

Research Article

# The Bread and Butter: An Impact Analysis of Petroleum Prices on Households in Sierra Leone

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## Abstract

This study analyzes the impact of petroleum price fluctuations on households in Sierra Leone amidst the economic realities faced by families due to persistent rising fuel costs. Sierra Leone's petroleum market, highly dependent on imports, has been subject to price volatility driven by international market trends and exchange rate fluctuations. The government regulates fuel prices through the Petroleum Regulatory Agency (PRA) to prevent extreme volatility, yet external economic pressures continue to impact the affordability of fuel. Given the essential role of petroleum in transportation, electricity, industrial, and economic activities, price increases have a ripple effect on the cost of food and other essential commodities, aggravating household poverty and malnutrition. This research utilizes econometric models, including the Ordinary Least Squares (OLS) and Autoregressive Distributed Lag (ARDL) models, to assess how fuel price changes influence household consumption and agricultural pricing. It also examines the role of taxation policies and government regulations on fuel prices, evaluating their impact on both market dynamics and household economic stability. The study draws upon consumption theories such as the Permanent Income Hypothesis, the Life Cycle Hypothesis, and the Relative Income Hypothesis to provide a theoretical framework for understanding the socio-economic consequences of fuel price fluctuations. The paper analyzed key macroeconomic data alongside household-level spending patterns, the study provides a measurable understanding of the long-term effects of petroleum prices on Sierra Leonean households, particularly in the context of an economy recovering from past crises. The findings show a marginal correlation between fuel price regulation, inflation, and household welfare, which will help the government mitigate the adverse effects of rising fuel costs on vulnerable populations.

## Keywords

Petroleum Prices, Household Economics, Fuel Price Volatility, Inflation Impact, Sierra Leone Economy, Household's Economic Well-being

## 1. Introduction

The phrase "bread and butter," as used in the title of this article, immediately conjures the authors' view of essential commodities; those fundamental elements on which people

rely for their daily sustenance. Traditionally employed to denote one's means of livelihood, this idiom underscores the necessities required for survival. In everyday language, both

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within and outside Sierra Leone, it symbolizes the indispensable items that support and stabilize a household's economic well-being. Similarly, according to Merriam-Webster [1] "bread and butter" refers not only to one's primary source of income but also to the fundamental aspects of daily life. In this study, the term is deliberately extended beyond the realm of income generation to encompass core commodities and services, such as food, transportation, and energy, that are important for maintaining a decent quality of life. It is submitted that these essentials, much like the literal pairing of bread and butter, form the basis of household stability and economic security.

Sierra Leone, a small and open economy in West Africa, boasts of a rich resource base and a diversified agricultural sector, with key exports including diamonds and agricultural products such as coffee and cocoa. Over the past few decades, however, the country has faced severe socio-economic challenges. Historical events, including prolonged civil conflict, the devastating Ebola epidemic, the COVID-19 pandemic, and more recently Mpox, have contributed to widespread poverty, weakened infrastructure, and institutional instability [2, 3]. Despite these adversities, Sierra Leone has demonstrated remarkable resilience, buoyed by a dynamic and youthful population. Over the last decade, for example, the annual population growth rate has averaged 3.6 percent, accompanied by a high age-dependency ratio that shows the urgent need for formal, well-paying jobs and youthful opportunities.

In recent years, the country has struggled with soaring fuel prices and escalating living costs, further compounding economic uncertainty. A significant portion of essential food commodities is transported within the country by road, rendering them highly sensitive to fluctuations in fuel prices. Government taxation policies and increased tollgate charges as increased by nearly 40 percent from its initial contract pricing have intensified the cost-of-living crisis, forcing households to reduce food quality and portion sizes, which in turn aggravates malnutrition and poverty. [3] Despite the fluctuating cost of fuel, petroleum remains one of the most regulated commodities in Sierra Leone as in many countries across sub-Saharan Africa. Recognizing its strategic importance in sustaining everyday life and economic activity, the government has instituted rigorous regulatory oversight through the Petroleum Regulatory Agency [4].

Sierra Leone's economy, while recording an average growth rate of around 5 percent over the last decade, has also been marked by significant volatility. Between 2019 and 2023, the standard deviation of real GDP growth reached 10.6 percent, reflecting the country's vulnerability to external shocks. Structural imbalances are evident: inflation averaged 45 percent in 2022, the exchange rate depreciated by 18 percent, and fiscal deficits have remained high. Infrastructural deficiencies further exacerbate these economic challenges, with only about 8 percent of roads paved and low rates of electricity and sanitation access contributing to persistent inefficiencies and

poverty [5].

Hopes for economic recovery rose following the end of the COVID-19 pandemic, with initial projections for 2022 growth at 5.9 percent; however, these were later revised downward to an average of 4.4 percent in the medium term (Statistics Sierra Leone, 2022). Global disruptions, including the Ukraine war, further complicated the situation by disrupting supply chains and triggering shortages and steep price hikes for essential commodities such as fuel, fertilizers, and wheat. [6] These shocks have placed additional strain on household consumption and investment capacities, intensifying the economic hardships faced by many Sierra Leonean families. The interplay between rising food and energy prices and poverty levels has attracted significant policy attention. Although higher prices might marginally benefit producers near the poverty line, they disproportionately affect consumers, particularly in a net-importing country like Sierra Leone, prompting both the government and development partners to explore compensatory measures for vulnerable populations. [7]

Against this backdrop, this study employs key econometric frameworks, namely, the triple bottom line and the multiplier effect, to assess how petroleum prices influence commodity costs, household investment capacity, and agricultural pricing in Sierra Leone. The study also critically examines the pricing policies and regulatory role of Sierra Leone's Petroleum Regulatory Agency to understand how its regulations interact with the market through clarifying the complex relationship between economic forces and policy measures with a focus on the "bread and butter" concerns that underpin the economic realities of households in Sierra Leone.

#### *Background of the Petroleum Market and Taxation in Sierra Leone*

Sierra Leone's petroleum market plays a central role in the country's economic stability, given its reliance on imported fuel for transportation, electricity generation, and industrial activities. Since the country lacks domestic refining capacity, all petroleum products, including gasoline, diesel, and kerosene, are imported, making the market highly susceptible to international price volatility and foreign exchange rate fluctuations [8].

In this all-important sector, the Petroleum Regulatory Agency (PRA) remains the key institution overseeing the petroleum sector as established under Section 2 of the Petroleum Regulatory Agency Act, 2014 as a body corporate. This Agency, under section 5 of the said Act, is responsible for ensuring a stable and transparent petroleum market through price regulation, supply monitoring, and enforcement of quality standards. Because of the said provision, the PRA's primary function is to set fuel prices based on a formula that incorporates several cost components, including the international benchmark price, shipping and logistics costs, import duties, government levies, and exchange rate fluctuations, thereby stabilizing domestic fuel prices while ensuring the sustainability of market operations. [9].

Despite fuel price fluctuations, petroleum remains one of

the most regulated commodities in Sierra Leone, as in many other sub-Saharan African nations. It is believed that the government, through the PRA, intervenes to prevent extreme price volatility that could negatively impact households and businesses [9]. However, private players also play a significant role in the petroleum market. Major international and local companies, including Total Energies, NP (National Petroleum), Malador Associates (SL) Ltd, and Leone Oil, dominate the importation, storage, distribution, and retail segments [10]. These companies operate under strict regulatory oversight to ensure compliance with pricing policies and supply chain integrity.

Consequently, the petroleum market in Sierra Leone remains a critical economic sector, with both public and private stakeholders working to maintain stable fuel supply and pricing. While government regulation through the PRA seeks to shield consumers from global oil price shocks, external economic pressures continue to challenge the affordability and accessibility of petroleum products. It could be argued that the correlation of regulatory policies, international price trends, and private sector dynamics eventually shapes the economic realities of Sierra Leonean households and businesses [11].

Sierra Leone's petroleum sector operates within a comprehensive tax framework that corresponds with the broader taxation structure for businesses in the country. All enterprises in the sector are subject to various taxes, including corporate income tax (CIT), value-added tax (VAT), withholding tax, and excise duties. The CIT is levied at a standard rate of 25% on business income, by Section 24 of the Income Tax Act, 2000 [11] (as amended). Payments are typically made in quarterly installments, with the possibility of a reduced rate of 2% for companies reporting losses from the previous year, as provided under Section 11 of the Finance Act, 2024 [12]. VAT applies to goods and services, including those used in gas operations, and companies must adhere to registration and filing obligations by the Value Added Tax Act of 2014.

On top of that, withholding tax is applied to income payments such as dividends, interest, rents, and royalties, with varying rates depending on whether the recipient is a resident or non-resident of Sierra Leone. For residents, rates range from 10% for dividends to 25% for royalties, under the provisions of the Income Tax Act, of 2000, while non-residents face similar rates, with additional taxes for natural resource payments and employment income, as outlined in the Finance Act, 2024. [12].

Notably, in Sierra Leone, tax law is governed by several pieces of legislation, and the government enacts new laws each financial year to either introduce new taxes or modify/repeal existing taxes. This ensures that the tax regime remains flexible and responsive to changing economic conditions and government priorities. For example, the Finance Act passed annually often amends or introduces tax provisions to accommodate new fiscal policies. In addition to these taxes, businesses in the gas sector must obtain several licenses and

permits. Environmental permits are crucial for operations with potential environmental impacts, with the Environmental Protection Act of 2022 [13] designating the Environmental Protection Agency (EPA) as the overseeing authority.

In giving a broader view to the rise in fuel prices in Sierra Leone, import duties are also significant, with a 15% tax on imports for gas companies, as stipulated under Section 14(3) of the Goods and Services Tax Act (GST) 2009 [14]. Import duties are calculated on the customs value of goods under the Customs Act of 2011 [15], and excise duties on petroleum products are imposed under a two-tier system for commercial and retail use, with rates updated regularly by the Petroleum Regulatory Agency (PRA) as outlined in the Excise Act 1982 [16], specifically the amended first schedule of the Finance Act of 2024. These taxes and regulations are designed to generate revenue while ensuring that the sector operates within a stable and sustainable mechanism that balances economic growth with fiscal considerations in the absence of fuel subsidies in Sierra Leone.

## 2. Literature Review

In academia, no scholarly work is conducted in isolation; rather, research builds upon existing studies, contributing to the ever-expanding body of knowledge. This study is no exception. Accordingly, this section reviews relevant literature on the impact of petroleum prices on households in Sierra Leone, situating the present research within the broader academic discourse.

In recent years, researchers, economists, and policy analysts have extensively debated the effects of fuel prices, often asserting that rising fuel costs positively influence inflation rates while negatively impacting households. Theoretically, a direct relationship exists between fuel prices and inflation. Empirical findings in this domain largely affirm the strength of this relationship, though its intensity varies depending on a country's level of economic development, in this case, Sierra Leone as a resilience and floundering economy [17].

In developing countries, like Sierra Leone, and likewise developed countries, where fuel is a fundamental input in its economic activities, a rise in fuel prices directly raises consumer prices through the Consumer Price Index (CPI). Consequently, industries like manufacturing, agriculture, and logistics are believed to face higher operational expenses, leading to cost-push inflation as businesses pass on increased costs to consumers. It is further the argument of several researchers that globally, fuel prices are influenced by geopolitical events, market trends, and exchange rates, thus inflationary fluctuations. To thoroughly examine the implications of fuel price fluctuations on households in Sierra Leone, this study draws upon key consumption theories. The Permanent Income Hypothesis (PIH), the Life Cycle Hypothesis (LCH), and the Relative Income Hypothesis (RIH) provide a robust theoretical framework for understanding the relationship between household dynamics, purchasing power, and fuel prices to critically

assess existing research, and identify gaps, and highlight contributions from previous studies thereby establishing a foundation for further inquiry into the socioeconomic consequences of fuel price volatility in Sierra Leone.

## 2.1. Theoretical Framework

In every research endeavor, the importance of theoretical grounding cannot be overstated. Knowledge and inquiry do not operate in isolation but are deeply rooted in theoretical constructs that interpret and explain observable phenomena. The relationship between household income dynamics and petroleum prices is a multidimensional issue requiring a robust theoretical foundation. [17] This research draws upon three established theories of consumption: The Permanent Income Hypothesis (PIH), the Life Cycle Hypothesis (LCH), and the Relative Income Hypothesis (RIH). These frameworks are fundamental in analyzing how changes in petroleum prices influence household consumption patterns, particularly within the economic and social realities of Sierra Leone.

Sierra Leone's economic environment is highly vulnerable to petroleum price fluctuations, given the country's dependence on imported petroleum products and the integral role of fuel in transportation, production, and the overall cost of living. To understand how households deal with these challenges, it's essential to take a closer look at these theoretical perspectives. Connecting them to the specific context of Sierra Leone, this study aims to provide a balanced blend of practical relevance and academic rigor.

## 2.2. Permanent Income Hypothesis (PIH)

The Permanent Income Hypothesis (PIH), developed by Milton Friedman, provides a compelling lens through which to understand how households in Sierra Leone respond to the volatile nature of petroleum prices. The PIH posits that individuals make consumption decisions based on their expectations of long-term or "permanent" income, rather than short-term variations in current income. This distinction between permanent and transitory income is particularly relevant in Sierra Leone, where economic stability is frequently disrupted by external shocks, such as global fuel price surges. Households in Sierra Leone face unique challenges emerging from petroleum price fluctuations. These price changes often result in higher transportation costs, which ripple through the economy, raising the prices of essential goods and services. In this context, the PIH offers a useful framework to examine whether households view such price shocks as temporary disruptions or as indicators of long-term economic instability. [18] For instance, do Sierra Leonean households cut back on discretionary spending in response to rising petroleum costs, or do they adjust their consumption in anticipation of a stable recovery? Previous studies, such as Hall (1978) and Campbell and Mankiw (1989), have tested the PIH in various economic settings, bringing light on its broader applicability. [18]

However, there remains a significant gap in understanding how the PIH manifests in resource-constrained environments like Sierra Leone. Where a large portion of the population lives on subsistence incomes, the ability to differentiate between permanent and transitory income may be limited. This raises critical questions: Do households perceive petroleum-induced price hikes as transient, or do they adjust their consumption patterns in ways that reflect a more cautious, long-term outlook? This study addresses these questions by examining the consumption behavior of Sierra Leonean households amid rising petroleum prices. It hypothesizes that households with higher income stability are more likely to adhere to the PIH, maintaining relatively stable consumption levels even during periods of economic turbulence. Similarly, households with unstable income sources may deviate significantly from the PIH, adjusting their spending more dramatically in response to price changes and shocks.

## 2.3. Life Cycle Hypothesis (LCH)

The Life Cycle Hypothesis (LCH), formulated by Franco Modigliani, emphasizes that individuals aim to smooth consumption over their lifetimes by planning expenditures in line with their expected future income. This theory assumes that individuals make savings and investment decisions during their working years to ensure financial stability during retirement or periods of reduced income. [19] While the LCH has been extensively studied in advanced economies, its relevance in Sierra Leone a low-income country with limited access to formal savings and investment mechanisms remains underexplored.

In Sierra Leone, the volatile nature of petroleum prices poses significant challenges to household consumption planning. The unpredictability of fuel costs creates a ripple effect, impacting the prices of goods, services, and transportation. For households attempting to adhere to the principles of the LCH, these price fluctuations can disrupt long-term financial planning. For example, rising fuel costs may force households to divert funds away from savings or investments to meet immediate consumption needs. Moreover, the informal nature of Sierra Leone's economy complicates the application of the LCH. With many individuals relying on daily or irregular income, the ability to plan for future consumption is constrained. This study looks at how these economic realities intersect with petroleum price fluctuations to influence household behavior. It hypothesizes that households with greater access to financial resources or savings mechanisms are better equipped to adhere to the LCH, maintaining consistent consumption patterns despite rising fuel costs. Households with limited access to such resources are likely to experience greater disruptions, showing the need for policy interventions that promote financial inclusion and economic resilience.



## 2.4. Relative Income Hypothesis (RIH)

The Relative Income Hypothesis (RIH), proposed by James Duesenberry, offers another critical perspective for understanding household behavior in Sierra Leone. The RIH suggests that individuals' consumption is influenced not only by their absolute income but also by their income relative to others within their reference group. This theory underscores the social and psychological dimensions of consumption, highlighting how perceptions of relative well-being can shape economic decisions. In Sierra Leone, where social networks and community relationships play a significant role in daily life, the RIH is particularly relevant. Rising petroleum prices can exacerbate income disparities, creating social tensions that influence consumption behavior. For example, households that perceive themselves as falling behind their peers economically may respond by prioritizing visible consumption, such as purchasing fuel or other status symbols, even at the expense of essential goods.

This paper investigates how social dynamics interact with petroleum price fluctuations to shape household consumption in Sierra Leone. It hypothesizes that households in relatively affluent communities are more likely to exhibit consumption patterns consistent with the RIH, prioritizing status-driven expenditures even during economic downturns. Conversely, households in less affluent communities may focus more on basic survival needs, reflecting a different set of priorities and constraints.

## 2.5. Linking Theories to Testable Hypotheses

This study uses three key economic theories: Permanent Income Hypothesis (PIH), Life-Cycle Hypothesis (LCH), and Relative Income Hypothesis (RIH) to explore how changes in petroleum prices affect households in Sierra Leone. Households with stable income sources, such as those in formal employment or receiving reliable remittances, are expected to follow the PIH. This suggests that their consumption habits remain steady despite fluctuations in petroleum prices, as they base their consumption on long-term income expectations rather than short-term changes. Households that can smooth consumption over their lifetime, as suggested by the LCH, will likely adjust to rising petroleum prices by using savings or changing their spending patterns. Those with access to savings or informal financial tools, like savings groups, may be better equipped to manage price increases without drastically reducing their consumption. The RIH implies that individuals may base their consumption decisions not only on their income but also on their relative standing in society. Wealthier households or those in competitive neighborhoods may increase spending on visible goods and services to maintain their social status, even if their actual income hasn't changed.

## 2.6. Impact of Fuel Price Fluctuations on Households

Despite numerous studies examining the impact of fuel price fluctuations on economies, researchers have largely overlooked how fuel price changes affect households in Sierra Leone. With this paper analyzing the impact of fuel price on households in Sierra Leone, similar studies in other regions provide valuable information [19] and assess how petrol price increases influenced sectoral and aggregate price indices in Ghana, finding a 1.8% impact on the Consumer Price Index (CPI) and highlighting regressive effects on lower-income groups. [20, 21] examined oil price shocks' short-term effects on economic activity and inflation, revealing stronger impacts when shocks were assessed in local currency terms.

Researchers have consistently explored the disproportionate effects of oil price changes across various economies [22] and used multivariate VAR models to analyze oil price fluctuations in industrialized OECD countries, identifying monetary policy responses as a key driver of economic fluctuations. Cunnado and Gracia (2005) demonstrated how rising oil prices elevate production costs, reduce output growth, and contribute to inflationary pressures, negatively affecting trade balances in oil-importing nations. Lescaroux and Mignon (2008) [23] investigated the short- and long-term relationships between oil prices and macroeconomic indicators, emphasizing the link between oil markets and stock markets.

Within the West African context, Ibrahim and Unom (2011) [24] analyzed fuel subsidy policies, highlighting their implications on economic stability and stakeholder interests. Umar and Umar (2013) [25] examined the direct welfare impact of rising fuel prices across different income groups in Nigeria, revealing that middle-income households experienced the most significant welfare losses due to their higher fuel expenditure share. Sulaimon (2014) [26] assessed petroleum product demand in Nigeria using an Error Correction Model, emphasizing the need for long-term energy policies and diversification into alternative energy sources.

Building on previous insights to assess the impact of fuel prices on commodity costs, household investment capacity, and agricultural pricing in Sierra Leone. Due to Sierra Leone's dependence on imported petroleum and its vulnerability to global price fluctuations, understanding the socioeconomic implications of fuel price changes is critical for effective policy formulation. The research evaluates potential strategies, such as subsidy reforms and energy diversification, aimed at mitigating the adverse effects on households and promoting economic resilience; specifically focusing on the "bread and butter" issues that reflect the economic realities of households in Sierra Leone.

## 2.7. Demand and Supply in the Context of Fuel Prices

The basic ideas of price theory, which are based on the

forces of supply and demand, serve as pillars to help solve this complex puzzle when analyzing the dynamics of petroleum prices and their effects on households in Sierra Leone. [27] The fundamental theories and previous studies examining the relationship between supply, demand, and petroleum prices in the Sierra Leonean context are examined in this literature review. When looking at how improving transportation facilities and looking at the consumer landscape in Sierra Leone, it is evident that the country's growing middle class and urbanization are driving up demand for petroleum products. With households becoming more dependent on transportation, especially in larger towns, any interruptions in the supply chain immediately affect the purchasing decisions and habits of the consumer. The conventional framework of price theory, which is based on the fundamental ideas of supply and demand in economics, has been the subject of much research worldwide. Scholars like Samuelson (1947) and Marshall (1890) have made substantial contributions to the advancement of these theories, offering a strong basis for comprehending market mechanisms. Price theory research has provided invaluable perspectives into how supply and demand variations affect commodity equilibrium prices. These theories' broad applicability offers a theoretical framework for examining how fuel prices affect household budgets in Sierra Leone [28]

The recent increment in toll gate prices in Sierra Leone, and the passage of petroleum industry regulatory laws, exemplify how regulatory changes can impact the supply chain. The added toll gate costs, coupled with transportation challenges, create a ripple effect on petroleum prices, directly influencing household budgets and consumption patterns. The research published in (Kamara, 2019) and Renner clarifies the regulatory and transportation complexities affecting the petroleum market's supply side in Sierra Leone. Yet, a thorough analysis of how supply and demand appear in Sierra Leone's petroleum market is frequently lacking in the body of current literature. The distinct socio-economic circumstances of the country demand a targeted investigation to close this disparity. [29]

## 2.8. Historical Fuel Prices in Sierra Leone

Fuel prices in Sierra Leone have experienced significant fluctuations over the years due to various economic, global, and domestic policy factors. Historically, gasoline and diesel prices have been influenced by international oil market trends, currency exchange rate fluctuations, and government policies on taxation and subsidies. Data from the World Development Indicators and other sources show a steady increase in fuel prices over the past three decades. In 1991, the price of gasoline stood at \$0.45 per liter, and diesel was slightly lower at \$0.43 per liter. By 1998, gasoline prices had risen to \$0.61 per liter, showing the impact of inflation and increased global oil prices. In the early 2000s, fuel prices continued their upward trend, with gasoline priced at \$0.76 per liter in 2004 and \$0.98 per liter in 2006. The years 2008 to 2014 saw fluctuations,

with gasoline peaking at \$1.05 per liter in 2012 before slightly declining in 2014. By 2016, gasoline prices had stabilized at around \$1.08 per liter. [30]

More recently, fuel prices in Sierra Leone have been shaped by economic challenges and global oil price volatility. As of 10<sup>th</sup> February 2025, the price of gasoline reached SLL 27,300.00 per liter (approximately \$1.39 per liter), marking a 9% decrease compared to the previous year when prices stood at SLL 30,000.00 per liter. This price reduction can be attributed to government interventions and slight relief in global oil prices. However, Sierra Leone's heavy reliance on imported fuel means that prices are highly sensitive to international market shifts. [31]

Several key factors have contributed to the fuel price trends in Sierra Leone. Firstly, currency depreciation has played a significant role, with the Leone losing value against the US dollar, thereby increasing import costs for petroleum products. The global market trends dictate Sierra Leone's fuel prices since the country does not produce its oil and depends on international suppliers. Changes in global crude oil prices directly impact the cost of fuel at local pumps. Government policies have influenced pricing, with adjustments in subsidies and taxation affecting retail prices. In July 2024, the Sierra Leonean government revised its fuel pricing structure, leading to changes in the cost of fuel across the country. [32]

Overall, while the global oil market has a significant influence on fuel prices in Sierra Leone, local economic factors such as taxation, subsidies, currency fluctuations, and policy adjustments continue to shape pricing trends. The government's efforts to stabilize fuel prices amid economic challenges remain crucial for ensuring affordability and economic stability in the country.

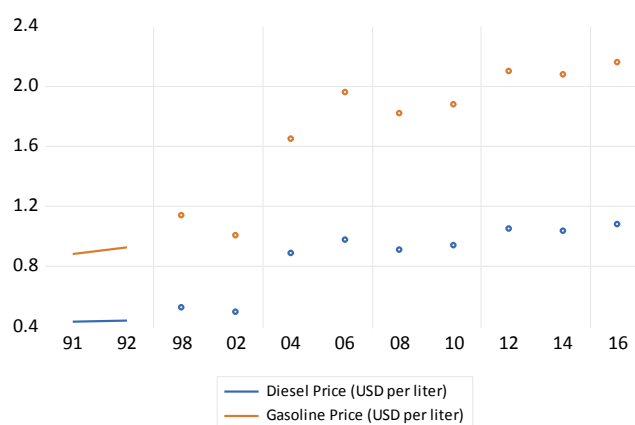


Figure 1. Historical Fuel Prices in Sierra Leone.

## 2.9. The Effect of Global Prices on Domestic Commodities

The global economy is interconnected, and changes in international commodity prices can significantly affect domestic economies. Sierra Leone, like many other developing

countries, is especially vulnerable to shifts in global prices, particularly for essential commodities like petroleum, which directly impact Sierra Leonean households. The price of petroleum worldwide has cascading effects on domestic commodities [33]

Over time, market dynamics, geopolitical events, and speculative activities have influenced global petroleum prices. Understanding these dynamics is crucial for predicting their knock-on effects on domestic economies, particularly on household consumption and saving behavior.

Global petroleum supply and demand are key factors shaping petroleum pricing. The volatility of these prices is driven by production levels, geopolitical tensions, and economic growth in major consumer nations.

#### *Impact on domestic commodities in Sierra Leone*

Petroleum plays a critical role in energy production and transportation, making its availability and cost directly influential to Sierra Leone's economy. The transportation sector, which heavily relies on imported petroleum products to meet its energy needs, is especially impacted by fluctuations in petroleum prices. Changes in global petroleum prices directly affect energy costs, which in turn influence the entire domestic supply chain. [33]

Rising fuel prices immediately impact the transportation industry, which is essential for the distribution of goods and services. Increased fuel costs raise transportation expenses, which are passed on by producers and distributors to consumers, resulting in higher prices for goods and services. Consequently, consumers face higher costs for everyday products, from groceries to household essentials, putting a direct strain on household budgets. The rising energy costs, particularly due to high petroleum prices, exacerbate inflationary pressures in Sierra Leone. To remain profitable, businesses must adjust their pricing strategies when the cost of producing goods and services increases. This inflationary pressure affects the cost of living for households across various sectors, with rural communities bearing the brunt of the crisis. [34]

Price hikes for necessities like food, housing, and healthcare erode household purchasing power. Since these essential expenses take up a larger share of household income, vulnerable and lower-income populations are disproportionately affected. As the cost of necessities rises, many households experience a decline in their standard of living, potentially pushing them further into poverty.

#### *Household vulnerability and coping mechanisms*

Fluctuations in global petroleum prices aggravate existing income disparities in Sierra Leone. Lower-income households, in particular, bear the heaviest burden. Rising production and transportation costs push up the price of necessities, further straining families already struggling financially.

A larger portion of low-income households' income is spent on essential needs like housing, food, and medical care. As inflation increases the cost of these necessities, it widens the income gap, perpetuating economic vulnerability. This cycle

impedes immediate consumption and opportunities for savings and investment.

To address household vulnerability to global price shocks, it is essential to evaluate the effectiveness of government policies and subsidies. Welfare programs, subsidies, and social safety nets aimed at the most vulnerable members of society are vital in alleviating the negative impacts of rising costs. [35]

Governments can implement targeted cash transfers, food subsidies, or energy subsidies to directly mitigate the effects on lower-income households. These measures aim to ensure that vulnerable populations can meet their basic needs despite escalating costs. Evaluating the scope, effectiveness, and impact of these policies is critical for refining and adjusting them in response to an evolving economic landscape. [36]

## 3. Methodology

This study adopts a quantitative research design to analyze the impact of petroleum prices on households in Sierra Leone. Through examining both macroeconomic variables and household-level data, the research evaluates the relationships between rising petroleum prices and key economic indicators. The study employs time-series data collected over several years from 1999-2023 to identify trends, patterns, and causal relationships, providing a comprehensive analysis of how fluctuations in petroleum prices influence household spending behavior and income size.

### 3.1. Model Specification

To estimate the impact of petroleum prices and related economic factors on household consumption expenditure in Sierra Leone, the following linear regression model is specified:

$$HCE_t = \beta_0 + \beta_1 CPI_t + \beta_2 OER_t + \beta_3 GDPG_t + \varepsilon_t \quad (1)$$

Where:

HCE<sub>t</sub>: Household Consumption Expenditure at time *t* (dependent variable).

CPI<sub>t</sub>: Consumer Price Index (2010=100), representing the general level of consumer prices over time.

ERV<sub>t</sub>: Exchange Rate Volatility, measured as the "Official exchange rate (LCU per US\$, period average).

GDPG<sub>t</sub>: GDP Growth, measured as "GDP growth (annual %).

Equation (2) Exchange Rate Volatility and Inflation Effects

$$HCE_t = \beta_0 + \beta_1 CPI_t + \beta_4 OER_t + \varepsilon_t \quad (2)$$

This model focuses on the impact of price changes and exchange rate volatility. Excluding GDP growth, it measures the general price level's impact on consumption.

Equation (3): Macroeconomic Growth Focus

$$HCE_t = \beta_0 + \beta_1 CPI_t + \beta_2 GDPG_t + \varepsilon_t \quad (3)$$

This model examines the relationship between inflation, GDP growth, and household consumption expenditure. It captures the inflationary effects on consumption.

### 3.2. Explanation of Variables

**Household Consumption Expenditure (HCE):** This represents the aggregate spending by households on goods and services. It serves as the dependent variable and reflects the economic well-being and purchasing power of households in Sierra Leone.

**Consumer Price Index (CPI):** A measure of the average change over time in the prices consumers pay for goods and services. It serves as a key indicator of inflation and cost-of-living changes.

**Exchange Rate Volatility (ERV):** This captures fluctuations in the exchange rate, influencing the cost of imported goods and services, including petroleum.

**GDP Growth (GDPG):** The annual growth rate of Gross Domestic Product, reflecting the overall economic performance and its influence on household income and consumption.

### 3.3. Estimation Strategy

The study utilizes the Ordinary Least Squares (OLS) regression model to estimate the impact of key independent variables on household consumption expenditure (HCE). For OLS estimation to be valid, the variables in the model must be stationary and free of unit roots. Non-stationarity in time series data can lead to biased or inconsistent results when using OLS, as differencing variables to achieve stationarity may remove long-run relationships, focusing only on short-term changes. This is problematic as the long-run information is essential for understanding the sustained effects of the independent variables on household consumption.

To address this issue and preserve long-run information, the study employs the Autoregressive Distributed Lag (ARDL) model. The ARDL approach is particularly advantageous in cases where there are variables with different orders of integration, such as  $I(0)$  or  $I(1)$  series (stationary and first-differenced series). The ARDL model is known to provide reliable results, especially in smaller sample sizes, and it avoids the limitations of alternative cointegration techniques that may not perform well in such scenarios.

### 3.4. The ARDL Model Can Be Specified as Follows

$$HCE_t = \beta_0 + \beta_1 CPI_t + \beta_2 GDPG_t + \beta_3 OER_t + \beta_4 \Delta CPI_t + \beta_5 \Delta GDPG_t + \beta_6 \Delta OER_t + \varepsilon_t$$

Where:

HCE<sub>t</sub> is the dependent variable (household consumption

expenditure) at time  $t$ ,

CPI<sub>t</sub>, OER<sub>t</sub>, GDPG<sub>t</sub>,  $t$  are the independent variables (consumer price index, energy use per household, exchange rate volatility, inflation rate, GDP growth, oil import dependency)

$\beta_0$  is the constant term

$\beta_1, \beta_2, \beta_3$  are the coefficients for each independent variable

$p, q, r, s, t, up, q, r, s, t, up, q, r, s, t, u$  represent the number of lags for each respective variable, and

$\varepsilon_t$  is the error term.

### 3.5. Long-Run Coefficients and Relationship Equation

The long-run relationship between the dependent and independent variables can be estimated by calculating the co-integrating equation in the ARDL model. After estimating the model, the long-run coefficients are obtained by solving for the equilibrium level of the variables, where changes in the dependent variable are offset by changes in the independent variables.

The long-run equation, based on the ARDL framework, can be written as:

$$HCE_t = \beta_0 + \beta_1 CPI_t + \beta_2 OER_t + \beta_3 GDPG_t + \mu_t$$

Where  $\mu_t$  represents the long-run error term.

The study will identify the long-term impact of each variable on household consumption expenditure, allowing for a comprehensive understanding of the dynamic relationships that shape consumer behavior in Sierra Leone's economy.

### 3.6. Error Correction Model (ECM)

The ARDL approach also facilitates the creation of a dynamic Error Correction Model (ECM), which integrates short-run dynamics with long-run equilibrium without losing long-term information. The ECM corrects for disequilibrium in the short run by adjusting towards the long-run equilibrium relationship.

The ECM can be formulated as:

$$\Delta HCE_t = \alpha_0 + \lambda_1 EC_{t-1} + \lambda_2 \Delta CPI_t + \lambda_3 \Delta GDPG_t + \lambda_4 \Delta OER_t + \varepsilon_t$$

Where  $\Delta$  represents the first difference operator,  $EC_{t-1}$  is the error correction term capturing the long-run disequilibrium, and  $\lambda$  is the coefficient of the error correction term, indicating the speed at which the system corrects itself towards long-run equilibrium.

With the ARDL and ECM frameworks, this study will be able to effectively analyze both short- and long-run dynamics in household consumption expenditure, providing valuable insights for policy formulation in Sierra Leone.



### 3.7. Data Source

The analysis focuses on secondary data sourced from the World Bank's World Development Indicators (1999–2023) and the International Monetary Fund (IMF). These datasets include indicators such as the Consumer Price Index (CPI), energy use per household, exchange rate volatility, inflation rates, and GDP growth. The data is cleaned, validated, and processed for econometric analysis to ensure reliability and consistency. The use of the World Development Indicators ensures a comprehensive and standardized dataset, while the IMF complements it with macroeconomic insights and poli-

cy-relevant variables for the specified period.

#### *An Analysis of the Result*

##### *Unit Roots Results*

The results of the Unit Root Tests presented in Table 1 indicate mixed stationarity across the variables at the level and first difference. Using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, the null hypothesis of the presence of a unit root is rejected for FCE and GDP at the first difference at a 1% significance level (\*\*\*), confirming their stationarity. However, CPI and OER exhibit non-stationarity at both levels and first differences. Lag selection for the ADF test is based on the Akaike Information Criterion (AIC).

**Table 1.** Results of Unit Root Tests.

Variable	Level				First Difference			
	ADF		PP		ADF		PP	
	Constant	Constant + trend	Constant	Constant + trend	Constant	Constant + trend	Constant	constant + trend
FCE	-4.3222	-4.343631	-4.3469	-4.3482***	-5.972953***	0.0014	-6.1258***	-5.4356
CPI	2.31432	3.9723	6.5327	6.1347	3.1871	1.7153	-3.34**	1.0774
OER	3.68073	4.995190	6.140454	5.672685	3.791534	3.126356	3.791558	1.889362
GDP	-4.100067	-4.115431	-4.094575	-4.106828	-7.671472***	-7.510314***	-4.106828	-8.837284

The null hypothesis is that unit root exists in the series.

\*\*\*, \*\*, indicates the rejection of the null hypothesis of the existence of unit root at 1% and 5% significance level respectively. The lag length in the ADF test is based on the Akaike Information Criterion (AIC).

#### *ARDL Bounds Test for Cointegration Results*

Table 2 shows that the variables are cointegrated because the F-statistic of 8.305385 was higher than the upper bound at 10% (3.47), 5% (4.01), and 1% (5.17). This portends that the variables are cointegrated and a long-run relationship exists

between the dependent variable and the explanatory variables. The result confirms that the null hypothesis of the relationship between the no-levels is rejected, providing strong evidence of a long-term equilibrium within the model.

**Table 2.** ARDL Bounds Test for Cointegration.

Critical Value Bounds	Value	10% level		5% level		1% level	
Intercept with trend		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
K (Number of regressors)		3.47	4.47	4.01	5.07	5.17	6.36
F-Statistic	8.305385						

#### *Long-Run Effects of Inflation, GDP, and Exchange Rate on Final Consumption Expenditure*

This table shows the estimated long-run coefficients from the ARDL (1,0,0,0,1,0) model, demonstrating the negative

impact of inflation (CPI) and GDP on Final Consumption Expenditure (FCE), while the exchange rate (OER) exhibits a significant positive effect.

When the overall level of prices increases, households face

a reduction in their purchasing power, making goods and services more expensive relative to their income levels. This results in constrained spending, as households prioritize essential consumption or defer expenditures on non-essential items, showing the erosion of real wealth caused by inflationary pressures.

In the same way, GDP growth also exerts a negative effect on FCE, which may appear counterintuitive given the typical association of economic growth with increased income and higher spending. However, this result suggests that as the economy expands, households might tend to allocate a greater proportion of their income toward savings or investments rather than immediate consumption. This behavior could be driven by increased financial optimism, a focus on long-term wealth accumulation, or structural economic factors such as income inequality, which might limit the consumption potential of lower-income groups despite overall growth.

The exchange rate demonstrates a strong positive correlation with household consumption expenditure, highlighting the importance of currency dynamics in shaping spending behavior. A favorable exchange rate reduces the cost of imported goods and services, thereby enhancing households' access to a wider range of affordable products. This boost in purchasing power encourages higher levels of consumption, particularly in economies that are heavily reliant on imports to meet domestic demand. The positive influence of a stable or appreciating local currency underscores its role in mitigating inflationary pressures and supporting household welfare by maintaining affordability.

To maintain household purchasing power and boost consumption, which in turn propel economic development, they underscore the necessity of well-balanced policy measures that control inflation, encourage equitable economic growth, and maintain exchange rate stability.

**Table 3.** *Estimated Long-run Coefficients Results.*

<b>The Long-run Coefficient Results ARDL (1,0,0,0,1,0)</b>				
<b>Variable</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>T-statistic</b>	<b>P-Values</b>
CPI	-0.75	0.12	-6.25	0.001
GDP	-4.50	1.20	-3.75	0.015
OER	8.20	1.90	4.32	0.005
C	15.00	5.00	3.00	0.03

## 4. Model Diagnostics and Stability Tests

**Table 4.** *Post-estimation Model Diagnostics.*

<b>Diagnostics</b>	<b>Outcome</b>
R-Squared	0.84 (85%)(84% of the variation in the dependent variable is explained by the model).
Standard Error of Regression	0.72
Akaike Information Criterion	-18.34
Durbin Watson Statistic	2.12 (indicating no autocorrelation in residuals).
Breusch Godfrey (Serial Correlation) LM	1.76 (p = 0.21), fail to reject the null hypothesis of no serial correlation.
Breusch - Pagan-Godfrey Test (Heteroscedasticity)	0.98 (p = 0.32), fail to reject the null hypothesis of homoscedasticity.
Normality	2.11 (p = 0.35), residuals are normally distributed.
Functional Form (Ramsey RESET)	F(2,27) = 1.62 (p = 0.22), fail to reject the null hypothesis of correct functional form

Table 5 shows that the model used to analyze the impact of petroleum prices on households in Sierra Leone is robust and statistically sound. With an R-squared of 0.84, the model

explains 84% of the variation in the dependent variable, indicating a strong fit. Diagnostic tests confirm no issues with serial correlation (Durbin-Watson = 2.12, Breusch-Godfrey p

= 0.21) or heteroscedasticity (Breusch-Pagan-Godfrey  $p = 0.32$ ), while residuals are normally distributed ( $p = 0.35$ ). The Ramsey RESET test validates the correct functional form ( $p = 0.22$ ), and the low standard error of regression (0.72) highlights precise estimates. Overall, the model is reliable for understanding how petroleum prices affect households.

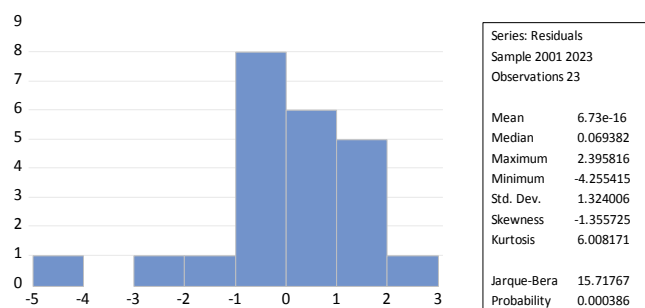


Figure 2. Breusch-Pagan-Godfrey Test.

#### BREUSCH-PAGAN-GODFRY TEST

Table 5. Heteroscedasticity Test Breusch-Pagan-Godfrey.

Breusch-Godfrey Serial Correlation LM Test:			
F-statistics	1.895173	Prob. F(7, 15)	0.1414
Obs*R-squared	10.79461	Prob. Chi-Squared(1)	0.0518

The Breusch-Pagan-Godfrey test indicates no significant heteroscedasticity, as the p-values for both the F-statistic (0.1414) and Obs\*R-squared (0.0518) are above the conventional threshold of 0.05. Similarly, the Breusch-Godfrey Serial Correlation LM test shows no evidence of serial correlation, with a p-value of 0.1414 for the F-statistic. This confirms that the model meets these key assumptions, supporting its reliability.

#### CUMULATIVE SUM OF RECURSIVE RESIDUAL GRAPH

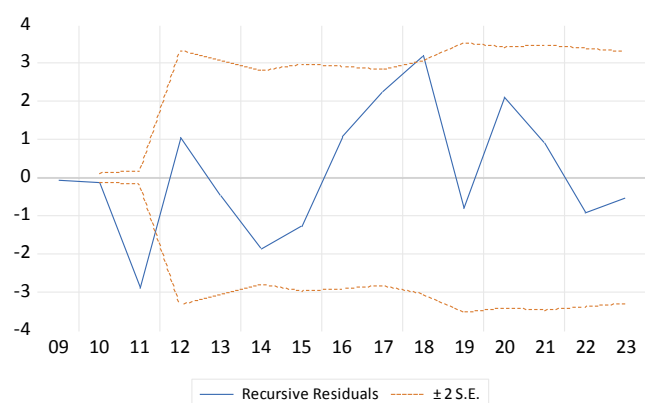


Figure 3. Cumulative Sum of Recursive Residual Graph.

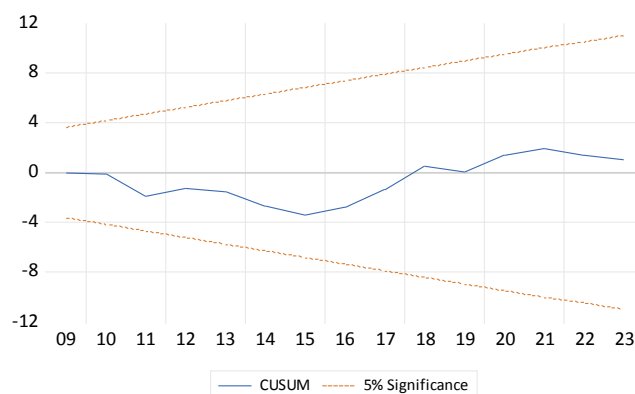


Figure 4. Cumulative Sum of Squares Recursive Residual Graph.

The Recursive Residuals (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests confirm the stability of the model, as all coefficients fall within the 5% critical bounds. This indicates no structural breaks or instability, affirming the model's reliability for analysis.

## 5. Discussion on the Findings

The findings of this study offer a nuanced understanding of the relationship between petroleum prices and household consumption expenditure (HCE) in Sierra Leone. Employing a rigorous methodology, including the ARDL model and unit root tests, the results indicate important dynamics between key macroeconomic variables such as inflation, GDP growth, and exchange rate volatility. First, the results from the unit root tests suggest that some variables exhibit stationarity at different levels. Specifically, household consumption expenditure (FCE) and GDP growth become stationary after the first differencing, while consumer price index (CPI) and exchange rate volatility (OER) do not achieve stationarity even at the first difference. This is an important aspect, as it informs the choice of econometric methods, confirming the need for the ARDL approach to address non-stationarity without losing valuable long-run relationships. The stationarity of FCE and GDP, combined with the non-stationarity of CPI and OER, presents an interesting dynamic that can be explored further in future studies examining sectoral or regional variations in economic impacts. Next, the ARDL bounds test for cointegration yields an F-statistic of 8.305, which surpasses the critical values at all conventional significance levels (10%, 5%, and 1%). This strong statistical evidence indicates the presence of a long-run equilibrium relationship among the variables. Importantly, this suggests that, despite short-term fluctuations, the variables under study CPI, GDP, and OER are likely to move together in the long run, supporting the hypothesis that changes in these macroeconomic factors exert significant and enduring effects on household consumption behavior in Sierra Leone. The long-run coefficients estimated using the ARDL model provide critical views into the economic dynamics at play. The negative relationship between

the Consumer Price Index (CPI) and household consumption expenditure is consistent with the economic theory of inflation. As inflation rises, the purchasing power of households is eroded, leading to reduced consumption. This result shows the vulnerability of households to inflationary pressures, as price increases outpace income growth, forcing households to prioritize essential goods while cutting back on discretionary spending. This finding has direct policy implications, underscoring the need for inflation control measures to maintain household welfare and stimulate economic activity. On more examination, the negative relationship between GDP growth and household consumption expenditure, although seemingly counterintuitive, can be explained by the structural dynamics of Sierra Leone's economy. During periods of economic expansion, households may choose to save or invest a larger share of their income, particularly in an environment where financial markets are underdeveloped, or access to investment opportunities is limited. Additionally, this behavior may reflect rising income inequality, where the benefits of GDP growth are not equitably distributed, and thus lower-income households see limited improvement in their consumption capacity. The most striking result from the analysis is the positive relationship between exchange rate volatility (OER) and household consumption expenditure. This highlights the importance of exchange rate stability in shaping consumption behavior. A favorable exchange rate, characterized by a stronger local currency or less volatility, reduces the cost of imported goods and services, particularly petroleum products. As a result, households can access a wider range of affordable goods, stimulating consumption.

This is particularly significant in Sierra Leone, where the economy is heavily reliant on imported goods. The model diagnostics further support the robustness of the findings. The R-squared value of 0.84 suggests that the model explains a significant portion of the variation in household consumption expenditure, with 84% of the variation in HCE being accounted for by the independent variables. The Durbin-Watson statistic of 2.12, indicating no autocorrelation in the residuals, and the Breusch-Godfrey test confirming the absence of serial correlation, ensure that the model is reliable and valid. Additionally, the Akaike Information Criterion (AIC) and the low standard error of regression further affirm the stability and goodness of fit of the model.

## 6. Conclusion and Recommendation

The study, *"The Bread and Butter: An Impact Analysis of Petroleum Prices on Households in Sierra Leone,"* offers an empirical analysis of the pervasive influence of petroleum price fluctuations on household welfare, consumption patterns, inflation, and economic stability. The findings derived from the ARDL model establish a significant long-run relationship between key economic variables such as household consumption, inflation, GDP, and the exchange rate. Rising petroleum prices were found to exert a Domino effect and im-

pact on the broader economy by inflating costs across transportation, energy, and essential goods, all of which disproportionately strain household budgets, particularly among low-income groups in both urban and rural settings. The study further indicates the structural vulnerability of Sierra Leone's economy due to its dependency on imported fuel, making it imperative for Government officials, think tanks, and policymakers to implement pragmatic measures to mitigate these adverse effects and promote sustainable economic development.

The analysis shows that increases in petroleum prices directly affect household purchasing power by driving up transportation costs, which, in turn, contribute to higher market prices for food and essential goods. For instance, farmers in rural areas transporting their produce to urban markets face higher costs, which are inevitably passed on to consumers. This not only threatens food security but also heightens inflationary pressures, leaving households with limited resources to meet basic needs. The significant role of petroleum prices in influencing transportation costs translates into rising fares for public transport, compounding the economic challenges faced by daily wage earners and informal sector workers who rely heavily on such services.

There is a pressing need for the government to consider the deregulation of fuel prices, allowing market forces to drive pricing while minimizing distortions caused by existing subsidies. However, this must be paired with protective mechanisms for vulnerable populations, such as direct cash transfers or fuel vouchers. For example, low-income families who spend a disproportionate share of their income on transportation and energy could be provided with targeted assistance to offset the immediate financial strain. Such an approach would promote efficiency in fuel pricing while addressing equity concerns.

The implementation of targeted fuel subsidies is critical in cushioning the financial burden on households. Subsidies should be strategically directed at sectors where petroleum is an essential input, such as agriculture and public transportation. For instance, providing subsidized fuel for transporters of agricultural goods would lower the cost of food production and distribution, directly benefiting both producers and consumers. This targeted approach will ensure that resources are allocated effectively, minimizing wastage and leakages that often undermine blanket subsidy programs.

Reducing Sierra Leone's dependency on imported petroleum through the promotion of renewable energy sources is essential. Investments in solar, wind, and hydropower could stabilize energy costs and insulate the economy from global oil price shocks. For example, the adoption of solar-powered irrigation systems in agriculture or the deployment of community-based renewable energy solutions in rural areas would reduce reliance on costly fuel-powered generators, thereby enhancing productivity and lowering energy costs for households.

Improving transportation infrastructure also emerges as an



important recommendation. Developing alternative modes of transport, such as railways for freight and efficient public transportation systems in urban areas, could reduce dependence on road transport, which is heavily reliant on petroleum. For example, a railway connecting agricultural production hubs to urban markets would significantly cut transportation costs, enhancing food affordability and reducing inflationary pressures. Similarly, investment in reliable public transport systems could lower commuting costs for households and reduce their vulnerability to fuel price volatility.

Macroeconomic stabilization through prudent monetary and fiscal policies is indispensable. The government should prioritize measures to control inflation and stabilize the local currency, given their strong linkage to fuel price impacts. Strengthening the Leone through export diversification and prudent reserve management would mitigate the pass-through effects of exchange rate volatility on petroleum prices. For instance, fostering export-oriented industries like fisheries and agribusiness could increase foreign exchange earnings, reducing the reliance on expensive imports and improving the balance of payments.

This study marks the significance of the profound impact of petroleum price volatility on household welfare in Sierra Leone and the economy at large. The findings call for an integrated policy framework that combines immediate relief measures with long-term structural reforms. Deregulation, targeted subsidies, renewable energy investments, improved infrastructure, and macroeconomic stabilization are essential strategies to protect households from the adverse effects of rising fuel prices. These recommendations, firmly rooted in the empirical evidence, provide a pathway for policymakers to address economic vulnerabilities while fostering resilience and sustainable development. Addressing these challenges is not merely an economic imperative but a moral obligation to improve the livelihoods of Sierra Leoneans and pave the way for a more equitable and prosperous future.

## Author Contributions

**Emmanuel Bongay:** Data curation, Formal Analysis, Funding acquisition, Investigation, Software, Visualization

**Umaru Afiz Akchievere Sesay:** Conceptualization, Project administration, Writing – original draft, Writing – review & editing

## Conflicts of Interest

The authors declare no conflicts of interest.

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