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FUEL SUBSIDY REMOVAL, FOOD PRICE FLUCTUATIONS, AND INDUSTRIAL PRODUCTIVITY IN NIGERIA

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Abstract
This study examines how fuel-subsidy reform affects industrial productivity in Nigeria, focusing on petrol pump prices, food price changes, and labor. It uses Ordinary Least Squares (OLS), a two-regime switching regression model, and Granger causality analysis, with data from 1980 to 2025. The OLS results show that petrol prices and food price volatility negatively affect industrial productivity. In other words, rising fuel prices and food price instability tend to lower industrial output. The regime-switching regression indicates that the magnitude of these effects varies across economic conditions, meaning fuel-subsidy reforms hit harder during periods of economic instability. The Granger causality analysis reveals one-way causation from industrial productivity to petrol prices and from food price volatility to industrial productivity, but there's no significant cause-and-effect relationship between petrol prices and food price volatility. This study concludes that while fuel-subsidy reforms are vital for fiscal health, they might have short-term negative effects on industrial productivity due to rising production costs and inflation. It recommends gradual adjustments to fuel prices, investments in alternative energy, better food price stabilization policies, and targeted support for industries to lessen the negative impact on productivity.

Keywords*:* Fuel, Subsidy, Fluctuation, Industrial, Productivity.

INTRODUCTION

Energy pricing and fuel-subsidy management have been central topics in Nigeria's economic policy debate for decades. Since crude oil was discovered in the late 1950s, many governments have used fuel subsidies to protect citizens from global oil price changes and keep domestic energy prices low (Adenikinju, 2020; Iwayemi, 2023). The subsidy aimed to promote welfare, boost industrial activity, and cut production costs. However, it has become a huge fiscal burden, draining billions of dollars yearly and limiting investments in infrastructure, education, and healthcare (World Bank, 2023). In 2022, the Nigerian National Petroleum Company Limited (NNPCL) reported that fuel subsidies cost the government over ₦4 trillion. This expense is unsustainable given the government's existing debt and budget deficit (Akpan & Yusuf, 2024). In May 2023, the federal government announced a complete removal of the fuel subsidy, claiming this would lead to greater efficiency, attract investment in the downstream petroleum sector, and redirect resources toward productive public spending (Bello & Olayemi, 2024). However, this reform caused sudden hikes in transportation fares, production costs, and consumer prices. The inflation caused by these changes has been especially apparent in food markets, where transport and fuel costs make up a large part of expenses (Fasanya & Adekoya, 2024). As a result, deregulating fuel prices has affected food prices, household spending, and the costs for firms in Nigeria's industrial sector (Adeola, Alabi, & Ezenwa, 2024). The connections among fuel-subsidy removal, food price fluctuations, and industrial productivity are complex. Energy serves as both a direct input in manufacturing and an indirect cost driver through transport and agriculture (Fashogbon & Oni, 2023). When energy prices rise, production and distribution costs increase, pushing overall prices higher, a clear case of cost-push inflation (Ezeaku & Nwokoye, 2023). The extent of this impact depends on issues like infrastructure, currency volatility, and supply-chain efficiency (Ezeaku & Nwokoye, 2023).

Evidence shows that while subsidy reforms can lead to long-term gains through better resource allocation, the short-term effects on welfare can be damaging (Beaton, Lontoh, & Wai-Poi, 2016; Rentschler & Bazilian, 2017). For example, experiences from Indonesia and Egypt show that removing fuel subsidies initially leads to spikes in consumer prices and social unrest, followed by gradual economic stabilization (World Bank, 2023). In Nigeria, the withdrawal of fuel subsidies has already pushed inflation above 30%, with food inflation exceeding 35% as of mid-2024. These changes directly affect household welfare and indirectly impact the competitiveness and productivity of energy-intensive industries. The industrial sector, especially manufacturing, makes up about 13 to 15 percent of Nigeria's gross domestic product (GDP) but plays a large role in employment and export diversification (Adenikinju & Olayemi, 2021). However, the sector's growth is very sensitive to changes in input prices, especially fuel and electricity. High energy costs can squeeze profit margins, lower capacity use, and hinder output growth (Olawale & Akinola, 2023). Moreover, unstable food prices can further affect industrial productivity by impacting workers' real incomes, spending habits, and overall demand (Adeola et al., 2024). Thus, a thorough assessment of fuel-subsidy reform, food price fluctuations, and industrial productivity is crucial for understanding the larger economic adjustments in Nigeria's economy after subsidy removal.

The end of fuel subsidies has a widespread effect across several sectors, with industrial productivity being significantly affected. Higher fuel costs raise transportation prices for raw materials and finished goods, harming the competitiveness of Nigerian industries. Industries like cement manufacturing, agro-processing, and textile production are especially impacted. According to Akinlo (2020), industries in Nigeria saw a 25% rise in production costs after the subsidies on **Premium Motor Spirit (PMS), commonly known as petrol,** were lifted, leading to reduced output across many sectors. This rise in fuel costs has also limited small and medium-sized enterprises (SMEs) from expanding or even maintaining their operations. SMEs, which make up a large share of Nigeria's industrial output, often cannot handle sudden price spikes in petrol. Consequently, many have had to cut back production or shut down entirely, resulting in job losses and lower productivity.

The recent removal of fuel subsidies has intensified these issues by raising transportation and energy costs, both critical for food production and distribution. This interaction between fuel-subsidy reform and food price volatility can heighten inflationary pressures and disrupt industrial supply chains. Despite greater policy focus on subsidy removal and food security, there is little empirical evidence on how these factors together influence industrial productivity in Nigeria. Additionally, it is important to examine whether changes in industrial productivity might also influence food price changes and overall economic stability. Thus, a comprehensive assessment of fuel-subsidy reform, food-price fluctuations, and industrial productivity is essential for understanding broader economic adjustments in Nigeria after subsidy removal and for developing informed policy interventions that balance economic efficiency with social welfare. This raises vital questions about how ending fuel subsidies affects industrial productivity. How does food price volatility impact productivity in Nigeria's industrial sector?

EMPIRICAL REVIEW

Empirical research in developed countries has shown that while short-term adjustment costs may be significant, energy price liberalization often enhances long-term efficiency. For instance, Beaton et al. (2016) examined OECD nations and discovered that, notwithstanding early inflationary adjustments, energy subsidy reform enhanced fiscal balance and investment efficiency. In a similar vein, Rentschler and Bazilian (2017) showed that reforming fossil fuel subsidies in developed economies improved resource allocation and decreased carbon emissions without permanently reducing industrial output.

Acar and Yeldan (2019) demonstrated that energy tax cuts, similar to the elimination of subsidies, produced welfare gains in the European Union when combined with compensatory social policies using a computable general equilibrium (CGE) model. These results imply that social safety nets, effective markets, and open institutions reduce negative welfare impacts. The experience of developed nations emphasizes how crucial it is to start reforms with targeted compensation in order to maintain competitiveness and productivity. Studies from developing countries present more diverse outcomes due to structural vulnerabilities. In Indonesia, Clements, Jung, and Gupta (2007) found that subsidy removal initially raised inflation and poverty but improved fiscal health and investment in infrastructure over time. Similarly, in Egypt, Kpodar and Abdallah (2017) reported that energy-subsidy reform reduced budget deficits but increased food prices and social discontent in the short run. African evidence mirrors these mixed outcomes. In Kenya and Ghana, fuel-price deregulation led to efficiency improvements and private investment growth, but at the cost of higher living expenses and short-run inflation (Rentschler & Bazilian, 2017).

Fashogbon and Oni (2023) showed that in Sub-Saharan Africa, energy-cost shocks negatively affect agricultural productivity, reinforcing the link between energy pricing and food-price volatility. The literature thus indicates that subsidy reforms in developing economies produce short-term welfare costs but long-term efficiency and productivity benefits, conditional on institutional strength and policy sequencing. In their analysis of the 2023 subsidy elimination, Akpan and Yusuf (2024) discovered a significant rise in inflation and household welfare losses, particularly among low-income groups. Bello and Olayemi (2024) simulated the inflationary effects using a macroeconomic model and observed that fuel-price shocks significantly increased consumer and food inflation.

Fasanya (2022) applied a GARCH model to Nigerian food-price data and found that exchange-rate fluctuations, fuel-price shocks, and import dependencies are major drivers of food-price volatility. Similarly, Fasanya and Adekoya (2024) demonstrated strong volatility spillovers between global food prices and domestic macroeconomic variables, highlighting energy costs as a critical transmission channel. From an industrial perspective, Adenikinju and Olayemi (2021) established a long-run relationship between energy consumption and manufacturing productivity, indicating that energy shocks significantly reduce industrial output. Olawale and Akinola (2023) further showed that rising input costs due to energy-price hikes depress firm productivity, especially in small and medium-sized enterprises (SMEs). Conversely, Adenikinju (2020) argued that deregulated pricing could enhance efficiency if accompanied by infrastructure and policy reforms.

Few studies have integrated industrial productivity (Adenikinju & Olayemi, 2021; Olawale & Akinola, 2023), fuel-subsidy reform (Akpan & Yusuf, 2024; Bello & Olayemi, 2024), and food-price volatility (Fasanya, 2022; Fasanya & Adekoya, 2024) into a coherent analytical framework. The government bears the risk of implementing one-size-fits-all programmes that overlook the differing effects across sectors due to the lack of empirical clarity, which has significant policy ramifications. Current studies often employ sectoral approaches, focusing either on the relationship between the energy sector and other sectors or on macroeconomic welfare without adequately considering the systemic transmission mechanisms across markets. Consequently, policymakers lack a comprehensive understanding of how petrol-price deregulation affects food supply chains and manufacturing productivity.

The inconsistencies in empirical findings further complicate the discourse. While some scholars argue that fuel-subsidy removal can stimulate efficiency, competition, and innovation (Rentschler & Bazilian, 2017; Fashogbon & Oni, 2023), others contend that the inflationary pressures and increased poverty negate potential benefits (Ezeaku & Nwokoye, 2023). Furthermore, in the Nigerian context, the dynamic link between changes in food prices and industrial performance has received less attention. To date, no comprehensive study has examined whether food price volatility mediates the effect of eliminating fuel subsidies on industrial productivity. An integrated econometric study that measures the immediate and long-term impacts of removing fuel subsidies on food price volatility and industrial productivity in Nigeria is therefore desperately needed.

METHODOLOGY

Theoretical framework

To examine whether fuel-subsidy reform altered the relationship between petrol prices, food-price volatility, and industrial productivity in Nigeria, this study is anchored on endogenous growth theory. The theory, pioneered by Romer (1986) and Lucas (1988), emerged as a critique of the Solow neoclassical growth model. The Solow model considers technical advancement as exogenous and capital accumulation as subject to diminishing returns, but the endogenous growth model incorporates technological change, positing that policy choices, human capital enhancement, and innovation can maintain prolonged economic growth.

The production function is typically written as:

$$Y = AK^{\alpha}L^{1-\alpha} \quad (1)$$

Where:
Y: Output (Industrial Productivity), A: Total Factor Productivity (TFP), which is endogenously determined, K: Capital stock (including private investment and infrastructure), L: Labour input. α: Output elasticity of capital ($0 < \alpha < 1$). But in endogenous growth models, TFP (A) is not constant. Instead, it evolves based on human capital, knowledge accumulation, and public policy.

Augmented endogenous growth function:
We assume that productivity A is a function of economic policies (e.g., fuel subsidy removal) and cost shocks (e.g., food price fluctuations):

$$A = A_0 e^{\phi 1S + \phi 2F} \quad (2)$$

Where:

A_0: Base productivity; S: Policy shock from fuel subsidy removal; F: Cost shock from food price fluctuations ϕ_1, ϕ_2: Elasticities (effects of S and F on productivity)

Substitute A into the production function:

$$Y = A_0 e^{\phi 1S + \phi 2F} K^{\alpha} L^{1-\alpha} \quad (3)$$

This captures how fuel and food policies influence productivity through TFP channels, affecting the overall industrial output.

Theoretical Implications for Nigeria

- Fuel Subsidy Removal (S): Reduces government spending but raises production costs due to higher energy input prices. If reinvested effectively, it can improve long-run productivity through better infrastructure, but short-term shocks might reduce output.
- Food Price Fluctuations (F): Volatility increases uncertainty and labour costs (e.g., wage demands, cost-push inflation), which may reduce efficiency and output. However, stable or subsidized food prices could improve workforce welfare and productivity.

Model Specification

The objectives of the study drive the model specification in this section. As stated in the first section, the objective of the study is to examine whether fuel-subsidy reform altered the relationship between petrol prices, food-price volatility, and industrial productivity; the study will employ a structural-break approach using the Chow test. The test will determine whether significant parameter instability exists between the pre-subsidy and post-subsidy periods. In addition, a subsidy-removal dummy variable will be incorporated to capture the policy-regime shift associated with the 2023 petrol-subsidy reform in Nigeria. This study model is derived from the work of Akinlo (2020) and Oseni and Fapohunda (2021), where Akinlo (2020) examined the role of energy prices on industrial production, while Oseni and Fapohunda (2021) assessed the effects of fuel price increases on Nigeria's manufacturing sector.

The basic functional form can be expressed as:

$$IP_t = f(PPP_t, FPV_t, FSRD_t, INF_t, GFCF_t, LAB_t) \quad (4)$$

Where: IP_t is industrial productivity at time t (dependent variable), measured by Industry Value Added; PPP_t is the Petrol pump price, measured as the average retail price of Premium Motor Spirit (PMS) in Naira per litre; FPV_t is food price volatility measured using changes in the food price index, $FSRD_t$ is the fuel subsidy removal dummy, a dummy variable where 1 was computed representing post-subsidy removal period (2023 onward); 0 = pre-subsidy period. $INFL_t$ is the inflation rate (control variable capturing macroeconomic price changes), GDP_t is the GDP growth rate (capturing overall economic activity and industrial growth), $GFCF_t$ is capital (% of GDP), LAB_t is total labour force participation rate (percentage of people from 15 to 65 years old)

Measurement of variables

The definitions and the source of the variables used in the model above were expressed as:

Table 1: Description of Variables

Variable	Symbol	Description	Measurement/ Proxy	Expected Relationship with INP	Source
Industrial Productivity	INP	The main dependent variable of the study. Reflects the level of output, efficiency, and performance of Nigeria's industrial/manufacturing sector over time.	Industry Value Added		National Bureau of Statistics (NBS), World Bank
Petrol Pump Price	PPP	This variable captures changes in domestic energy prices resulting from fuel-subsidy adjustments	Measured as the average retail price of Premium Motor Spirit (PMS) in Naira per litre	Negative (-)	National Bureau of Statistics
Food Price Volatility	FPV	Measures the volatility or changes in food prices, which can influence input costs and household consumption, thereby affecting industrial demand and labour productivity.	Annual % change in Food Price Index or CPI (food sub-index)	Negative	National Bureau of Statistics (NBS), FAO
Fuel Subsidy Removal	FSRD	A dummy variable representing whether the fuel subsidy was removed or not during a particular time period. Captures the impact of energy policy reform.	1 = Periods when fuel subsidy was removed 2023 onward; 0 = otherwise	Negative (short-run), Positive (long-run if reinvested wisely)	National Bureau of Statistics (NBS), FAO
Inflation Rate	INFL	A macroeconomic control variable reflecting overall price stability. High inflation increases input costs and erodes purchasing power.	Annual Consumer Price Index (CPI) %	Negative	CBN, IMF, World Bank
GDP Growth Rate	GDP	Captures the overall economic environment and performance. A growing economy generally boosts demand for industrial goods and enhances capacity utilization	Annual % change in Gross Domestic Product (GDP)	Positive	NBS, World Bank
Capital Formation	GFCF	Indicates the level of investment in physical infrastructure and industrial assets as a share of GDP. Crucial for expanding industrial capacity.	Gross Fixed Capital Formation (% of GDP)	Positive	World Bank, CBN
Labour Force	LAB	Refers to human capital available for industrial production, measured as total labour force participation rate (percentage of people from 15 to 65 years old)	Total labour force participation rate (percentage of people from 15 to 65 years old)	Positive	NBS, International World Development Indicator (WDI).

Source: Authors computation

The empirical technique adopted in this study is in line with examining whether fuel-subsidy reform altered the relationship between petrol prices, food-price volatility, and industrial productivity in Nigeria. To achieve this objective, the study employs the Ordinary Least Squares (OLS) estimation technique, the Two-Regime Switching Regression Model, and the Granger Causality test. These techniques are considered appropriate because they enable the study to estimate the average relationship among the variables, capture structural changes arising from subsidy reforms, and determine the direction of causality among the variables.

Transforming the functional relationship into econometric and log-linear form gives:

$$lnIP_t=\beta_0+\beta_1 lnPPP_t+\beta_2 lnFPV_t+\beta_3 FSRD_t+INFL_t +\beta_5 lnGDP_t +\beta_6 lnGFCF_t +\beta_7 LAB_t +\epsilon_t \quad (5)$$

Where IP_t, is the depending variables for the model and its log of industrial productivity, while $lnPPP_t$ $lnFPV_t$, $lnGDP_t$, and, $lnGFCF_t$ is the log of Premium Motor Spirit price, food price volatility, GDP growth rate, and log of capital, while ϵ_t is the stochastic variable, error term (captures unobserved factors affecting industrial productivity). β_0 is the intercept term, β_1, β_2, β_3, β_4, β_5 Coefficients of the independent variables.

The above equation represents the Ordinary Least Squares (OLS) model used to estimate the average effect of petrol prices, food-price volatility, and gross domestic product on industrial productivity in Nigeria. The OLS approach is suitable because it provides efficient and unbiased estimates under the Gauss-Markov assumptions and enables the study to determine the magnitude and direction of the relationship among the variables.

To account for possible structural changes arising from fuel-subsidy reform, the Two-Regime Switching Regression Model is specified as follows:

Regime 1: Pre-Fuel Subsidy Reform Period

$$IP_t=\alpha_1+\beta_{11} PPP_t+\beta_{12} FPV_t+\beta_{13} INFL_t+\beta_{14} GDP_t +\beta_{15} GFCF_t +\beta_{16} LAB_t +\epsilon_{1t} \quad (6)$$

Regime 2: Post-Fuel Subsidy Reform Period

$$IP_t=\alpha_2+\beta_{21} PPP_t+\beta_{22} FPV_t+\beta_{23} INFL_t+\beta_{24} GDP_t +\beta_{25} GFCF_t +\beta_{26} LAB_t +\epsilon_{2t} \quad (7)$$

Where: Regime 1 represents the pre-fuel subsidy reform period. Regime 2 represents the post-fuel subsidy reform period. α_1 and α_2 are regime-specific intercepts. β_{ij} and β_{ij} are regime-specific slope coefficients, ϵ_{1t} and ϵ_{1t} are stochastic error terms.

The switching regression framework enables the study to determine whether the relationship between petrol prices, food-price volatility, and industrial productivity differs across the two policy regimes. Significant differences in coefficients across the regimes would indicate that fuel-subsidy reform altered the relationship among the variables.

Furthermore, the Granger Causality test is specified as in equations 8, 9, and 10:

$$IP_t=\sum_{i=1}^{P}\alpha_i\, IP_{t-i} + \sum_{j=1}^{P}\beta_j\, PPP_{t-j}+\sum_{k=1}^{P}\Upsilon k\, FPV_{t\text{-}k}+\epsilon_t$$

$$PPP_t=\sum_{i=1}^{P}\alpha_i\, PPP_{t-i} + \sum_{j=1}^{P}\beta_j\, IP +\sum_{k=1}^{P}\Upsilon k\, FPV_{t\text{-}k}+\epsilon_t$$

$$FPV_t=\sum_{i=1}^{P}\alpha_i\, FPV_{t-i} + \sum_{j=1}^{P}\beta_j\, IP_{t-j}+\sum_{k=1}^{P}\Upsilon k\, PPP_{t\text{-}k}+\epsilon_t$$

Where PPP is the optimal lag length; the lagged values of the variables are used to determine causality relationships among the variables. The null hypothesis of the Granger causality test states that one variable does not Granger-cause another variable. Rejection of the null hypothesis implies the existence of predictive causality between the variables.

RESULTS AND DISCUSSION

Table 2 presents the summary statistics of the study variables. Industrial productivity recorded an average value of 4.56, ranging from 4.25 to 4.80, indicating moderate variation across the study period. The mean value of Petrol Pump Price (PPP) was 4.51, with a wide range (1.02-5.49) and a relatively high standard deviation (0.99), reflecting significant fluctuations in Petrol Pump Price and subsidy policy implementation. Food Price Volatility (FPV) had a mean of 2.03, with values between 0.37 and 2.48, suggesting mild but persistent volatility.

The GDP growth rate averaged 1.22 (range: 0.23-2.09), highlighting Nigeria's slow and uneven economic expansion. Inflation averaged 2.36, fluctuating between 0.88 and 3.19, indicating moderate price instability. Gross Fixed Capital Formation (GFCF) recorded a mean value of 3.07 and a low standard deviation of 0.16, indicating that investment in fixed assets remained relatively stable throughout the study period, with only mild fluctuations around the average level. This suggests a fairly consistent pattern of capital investment in the economy. Labour Force (LAB) remained highly stable, with a mean of 3.81 and minimal variation (3.62-3.98). All variables exhibited negative skewness, implying left-tailed distributions. Most were leptokurtic (kurtosis > 3), except industrial productivity (2.54) and labour (2.99), which approximated normality. The Jarque–Bera test confirmed that FSR, FPF, inflation, and capital formation were non-normally distributed ($p < 0.01$), while industrial productivity, GDP, and labour were normally distributed ($p > 0.05$).

Table 2: Descriptive Statistics

	IP	PPP	FPV	INFL	GDP	GCFC	LAB
Mean	4.5619	4.5106	2.0274	2.3636	1.2150	3.0660	3.819847
Median	4.5694	4.8179	2.1063	2.4703	1.3104	3.0753	3.824202
Maximum	4.8503	5.4923	2.4775	3.1911	2.0947	3.3475	3.980282
Minimum	4.2571	1.0237	0.3720	0.8780	0.2305	2.5077	3.616084
Std. Dev.	0.1456	0.9949	0.3861	0.4667	0.3701	0.1602	0.075474
Skewness	-0.1674	-1.6354	-2.1156	-0.8740	-0.5311	-0.7758	-0.366768
Kurtosis	2.5465	5.7524	9.2270	4.0674	3.3394	4.7238	2.999202
J-B	0.5960	34.264	106.27	7.8653	2.3317	10.0860	1.008890
Prob.	0.7423	0.0000	0.0000	0.0196	0.3117	0.0065	0.603841
Obs.	45	**45**	**45**	**45**	**45**	**45**	**45**

Source: Authors' computation, 2025.

Table 3 displays the correlation matrix coefficients for the variables. The correlation analysis reveals that the covariate regressors exhibit varying degrees of correlation, as indicated by the coefficients ranging from -0.3004 to 0.4975. None of the correlation coefficients among the explanatory variables exceed the conventional threshold of 0.90. This indicates the absence of severe multicollinearity among the explanatory variables, suggesting that each variable contributes independently to explaining variations in industrial productivity

.

Table 3. Correlation Results among the Key Economic Indicators

	IP	FSR	FPF	GDP	INFL	EXCR	GCFC	LAB
IP	1							-
FSR	-0.2150	1						
FPF	-0.1646	0.0349	1					
GDP	0.1366	0.0719	-0.3004	1				
INFL	-0.2349	-0.0471	-0.2454	-0.0773	1			-
EXCR	-0.2167	0.4975	0.0757	-0.1258	-0.1279	1		
GCFC	0.2323	-0.1227	0.0359	-0.1545	0.0725	-0.0912	1	
LAB	-0.0455	0.1030	0.0481	0.0587	-0.0451	0.2613	0.2231	1

Source: Author's Computation, 2025.

Table 4 presents the Augmented Dickey-Fuller (ADF) unit root test results for all the variables employed in the study. The results indicate that each variable is stationary at level, as their ADF statistics are significant at the 1% and 5% levels. This implies that the series are integrated of order zero, I (0), meaning their mean and variance remain constant over time and that they revert to equilibrium after short-term shocks. This is methodologically significant because it justifies the use of the Ordinary Least Squares (OLS) model for this study, which can accommodate variables that are I (0). Thus, the underlying time series characteristics do not pose any risk of spurious regression, and all estimated relationships can be interpreted reliably.

Table 4: Unit root test results.

Augmented Dickey-Fuller (ADF)			
Variable	**Level**	**1st Difference**	**Remark**
IP	-6.106603***	-8.002980***	**I(0)**
PPP	-3.592942***	-4.175573**	**I(0)**
FPF	-7.619833***	-------	**I(0)**
GDP	-6.587737***	-------	**I(0)**
INFL	-7.279447***	-------	**I(0)**
GCFC	-7.112820***	-------	**I(0)**
LAB	-9.402663***	--------	**I(0)**

*** and ** represent significance levels at 1% and 5%, respectively.

Table 5 presents the results of the Ordinary Least Squares (OLS) regression analysis. The intercept (C) is positive and statistically significant at the 1% level, indicating a strong underlying level of industrial productivity even when all the explanatory variables are held constant at zero.

The results further show that petrol pump price (PPP), food price volatility (FPV), and labour (LAB) all have negative but statistically insignificant effects on industrial productivity. The negative coefficient of petrol pump price suggests that increases in fuel prices tend to reduce industrial productivity, likely because higher fuel costs raise production and transportation expenses for firms. Similarly, the negative effect of food price volatility implies that unstable or rising food prices may indirectly weaken industrial performance by increasing workers' cost of living and reducing purchasing power. Labour also shows a negative relationship with industrial productivity, indicating that labour input does not significantly explain changes in productivity within this model specification. This may reflect labour inefficiency, underemployment, or structural challenges in the industrial sector.

Inflation (INFL), however, has a negative and statistically significant effect on industrial productivity. This suggests that rising inflation adversely affects industrial output by increasing production costs and creating macroeconomic instability. GDP has a positive but statistically insignificant relationship with industrial productivity, implying that short-run changes in economic growth do not significantly influence industrial output within the context of this model. Gross Capital Formation (GCF) exerts a positive effect and is marginally significant at the 10% level, indicating that increased investment in capital projects, infrastructure, and productive assets may contribute positively to industrial performance.

The R-squared value of 0.231458 indicates that about 23.1% of the variation in industrial productivity is explained by the independent variables included in the model. The adjusted R-squared value of 0.1101 further suggests that the overall explanatory power of the model is relatively weak after adjusting for the number of explanatory variables. In addition, the F-statistic of 1.907378, with a probability value of 0.104750, shows that the explanatory variables are not jointly significant at the conventional 5% significance level. This means that, collectively, the variables do not strongly explain variations in industrial productivity.
The Durbin-Watson statistic of 1.9017 is close to 2, indicating little or no evidence of autocorrelation in the residuals, which supports the reliability of the model estimates. Overall, the findings identify inflation as the major significant factor negatively affecting industrial productivity, while other important policy-related variables such as fuel subsidy reform and food price volatility are not statistically significant in this static linear framework. The relatively low explanatory power of the model suggests that some important variables may have been omitted or that industrial productivity is influenced by more dynamic relationships that cannot be fully captured by the OLS approach. Consequently, more advanced econometric techniques such as VECM or regime-switching models may provide deeper insight into both the short-run and long-run relationships among the variables.

The Panel C section concludes with the post-estimation diagnostic tests carried out to examine the validity and reliability of the estimated model. These tests are important because they help determine whether the model satisfies the assumptions underlying regression analysis and whether the results are suitable for policy recommendations. Based on the reported probability values, the study fails to reject the null hypotheses of homoskedasticity and absence of serial correlation. This indicates that there is no significant evidence of heteroskedasticity or autocorrelation in the model. Furthermore, the study also fails to reject the null hypothesis of normality, implying that the residuals are approximately normally distributed. Taken together, these diagnostic results suggest that the model is statistically reliable and appropriate for inference.

Table 5: Ordinary Least Squares

Panel A:				
Variable	**Coefficient**	**Std. Error**	**t-Stat**	**Probability**
C	4.971238	1.077289	4.614583	0.0000
PPP	-0.027230	0.021213	-1.283614	0.2070
FPV	-0.077461	0.058780	-1.317825	0.1955

$INFL$	-0.096738	0.046524	-2.079312	0.0444
GDP	0.044578	0.060473	0.737162	0.4656
GCF	0.253653	0.136314	1.860804	0.0705
LAB	-0.191804	0.286053	-0.670518	0.5066
Panel B:				
Variable	**Coefficient**			
R-squared	0.231458			
Adj. R-squared	0.110109			
F-statistic	1.907378			
Prob(F-statistic)	0.104750			
Durb − Wat stat	1.901715			

Panel C: Diagnostic test	**Statistic**	**Prob**
Heteroskedasticity Test	0.412491	0.8661
Serial Correlation LM Test	1.138528	0.3316
Normality Test	1.036953	0.5954

Source: Author's Computation, 2026

Note: ***, **, and * represents statistical significance at 1%, 5%, and 10%, respectively.

Table 6 below presents the results of the two-regime switching regression model, which indicates that the relationship between industrial productivity (IP) and the explanatory variables changes across two different economic conditions in Nigeria between 1980 and 2025. Regime 1 appears to reflect a relatively stable economic environment, as most of the coefficients are moderate and economically meaningful.

The coefficient of petrol pump price (PPP = -0.0248) shows that increases in fuel prices slightly reduce industrial productivity. This suggests that higher fuel costs raise production and transportation expenses for firms, thereby reducing industrial output. Food Price Volatility (FPV = -0.0804) also exerts a negative effect on industrial productivity. This implies that instability in food prices increases the cost of living for workers and weakens their purchasing power, which may indirectly reduce labour efficiency and industrial performance. The Fuel Subsidy Reform Dummy (FSRD = -0.0419) has a mild negative impact on industrial productivity in this regime. This indicates that subsidy removal may initially increase operational and energy costs for industries, thereby slowing productivity in the short run.

Economic growth (GDP = 0.0351) positively influences industrial productivity, suggesting that improvements in economic activities stimulate investment, demand, and industrial expansion. Inflation (INFL = -0.0983), however, negatively affects industrial productivity, indicating that rising prices increase production costs and create macroeconomic uncertainty for firms. Gross Fixed Capital Formation (GCFC = 0.2480) has a positive effect on industrial productivity, implying that investment in infrastructure, machinery, and other productive assets contributes significantly to industrial growth and efficiency. Labour (LAB = -0.1731) carries a negative coefficient, suggesting that increases in labour input do not necessarily translate into higher productivity. This may reflect labour inefficiency, underemployment, low skill levels, or structural challenges within Nigeria's industrial sector.

Regime 2 represents a more unstable or crisis-prone economic condition, as reflected in the unusually large and volatile coefficients. In this regime, petrol pump price (PPP = -53.668) has an extremely strong negative effect on industrial productivity, implying that industries become highly vulnerable to fuel price shocks during periods of instability. Inflation (INFL = -12.185) also severely reduces industrial productivity, suggesting that periods of high inflation create serious macroeconomic instability, increase production costs, and weaken industrial performance.

Unlike Regime 1, Gross Fixed Capital Formation (GCFC = -19.145) negatively affects industrial productivity in this regime. This may imply that investments become inefficient during crisis periods due to poor utilization of capital projects, economic uncertainty, or reduced returns on investment. Labour (LAB = -27.718) also exerts a strong negative effect on industrial productivity. This could be linked to declining labour efficiency, industrial layoffs, skill mismatches, or distortions within the labour market during unstable economic periods. Interestingly, the Fuel Subsidy Reform Dummy (FSRD = 0.0455) becomes positive in Regime 2. This suggests that under unstable conditions, subsidy reforms may improve fiscal sustainability, enhance resource allocation, or encourage more efficient energy use within the economy.

The Regime Transition Probability parameter (P1-C = 114.2402) is abnormally large, indicating possible estimation instability or convergence problems in the model. As a result, the transition probabilities should be interpreted with caution and not relied upon heavily for policy conclusions. The Durbin-Watson statistic of approximately 1.95 suggests little evidence of autocorrelation in the residuals. In addition, the relatively high log-likelihood value and negative Akaike Information Criterion (AIC) indicate that the regime-switching model provides a better fit than a simple linear regression model.

Overall, the findings suggest that industrial productivity in Nigeria responds differently under varying economic conditions. During stable periods (Regime 1), macroeconomic variables have moderate and more predictable effects on industrial productivity. However, during unstable periods (Regime 2), factors such as petrol price increases and inflation become highly damaging to industrial performance. While fuel subsidy reform may generate short-run adjustment costs, it could also produce positive outcomes under certain macroeconomic conditions.

Nevertheless, the presence of singular covariance and the absence of identifiable standard errors point to instability in parameter estimation. Therefore, the results should be interpreted cautiously and viewed mainly as evidence of possible regime-dependent relationships rather than conclusive statistical proof.

Table 6: Simple Switching Regression

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
PPP	-0.024811			
FPV	-0.080371			
FSRD	-0.041937			
GDP	0.035079			

INFL	-0.098268			
GCFC	0.248027			
LAB	-0.173104			
C	4.929665			
Regime 2				
PPP	-53.66819			
FPV	-0.013845			
FSRD	0.045476			
GDP	0.167075			
INFL	-12.18519			
C	-19.14503			
LAB	-27.71822			
C	-1.294990			
Common				
LOG(SIGMA)	-2.083403			
Probabilities Parameters				
P1-C	114.2402	NA	NA	NA
Mean dependent var	4.560582	S.D. dependent var		0.144276
S.E. of regression	0.156806	Sum squared resid		0.713057
Durbin-Watson stat	1.947552	Log likelihood		30.56604
Akaike info criterion	-0.546350	Schwarz criterion		0.169206
Hannan-Quinn criterion	-0.278298			

Source: Author's Computation, 2026

Table 7 presents the results of the Pairwise Granger Causality Test, which examines whether the past values of one variable can be used to predict another. The decision is based on the probability value (p-value), where a value less than 0.05 indicates significant causality at the 5% level, while values below 0.10 indicate weak or marginal significance.

Panel A shows the causality relationship between petrol pump price (PPP) and industrial productivity (IP). The result indicates that the null hypothesis that PPP does not Granger-cause IP has a probability value of 0.0806. Although this is not statistically significant at the 5% level, it is significant at the 10% level, suggesting weak evidence that changes in petrol pump prices can predict industrial productivity in Nigeria. This implies that fluctuations in petrol prices may have a mild influence on industrial performance. Conversely, the null hypothesis that IP does not Granger-cause PPP has a probability value of 0.0074, which is statistically significant at the 1% level. This indicates that industrial productivity significantly predicts changes in petrol pump prices. Therefore, a unidirectional causality exists from industrial productivity to petrol pump price. Economically, this suggests that changes in industrial activities may affect energy demand and market conditions, thereby influencing petrol pricing dynamics.

Panel B presents the causality relationship between food price volatility (FPV) and industrial productivity (IP). The null hypothesis that FPV does not Granger-cause IP has a probability value of 0.0578. While this is insignificant at the 5% level, it is significant at the 10% level, indicating weak evidence that food price volatility predicts industrial productivity. This suggests that instability in food prices may indirectly affect industrial output through rising production costs, inflationary pressure, or reduced consumer purchasing power. However, the null hypothesis that IP does not Granger-cause FPV has a probability value of 0.9467, which is highly insignificant. This means that industrial productivity does not significantly predict food price volatility. Overall, the result reveals a weak unidirectional causality running from food price volatility to industrial productivity.

Panel C further shows that there is no causal relationship between food price volatility and petrol pump price. The null hypothesis that FPV does not Granger-cause PPP has a probability value of 0.1621, while the null hypothesis that PPP does not Granger-cause FPV has a probability value of 0.9037. Since both values are greater than 0.05 and 0.10, the results indicate the absence of causality between the two variables. This implies that past changes in food price volatility do not significantly predict petrol pump prices, and petrol pump prices also do not significantly predict food price volatility during the study period.

Table 7: The result of direction of causality among petrol pump price, food price volatility and industrial productivity in Nigeria.

	W-stat	Prob	Remarks
A: The Petrol Pump Price and Industrial Productivity			
$PPP \nRightarrow IP$	2.68846*	0.0806	
$IP \nRightarrow PPP$	5.57168***	0.0074	Bidirectional causality
B: Food Price Volatility and Industrial Productivity			
$FPV \nRightarrow IP$	3.07019*	0.0578	
$IP \nRightarrow FPV$	0.05489	0.9467	Uni-directional causality
A: Food Price Volatility and Petrol Pump Price			
$FPV \nRightarrow PPP$	1.90697	0.1621	
$PPP \nRightarrow FPV$	0.10148	0.9037	No-directional causality

Source: Author's Computation, 2026

Note: ***, ** and* represent statistical significance at 1%, 5%, and 10%, respectively.

$\nRightarrow$ represents homogeneous Granger causality

The findings of this study are generally consistent with previous empirical studies on the relationship between fuel prices, food price volatility, and industrial productivity in developing countries, especially Nigeria.

The OLS results showed that petrol pump price (PPP) and food price volatility (FPV) have negative effects on industrial productivity. This finding is in line with the studies of Adenikinju and Oriakhi, who observed that increases in energy prices negatively affect manufacturing output and industrial performance in Nigeria due to rising production and transportation costs. According to their studies, higher fuel prices increase the operating costs of firms, reduce profitability, and weaken productive activities, particularly in sectors that rely heavily on energy. In the same vein, the result agrees with the findings of Iwayemi, who argued that fuel-price increases and subsidy reforms contribute to inflationary pressures capable of slowing industrial growth.

The negative impact of food price volatility on industrial productivity also supports the findings of Abdulai and Cudjoe, who found that instability in food prices negatively affects economic productivity through reduced purchasing power, higher labour demands, and increased inflationary pressure on firms. This implies that persistent fluctuations in food prices create uncertainty in the economy and weaken the performance of productive sectors.

The regime-switching regression results further revealed that the effects of petrol pump prices and food price volatility vary across different economic regimes. This finding is consistent with studies that applied nonlinear or regime-dependent models in analyzing macroeconomic relationships. For example, Hamilton found that oil-price shocks have asymmetric effects on economic performance, especially during periods of economic instability. Similarly, Sims argued that macroeconomic variables often behave differently during periods of economic expansion and contraction, suggesting that the effect of fuel-price reforms may change depending on prevailing economic conditions.

In addition, the Granger causality result showing that industrial productivity significantly predicts petrol pump price agrees with studies emphasizing the relationship between industrial demand and energy pricing. The study by Akinlo found that increased industrial activities tend to raise energy demand, thereby influencing fuel consumption and pricing dynamics. However, the weak causality running from petrol pump price to industrial productivity differs slightly from some earlier studies that reported a stronger causal relationship between fuel prices and industrial output. This variation may be due to differences in methodology, study period, or the structure of the Nigerian economy during the period under review.

Furthermore, the finding that food price volatility weakly Granger-causes industrial productivity supports the work of Babatunde, who noted that food inflation can indirectly affect industrial output through rising living costs and wage pressures. However, the absence of causality between food price volatility and petrol pump price contradicts some previous studies that found strong transmission effects between energy prices and food inflation. This difference may be attributed to the influence of other macroeconomic factors such as exchange-rate fluctuations, import dependence, and government policy interventions during the study period.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study examined the effect of fuel-subsidy reform on industrial productivity in Nigeria using petrol pump price, food price volatility, and labour as explanatory variables. Employing the Ordinary Least Squares (OLS), Two-Regime Switching Regression Model, and Pairwise Granger Causality Test, the study found that petrol pump price and food price volatility negatively affect industrial productivity. The results further revealed that the impact of these variables differs across economic regimes, indicating that periods of economic instability intensify the adverse effects of fuel-price increases on industrial performance. The Granger causality results also showed evidence of unidirectional causality among some of the variables, particularly from industrial productivity to petrol pump price and from food price volatility to industrial productivity. Overall, the study concludes that fuel-subsidy reforms, though important for fiscal sustainability, generate inflationary pressures and increased production costs that can weaken industrial productivity in Nigeria.

Recommendations

Based on the findings, the study recommends that the government should implement gradual and well-managed fuel-price reforms to reduce shocks on industries. Efforts should also be made to improve the electricity supply and invest in alternative energy sources in order to reduce industrial dependence on petroleum products. In addition, policies aimed at stabilizing food prices through increased agricultural investment and improved supply systems should be strengthened. The government should further provide support for industries through tax incentives, credit facilities, and infrastructural development to cushion the adverse effects of rising fuel prices and enhance industrial productivity in Nigeria.

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