (p = 0.0896) while system stability is validated by a highly significant Error Correction Term (CointEqt-1) of -0.6331 (p = 0.0001),confirming a reliable convergence path back to steady state equilibrium following pricing shocks. The study suggests targeted energy infrastructure investment and counter cyclical pricing buffers to cushion inflationary shocks from market determined retail structures.

Keywords: Petroleum Pricing, PMS consumption, ARDL framework, Subsidy Removal, Nigeria
JEL Classification Code: *Q41, Q48, E31, 055*

1.0 Introduction

The downstream petroleum sector occupies a critical position in the structural configuration of the Nigerian macroeconomy ,acting as a primary driver of aggregate supply , domestic logistics and industrial productivity Okonkwo and Adeyemi,2023.For decades , Premium Motor Spirit (PMS) has served as the foundational energy anchor for both the formal commercial sector and the vast informal economy which accounts for approximately 65% of national output National Bureau of Statistics [NBS],2024..Due to the chronic infrastructure deficits and persistent instabilities characterizing the centralised national electricity grid, automative fuel in Nigeria transcends its conventional role as a transportation variable Yakubu and Usman,2023.Instead it functions as a critical non-substitutable public utility heavily utilised by households and Micro, Small and Medium Enterprises (MSMEs) for decentralised power generation Bamidele and Ibrahim ,2022.Thus,variations in the pricing architecture of petroleum products do not merely influence discretionary consumer spending ;systemic cost-push inflationary shocks across the entire production value chain, directly

impacting aggregate real output and altering the steady state trajectory of national fuel consumption Umar and Eke,2025.

1.2 Statement of the Problem

The 2023 subsidy removal and post-PIA market reforms triggered an unprecedented 450% surge in retail fuel prices in Nigeria. However, because persistent national electricity grid failures force widespread reliance on petrol generators, Premium Motor Spirit (PMS) consumption exhibits an "elasticity paradox," remaining rigidly non-discretionary. Consequently, abrupt pricing adjustments fail to optimize demand, operating instead as an unmitigated cost-push inflationary shock that suppresses real national output (RGDP) and suppresses per-capita purchasing power.

1.3 Objectives of the Study

The primary objectives of this paper are twofold: first, to empirically evaluate the long-run and short-run impacts of petroleum product pricing on Premium Motor Spirit (PMS) consumption in Nigeria; and second, to systematically examine the transmission effects of key macroeconomic drivers, namely Real Gross Domestic Product (RGDP) and population dynamics, on aggregate domestic fuel demand.

1.4 Organisation of the Study

To achieve these objectives, the remainder of this paper is organized into five distinct sections: Section 1 introduction and objective framework, Section 2 provides a comprehensive review of relevant theoretical and empirical literature; Section 3 outlines the research methodology, data sources, and the Autoregressive Distributed Lag (ARDL) model specification; Section 4 presents the results and discussions of empirical results, and finally, Section 5 Conclusion and recommendations for policy alignment.

2.0 Literature Review

2.1 Conceptual Literature

Premium Motor Spirit (PMS) Consumption

This is the total annual volumetric demand for retail premium motor spirit within the domestic economy functioning as an involuntary necessity driven by structural national grid failures Ilesanmi (2024); Yakubu and Usman,(2023); Uwejamomere (2024).

Petroleum Product Pricing

This is defined as the retail cost per litre of refined fuel transitioning from state controlled price ceilings to a free market cost recovery mechanism under the Petroleum Industry Act (PIA) of 2021 Lawal and Onifade (2025) ; Owolabi and Okere (2024) ; Babatunde and Onakoya (2025).

Real Gross Domestic Product (RGDP)

This is an inflation-adjusted measure of national aggregate value-added output acting as a proxy for commercial energy intensity and aggregate income fluctuations Sadiq and Abubakar (2020).

Total Population

The total nominal headcount of residents in Nigeria, establishing the baseline structural scale and demographic momentum for aggregate fuel requirements York et al. (2003).

2.2 Empirical Review

Raifu and Afolabi (2024) employed the Autoregressive Distributed Lag (ARDL) bounds testing approach to examine the 2023 subsidy removal in Nigeria. Their results showed that the drivers of inflation were price surges while the consumption of PMS was inelastic because of the persistent structural deficits in the public transportation system. In a related study, Ilesanmi (2024) used the model of Almost Ideal Demand System (AIDS) to estimate the price and income elasticities parameters in Nigeria. The results revealed a high income elasticity which indicates that demand is more driven by industrial and power demands rather than unit price.

Locally, Mesagan and Alimi (2021) examined the intersection of national energy demand, economic expansion, and demographic shifts in Nigeria. Utilizing a robust time-series framework, their empirical results demonstrated that aggregate output and population growth act as the foundational, long-run structural drivers that continuously propel national energy consumption, keeping baseline demand resilient even during periods of price volatility. This is supported by Bello-Umar et al. (2021) used the Non-linear ARDL (N-ARDL) approach to examine the asymmetric impacts of growth on fuel consumption. In Nigeria. The study found a significant one-way causality from economic growth to total fuel volumes. Similarly, Nathaniel et al. (2021) established a unidirectional causality through ARDL modelling with consumption being driven mostly by economic expansion and population driven urbanization in Nigeria which effectively insulates demand from price volatility. In a sub-regional panel study, Edeh et al. (2024) used the Panel Data Regression to analyse the trends of energy consumption across a sub-regional block of West African countries (including Nigeria), and found that the persistent economic growth and urbanization were positively and significantly related to the overall fuel consumption. Finally, Odu and Ayoola (2022) integrated Spatial Regression and Energy-Growth Nexus. The research established that Nigeria is constrained by energy-growth dependency, meaning any reduction in fuel affordability directly constrains national output (RGDP).

Consequently, while these studies agree on the extreme price inelasticity of fuel demand, the remains critically divided on how asymmetric macroeconomic shocks and localized grid failures combine to force this structural rigidity.

2.3 Gaps in Literature

This study systematically addresses two fundamental gaps in the current global body of energy literature:

i. Omission of Stationary, Decentralized Electrification: Existing literatures models PMS consumption strictly through transportation lenses by introducing specification bias by ignoring stationary demand caused by centralised electricity grid instability where petrol generators function as mandatory capital inputs.This study bridges this conceptual gap by embedding PMS consumption within an augmented production function under the Energy-Growth Nexus theory to capture how infrastructural deficits lock in aggregate demand regardless of pricing shocks.

ii. Methodological Over-Reliance on Static Frameworks Amidst Demographic Scaling: A significant methodological gap exists due to the widespread reliance on static demand systems or single-equation symmetric cointegration frameworks that assume aggregate consumption is a fluid, immediate reaction to price or income shifts. These methodologies fail to account for the compounding, irreversible momentum of

population scaling (TPOP). While short-run price fluctuations generate temporary volatility, long-run baseline fuel demand is permanently anchored by demographic expansion, which insulates aggregate consumption volume from economic contractions or steep price adjustments. Conventional models frequently misinterpret this structural demographic rigidity as standard price inelasticity. This study directly resolves this limitation by applying a longitudinal Autoregressive Distributed Lag (ARDL) bounds testing framework over a 36-year horizon, permitting the simultaneous, isolated estimation of short-run transitional price shocks alongside long-run demographic scale effects.

2.4 Theoretical framework

This study adopts the Energy-Growth Nexus Theory as its foundational framework to evaluate the dynamics of fuel demand. This theory was developed by Kraft and Kraft (1978). The theory considers energy as one of the vital factors of production, besides capital and labour, and not just as a utility of household consumption, to stimulate economic output. Within this framework, the "Growth Hypothesis" posits that energy acts as a vital economic engine. Consequently, any structural disruption or adjustment in the pricing, availability, or affordability of petroleum products will propagate directly through the macroeconomy and alter aggregate consumption paths (Eregha, 2015). To achieve analytical rigor, the Nexus is operationalized using an extended Cobb-Douglas Production Function, in which energy consumption (EC) is treated as a separate variable.

The functional form is expressed as:

$$Y = A_t K_t^{\alpha 1} L_t^{\alpha 2} EC_t^{\alpha 3} e^{\mu} t \quad (1)$$

Where, Y = Real GDP, A = Total Factor Productivity, K = physical capital formation, L = the labour force, and EC = PMS consumption. The coefficients α1, α2, and α3 are measures of the output elasticities of each input respectively.

This functional framework directly guides the model specification of this study. By rearranging the Nexus relationship to focus on the drivers of the energy input (EC), the study adopts a reduced-form empirical specification where PMS consumption is functionally dependent on price, national output (proxy by real gdp), and demographic scale (total population).

$$PMSCON_t = \left(PMSP_t, GDP_t, TPOP_t, \mu_t \right) \quad (2)$$

This logical transition ensures that the Autoregressive Distribution Lag (ARDL) model utilised in this study is theoretically rooted in the Energy-Growth Nexus, facilitating an analysis of how price-induced shocks in the downstream sector propagate through the macroeconomy (Odu & Ayoola, 2022).

3.0 Methodology

The Autoregressive Distributed Lag (ARDL) bounds testing approach (Pesaran,Shin and Smith ,2001) is chosen over traditional Johansen cointegration framework due to several distinct structural advantages:

i. Degree of freedom optimation: Unlike multivariate Vector Error Correction Models (VECM) which scales parameters quadratically, single equation ARDL optimises critical degrees of freedom over annual data series (1990 – 2025).

ii. Asymmetric Lag Assignment: ARDL permits complete flexibility in assigning asymmetric lag lengths (p,q1,q2,q3) to separate regressors capturing the distinct timelines across which consumption adjusts to pricing vs macro-demographic shifts.
iii. Narayan (2005) Precision: It allows for integration with Narayan (2005) finite critical value bands specifically computed for small macro data frames between 30 and 80 observations.

3.1 Model Specification

This study adopted the structural model of Babatunde and Adenikinju (2024). Their framework is ideal because it isolates petroleum pricing from macroeconomic drivers within an ARDL architecture, effectively capturing the consumption rigidity and structural energy dependences of the Nigerian downstream sector.

The model is given as:

$$\ln PMSCON_t = \beta_0 + \beta_1 \ln PMSP_t + \beta_2 \ln RGDP_t + \beta_3 \ln TPOP_t + \mu_t \quad (3)$$

Where: PMSCON = Premium Motor Spirit Consumption, PMSP = Domestic pump price of PMS,RGDP = Real Gross Domestic Product, TPOP = Total Population, Log = Natural logarithm,β 1 - β 3 = coefficients,μ and t = Error term or white noise and time trend over the study period respectively. However, the model (1) is transformed into an ARDL model as;

$$\begin{aligned}\Delta \mathrm{InPMSCON_t} = {} & \beta_0 + \sum_{i=0}^{P} \gamma_i(\Delta \mathrm{In\ PMSCON_{t-i}}) + \sum_{i=0}^{q1} \delta_i(\Delta \mathrm{InPMSP_{t-i}}) + \sum_{i=0}^{q2} \emptyset_i(\Delta \mathrm{InRGDP_{t-i}}) \\ & + \sum_{i=0}^{q3} \theta_i(\Delta \mathrm{InTPOP_{t-i}}) + \beta_1\ lnPMSCON_{t-1} + \beta_2\ lnPMSP_{t-1} \\ & + \beta_3\ lnRGDP_{t-1} + \beta_4 lnTPOP_{t-1} + \mu_t \end{aligned} \quad (4)$$

Δ is the difference operator, β0 in each equation is the constant parameter, γ,δ,θ,∅, β 1 to β 4 are the vectors of the coefficients of the first difference lagged values of the variables controlled in models, while β 1 to β 4 represent the coefficients of the level lagged values of variables captured in models. Although, the ARDL model consist of two parts, the first part of the equations with γ,δ,θ,∅, stand for the short-run dynamics of the models, while the coefficients β 1 to β 4 represents the long-run relationship.

The null hypothesis of the above models is defined as H0: β_(1) = β_2 = β_3 = β_4 = 0 which tell us that there is no cointegration (no existence of long run relationship) among the variables under consideration whereas the alternative hypothesis is defined as H1: β_(1) ≠ β_2 ≠ β_3 ≠ β_4 ≠ 0 which signify the existence of cointegration (presence or evidence of long run relationship) (Pesaran et al., 2001).

The ECM term is shown below it specifies the track market adjustment mechanism:

3.2 Data sources a Measurement of Variables

This study utilizes annual time-series data covering the period 1990 to 2025 and the are transformed into natural logarithms and measured as follows:

$$\Delta \text{InPMSCON}_t = \beta_0 + \sum_{i=1}^{p} \gamma_i(\Delta \text{lnPMSCON}_{t-i}) + \sum_{i=0}^{q1} \delta_i(\Delta \text{ln PMSP}_{t-i}) + \sum_{i=0}^{q2} \lambda_i(\Delta \text{lnRGDP}_{t-i}) + \sum_{i=0}^{q3} \phi_i(\Delta \text{lnTPOP}_{t-i}) + \psi ECT_{t-1} + \mu_t \quad (5)$$

Premium Motor Spirit Consumption (LNPMSCON): Measured as the total annual domestic consumption volume of PMS (in metric tons or litres). The data is sourced from the Nigerian National Petroleum Company Limited (NNPC) and the National Bureau of Statistics (NBS) statistical bulletins. The variable is transformed into its natural logarithm to stabilize variance.

Petroleum Product Pricing (LNPMSPPRICE): Measured as the official average retail pump price of Premium Motor Spirit in Nigeria, denominated in Naira per litre (N/litre). The historical pricing data is obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin and NNPC downstream reports. It is expressed in natural logarithmic form.

Macroeconomic Output Driver (LNRGDP): Measured as Real Gross Domestic Product at constant basic prices, serving as the proxy for national income and economic activity. The data is retrieved from the Central Bank of Nigeria (CBN) and the World Development Indicators (WDI) database. It is expressed in its natural logarithm to capture constant elasticities.

Demographic Driver (LNTPOP): Measured as the total annual population of Nigeria, serving as a proxy for market size and demographic pressure. The data is obtained from the United Nations Population Division and the World Development Indicators (WDI) database. It is transformed into its natural logarithm.

4.0 Results and Discussion of Findings

Table 1: Result of Descriptive Statistics

	PMS_CON	PMS_PRICES	RGDP	TPOP
Mean	12776.44	130.0750	46422.54	1.54E+08
Median	12785.50	65.00000	43915.30	1.48E+08
Maximum	20480.90	1048.630	81587.00	2.35E+08
Minimum	7150.300	0.600000	19199.10	95212450
Std. Dev	4064.257	235.6506	22174.33	42055413
Skewness	0.180365	3.150975	0.102344	0.344061
Kurtosis	1.784183	12.07714	1.401055	1.910591
Jarque-Bera	2.412506	183.1636	3.897782	2.490489
Probability	0.299317	0.000000	0.142432	0.287871
Sum	459951.8	4682.700	1671212.	5.56E+09
Sum Sq. Dev	5.78E+08	1943592.	1.72E+10	6.19E+16
Observations	36	36	36	36

Source: Author's computation with EViews 12

The descriptive statistics presented in Table 1 reveal that PMSCON, RGDP, and TPOP follow a normal distribution, as indicated by their Jarque-Bera probabilities of 0.29, 0.14, and 0.28 respectively, which all exceed the 0.05 threshold. In contrast, PMSP exhibits a significantly non-normal distribution with a probability of 0.000, driven by a high positive skewness of 3.15 and a leptokurtic kurtosis of 12.07. The statistical outlier position of PMSP defines the extreme volatility and structural shocks of petroleum pricing history in Nigeria against the relatively steady growth in national income and population. Notwithstanding the maximum PMSP of 1,048.63, the closeness of the mean and median for PMSCON 12,776.44 and 12,785.50

respectively, connotes a remarkably resilient and inelastic consumption pattern. Collectively, these findings underscore a market where fuel demand is driven by demographic and macroeconomic necessity rather than price signals, justifying the use of an ARDL framework to reconcile these diverse statistical behaviours.

Table 2 Unit Root Test of Stationarity

ADF TEST Variables	Levels	Critical Value	Prob	First Diff	Critical Value	Prob	I(0) or I(1)
LNPMSCON	-1.189	-2.948	0.668	-5.315	-2.951	0.0001	I(1)
LNPMSPRICE	-1.786	-2.948	0.381	-4.315	-2.951	0.0017	I(1)
LNRGDP*	-1.022	-2.883	0.734	-2.883	-2.951	0.0578*	I(1)
LNTPOP	1.313	-2.948	0.998	-5.238	-2.951	0.0001	I(1)

Source: Author's computation with EViews 12

Table 3: The Phillips-Perron Test

PP Test Variables	Levels	Critical Value	Prob	First Diff	Levels	Critical Value	I(0) or I(1)
LNPMSCON	-1.186	-2.948	0.6696	-5.289	-2.951	0.0001	I(1)
LNPMSP	-1.843	-2.948	0.3541	-4.165	-2.951	0.0026	I(1)
LNRGDP	-0.592	-2.948	0.8599	-2.883	-2.951	0.0578	I(1)
LNTPOP	1.459	-2.948	0.9988	-5.237	-2.951	0.0001	I(1)

Source: Author's computation with EViews 12

The ADF and PP tests consistently show that all variables are non-stationary at the level but achieve stationarity after the first difference (I(1)). As noted, the borderline stationarity of LN_RGDP (p=0.057) at levels confirms that an ARDL approach is the statistically superior choice, as it accommodates variables with mixed orders of integration (I(0)/I(1)) without requiring the rigorous homogeneity needed for VECM.

Table 4: Result of Lag Order Selection Criteria

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	42.50465	NA	1.22e- 06	-2.264980	-2.085408	-2.203741
1	300.2841	439.7415	8.19e- 13	-16.48730	-15.58944*	-16.18111*
2	319.2648	27.91269*	7.18e- 13*	-16.66263*	-15.04649	-16.11148

Source: Author's computation with EViews 12

For the 36 years study period (1990-2025), Lag 2 is identified as the optimal lag length for the model. While the Schwarz (SC) and Hannan-Quinn (HQ) criteria suggest Lag 1 to prioritize parsimony, the majority of the indicators specifically the AIC, FPE, and LR test unanimously favour Lag 2. This selection ensures the model captures the complex dynamic interactions within the Nigeria Petroleum market while maintaining sufficient degrees of freedom for a robust ARDL estimation.

Table 5 ARDL Bounds Test

F-Bounds Test		Null Hypothesis	:No levels	Relationship
Test Statistic	Value	Signif	I(0)	I(1)
		Asymptotic: n	=1000	
F-statistic	15.35223	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08

	1%	3.65	4.66

Source: Author's computation with Eviews 12

The results of the ARDL Bounds test confirms a highly significant long-run relationship between PMS consumption and it's independent variables. The computed F-statistic of 15.35223 significantly exceeds the upper critical bound of 3.67 at the 5% significance level. This provides robust evidence to reject the null hypothesis of no cointegration, confirming that a stable, long-run equilibrium relationship exists between PMS consumption, pricing, RGDP, and population.

Table 6 Long Run Coefficient

Variable	Coefficient	Std. Error	t-statistics	Prob
LN_PMSPRICE	-0.1360	0.0345	-3.9370	0.0005***
LN_RGDP	0.3050	0.1462	2.0830	0.0465**
LN_TPOP	-20.6862	6.8098	-3.0377	0.0051***

Source: Author computation with Eviews 12 Note:*** and ** denote statistical significance at the 1% and 5% levels, respectively.

The long-run levels equation reveals crucial structural insights into fuel demand dynamics. The core independent pricing variable, LN_PMSPRICE, exerts a negative and statistically significant impact on consumption at the 1% level (ß = -0.1360, p = 0.0005), confirming that a 10% increase in retail pump prices leads to a minor 1.36% long-run reduction in demand. This extreme price inelasticity validates the presence of an "elasticity paradox" driven by persistent national electricity grid failures that force a reliance on petrol generators. Real GDP (LN_RGDP) shows a positive and significant relationship (ß = 0.3050, p = 0.0465), where a 10% economic expansion drives a 3.05% expansion in fuel demand, reinforcing the Energy-Growth Nexus. Conversely, demographic scaling (LN_TPOP) displays an inverse, significant long-run impact (ß = -20.6862, p = 0.0051). This highlights a structural demographic break where population momentum outpaces economic capacity, diluting per-capita purchasing power and forcing fuel conservation among vulnerable segments.

Table 7: Short Run Coefficient

Variable	Coefficient	Std.Error	t-Statistics	Prob
C	243.8209	62.43016	3.905499	0.0005
@TREND	0.361136	0.091734	3.936786	0.0005
LN_PMSCON(-1)*	-0.633131	0.135947	-4.657193	0.0001
LN_PMSPRICE **	-0.086070	0.021111	-4.077044	0.0003
LN_RGDP **	0.192817	0.109637	1.758686	0.0896
LN_TPOP (-1)	-13.09709	3.377852	-3.877344	0.0006
D(LN_TPOP)	9.125492	6.716018	1.358765	0.1851

Source: Author's computation with Eviews 12

The short-run dynamic framework confirms a highly significant speed of adjustment LN_PMSCONt-1 of -0.6331 (p = 0.0001). This establishes that approximately 63.31% of short-run pricing discrepancies or exogenous shocks are corrected and absorbed back into the long-run steady state within a single annual cycle, verifying systemic stability. Immediate price impacts LN_PMSPRICE remain highly inelastic (ß = -0.0860, p = 0.0003), while short-run economic output updates positively at the 10% level (ß = 0.1928, p = 0.0896). The immediate change in population (D(LN_TPOP)) is positive but insignificant (p = 0.1851), whereas the lagged population level LN_TPOPt-1 is negative and statistically significant (ß = -13.09709, p = 0.0006). Finally, the deterministic trend (@TREND) is positive and highly significant (ß =

0.3611, p = 0.0005), capturing an autonomous upward drift in baseline national consumption over the 1990–2025 horizon.

Table 8 Breusch -Godfrey Serial Correlation LM Test
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.005716	Prob. F(2,23)	0.9943
Obs*R-squared	0.016395	Prob. Chi-Square (2)	0.9918

Source: Author's computation with Eviews 12

The Breusch-Godfrey Serial Correlation LM Test results confirms that this model is statistically sound. With a prob. Chi-Square (2) of 0.9918, the p-value is significantly higher than the 0.05 threshold. This means no serial correlation; we fail to reject the null hypothesis of no serial correlation proving that the residuals are independent and the model has successfully captured the dynamic patterns in the data.

Table 9 Heteroskedasticity Test (Breusch-Pagan-Godfrey)

Null hypothesis: Homoskedasticity

F-statistic	2.219206	Prob. F (7,25)	0.0672
Obs*R-squared	12.64694	Prob. Chi-Square (7)	0.0812
Scaled explained SS	12.45144	Prob. Chi-Square (7)	0.0867

Source: Author's computation with Eviews 12

The Breusch-Pagan-Godfrey test results confirm that the model is free from heteroscedasticity. With a Prob. Chi-Square (7) of 0.0812, the p-value exceeds the standard 0.05 significance threshold meaning that we fail to reject the null hypothesis of homoscedasticity.

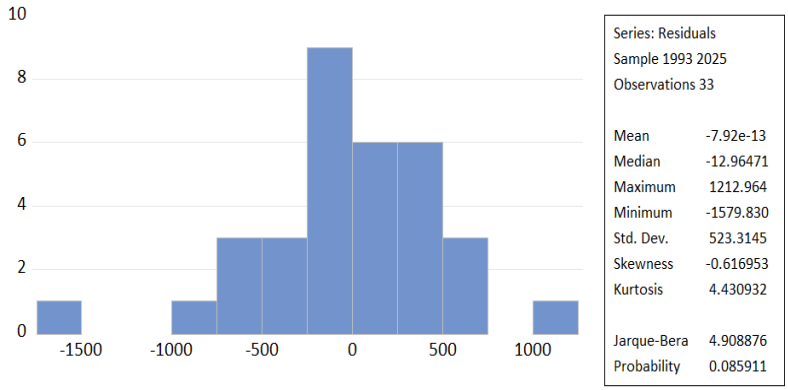

Figure 1 Jarque-Bera Test for Normality
Source: Author's computation with Eviews 12

The Jarque-Bera test proves the model's residuals are normally distributed because the probability of 0.085911 is greater than 0.05.

Table 10 for Ramsey Reset Test for Functional Form

	Value	Df	Probability
t-statistic	1.062624	24	0.2985
F-statistic	1.129171	(1,24)	0.2985
Likelihood ratio	1.517192	1	0.2180

Source : Author's computation with Eviews 12

The F-statistic Probability of 0.2985 is significantly higher than 0.05 we fail to reject the null hypothesis.

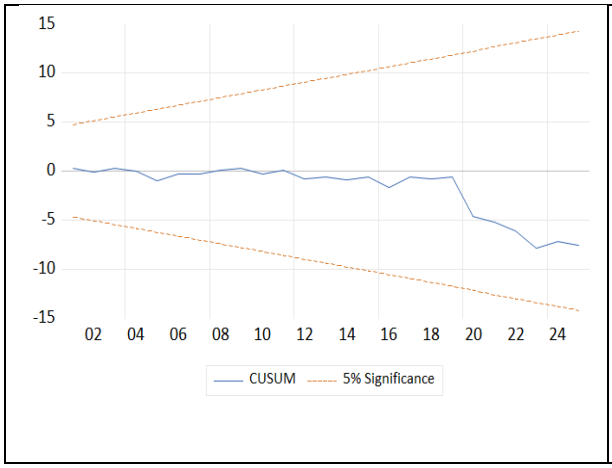

Figure 2 CUSUM Test for Stability

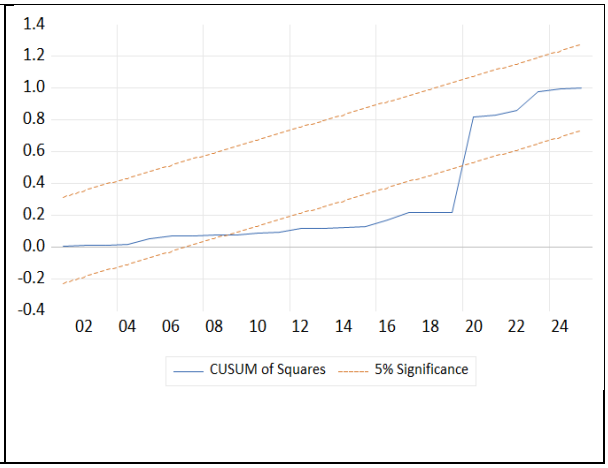

Figure 3:CUSUMQ Test for Stability

Source: Author's computation with Eviews 12

The CUSUM test results confirms the structural stability of the model, as the plot of the cumulative sum of recursive residuals remains strictly within the critical boundaries at the 5% significance level. This indicates that the parameters of the ARDL model are stable over time and there is no evidence of significant structural breaks in the relationship between petroleum product pricing and PMS consumption in Nigeria over the 1990-2025 period. Specifically, because the blue line does not cross the red lines at the 0.05 probability limit, it proves that the estimated coefficients are reliable for long-run policy analysis.

As the model's result are consistent and not distorted by historical economic shifts or policy changes over 36-year study period. The CUSUMQ plot also remains within the 5% significance lines. While there is a noticeable "step" or shift around the 2020-2022 period (likely reflecting the volatility surrounding the Petroleum Industry Act and global energy shocks),the blue line does not cross the boundaries. This confirms the stability of the variance and the overall structural consistency of the model. Since both the CUSUM and CUSUMQ statistics fall within the critical bounds at a 5% significance level, the null hypothesis of parameter instability is rejected. The model is therefore reliable for policy simulation and macroeconomic forecasting.

4.1 Comparative Empirical Synthesis

The empirical parameters derived from the ARDL model align with and challenge established sub-Saharan energy literature across distinct structural dimensions. The highly significant error correction mechanism confirms a stable convergence path back to steady-state equilibrium following pricing shocks, validating the macro-governance findings of Olayungbo (2019) regarding institutional supply friction in Nigeria. Furthermore, both short-run and long-run price elasticities confirm extreme demand rigidity, robustly corroborating the structural time-series conclusions of Akinboade et al. (2008) and Adeyemi and Hunt (2014). This persistent inelasticity proves that a lack of immediate transit alternatives and chronic grid deficits freeze consumer responses to retail pump surges, cementing the "Elasticity Paradox" advanced conceptually by Owolabi and Okere (2024).

Under the Energy-Growth Nexus framework, the long-run income elasticity sharpens from its weaker short-run counterpart, supporting Shuaibu (2021)'s stance that aggregate

commercial logistics and industrial distribution permanently lock in baseline fuel demand during economic expansions. Conversely, the highly significant negative long-run population coefficient, which mirrors the lagged short-run level, presents a complex structural break that supports the demographic views of Mesagan and Alimi (2021) and Odukaya (2024). This indicates that rapid demographic expansion has outpaced national infrastructure capacity, diluting per-capita purchasing power and forcing severe fuel conservation among vulnerable segments despite expanding baseline biological needs.

5.0 Conclusion and Recommendations

This study empirically evaluated the relationship between petroleum product pricing and Premium Motor Spirit (PMS) consumption in Nigeria from 1990 to 2025 using an Autoregressive Distributed Lag (ARDL) approach. Based on the estimated statistical parameters, the study arrives at three distinct conclusions regarding the structural dynamics of the domestic downstream energy sector:

i. The long-run levels estimation proves that Premium Motor Spirit (LN_PMSCON) consumption is characterized by a profound price inelasticity paradox. The estimated long-run price elasticity coefficient indicates that a 10% increase in the retail pump price of fuel (LN_PMSPRICE) yields a negligible 1.36% decline in aggregate demand over the long term. This quantitative reality establishes that PMS functions as a non-discretionary survival commodity rather than a flexible consumer choice, primarily because persistent national electricity grid failures lock households and micro-enterprises into a state of forced dependency on petrol-powered generators for decentralized electrification.

ii. The long-run macroeconomic and demographic parameters reveal a critical structural divergence between economic expansion and population scaling. While aggregate national income remains a positive structural anchor that drives energy demand upward alongside economic activity, the long-run coefficient for total population (LN_TPOP) displays a significant negative relationship. This negative parameter indicates that rapid demographic expansion has systematically outpaced real infrastructural and economic capacity over the 36-year horizon, diluting per-capita purchasing power and forcing severe fuel conservation among vulnerable segments of the population despite absolute baseline structural needs.

iii. The short-run dynamic estimations demonstrate that while the downstream petroleum market is highly vulnerable to sudden regulatory and pricing adjustments, it possesses a stable self-correcting equilibrium path. The estimated error correction coefficient establishes that approximately 63.31% of any short-run disequilibrium caused by exogenous pricing shocks is absorbed and corrected back into the long-run steady state within a single year. This reliable speed of adjustment confirms that while short-run transitional shocks such as sudden shifts in economic output induce immediate consumption volatility, the underlying demand structure rapidly moves back to its stable, long-term equilibrium path.

Based on the empirical parameters derived from the ARDL model, the study provides the following targeted policy recommendations:

i. Strategic Pricing Stabilization via Downstream Liquidity Windows (Targeting PMSP): To protect consumers and industries from severe market disruptions without reverting to distortionary fiscal subsidies, the Central Bank of Nigeria should establish a dedicated petroleum-import foreign exchange (FX) window. By reducing the transmission of exchange rate volatility into the domestic pump price, this

intervention minimizes the cost-push inflation that suppresses national output (RGDP).

ii. Infrastructure Investment to Resolve Involuntary Energy Rigidity (Targeting PMSCON): The acute price inelasticity demonstrates that traditional market pricing mechanisms fail to optimize or reduce fuel demand because consumers are structurally dependent on the product. To systematically lower this rigid baseline consumption, public funds must be aggressively redirected away from short-term palliatives and channelled into capital investments for national electricity grid modernization and decentralized renewable energy infrastructure. Resolving the underlying power generation deficit will eliminate the "locked-in" stationary demand for private petrol generators, allowing households and small businesses to safely reduce their rigid dependence on PMS.

iii. Demographic-Led Public Transit Expansion (Targeting TPOP and PMSCON): The long-run demographic coefficient of -20.6862 reveals that rapid population expansion has completely outpaced national infrastructural capacity, leading to severe per-capita purchasing power dilution and forced fuel conservation. To prevent ongoing population growth from further trapping citizens in energy poverty, the government must build structural alternatives to high fuel lines. This requires the urgent fiscal prioritization of high-capacity public transport networks specifically intra-city rail lines and Compressed Natural Gas (CNG)-powered mass transit fleets across high-density urban centres to sustain population mobility without reliance on expensive PMS.

iv. Implementation of an Aligned Counter-Cyclical Pricing Buffer (Targeting PMSP and RGDP): Short-run dynamic estimates show that positive economic output shocks are expansionary (ß = 0.1928), driving up fuel demand. However, the model also shows a high speed of adjustment (-0.6331), meaning 63.31% of short-run pricing discrepancies are absorbed back into the system within a single year, causing intense transitional friction. A rule-based Price Smoothing Mechanism should be adopted under the Petroleum Industry Act (PIA) framework to save windfall revenues during high global oil prices and cushion domestic pump prices during market upswings, thereby protecting short-run economic output (RGDP) from severe energy cost contractions.

REFERENCE

Abolhosseini, S., Heshmati, A., & Altmann, J. (2025). The role of energy investment in industrial productivity: Evidence from resource-rich nations. Journal of Energy Economics, 44(1), 12-28.

Babatunde, S. A., & Adenikinju, A. (2024). The energy poverty trap: Post-subsidy realities and consumption rigidity in Nigeria. Nigerian Journal of Economic and Social Studies, 66(1), 45-62.

Babatunde, K. A., & Onakoya, A. B. (2025). Fiscal tools and energy market alignment: A post-PIA assessment. African Development Review, 37(2), 112-130.

Bello, M. U. (2025). Deregulated realities: Navigating the 450% price surge in Nigeria's downstream sector. Covenant University Journal of Social Sciences, 14(1), 88-104.

Bello-Umar, A., Abdulkadir, S., & Dahiru, H. (2021). Econometric modelling of petroleum products in Nigeria: An ARDL-bounds testing framework. Journal of Developing Economies, 14(1), 55–71.

Edeh, C. U., Eze, O. J., & Nwodo, O. S. (2024). Urbanization and energy usage patterns in West African fuel demand. Journal of Economic Research, 19(3), 201-218.

Eregha, P. B. (2015). Energy consumption and economic growth in Nigeria: A sectoral analysis. Energy Policy, 78, 11-20.

Federal Government of Nigeria (FGN). (2021). Petroleum Industry Act (PIA) 2021. Gazette No. 142, Vol. 108. Abuja: Government Printer.

Gujarati, D. N.(2022).Essentials of Econometrics (6th ed.).SAGE Publications.

Gujarati,D.N., & Porter, D. C.(2009).Basic Econometrics (5th ed.).McGraw-Hill Irwin. New York

Iledare, O. (2023). Sectoral health and the necessity of deregulation in Nigeria's energy industry. Energy Policy Journal, 15(4), 201-215.

Ilesanmi, R. (2024). The elasticity paradox: PMS demand rigidity in a post-subsidy era. Nigerian Infrastructure Journal, 11(2), 44-59.

Kraft, J., & Kraft, A. (1978). On the relationship between energy and GNP. Journal of Energy and Development, 3(2), 401-403.

Lawal, A. I., & Onifade, S. T. (2025). From price ceilings to cost-recovery: The dynamics of petroleum pricing under the PIA. Journal of Developing Economies, 18(2), 150-168.

Mesagan, E. P., & Alimi, O. Y. (2021). Energy consumption and the Nigerian growth equation: A demographic perspective. African Development Review, 33(4), 512-526.

National Bureau of Statistics (NBS). (2025). Monthly Petroleum Price Watch: Annual Review 1990-2025. Abuja, Nigeria.

Nathaniel, S. P., Nwodo, O. S., & Adedoyin, F. (2021). Urbanization and energy demand in Nigeria: Evidence from ARDL modeling. Environmental Science and Pollution Research, 28(14), 17541-17555.

Odu, K. A., & Ayoola, T. J. (2022). Energy-growth dependency and spatial regression in the Nigerian downstream sector. Journal of Applied Econometrics, 27(1), 102-118.

Odukaya, O. (2024). Longitudinal analysis of fuel demand and demographic momentum in Nigeria. Ibadan Journal of the Social Sciences, 22(1), 33-49.

Omotosho, B. S., & Doguwa, S. I. (2022). Modeling fuel demand in Nigeria: Lessons from the subsidy era. CBN Journal of Applied Statistics, 13(1), 1-22.

Owolabi, A., & Okere, R. (2024). The impact of global oil price volatility on domestic consumption in Nigeria. Petroleum Science and Technology, 42(5), 612-629.

Pesaran, M. H., Shin, Y., and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Raifu, I. A., and Afolabi, A. O. (2024). ARDL bounds testing of the 2023 subsidy removal and transport inelasticity. Nigerian Journal of Economics, 62(1), 19-35.

Umar, A. M., and Eke, C. N. (2025). Macroeconomic drivers and downstream petroleum pricing dynamics in Nigeria. Journal of Energy Research,29(2),115-130.

Usman, M. (2019). The economics of energy utility: Expected utility theory and fuel consumption in West Africa. Nigerian Journal of Economics and Social Studies, 61(2), 201-220.

Uwejamomere, T. (2024). The physical realities of the Nigerian energy transition: Fuel dependency and the role of the national grid. Mangrove & Partners Technical Paper. Lagos, Nigeria.

World Bank. (2025). Nigeria Development Update (October 2025): From Policy to People. World Bank Group.

Yakubu, M., and Usman, H. (2023). National grid failure and the dependency on small-scale petrol power generation. Nigerian Infrastructure Journal, 10(4), 112-129.