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The Impact of Petrol Price Changes on Economic Welfare in Tanzania: A Time Series Analysis (2000–2024)

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KEYWORDS

Petrol prices; Volatility; CPI; Poverty; GARCH

ABSTRACT

The study investigates the impact of petrol price changes on economic welfare in Tanzania, focusing on two key indicators: the Consumer Price Index (CPI) and the poverty headcount ratio (HCR). The study employed a quantitative time-series approach using monthly data spanning from 2000 to 2024. Data were obtained from EWURA for petrol prices and National Bureau of Statistics (NBS) for CPI and poverty data. To model petrol price volatility, the study applied ARCH and GARCH models. Additionally, regression models, including log-log linear specifications, were used to assess the relationship between petrol prices and macroeconomic indicators. In this study STATA 16.0 was used to analyse the data. The findings reveal significant volatility clustering in petrol prices, which is best captured by the ARCH (1), GARCH (1) model. A key result indicates that a 1% increase in petrol prices leads to a 0.96% increase in CPI, highlighting a strong inflationary effect. Also, the findings reveal that both current and lagged petrol prices significantly influence the Poverty Headcount Ratio explained by 32.9% and 24.45% respectively. The study concludes that petrol price fluctuations have considerable implications for inflation and poverty trends in Tanzania. The study recommends strengthening price stabilization mechanisms, enhancing macroeconomic resilience, and expanding targeted social protection programs. These findings contribute to the growing body of literature on energy economics and offer practical insights for Tanzanian policymakers in formulating sustainable fuel and poverty alleviation policies.

1. Introduction

Petrol price volatility remains a critical global economic issue affecting both developed and developing economies. In Tanzania, changes in fuel prices affect transport, production costs, and household expenditure, which directly influence inflation measured by the Consumer Price Index (CPI) and poverty outcomes reflected in the Headcount Ratio. Over the past two decades, global fuel markets have been marked by repeated shocks including the 2008 financial crisis, the COVID-19 pandemic, and the 2022 Russia–Ukraine conflict which have generated volatility in domestic fuel prices. Within the East African Community, Tanzania has generally maintained relatively lower fuel prices than its neighbours; however, domestic fluctuations remain sensitive to global crude oil prices, exchange rate changes, taxes, and government policy interventions.

In developed economies, extensive research has established strong links between energy prices, inflation, and macroeconomic stability. For instance, Baumeister and Kilian (2016) showed that oil price shocks significantly drive inflation volatility in the United States and Europe, while Hamilton (2009) demonstrated that energy price spikes have historically preceded recessions in advanced economies. In the United Kingdom, Brown and Yücel (2002) found that petrol price volatility strongly influenced inflation expectations and household expenditures, while Elliott et al. (2018) highlighted how rising energy costs disproportionately affect low-income households in England, intensifying fuel poverty. In France, Blanchard and Galí (2007) showed that oil shocks significantly reduced output growth and raised inflation, with fuel taxes amplifying consumer price responses. More recently, Chevallier and Ielpo (2013) analyzed French energy markets and found that volatility persistence in fuel prices directly feeds into broader inflation dynamics.

Across Africa, petrol price shocks have been shown to aggravate inflationary pressures, raise production costs, and heighten poverty. Alem and Söderbom (2012) in Ethiopia found that fuel price increases disproportionately raised poverty among low-income households. Arndt et al. (2008**)** in Mozambique highlighted that higher fuel prices triggered welfare losses across all income groups, especially among the poorest quintiles. In Nigeria, Ogunleye (2016) and Omotosho (2020) demonstrated that fuel price hikes reduced household purchasing power and contributed to macroeconomic instability, while Odhiambo (2018) in Kenya showed that rising fuel prices translated quickly into higher CPI through transport and food costs. These studies highlight that in Africa, where households spend a larger share of their income on fuel and food, the adverse effects of petrol price volatility are magnified compared to developed nations.

Within the East African Community, fuel prices vary significantly across countries, shaped by different taxation systems and subsidy policies. Kenya consistently records the highest fuel prices, followed by Uganda and Rwanda, while Tanzania maintains relatively lower levels (Bank of Tanzania, 2024). Nevertheless, Tanzania is highly exposed to global oil price volatility. Over the past two decades, petrol prices in Tanzania have reflected global shocks, such as the 2008 financial crisis, the COVID-19 pandemic in 2020, and the Russia–Ukraine conflict in 2022–2023.

According to EWURA (2024), average pump prices in Dar es Salaam fell to TZS 2,943 per liter in late 2024 due to easing global oil prices, but the country remains vulnerable to international supply disruptions and exchange rate depreciation. Empirical research in Tanzania is still limited. Chegere, Kidane, and Leyaro (2013) showed that fuel price hikes increased production costs across all sectors, negatively affecting real household consumption, while Mkenda et al. (2022) confirmed that fuel costs are a major driver of inflation. Yet, few studies have examined long-term volatility or explicitly linked petrol prices to both CPI and poverty.

This study investigates the impact of petrol price changes on economic welfare in Tanzania over a 25-year period (2000–2024). Specifically, it examines the trends in fuel prices, identifies suitable models of price volatility using ARCH/GARCH approaches, and analyzes the effect of fuel prices on CPI and poverty levels, including nonlinear specifications to capture threshold effects. By combining volatility analysis with welfare outcomes, the study contributes new insights into energy economics in Tanzania.

The paper documents empirical evidence to guide inflation-targeting and poverty reduction strategies, assists firms in managing operational risks from fuel price shocks, and informs social protection programs aimed at cushioning vulnerable populations. The scope covers monthly and annual data from 2000 to 2024, ensuring robust analysis across different economic cycles. This research would be an important development for policymakers, businesses, and households.

This paper has the following structure: Section 2 presents the empirical reviews. Section 3 describes methodology data and empirical model specification. Section 4 presents descriptive statistics, main results and discussions. Lastly, summary, conclusion and implications from the findings are presented in Section 5.

2. Theoretical and Empirical Reviews

2.1 Theoretical Ground Underpinning the Study

The study is grounded in three key theoretical frameworks that explain the relationship between petrol price changes and economic welfare. Cost-push inflation theory posits that rising production costs, including fuel prices, shift the aggregate supply curve leftward, resulting in higher equilibrium prices and general inflation as measured by the CPI (Samuelson & Nordhaus, 2010). Consumer welfare theory further suggests that higher prices reduce consumer surplus and real income, leading to welfare losses; in this context, petrol price increases directly erode household purchasing power and lower living standards (Varian, 2014). Finally, the macroeconomic transmission mechanism explains how energy price shocks propagate through production, transportation, and expectations channels, ultimately affecting output, employment, and household income. This process reinforces the link between fuel price volatility and economic welfare (Kilian, 2017; Baumeister & Kilian, 2016). Both theories remain highly relevant in explaining the dynamics of the current study Both theories are relevant and informative to the current area of study

2.2 Review of Selected Empirical Studies

Empirical studies have consistently documented the strong link between fuel price changes and macroeconomic outcomes. Hamilton (2009), in the United States, demonstrated that global oil price shocks have historically triggered recessions by increasing production and transport costs, thereby raising the overall price level. Arezki, Blanchard, and Dabrowski (2016), using global cross-country data, showed that fuel price increases have regressive welfare effects, disproportionately burdening low-income households.

Evidence from Sub-Saharan Africa is particularly compelling. Alem and Söderbom (2012), in Ethiopia, found that fuel price shocks raise poverty by significantly increasing food and transport expenditures. Similarly, Arndt et al. (2008), in Mozambique, applied a Computable General Equilibrium (CGE) model and confirmed that higher fuel prices negatively affect real household incomes and exacerbate poverty through indirect effects on wages and commodity prices.

In Tanzania, Amin and Karumba (2020) demonstrated persistent volatility clustering in petrol prices using GARCH models, implying that shocks are not only significant but also long-lasting. Adam et al. (2016), In Tanzania found a strong relationship between fuel price movements and the Consumer Price Index (CPI), confirming cost-push inflation dynamics. Chegere et al. (2013), also in Tanzania, observed that rising fuel prices significantly increased rural food prices and contributed to higher poverty levels, especially among net food buyers. Mkenda et al. (2022), in Tanzania, reported that inflation spikes coincide with international fuel price hikes, reinforcing the transmission of global shocks into domestic inflation.

Policy-focused studies strengthen the argument for cushioning measures. Parry, Heine, Lis, and Li (2014), using global data, argued that energy price reforms should be paired with targeted transfers to protect poor households. The World Bank (2023), in Tanzania, and UNDP (2020), across Sub-Saharan Africa, stressed the importance of price stabilization mechanisms and social protection programs to mitigate the adverse welfare impacts of fuel price volatility.

Studies employing volatility models provide further insight. Bollerslev (1986), pioneered the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, which remains a benchmark for volatility modeling. Fong and See (2002), in Singapore, applied GARCH models to crude oil prices and confirmed the presence of volatility clustering and persistence. Salisu and Fasanya (2013), in Nigeria, modeled oil price volatility with GARCH-family models and found strong evidence of long memory and volatility clustering. Mensah et al. (2019), in Ghana, applied GARCH (1,1) and GJR-GARCH models and reported significant asymmetry, with negative price shocks exerting a stronger effect on volatility.

Lastly, in 2023, Gachehe and Mulugeta conducted a panel data study across East African Community countries (Kenya, Tanzania, Uganda, Rwanda, and Burundi) and reported a high CPI elasticity to fuel price shocks. Their results indicated that a 1% increase in international fuel prices significantly raised domestic CPI within 1–2 months, confirming rapid pass-through effects from global to domestic markets. These findings are consistent with Mkenda et al. (2022), who documented similar fuel price–inflation transmission patterns in Tanzania, these results reinforce the importance of considering fuel price volatility when designing macroeconomic and welfare policies.

2.3 Synthesis of Reviews and Hypotheses Development

The experiential and academic works reviewed and presented in Section 2.2 collectively point to petrol price changes as a critical determinant of both inflationary pressures and poverty outcomes in developing economies. Several studies document that fuel price shocks not only exert upward pressure on the Consumer Price Index (CPI) through higher transport and production costs but also worsen household welfare by reducing disposable income and increasing the Poverty Headcount Ratio (Alem & Söderbom, 2012; Arndt et al., 2008; Mkenda et al., 2022). Similar results have been observed across East Africa, where studies such as Gachehe and Mulugeta (2023) report rapid pass-through of international fuel price shocks into domestic inflation, implying that welfare impacts are immediate and significant.

The nature of existing empirical findings reported and discussed suggests a clearly visible research gap. Many of the previous studies focus either on inflation dynamics or on poverty outcomes in isolation, with limited integration of petrol price volatility modeling as a driver of these outcomes. Additionally, most empirical works concentrate on short-run effects, leaving limited insight into the persistence of petrol price shocks and their long-term implications for economic welfare in Tanzania.

In view of the discussed empirical results, there remains room for a comprehensive investigation that simultaneously considers petrol price changes, volatility clustering, and their joint effects on CPI and poverty dynamics using advanced econometric models such as GARCH. Addressing this gap is important because Tanzania, as a net oil importer, remains highly vulnerable to international oil price shocks that can destabilize domestic markets.

Thus, the following research questions remains to be valid: “to what extent do petrol price changes affect the Consumer Price Index in Tanzania? How do petrol price changes influence the Poverty Headcount Ratio? Does petrol price volatility amplify the welfare effects of price shocks over time? In order to respond to these questions and achieve the general and specific objectives of this study, the following hypotheses were developed and statistically tested using time-series regression and volatility modelling approaches, with a GARCH (1,1) specification adopted for the volatility analysis.

General Hypothesis: $H_{0\cdot1}$: There is no statistically significant relationship between petrol price changes and economic welfare indicators (CPI and Poverty Headcount Ratio) in Tanzania.

Specific hypotheses: $H_{0\cdot2}$: Petrol price volatility does not significantly contribute to the deterioration of economic welfare over time.

$H_{0\cdot3}$: Petrol price changes have no statistically significant effect on the Consumer Price Index (CPI) in Tanzania.

$H_{0\cdot4}$: Petrol price changes have no statistically significant effect on the Poverty Headcount Ratio in Tanzania.

3. Methodology

This study employed a longitudinal quantitative research design to examine the impact of petrol price changes on economic welfare in Tanzania, focusing on the Consumer Price Index (CPI) and Poverty Headcount Ratio (HCR). The longitudinal design enabled analysis over a 25-year period (January 2000 – December 2024), capturing both short-term shocks and long-term effects (Gujarati & Porter, 2009).

3.1 Sample and Sample Selection

The dataset comprised 300 monthly observations for petrol prices and CPI, and annual observations for poverty data, which were linearly interpolated to monthly frequency. The sample was purposively selected to cover key global and domestic events such as the 2008 global financial crisis, the 2014 oil price slump, the COVID-19 pandemic, and the Russia–Ukraine conflict.

3.2 Source of Data

Petrol Prices: Monthly retail pump prices (TZS per litre) from the Energy and Water Utilities Regulatory Authority (EWURA). CPI: Monthly CPI data from the National Bureau of Statistics (NBS); Poverty Headcount Ratio: Annual data from Household Budget Survey (HBS) reports, interpolated to monthly values. All variables were log-transformed where appropriate to stabilize variance and allow elasticity interpretation, as recommended by Hamilton (2009) and Mkenda & Ngasamiaku (2013).

3.3 Model Specification

Given the objective of modelling petrol price volatility, the study first employed the **GARCH (1,1)** model developed by **Bollerslev (1986)** to capture volatility clustering and persistence. The model is specified as:

$$\sigma^2_t = \alpha_0 + \alpha_1\varepsilon^2_{t-1} + \beta_1\sigma^2_{t-1} \text{ -- } (1)$$

Where: σ^2_t = Conditional variance of petrol price returns at time t
α_0= constant term
ε^2_{t-1} = Lagged squared residual (ARCH effect)

σ^2_{t-1} = Lagged conditional variance (GARCH effect)

Stationarity of the differenced log-price series was confirmed using the Augmented Dickey-Fuller (ADF) test. The ARCH-LM test detected volatility clustering. Competing GARCH specifications—GARCH (1,1), GARCH (1,2), GARCH (2,1), and GARCH (2,2) were estimated and compared using Akaike Information Criterion (AIC) and log-likelihood statistics. The parsimonious GARCH (1,1) model provided the best fit and was used for volatility forecasting (2025–2030). Diagnostic checks were performed to ensure model validity. These included normality of residuals (Jarque–Bera test), homoscedasticity (Breusch–Pagan test), and Durbin–Watson statistic were used to test serial correlation.

Following the volatility estimation, the study examined the mean impact of petrol prices on welfare indicators using Ordinary Least Squares (OLS) regression models, consistent with Arezki et al. (2016) and Amin & Karumba (2020). Ordinary Least Squares (OLS) regression models were applied to quantify the impact of petrol prices on CPI and poverty. The analysis combines both current and lagged petrol prices were to capture immediate and delayed effects. In addition, nonlinear models (log-log and polynomial specifications) were tested to capture threshold effects in poverty responses. The regression model employed in the research takes the forms:

Log- Linear Regression Model

$$\ln(Y_t) = \beta_0 + \beta_1\ln(X_t) + \varepsilon_t \text{ -- } (2)$$

This specification captured elasticity, where β_1 measures the percentage change in Y

Where: Y_t = dependent variable (CPI or Poverty Headcount Ratio)
X_t = petrol price (current or lagged)
β_0 = constant
β_1 = regression coefficient
ε_t = error term

Polynomial Regression Model

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 X_t^2 + \varepsilon_t \quad \text{---} \quad (3)$$

This model captured potential nonlinear effects, where $\beta_2 > 0$ indicates a convex relationship.

Model (1) was used to test hypotheses $H0._2$ quantifying volatility clustering and persistence of shocks, thus capturing the dynamic risk profile of petrol price changes and their potential to destabilize economic welfare, and Model (2) and (3) were applied to test $H0._1$; $H0._3$; & $H0._4$ measuring the mean impact of petrol price changes (linear and nonlinear effects) on CPI and HCR.

The strength of the relationship between petrol prices and economic welfare indicators (CPI and Poverty Headcount Ratio) was drawn based on the resulting R^2 and other goodness-of-fit statistics from the regression models. This approach is consistent with Hamilton (2009) and Mkenda & Ngasamiaku (2013), who argue that a stronger contemporaneous association between fuel price movements and CPI—reflected in higher R^2 values indicates a higher explanatory power and policy relevance of the estimated model. Accordingly, models with higher R^2 were interpreted as providing a superior fit and more reliable evidence of the effect of petrol prices on welfare outcomes.

The time-series dataset was analysed using STATA version 16.0, and all series were confirmed to be well structured and properly transformed (logs and returns) for time-series modelling. STATA was chosen because of its robust econometric capabilities suitable for quantitative research. Pre-estimation diagnostic tests, including unit root tests and ARCH-LM tests, were conducted to ensure stationarity and the presence of heteroskedasticity effects before model estimation. For the volatility analysis, the GARCH model was selected, as it provided consistent and statistically significant parameter estimates, confirming volatility clustering in petrol price returns.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1 Descriptive Statistics Results

Table 4-1 presents descriptive statistics for petrol prices over the period 2000–2024. The mean petrol price was TZS 1,765.09 per litre, with a median of TZS 1,867.13, indicating a nearly symmetric distribution (skewness ≈ 0.01). The standard deviation of TZS 724.34 reveals substantial variability, consistent with major global oil price shocks and domestic adjustments during the study period. The minimum recorded price was TZS 520.11, while the maximum reached TZS 3,410.00, highlighting the wide price range experienced in Tanzania over the last 25 years. These findings underscore the importance of analysing both price levels and their fluctuations when assessing the welfare implications of fuel price dynamics.

Table 4-1: Descriptive Statistics for Petrol Prices, Log Prices (2000–2024)

variable	*mean*	*sd*	*min*	*max*	*p50*	*skewness*	*kurtosis*	*N*
Petrol_pri~e	*1,765.09*	*724.34*	*520.11*	*3,410.00*	*1,867.13*	*0.011*	*2.41*	*300*

*All figures are presented in TZS. Variables are defined as follows: N is the number of observations sd is the standard deviation; p50 is the median value and Petrol_price is the petrol pump price per litre.

***Table 4-2**: Descriptive Statistics for Consumer Price Index (CPI) and Poverty Headcount Ratio (2000–2024)*

variable	*mean*	*sd*	*min*	*max*	*p50*	*skewness*	*kurtosis*	*N*
MonthlyCPI2020100	*66.52*	*18.46*	*48.20*	*116.86*	*67.29*	*.13*	*1.53*	*300*
PovertyHCR~r	*27.00*	*2.07*	*24.43*	*31.30*	*26.40*	*0.98*	*0.45*	*20*

*MonthlyCPI2020100 represent official Consumer Price Index (2020 = 100); PovertyHCR~r - represents the Headcount Poverty Ratio (Incidence of poverty).

Table 4-2 summarizes the descriptive statistics for the Consumer Price Index (CPI) and the Poverty Headcount Ratio (HCR) over the study period. The mean CPI was 66.52 (2020=100 base year), with a median of 67.29, indicating a relatively symmetric distribution (skewness = 0.13). The standard deviation of 18.46 reflects substantial variation in consumer prices across the 25-year period, driven by domestic inflationary trends and external price shocks such as the 2008 global financial crisis and the 2022 energy market disruptions.

The Poverty Headcount Ratio averaged 27.0%, with moderate variability (standard deviation = 2.07), suggesting gradual improvements in poverty reduction over time. The median value (26.40%) is slightly lower than the mean, and the positive skewness (0.98) indicates that a few years recorded relatively higher poverty levels compared to the general trend. Together, these results highlight the coexistence of rising price levels and slow poverty reduction, providing a strong justification for econometric analysis of how petrol price changes affect both cost of living and welfare outcomes.

4.2 Pairwise Correlations and Volatility Diagnostics Results

Pairwise Pearson correlation analysis was conducted to examine the linear association between petrol prices, the Consumer Price Index (CPI), and the Poverty Headcount Ratio (HCR). The correlation coefficient between petrol prices and CPI was found to be positive and statistically significant ($r \approx 0.78$, $p < 0.05$), indicating that increases in petrol prices are strongly associated with higher cost of living, consistent with cost-push inflation theory (Samuelson & Nordhaus, 2010). The correlation between petrol prices and HCR was also positive, though of lower magnitude ($r \approx 0.56$, $p < 0.05$), suggesting that higher petrol prices are associated with a higher incidence of poverty. The positive correlations across all key variables justify further econometric modeling to establish causal relationships and test the study's hypotheses. This signifies consistency of such variables with existing literature.

Before modelling volatility, stationarity tests were conducted on petrol price series. The log of petrol prices was first computed, and returns were derived as first differences of the log-transformed series Augmented Dickey–Fuller (ADF) tests rejected the null of a unit root ($p < 0.01$), confirming that returns are stationary and suitable for conditional heteroskedasticity modeling. The LM test for ARCH effects ($\chi^2 = 30.79$, $p < 0.001$) indicated significant time-varying volatility, justifying the use of GARCH specifications (Engle, 1982).

Also, the autocorrelation function (ACF) and partial autocorrelation function (PACF) were examined for the return series rtr$_t$rt. The results showed very low autocorrelations for lags 1–5 ($AC_1 = 0.028$), which were statistically insignificant ($p > 0.6$), and no significant autocorrelations beyond lag 5 up to lag 40. This pattern indicates that the return series behaves like white noise in the mean equation, with no systematic serial correlation, thereby satisfying a key assumption required for ARCH/GARCH volatility modeling.

4.3 Main Empirical Results

4.3.1 Volatility Modelling and Model Fitness

Table 4-3 presents the fit statistics for competing GARCH model specifications estimated using Maximum Likelihood Estimation. The GARCH (1,1) model yields the highest log-likelihood (LL = 494.113) and the lowest AIC and BIC, indicating that it provides the best balance between model fit and parsimony (Bollerslev, 1986). This result supports the selection of GARCH (1,1) as the preferred specification for modeling petrol price volatility in Tanzania.

Table 4-3: Summary results of GARCH Models Comparison

Model	*LL*	*AIC*	*BIC*
GARCH (1,1)	*494.113*	*-980.227*	*-965.438*
GARCH (1,2)	*486.358*	*-964.715*	*-949.927*
GARCH (2,1)	*461.752*	*-915.503*	*-900.715*
GARCH (2,2)	*458.011*	*-908.022*	*-893.234*

*Note. *LL = Log-likelihood; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion. Lower AIC and BIC values and higher LL indicate a better-fitting and more efficient model.*

The estimated GARCH (1,1) equation ($\sigma^2_t = \alpha_0 + \alpha_1\varepsilon^2_{t-1} + \beta_1\sigma^2_{t-1}$) , yielded $\alpha_0 = 0.000903$, $\hat{\alpha}_1 = 0.5983$***, $\hat{\beta}_1 = 0.35$***, with $\alpha_1 + \beta_1 = 0.9483 < 1$, confirmin covariance stationarity. This implies that volatility shocks have a strong immediate impact and moderate persistence, meaning volatility clusters but eventually reverts to its long-term mean.

Volatility spikes were most pronounced in 2000–2001, 2011–2012, 2019–2020, and 2022–2023, aligning with global oil price shocks, the COVID-19 pandemic, and geopolitical disruptions (Baumeister & Peersman, 2013; IMF, 2012; EWURA, 2011). These results are consistent with findings by Nkurlu (2023) and Mbilinyi (2020), who reported persistent volatility in Tanzanian petroleum markets.

Additionally, using the stationary GARCH (1,1) model, monthly petrol price forecasts were produced for 2025–2029. The projections reveal a gradual but persistent upward trend, with widening 95% confidence intervals, reflecting growing forecast uncertainty. This finding is consistent with the hypothesis $H_{0.2}$, which proposed persistent volatility effects, and aligns with Tsay (2010) and Francq & Zakoïan (2010). These results validate the rejection of H_0.2, confirming that petrol price volatility is significant and persistent.

4.3.2 Impact of Petrol Price Changes on Consumer Price Index (CPI)

A log–log regression model equation (2) was estimated to assess the effect of petrol prices on the Consumer Price Index (CPI): The estimated elasticity ($\hat{\beta}_1 = 0.96$, $p < 0.01$) indicates that a 1% increase in petrol prices leads to a 0.96% rise in CPI, with $R^2 = 0.56$. These findings directly test Hypothesis $H_{0.3}$, which posited that petrol price changes have no statistically significant effect on CPI. Based on the regression results, $H_{0.3}$ is rejected**.** The strong positive and statistically significant elasticity confirms the theoretical expectation under **cost-**push inflation theory (Samuelson & Nordhaus, 2010), which asserts that rising input costs shift the aggregate supply curve leftward, leading to higher equilibrium prices.

The results are consistent with a growing body of empirical literature. Mkenda et al. (2022) confirmed that fuel price fluctuations are a major driver of Tanzanian inflation, primarily through elevated transport and production costs. Amin and Karumba (2020) documented similar inflationary pass-through effects of fuel price shocks across East African economies, while Gachehe and Mulugeta (2023) reported a high CPI elasticity to fuel prices in East African cities, indicating rapid price transmission mechanisms in the region. Internationally, Omotosho (2020) found that persistent petrol price hikes in Nigeria significantly contributed to headline inflation and eroded household purchasing power.

Taken together, these results validate that petrol prices are a primary driver of inflation dynamics in Tanzania, supporting the rejection of H_0.3. For policy, this underscores the critical need to integrate fuel price stabilization mechanisms such as strategic fuel reserves, calibrated excise taxes, and improved distribution efficiency — into Tanzania's inflation management framework. By mitigating abrupt petrol price shocks, policymakers can help stabilize CPI and protect real incomes, especially for vulnerable households.

4.3.3 Impact of Petrol Price Changes on Poverty (Headcount Ratio)

Regression analysis showed that petrol price levels significantly affect poverty. The contemporaneous model indicated $\hat{\beta}_1 = 0.012$ ($p = 0.01$, $R^2 = 0.329$), while the lagged model confirmed persistence effects with $\hat{\beta}_1 = 0.010$ ($p = 0.037$, $R^2 = 0.244$). Both results imply that rising petrol prices exacerbate poverty immediately and over time. Nonlinear models revealed threshold effects, consistent with Ivanic & Martin (2008) and Arndt et al. (2008).

The regression results demonstrated a statistically significant positive association between petrol prices and poverty, with the contemporaneous model explaining 32.9% of the variance ($R^2 = 0.329$) and the lagged model explaining 24.4% ($R^2 = 0.244$). These results provide strong evidence that rising petrol prices have both immediate and persistent effects on poverty outcomes in Tanzania. Importantly, the nonlinear specifications (quadratic and log–log models) revealed that the impact of petrol prices on poverty is nonlinear and convex, meaning that welfare losses accelerate once petrol prices exceed critical thresholds.

These empirical findings directly address Hypothesis $H_{0.4}$, which posited that petrol price changes have no statistically significant effect on the Poverty Headcount Ratio. Based on the regression results, $H_{0.4}$ is decisively rejected. The evidence indicates that petrol price increases significantly exacerbate poverty both in the short run and over time, supporting the theoretical expectation of cost-push poverty effects within the study's conceptual framework.

This conclusion aligns with global and regional literature. Ivanic and Martin (2008) found that fuel price shocks disproportionately harm the poorest households, magnifying poverty gaps, while Arndt et al. (2008) reported that fuel price shocks significantly lower real household consumption in Mozambique. Alem and Söderbom (2012) demonstrated similar nonlinear welfare losses in Ethiopia, especially for vulnerable urban populations. The lagged effects found in this study echo Adegboye (2020), who documented that energy price shocks gradually pass through to food, rent, and transport markets, prolonging household hardship.

By confirming that petrol price shocks have both direct and lagged effects on poverty, this study strengthens the case for pro-poor stabilization measures. Policy responses should include short-term interventions (e.g., targeted subsidies or cash transfers during price spikes) and medium-term strategies (e.g., diversifying energy sources, improving supply chain efficiency, and integrating price shock scenarios into fiscal planning). Such interventions are crucial to avoid reversing Tanzania's poverty reduction gains and to mitigate the welfare risks posed by future global fuel market disruptions.

5. Summary Conclusions and Recommendations

This study investigated the impact of petrol price changes on economic welfare in Tanzania, focusing on price volatility, inflation (CPI), and poverty (HCR). Using monthly data from 2000–2024, the analysis applied GARCH models for volatility, log–log regressions for CPI, and linear and nonlinear regressions for poverty.

The GARCH (1,1) model was identified as the most parsimonious specification, with $\hat{\alpha}_1 + \hat{\beta}_1 = 0.9483 < 1$, confirming covariance stationarity and mean reversion. Volatility clustering was evident during major global shocks, including the 2008 financial crisis, the 2011 oil price surge, the COVID-19 pandemic (2020), and the Russia–Ukraine conflict (2022–2023). Forecasts for 2025–2029 indicated a gradual price uptrend with widening confidence intervals, reflecting increasing uncertainty over time. These results confirmed $H_{0.2}$ is rejected, indicating persistent volatility risk with important macroeconomic implications (Bollerslev, 1986; Tsay, 2010).

Log–log regression results revealed a statistically significant positive relationship between petrol prices and CPI, with $\hat{\beta}_1 = 0.96$ ($p < 0.01$, $R^2 = 0.56$), suggesting nearly full pass-through of petrol price changes to consumer prices. This finding supports cost-push inflation theory (Samuelson & Nordhaus, 2010) and validates the rejection of $H_{0.3}$, highlighting petrol prices as a major determinant of inflationary dynamics in Tanzania (Mkenda et al., 2022; Amin & Karumba, 2020). Also, Regression results showed that petrol price increases significantly worsen poverty, both contemporaneously ($\hat{\beta}_1 = 0.012$, $p = 0.01$) and with lagged effects ($\hat{\beta}_1 = 0.010$, $p = 0.037$). Nonlinear models confirmed threshold effects, where poverty impacts accelerate at higher price levels, consistent with international literature (Ivanic & Martin, 2008; Alem & Söderbom, 2012). These findings reject $H_{0.4}$ and indicate that petrol price shocks act as poverty multipliers, with severe implications for welfare.

The collective indicates that petrol price volatility and price changes significantly affect both inflation and poverty in Tanzania. These results underscore the importance of fuel price stabilization mechanisms, targeted subsidies, and social protection interventions to mitigate the adverse welfare impacts of future fuel price shocks.

As much as this research has been valuable in examining the effects of petrol price fluctuations on the Consumer Price Index (CPI) and poverty in Tanzania, there remains scope for further investigation to deepen the understanding of these dynamics. Future studies could explore sector-specific impacts of petrol price volatility, particularly in transport, agriculture, and manufacturing. Moreover, assessing the effectiveness of government interventions such as price stabilization mechanisms, subsidies, and fuel taxation policies would provide critical evidence on their adequacy and inform the design of more resilient and equitable policy frameworks. Addressing these areas would complement the current findings, enrich the empirical evidence base, and support more comprehensive decision-making for poverty reduction and economic stability in Tanzania and comparable developing economies.

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