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Review Paper

Statistical Evaluation of the Effect of Fuel Subsidy Removal on Nigeria's Economic Indicators

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ABSTRACT
The removal of fuel subsidies in Nigeria has long been a contentious economic and political issue, with widespread implications for macroeconomic stability. This study investigates the impact of subsidy removal on key economic indicators, namely Real Gross Domestic Product (RGDP), Headline Inflation Rate (HIR), Average Exchange Rate (AER), and Foreign Direct Investment (FDI), using quarterly data spanning from 2012 to 2023. Secondary data were obtained from the Central Bank of Nigeria and the National Bureau of Statistics. The analysis employed time series techniques—including ARIMA modeling, decomposition methods, the Augmented Dickey-Fuller (ADF) test, Granger causality test, and the Chow structural break test—to evaluate trends, stationarity, causality, and policy impacts.The results reveal significant changes in economic indicators following the subsidy removal, including a sharp rise in inflation and exchange rates, as well as a statistically significant structural break in Q1 2023. While FDI showed increased volatility, RGDP reflected potential long-term growth benefits. The findings underscore the complex trade-offs involved in subsidy reforms and provide actionable policy recommendations centered on inflation control, policy consistency, economic diversification, and infrastructure investment. The study offers timely insights for policymakers aiming to balance fiscal sustainability with equitable economic development.

Keywords: *Fuel subsidy, Economic indicators, Nigeria, Structural break, RGDP, Inflation, Exchange rate, FDI, Time series analysis.*

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I. INTRODUCTION

The issue of fuel subsidy removal in Nigeria has emerged as one of the most hotly debated economic policy shifts in the nation's contemporary history. For decades, the Nigerian government maintained fuel subsidies to cushion the effect of volatile global oil prices and to make petroleum products more affordable for the population. While initially conceived as a temporary relief measure during oil price shocks in the 1970s, these subsidies evolved into a permanent feature of Nigeria's fiscal landscape, consuming billions of dollars annually and contributing significantly to the nation's budgetary imbalance. The subsidy structure has created distortions in the oil and gas market, reduced the competitiveness of the downstream sector, and discouraged private investment. Despite these drawbacks, the subsidies were politically sensitive and widely viewed as a social welfare tool, particularly by low- and middle-income households who depended on cheap fuel for transport and energy.

Over the years, however, the financial burden of sustaining fuel subsidies became unsustainable, with reports suggesting expenditures exceeding $13 billion in 2011 alone. The economic rationale for subsidy reform gained renewed momentum as corruption, inefficiencies, and smuggling activities further compounded fiscal leakages. Successive administrations attempted to implement partial or full subsidy removals, often encountering widespread resistance and public protests, such as the "Occupy Nigeria" movement in 2012. Although efforts were made to restructure subsidy regimes and reduce costs, political considerations often led to reversals or compromises that undermined the long-term benefits of reform.

In 2023, the administration of President Bola Ahmed Tinubu announced the complete removal of fuel subsidies as part of broader economic restructuring efforts. This decisive move was met with mixed reactions. On one hand, it was praised by economists and international financial institutions as a necessary step toward restoring fiscal balance, promoting investment in critical sectors, and fostering macroeconomic stability. On the other hand, it led to immediate inflationary pressures, increased transportation costs, reduced household purchasing power, and heightened concerns over rising poverty levels. These consequences triggered calls for the government to introduce robust social safety nets and compensatory measures to protect vulnerable populations during the transition period.

The economic implications of subsidy removal extend beyond short-term inflation and price adjustments. Key macroeconomic indicators—such as the Real Gross Domestic Product (RGDP), Headline Inflation Rate (HIR), Average Exchange Rate (AER), and Foreign Direct Investment (FDI)—are critical measures of the policy's impact on the broader economy. Understanding the behaviour of these indicators in response to subsidy removal is essential for policymakers, economists, and investors in evaluating the success or failure of the reform and for guiding future policy decisions.

This study is therefore a comprehensive empirical investigation into the effects of fuel subsidy removal on Nigeria's economic indicators from 2012 to 2023. It adopts a time series approach, applying econometric models such as the Augmented Dickey-Fuller test, Granger causality analysis, and the Chow test for structural breaks. The aim is to determine whether and how the removal of subsidies has influenced economic growth, inflation, exchange rates, and foreign capital inflows over the study period. Through rigorous analysis of secondary data obtained from credible sources such as the Central Bank of Nigeria and the National Bureau of Statistics, this research seeks to isolate the causal impacts of policy change and identify any structural shifts in the economy.

Ultimately, the findings of this study are intended to contribute meaningfully to the ongoing debate about fuel subsidy reforms in Nigeria. By providing evidence-based insights into the consequences of subsidy removal on macroeconomic stability, the study hopes to inform future policy frameworks that prioritize economic efficiency while ensuring equitable outcomes. It underscores the importance of well-calibrated reform strategies that balance fiscal prudence with social welfare, particularly in a nation where economic vulnerabilities and public trust are critical variables in the success of large-scale policy shifts.

II. Literature Review

The removal of fuel subsidies has long been a critical issue in Nigeria, drawing extensive scholarly attention due to its far-reaching economic and social implications. Numerous studies have explored the theoretical, conceptual, and empirical underpinnings of subsidy regimes, their economic distortions, and the outcomes of reform. Fuel subsidies are widely acknowledged to be a form of economic intervention aimed at making energy more affordable. However, they also create market inefficiencies and contribute to fiscal imbalances. Theoretical perspectives such as welfare economics posit that while subsidies aim to improve social welfare, their benefits are often disproportionately skewed toward higher-income groups who consume more fuel. This misallocation of public funds undermines equity objectives and reduces the fiscal space for investment in pro-poor sectors like healthcare and education.

Adefolaju, (2019) the removal of fuel subsidy in Nigeria presents both significant challenges and long-term economic prospects. While the immediate aftermath includes increased cost of living and heightened public discontent, the policy holds potential for fiscal sustainability, reduced corruption, and improved investment in infrastructure and social services. To harness these benefits, the government must implement transparent, equitable reinvestment strategies and engage in effective public communication to build trust and ensure inclusive development.

From a behavioural standpoint, the resistance to fuel subsidy reforms is tied to the psychological framing of losses and gains. According to prospect theory, individuals are more sensitive to losses (higher fuel prices) than to potential future gains (better infrastructure or public services). Historical evidence in Nigeria, including the Occupy Nigeria protests of 2012, underscores how subsidy removals often trigger mass dissent if not accompanied by adequate social compensation. Empirical research shows mixed results; while subsidy removal is associated with increased government revenues and reduced corruption, it can also result in immediate inflationary pressures and reduced household purchasing power. For example, Jaffe and Stavins (1994) found that transparent, market-driven energy pricing can boost FDI by improving investor confidence. Conversely, Coady et al. (2010) highlighted that abrupt subsidy removal exacerbates poverty, especially when compensatory mechanisms are weak or poorly executed. Agbede, M. O., & Aigbiremolen, M. O. (2018), Fuel subsidies in Nigeria have historically served as a means to cushion the impact of rising energy costs on consumers, but their long-term effect on the economy has been largely detrimental. The policy has encouraged fiscal indiscipline, distorted market dynamics, and created significant opportunities for corruption and

inefficiency. Ultimately, the continuation of fuel subsidies undermines economic sustainability by diverting critical resources away from productive sectors such as education, health, and infrastructure.

The Nigerian experience reflects a cyclical struggle between economic necessity and political feasibility. The 2012 and 2016 subsidy reform efforts were met with intense public backlash, which forced the government to partially reinstate the subsidies. The complete removal in 2023 under President Bola Tinubu's administration, though lauded by economic experts, triggered immediate inflation and sparked renewed debates on the adequacy of Nigeria's social safety nets. Literature also emphasizes the structural implications of subsidy removal. Time series and econometric analyses show that changes in RGDP, inflation, exchange rates, and FDI closely follow major fuel price adjustments. Burniaux and Chateau (2011) argue that subsidy removals can enhance long-term economic efficiency, but only when supported by targeted investments and transparent governance structures.

Empirical frameworks further explore sector-specific consequences. Studies such as David et al. (2024) using a Vector Error Correction Model (VECM), reveal a negative but statistically significant relationship between fuel subsidy expenditure and GDP growth. Meanwhile, Garba (2023) presents a historical narrative that captures the oscillation between reform attempts and reversals, revealing deep-rooted public distrust in government initiatives. The literature also explores poverty and social impact analyses (PSIA), which show that removing subsidies without direct transfers or welfare interventions exacerbates inequality and urban-rural disparities. Recommendations from scholars like Farouk (2024) call for inclusive palliative strategies involving civil society, community leaders, and independent stakeholders to ensure transparency and build public trust. Conceptually, studies favour multi-dimensional models that incorporate fiscal, macroeconomic, and distributional outcomes. Clements et al. (2013) argue that while fuel subsidy removal is a necessary condition for macroeconomic stability, its sufficiency hinges on how savings are redirected. Public communication, accountability, and phased implementation are critical factors in managing reform risks. Literature also emphasizes international comparisons; nations like Indonesia and Ghana successfully navigated subsidy reforms through structured compensatory frameworks, gradual implementation, and consistent public engagement. Ezeani, E. O., & Nwaneri, J. N. (2022) state that the history of fuel subsidy in Nigeria is marked by recurring cycles of government attempts at removal and consequent public resistance. Subsidy withdrawal has often triggered widespread protests and civil unrest, driven by the perception that such policies disproportionately affect the poor while benefiting political elites. These reactions underscore the deep-seated mistrust between citizens and the state and highlight the need for inclusive policy dialogue, transparency, and effective communication when implementing economic reforms. In conclusion, the literature reveals that while fuel subsidy removal is economically justifiable, its success is contingent upon political will, institutional capacity, and the implementation of inclusive, transparent, and compensatory policies. Policymakers are urged to design reforms that are socially sensitive and supported by robust empirical analysis to anticipate and mitigate adverse outcomes. By integrating economic theory, empirical data, and stakeholder perspectives, effective subsidy reforms can promote fiscal sustainability and inclusive development in Nigeria.

Goodness (2024) states that the removal of fuel subsidies by the Nigerian government has had profound macroeconomic implications, including increased inflation, higher transportation costs, and reduced consumer purchasing power. While the policy aims to improve fiscal balance and redirect public funds to more productive uses, its immediate impact has placed significant strain on low- and middle-income households. A data-driven approach reveals the urgent need for targeted palliative measures, social safety nets, and transparent reinvestment strategies to mitigate the adverse effects on vulnerable populations.

III. METHODOLOGY

This study adopted an ex post facto research design, which is appropriate for analyzing events or phenomena that have already occurred. This non-experimental design allows for the examination of historical data to explore relationships among variables without manipulation. It was chosen to investigate the aftereffects of subsidy removal on Nigeria's macroeconomic indicators by relying solely on observed data trends over time.

The research utilized secondary data sourced from reliable and publicly available datasets including the Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS), United Nations Conference on Trade and Development (UNCTAD), Trading Economics, Statista, and the Nigerian Economic Summit Group (NESG). The dataset comprised quarterly data from 2012 to 2023 covering RGDP, HIR, AER, and FDI.

A combination of descriptive and inferential statistics was used. Nwafor *et al* (2025), the selection of statistical techniques is based on the characteristics of the collected data and questionnaire design, as well as the goal of the scientific inquiry. Descriptive statistics provided an overview of the central tendency and dispersion of the data. The inferential approach, specifically time series analysis, was employed to model the temporal dynamics and structural behavior of macroeconomic indicators.

Time series modeling helps detect trends, seasonal variations, and cyclical movements. Nwafor (2016) The VAR residual portmanteau tests for autocorrelations checks the null hypothesis that all residual autocovariances are zero and thus achieves model adequacy. The data was analyzed using both additive and multiplicative decomposition models, defined as:

$$Additive: Y(t) = T(t) + S(t) + C(t) + R(t)$$
$$Multiplicative: Y(t) = T(t) \times S(t) \times C(t) \times R(t)$$
$$Where\ T(t) = Trend, S(t) = Seasonal\ Component, C(t) = Cyclical\ Component, R(t) = \frac{Random}{Irregular} Component.$$

The Augmented Dickey − Fuller (ADF)test was used to verify the stationarity of each time series. A stationary series has a constant mean and variance over time, a prerequisite for most time series analyses.

$$The\ general\ ADF\ test\ equation\ is:$$
$$\Delta y_t = \alpha + \beta t + \varphi y_{t-1} + \Sigma \gamma_i \Delta y_{t-i} + \varepsilon_t$$

The decision rule is to reject the null hypothesis (H_0) if the ADF statistic is less than the critical value or if the p-value is less than 0.05, indicating that the series is stationary.

Granger causality testing was conducted to determine if one variable statistically predicts another. It assesses predictive causality. Two models are estimated: a restricted model without the predictor and an unrestricted model with the predictor. If the p-value is less than 0.05, the null hypothesis is rejected, indicating predictive causality.

The Chow test was applied to determine whether the fuel subsidy removal introduced a structural change in the model, particularly at Q1 2023.
The F-statistic formula used is:

$$F = [(RSS\_T - (RSS_1 + RSS_2))/k] / [(RSS_1 + RSS_2)/(n_1 + n_2 - 2k)]$$

Where RSS_T is the residual sum of squares for the full model, RSS_1 and RSS_2 are the RSS for sub-periods, k is the number of estimated parameters, and n_1 and n_2 are the number of observations in each period. A significant F-statistic or p-value less than 0.05 indicates a structural break, affirming that the subsidy removal altered economic relationships among the studied variables.

By employing a robust methodology that integrates stationarity checks, causality testing, decomposition analysis, and structural break identification, the study is well-equipped to provide evidence-based insights into the macroeconomic implications of fuel subsidy removal in Nigeria. This approach ensures that findings are grounded in rigorous statistical analysis and capable of informing sound economic policymaking.

IV. RESULTS

The analysis of Nigeria's macroeconomic indicators between 2012 and 2023 reveals critical insights into the economic effects of fuel subsidy removal. Descriptive statistics of the Real Gross Domestic Product (RGDP), Headline Inflation Rate (HIR), Average Exchange Rate (AER), and Foreign Direct Investment (FDI) show that all variables exhibit positive skewness and moderate to high kurtosis. Specifically, the mean RGDP was ₦17,305.58 billion, while HIR, AER, and FDI had mean values of 13.91%, ₦303.47, and $1,198.11 million, respectively. FDI displayed the highest level of variability with a standard deviation of $1,971.69 million, suggesting extreme volatility in foreign investments over the study period. Additionally, the skewness and kurtosis measures suggest the presence of outliers, especially in FDI, which was further confirmed by its significantly larger gap between the mean and median values.

Time series plots of these indicators from 2012 to 2023 indicate marked fluctuations around 2023, the year of full fuel subsidy removal. Notably, RGDP increased significantly in Q4 2023, a trend possibly driven by redirected fiscal spending and infrastructure investment. HIR showed a moderate rise in 2016 and 2021, both linked to subsidy reform attempts, but rose sharply in Q4 2023 following the full removal of subsidies, likely due to increased transportation and production costs. AER recorded significant depreciation of the Naira during the same quarter, reflecting the pressures of inflation and reduced confidence in the currency. Meanwhile, FDI declined markedly in the third and fourth quarters of 2023, pointing to investor caution amid economic uncertainty and exchange rate volatility.

Stationarity of the time series was assessed using the Augmented Dickey-Fuller (ADF) test. All variables (RGDP, HIR, AER, FDI) were found to be non-stationary at level but stationary at first difference, indicating that each series is integrated of order one, I(1). This outcome validates the application of differencing in further time series modeling and suggests that macroeconomic shocks, such as fuel subsidy removal, have lasting impacts on these variables.

Granger causality tests were employed to identify predictive relationships between the variables. The results revealed unidirectional causality from HIR to RGDP and a bidirectional relationship between AER and RGDP. These findings suggest that inflation and exchange rate dynamics play a significant role in driving economic output and vice versa. However, no significant causality was observed between FDI and the other indicators, indicating that foreign investment inflows may be influenced by factors outside the immediate macroeconomic environment such as political stability, investor confidence, and global capital market trends.

The Chow test was then applied to evaluate whether the structural relationship between the variables changed significantly after subsidy removal in Q1 2023. The test produced an F-statistic of 6.71 with a p-value of 0.0008, providing strong evidence of a structural break. This means that the economic relationships among RGDP, HIR, AER, and FDI experienced a significant shift post-subsidy removal, confirming that the reform acted as a policy shock with measurable economic consequences.

In summary, the analysis shows that Nigeria's fuel subsidy removal had a profound and multi-dimensional impact on key macroeconomic indicators. The rise in inflation and exchange rate instability, alongside the decline in FDI, highlight the short-term challenges associated with the policy shift. At the same time, the rise in RGDP suggests potential for longer-term gains if fiscal resources are effectively reallocated. These results underscore the importance of complementary policies—such as inflation control, foreign exchange stabilization, and investment-friendly reforms—to maximize the benefits of subsidy removal and safeguard economic stability.

V. CONCLUSION

This study set out to evaluate the economic implications of fuel subsidy removal on Nigeria's key macroeconomic indicators—specifically Real Gross Domestic Product (RGDP), Headline Inflation Rate (HIR), Average Exchange Rate (AER), and Foreign Direct Investment (FDI)—over the period 2012 to 2023. By employing robust econometric techniques such as the Augmented Dickey-Fuller (ADF) test, Granger causality analysis, and the Chow structural break test, the study provided empirical insights into how this major policy reform reshaped Nigeria's economic dynamics.

The findings revealed that subsidy removal had immediate and significant impacts on several economic indicators. Inflation surged following the removal, driven by elevated costs of fuel, transportation, and goods and services. The exchange rate experienced substantial depreciation, reflecting weakened purchasing power and confidence in the local currency. Meanwhile, FDI showed a marked decline in the latter part of 2023, suggesting heightened investor caution in the wake of policy uncertainty and macroeconomic instability. The Chow test confirmed a structural break in Q1 2023, indicating that the subsidy removal fundamentally altered the relationships between RGDP and the other variables.

Despite these short-term economic shocks, the data also revealed an upward movement in RGDP in the final quarter of 2023. This suggests that the fiscal space created by ending subsidies may have enabled increased government investment in productive sectors, potentially offsetting some of the negative consequences. The Granger causality analysis further confirmed the critical interdependence of macroeconomic variables, particularly the influence of inflation and exchange rate on economic growth.

These findings reinforce the notion that while subsidy removal is fiscally necessary, its success hinges on the government's ability to implement accompanying policies that mitigate its adverse effects. Countries that have successfully navigated similar reforms—such as Indonesia and Ghana—did so through the introduction of targeted social safety nets, transparent policy communication, and phased implementation strategies. Nigeria's experience suggests that an abrupt removal without adequate public cushioning mechanisms can lead to significant social and economic stress, eroding public trust and limiting policy effectiveness.

Moving forward, the government must prioritize transparency, accountability, and inclusivity in the redistribution of subsidy savings. Targeted investments in infrastructure, healthcare, education, and job creation can ensure that the fiscal gains from subsidy removal yield tangible benefits for the population. Additionally, strengthening institutional frameworks, enhancing data quality for policymaking, and maintaining macroeconomic stability will be critical in attracting foreign investment and stimulating long-term economic growth.

In conclusion, the removal of fuel subsidies in Nigeria is a pivotal economic reform with both challenges and opportunities. Its impact on inflation, exchange rate, and investment inflows underscores the importance of well-coordinated monetary and fiscal responses. While the structural break detected in 2023 represents a significant shift in economic trajectory, it also opens a window for a new economic order—one

driven by efficiency, diversification, and sustainability. The onus now lies with policymakers to harness this opportunity and guide Nigeria toward a more resilient and inclusive economic future.

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