Vol. 5 (Iss. 4) 2024, pp. 1089-1106 African Journal of Empirical Research https://ajernet.net ISSN 2709-2607

# The Relationship between Crude Oil Price Fluctuations and Economic Growth in Tanzania

Stella Richard[1]
Dr. Seif Ramadhan Muba[2]

[1]richardstella100@gmail.com
[2]deemuba@mzumbe.ac.tz

[1,2]Mzumbe University, Dar es Salaam Campus

## ABSTRACT

*This paper studies the relationship between crude oil price fluctuations and economic growth in Tanzania employing a Vector Error Correction Model (VECM) to capture both short-run and long-run relationships from annual secondary time series data from 1988 to 2022. The ADF and PP unit root tests were used to check for stationarity and the variables became stationary at first differencing (I(1)). Johansen cointegration tests revealed at least one cointegration vector, indicating a strong long-run relationship among variables. Long-run equations were estimated using least squares, short-run equations were estimated using error correction model, and Granger causality tests were conducted to analyze dynamic relationships. Model diagnostic tests included the Jarque-Bera test for normality, the Lagrange multiplier for autocorrelation, and the Eigenvalue stability condition for model stability. The findings revealed that in the short run, the relationship between crude oil price fluctuation and GDP is insignificant, indicating that immediate fluctuation in oil prices does not significantly impact economic growth. However, there is a negative relationship between crude oil prices and GDP in the long run, reflecting the adverse impact of prolonged increases in crude oil prices on economic growth. Granger causality tests provided compelling insights, as crude oil prices and interest rates unidirectionally drive GDP, while GDP exhibits a bidirectional causality with both inflation and exchange rates. Moreover, the joint influence of these variables has a significant impact on GDP. The study recommended that in the long run, the diversification of energy sources to reduce dependency on oil import while broadening the economic base. In the short run, strategic oil reserves and financial instruments are to be used in managing crude oil price fluctuations. Furthermore, the study recommends that policymakers consider complex interrelationships among the variables when analyzing economic growth and when making policy decisions.*

**Keywords**: Crude Oil Price, Economic Growth, Exchange Rate, Interest Rate, Inflation rate

## I. INTRODUCTION

Energy has been an essential driver of global economic growth, playing a crucial role across several sectors since its discovery (Tehranchian & Abdi Seyyedkolaee, 2017). The significance of oil has increased to the level that without oil in the world, major systems of distribution that are crucial for economic transactions beyond local levels will fail and the world economy will collapse (Tehranchian & Abdi Seyyedkolaee, 2017). Thus, the increasing crisis in prices of crude oil has, at times, caused significant global economic challenges (Ahmad *et al.*, 2022). The volatility in oil prices affects economies differently, based on whether the countries are net oil import or net oil export countries. For countries that are oil-importing, high oil prices might result in high import costs and unfavorably affect GDP, inflation, the balance of payment, and currency exchange rate. Nevertheless, in net oil exporter countries, high prices of crude oil increase oil revenue and so improve the balance of payment (Gershon *et al.*, 2019).

Since the 1970s, crude oil prices have undergone significant changes which are related mostly to historical events, leading to a lasting effect on both the global economy and politics. Notable instances such as the 1973-1975 oil crisis in the Middle East, the 1979 Iranian Revolution, oil prices substantial plummet in the 1980s, a drop in oil prices in 1990, and oil prices fall in 2001 (Dinh, 2022). In the past decade, the world witnessed the collapse of the oil market in 2014/2015, the COVID-19 pandemic that resulted in an unprecedented fall in prices, and the ongoing war between Russia and Ukraine. The ongoing Russia-Ukrainian war disrupted oil supplies and increased uncertainty in the oil market compared to the crises prior such as COVID-19 (Mati et al., 2023). The eruption of the war triggered a series of events that gave rise to a dramatic surge in crude oil prices which disrupted the global economy with Tanzania not exempted from this trend. The Brent and West Texas Intermediate and crude oil futures prices per barrel in March 2022 were $133.460 and $139.130, respectively, the highest since July 2008; these prices were $ 147.50 and $ 147.27 per barrel, respectively(Zhang et al., 2024).

In Africa, despite having numerous refineries, the continent remains heavily dependent on costly oil imports, making it energy-poor and vulnerable to price fluctuations (Digha, 2022). The ongoing trend of global oil prices has driven significant concern regarding economic implications. By October 2023, retail prices for petroleum products in Tanzania reached unprecedented levels, with diesel costing Tzs 3,448 per liter (approximately $1.35) and petrol at Tzs

3,281 per liter (approximately $1.29), reflecting increases of 52% and 35%, respectively, since October 2021. Although the government initially implemented subsidies to mitigate rising prices, these were removed in January 2023, exacerbating fuel inflation (Digha, 2022). These oil price fluctuations have raised significant concerns about their impact on the economy and household budgets (Sabayo et al., 2023).

Considerable research such as Abdelmoula & Abdelsalam (2019); Ahmad *et al.* (2022); Chang & Wong (2003); Deyshappriya *et al.* (2023); Dinh (2022); A. Gonzalez & Sherzod (2009), Gershon et al. (2019); Korley & Giouvris (2022) and Ogboru *et al.* (2017) studies about the relationship of changes in the price of crude oil on economies, however, gaps remain in the understanding of their specific direction effects on individual countries, such as those that are net oil importers like Tanzania. Abdelmoula & Abdelsalam (2019); and Ahmad *et al.* (2022) point out that high and volatile oil prices pose challenges by increasing import bills, contributing to inflation, and impacting economic growth. This study seeks to fill these gaps by investigating whether the economic growth in Tanzania can be explained by fluctuations in crude oil prices, through analyzing historical data and relevant literature using VECM from 1988 to 2022,

This study draws both theoretical and practical contributions in more ways to the body of knowledge. The author's contribution to this study lies in analyzing the relationship between fluctuation in crude oil prices and economic growth in Tanzania from 1988 to 2022. In addition, the study's conclusions will guide policymakers and regulators in Tanzania in understanding the relationship between crude oil prices and economic growth and assist them in formulating prudent policies without fearing the changes in crude oil prices. The study comes with methodology benefits, providing country-specific analysis that leads to reliable findings. Furthermore, the study will contribute to the existing literature on the relationship between crude oil price fluctuations and economic growth. The study's findings will contribute to the broader discussion on the relationship between crude oil price fluctuations on economic growth, particularly in the context of net oil-importing countries in Africa including Tanzania. The remainder of this study is organized in such that, an introduction is followed by a literature review, which is followed by methodology, empirical results, discussion, and conclusion.

### 1.1 Statement of the Problem

A stable and moderate trend in crude oil prices is essential for sustained economic growth, as emphasized by the Organization of the Petroleum Exporting Countries (OPEC). Predictability in oil prices allows governments and businesses to plan effectively, reducing uncertainty in the economic environment, which benefits both oil-importing and exporting nations (Pierru et al., 2018). However, the outbreak of the Russia-Ukraine War in February 2022 has resulted in a significant global surge in oil prices, with Tanzania also affected. The average price of crude oil per barrel increased dramatically from $70.76 in 2021 to $98.65 in 2022, representing a 40% rise (EWURA, 2023). This escalation had a cascading effect on refined product prices, with Free On Board (FOB) prices for diesel, petrol, and kerosene/jet A-1 rising by 36%, 69%, and 66%, respectively, compared to the previous year (EWURA, 2023).

The crude oil price fluctuation is unpredictable and surpasses that of any other commodity due to its immense global significance, as its consequences are not limited to the cost of fuel which creates uncertainty in the economy (Abdelmoula & Abdelsalam, 2019; Ahmad *et al.*, 2022). The fluctuation in crude oil prices poses challenges for oil-importing countries by inflating import bills and contributing to inflation, thus adversely affecting economic growth. Oil products are the principal input in crucial sectors like transportation, power generation, and manufacturing, thus putting the nation's economy under the alarming impacts of price fluctuation and the overall economy (Ahmad *et al.*, 2022). Despite these challenges, Tanzania's GDP growth rate reached 4.6% in 2022 and 5.1% in 2023, with projections of 6% by 2025 (International Monetary Fund, 2022; World Bank, 2024). This resilience amid economic turmoil necessitates further investigation into the relationship between crude oil price fluctuations and economic growth in Tanzania.

### 1.2 Research Objective

#### 1.2.1 General Research Objectives

The main study objective was to analyze the relationship between crude oil price fluctuation and economic growth in Tanzania.

#### 1.2.2 Specific Objectives

The study was guided by the following specific objectives

i. To determine the existence of the long-run relationship between crude oil price fluctuation and Tanzania's economic growth.
ii. To determine the existence of the short-run relationship between crude oil price fluctuation and Tanzania's economic growth.
iii. To investigate the causal relationship between Tanzania's economic growth and crude oil prices.

### 1.3 Research Question

The study focuses on answering the following research questions

i. Is there a long-run relationship between crude oil price fluctuations and Tanzania's economic growth?
ii. Is there a short-run relationship between crude oil price fluctuations and Tanzania's economic growth?
iii. What is the causal relationship between Tanzania's economic growth and crude oil prices?

## II. LITERATURE REVIEW

### 2.1 Theoretical Review

This section provides a theoretical foundation by reviewing three key theories on the relationship between crude oil price fluctuations and economic growth: The Linear/Symmetric Relationship Theory, the Asymmetry in Effects Theory, and the Renaissance Growth Theory.

The Linear/Symmetric Relationship Theory argues that fluctuations in oil prices have a significant and inverse impact on economic growth. This theory, supported by studies like Hamilton (1983) and Hooker (1996), demonstrates a symmetrical relationship where both increases and decreases in oil prices affect GDP, however, the impact of price decreases may vary across countries. The Asymmetry in Effects Theory suggests that oil price increases have a more significant negative effect on GDP compared to price decreases. This theory was applied to the U.S. economy and OECD countries, showing diverse effects of oil price fluctuations. Ferderer (1996) provides explanations for this asymmetry, such as sectoral shocks and monetary policy responses. The Renaissance Growth Theory, introduced by Lee (1998), critiques the symmetric theory by distinguishing between oil price changes and volatility. The study concluded that price volatility has a longer-term negative impact on economic growth, while the effects of price changes diminish after a year.

This research adopts the Renaissance Growth Theory due to its relevance to the study's focus on the relationship between crude oil price fluctuations and economic growth in Tanzania. This theory allows for a comprehensive analysis of both short-term and long-term effects of oil price dynamics, aligning closely with the study's objectives.

### 2.2 Empirical Review

Several researchers have been attracted to the study of the oil prices and economic growth relationship since the pioneering work of Hamilton (1983). The majority of empirical results revealed a negative correlation between oil prices and economic growth and the fluctuation of oil price impacts on economic growth varies from one country to another country depending on the extent the economy relies on oil (Sabayo *et al.*, 2023). However, despite of majority of studies revealing a significant inverse relationship between oil price fluctuation and economic growth, there are conflicting results and different opinions presented in several studies ended up with such as Asaleye *et al.* (2019), Chang & Wong (2003), Charfeddine *et al.* (2020) and Gonzalez (2014). These studies show that oil price fluctuation and economic growth relationship appears to be slightly weaker. In this case, this research revisited the relationship between oil prices and economic growth by ensuring more rigorous and up-to-date empirical evidence.

#### 2.2.1 The Long-Run Relationship between Crude Oil Price Fluctuation and Economic Growth

There is an ongoing discussion in the literature regarding how oil price changes affect a country's economic activity during a specified time frame. Studies examining the long-run relationship between crude oil price changes and economic growth have produced mixed findings. Dinh (2022) examined the relationship across nine countries and concluded that prices of crude oil significantly impacted the economic growth of South Korea, Vietnam, and China, while other countries showed minimal impact. The study concluded that crude oil prices have a significant negative impact in the long run on economic growth due to increased production costs leading to higher consumer prices. Similarly, Benli *et al.* (2019) discovered an asymmetric long-run effect of oil prices on Turkey's economic growth. The study revealed a negative impact of oil prices on economic growth in the long run however economic growth does not respond to decreases in prices of oil and responds to increases in oil prices since decreases in oil prices were found to be statistically insignificant. Odhiambo and Nyasha (2019) concluded in Kenya there is a one-way directional Granger causality from economic growth to oil prices, suggesting that long-term GDP performance is not impacted by fluctuations in oil prices. Conversely in Tanzania, Sabayo *et al.* (2023) discovered that in the long run when export and import effects are controlled, oil price unpredictability negatively impacts economic growth.

#### 2.2.2 The Short-Run Relationship between Crude Oil Price Fluctuation and Economic Growth

Furthermore, the relationship between crude oil price fluctuations and economic growth has shown significant variations in the short run across different studies. Dinh (2022) noted that in the short term, crude oil price fluctuation significantly impacted the economies of South Korea, Vietnam, and China while other countries in the study exhibited

minimal effects. While in Tanzania, Sabayo *et al.* (2023) discovered that oil price volatility has a positive impact on economic growth in the short run. Ahmad *et al.* (2022) focused on South Asian countries and resolved that global oil prices significantly influence their economies, where each country responds differently based on their economic structures. Hamilton (1983) conducted a study on the U.S. economy and discovered a unidirectional causality where oil price instability led to economic recessions, a finding supported by subsequent studies by Gershon *et al.* (2019) and Charfeddine *et al.* (2020), these studies emphasized the impact of changes on oil price GDP growth over different periods and economies.

### 2.2.3 Causality between Crude oil Price Fluctuation and Economic Growth

Hamilton (1983) explored the impact of oil price volatility on the U.S. macroeconomy from 1948 to 1972, demonstrating that oil price instability was a key factor in U.S. economic recessions. Using the Granger causality test, Hamilton found a one-way relationship, where oil prices influenced economic production. Later studies by Ferderer (1996), Hooker (1996), and Gadea *et al.* (2016) confirmed this relationship between oil price fluctuations and macroeconomic outcomes. However, Charfeddine *et al.* (2020) replicated Hamilton's study, using data from 1947 to 2019, results confirmed oil prices' influence on GDP growth but found weaker effects in certain periods. Decreases in oil prices had uncertain impacts on GDP. Furthermore, Gershon *et al.* (2019) examined the effect of oil price shocks on West African oil-importing countries, revealing mixed results. While oil prices positively impacted GDP in Sierra Leone and Liberia, no significant causality was found for The Gambia and Cape Verde. Odhiambo & Nyasha (2019) investigated oil prices and economic growth in Kenya (1980–2015), showing a unidirectional causality where economic growth influenced oil prices, but not vice versa. Finally, Sabayo *et al.* (2023) examined oil price fluctuations' impact on inflation and growth in Tanzania from 1970 to 2020 and found no causality between GDP and oil price volatility, but a bidirectional relationship between inflation and economic growth**.**

Moreover, there is a notable gap in research conducted concerning oil-importing developing countries such as Bangladesh, Thailand, El Salvador, Kenya, Uganda, Tanzania, Ethiopia, Mozambique, Gambia, Senegal, and Mali (Akinsola and Odhiambo, 2020). According to Akinsola and Odhiambo (2020), oil price fluctuation impact on developing countries could be disproportionately severe related to the highest income group on which the extent of the impact based on the distribution of oil imports among net oil importers and both oil importers and oil exporters portfolio preferences. Most of these studies concentrated on developed countries (Ahmad *et al.,* 2022; Chang and Wong, 2003; Deyshappriya *et al.*, 2023; Dinh, 2022; A. Gonzalez and Sherzod, 2009), net oil exporting countries and in Africa, only West Africa countries were reviewed mostly (Abdelmoula and Abdelsalam, 2019; Gershon *et al.*, 2019; Korley and Giouvris, 2022; Ogboru *et al.*, 2017). While this study was anchored on the related research in some respects, the difference however lies in the source of data, study duration covered and the area of the study, thus, the researcher establishes the study in the Tanzania context. In this study, the oil price fluctuation and the economic growth of Tanzania relationship was investigated from 1988 to 2022, while measuring economic growth and other variables such as interest rate, currency exchange rate, and inflation allowing the inclusion of additional data to validate the conclusions drawn from the study.

## III. METHODOLOGY

In this study, time series data applied from the years 1988 to 2022 were acquired from the World Bank (WB), and Bank of Tanzania (BOT). Real GDP is the dependent variable used as the measure of economic growth, while crude oil price is the independent variable, and control variables of inflation rate, currency exchange rate, and interest rate. Thus, the study had a total number of 31 observations to answer the research hypothesis. The data selected aligns with the availability of quantitative data and encompasses major oil shocks which allow examination of how these trends influenced the economic growth of Tanzania. A causal or explanatory research design was adopted in this study aims to establish a cause-and-effect relationship enabling the researcher to effectively explore the cause-and-effect relationship between variables by employing various statistical techniques. To differentiate itself from previous studies such as (Ahmad et al., 2022; Benli et al., 2019; Gershon et al., 2019; Odhiambo & Nyasha, 2019; Sabayo et al., 2023), this study adopts a Vector Error Correction Model (VECM), which allows for analyzing both short-run and long-term equilibrium relationships between the variables. Unlike traditional models, VECM is suited for time series data that are non-stationary but cointegrated, enabling the study to better capture the underlying adjustments toward equilibrium over time.

### 3.1 Empirical Model

The study used VECM to investigate the relationship between changes in the price of crude oil and economic expansion. To examine the statistical relationship between dependent and independent variables, the multiple linear

regression model was employed. As a result, the econometric model that was applied to achieve the research goals is given as;

$GDP_t = \beta_0 + \beta_1 COP_t + \beta_2 Infl_{t_2} + \beta_3 it_{t_3} + \beta_4 Ex_{t4} + \varepsilon_i$

Where $GDP_t$ is the Gross Domestic Product in period t as a measure of Economic growth. $COP$ is Crude Oil Price at period t, $Infl_t$ is the inflation rate at period t, and $Ex$ stands for the Interest rate at time t and exchange rate respectively. $\beta_{i's}$ are unknown parameters that were estimated and $\varepsilon_t$ is the error term.

The long-run equilibrium and the short-run adjustment are successfully combined by the Error Correction Model (ECM) without compromising information on the long-run relationship. The ECM was adopted and the equation is modeled on a function of lagged differences of all variables and error correction terms as follows;

$$\Delta GDP_t = \alpha + \sum_{i=1}^{n} \beta_i \, \Delta COP_{t-i} + \sum_{j=1}^{n} \gamma_j \, \Delta it_{t-j} + \sum_{k=1}^{n} \delta_k \, \Delta Infl_{t-k} + \sum_{l=1}^{n} \delta_l \, \Delta Ex_{t-l} + \lambda(ECT_{t-1}) + \epsilon_t$$

Where ($ECT_{t-1}$) is the Error correction term from the co-integration equation, indicating the adjustment back to the long-run relationship. λ represents the coefficient on the error correction term, indicating the speed of adjustment towards equilibrium. N is the number of lags chosen and is Δ the first difference operator.

To investigate causation among variables, the Granger causality approach was adopted, and the causality direction was determined through the following equations which are used simultaneously:

$$GDP_t = \alpha_0 + \sum_{i=1}^{p} \alpha \, GDP_{t-i} + \sum_{i=1}^{p} \beta_i \, COP_{t-i} + \sum_{i=1}^{p} \gamma_i \, Z_{t-i} + \epsilon_t$$

$$COP_t = \delta_0 + \sum_{i=1}^{p} \delta \, COP_{t-i} + \sum_{i=1}^{p} \gamma_i \, GDP_{t-i} + \sum_{i=1}^{p} \theta_i \, Z_{t-i} + v_t$$

Where $\alpha_0$, $\beta_i$, $\gamma_i$, $\delta_0$, and $\theta_i$ are estimated parameters. $Z_{t-i}$ represents other control variables included in the analysis. $\epsilon_t$ and $v_t$ are the error terms in each equation.

## IV. FINDINGS & DISCUSSIONS

The study's main objective was to examine how Tanzania's economic growth and changes in crude oil prices from 1988 to 2022 relate to one another. A quantitative approach was employed for the analysis, and the Vector Error Correction (VEC) Model was applied using an economic software package called Stata to assist in data analysis. The reasons for selecting VECM were drawn from the outcomes of preliminary tests of the series which discovered cointegration evidence among variables. VECM model is intended to be applied when variables are non-stationary series in the level but become stationary after first differencing and the presence of cointegration is known (Hill *et al.*, 2011).Engle & Granger (1987) discussed that when variables are cointegrated, their dynamic relationship can be expressed through an error correction representation. To capture both the long-run and short-run relationships, an error correction term derived from the long-run equation must be included.

### 4.1 The Trend of Macroeconomic Variables


**Figure 1**

*Time Series Plot of Gross Domestic Product, Exchange Rate, Crude Oil Price, Interest Rate, And Inflation Rate*

Figure 1 shows the nature of each time series data in terms of the components it comprises, and it also provides a picture of whether the time series data is stationary or not by just visual inspection even though later the formal test of argument Dickey fuller test employed. The gross domestic product (GDP) and exchange rate both exhibit only a trend component, and also, this is nonstationary since the figure depicts that from the year 1988 up to 2022, there is an upward increase in the gross domestic product and exchange rate, so this provides the picture that both variance and mean increase with time and not constant.

Similarly, the crude oil price shows three components: trend, cyclical, and irregular, because of that, this time series shows the wander up and down and trending in an upward direction also making it nonstationary. The interest rate and inflation rate, each with trend, cyclical, and irregular components, demonstrate changing means and variances over time, further confirming their nonstationary nature. Consequently, all-time series in Figure 1 are nonstationary in their level form, suggesting there is a need to apply a different process to determine the order of integration of each time series data employed in this study.

#### 4.1.1Summary Statistics of Macroeconomic Variables

**Table 1**

*Descriptive Statistics*

| Variables | GDP | CP | Ln(GDP) | ln(CP) | INF | ER | IR |
|---|---|---|---|---|---|---|---|
| **Obs** | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| **Mean** | 2.71E+10 | 47.945 | 23.62 | 3.649 | 12.68 | 1206.162 | 20.2 |
| **Std. Dev.** | 2.22E+10 | 31.019 | 0.975 | 0.69 | 10.21 | 715.034 | 6.4 |
| **Min** | 4.26E+09 | 13.06 | 22.172 | 2.57 | 3.3 | 125 | 14.1 |
| **Max** | 7.57E+10 | 105.01 | 25.05 | 4.654 | 35.9 | 2303.074 | 36 |
| **Skew.** | 0.701 | 0.584 | -0.163 | 0.031 | 1.02 | 0.236 | 1.16 |
| **Kurt.** | 2.181 | 1.973 | 1.661 | 1.524 | 2.59 | 1.839 | 3.15 |

Ln= Natural logarithms, CP=Crude oil price, INF= Inflation, ER = Exchange rate and IR interest rate

Table 1 shows the summary statistics of time series data employed in this study that provide a picture of the number of observations used for each time series, which was 35 observations that cover a period from 1988 to 2022. Table 1 noted a significant GDP standard deviation of 2.22E+10, which was reduced to 0.975 after a logarithmic

transformation. Through this transformation, the mean, minimum, maximum values, skewness, and kurtosis were reduced, suggesting variance stabilization and a reduction in the impact of outliers, thus model performance improvement by aligning with parametric test assumptions. This is similar to the case of crude oil prices exhibiting all GDP characteristics after applying logarithms

Moreover, the inflation rate is depicted by a positively skewed of 1.02, meaning it has a heavy tail on the right side, with a kurtosis of 2.59 this indicates that inflation data is platykurtic (kurtosis < 3), implying that its distribution is flatter than the normal distribution. The gap between them, is not big, implying that there might be no outlier. The exchange rate shares these platykurtic characteristics. In contrast, the interest rate was found to be leptokurtic (kurtosis > 3); this is a sign of a potential outlier, however, when comparing other summary statistics such as the difference between maximum value (36) and minimum value (14.1) together and the average value (20.2), you can notice that them their gap is minimal so as that this signifies no outlier.

### 4.1.2 Correlation Matrix

**Table 2**

*Pairwise Correlations*

| Variables | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **(1) Gross domestic product** | 1.000 | | | | |
| | | | | | |
| **(2) Crude oil price** | 0.842 | 1.000 | | | |
| | (0.000) | | | | |
| **(3) Inflation rate** | -0.817 | -0.606 | 1.000 | | |
| | (0.000) | (0.000) | | | |
| **(4) Exchange rate** | 0.967 | 0.764 | -0.764 | 1.000 | |
| | (0.000) | (0.000) | (0.000) | | |
| **(5) Interest rate** | -0.784 | -0.741 | 0.768 | -0.662 | 1.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) | |

Table 2 shows the finding of pairwise correlation for both independent variables and dependent variables employed in the analysis, offering a valuable understanding of the relationship between economic variables and potential multicollinearity. The findings indicate that the independent variables used in the model are free from the multicollinearity problem as all pairwise correlation coefficients of independent variables did not exceed 0.8 in absolute value except for the case of pairwise correlation between the independent variables and a dependent variable.

In addition, the findings depict a very strong, significant positive linear relationship between crude oil price and GDP since the coefficient of a linear relationship ($r = 0.842$, $p = 0.000$) as well as between exchange rates and GDP ($r = 0.967$, $p = 0.000$), suggesting strong associations where higher crude oil prices and exchange rates align with increased GDP. Conversely, there was a strong negative linear relationship between inflation rates and GDP ($r = -0.817$, $p = 0.000$) as well as between interest rates and GDP ($r = -0.784$, $p = 0.000$), indicating that higher inflation and interest rates tend to be associated with lower economic growth. These results underscore the significant impact of these economic indicators on GDP, reflecting both positive and negative economic relationships crucial for understanding broader economic dynamics.

### 4.2 Lag Length Selection

The initial step in analyzing a model involves determining the appropriate number of lags for each variable as the lags represent the time it takes for past changes in a variable to impact the current value of another variable. Several criteria are used to select the optimal lag length, including the Akaike Information Criterion (AIC), the Final Predictive Error (FPE), Schwarz Bayesian Information Criterion (SBIC), and Hannan-Quinn Information Criterion (HQIC).

**Table 3**
*Lag Length Selection*

| Variable | Lag | FPE | AIC | HQIC | SBIC |
|---|---|---|---|---|---|
| **GDP** | | | | | |
| | 0 | 0.82604 | 2.64674 | 2.66182 | 2.693 |
| | 1 | .010964* | -1.67547* | -1.64531* | -1.58295* |
| | 2 | 0.01117 | -1.6576 | -1.6124 | -1.5188 |
| | 3 | 0.0119 | -1.5951 | -1.5348 | -1.4101 |
| | 4 | 0.01269 | -1.5321 | -1.4567 | -1.3008 |
| **Crude oil price** | | | | | |
| | 0 | 0.46979 | 2.08239 | 2.09747 | 2.12865 |
| | 1 | .079626* | .307285* | .337442* | .3998* |
| | 2 | 0.08384 | 0.35847 | 0.40371 | 0.49724 |
| | 3 | 0.07991 | 0.30962 | 0.36993 | 0.49465 |
| | 4 | 0.08483 | 0.36794 | 0.44333 | 0.59923 |
| **Inflation rate** | | | | | |
| | 0 | -107.782 | 65.3891 | 7.01821 | 7.03329 |
| | 1 | 13.8343 | 5.46485 | 5.49501 | 5.55736* |
| | 2 | 14.4908 | 5.51079 | 5.55602 | 5.64956 |
| | 3 | 13.0587* | 5.40589* | 5.4662* | 5.59092 |
| | 4 | 13.5306 | 5.43999 | 5.51538 | 5.67128 |
| **Exchange rate** | | | | | |
| | 0 | 436502 | 15.8244 | 15.8395 | 15.8707 |
| | 1 | 8734.24* | 11.9127* | 11.9429* | 12.0052* |
| | 2 | 9313.53 | 11.9765 | 12.0217 | 12.1153 |
| | 3 | 9765.05 | 12.023 | 12.0833 | 12.208 |
| | 4 | 10391 | 12.0837 | 12.1591 | 12.315 |
| **Interest rate** | | | | | |
| | 0 | 44.0197 | 6.62249 | 6.63757 | 6.66875 |
| | 1 | 7.94507* | 4.91025* | 4.94041* | 5.00276* |
| | 2 | 8.07869 | 4.9265 | 4.97174 | 5.06527 |
| | 3 | 8.62396 | 4.99097 | 5.05129 | 5.17601 |
| | 4 | 9.16313 | 5.05022 | 5.12562 | 5.28151 |

*Show the maximum number of lags suggested by the criterion

Table 3 shows the findings of the maximum number of lags of each time series variable employed in this study after applying four methods or criteria for choosing the maximum number of lags. All criteria consistently suggest a maximum number of lags is one, indicating strong agreement across methods. However, the inflation rate indicated variation in the optimal lag length: except for SBIC which suggests one lag, FPE, AIC, and HQIC suggest three lags, suggesting the influence of these criteria when there are fewer observations.

### 4.3 Unit Root Test or Stationarity Test Results

The variable's unit root was examined using both the Dickey-Fuller test and the Phillips–Perron test. Although the Dickey-Fuller test is more widely applied than other tests of unit root, it is known to be biased. To mitigate this issue both tests of unit root were applied. The results of both the ADF and PP tests will be presented in Table 4.

**Table 4**

*Augmented Dickey-Fuller Test and Phillips's Perron Test for Stationarity.*

| **ADF Test** | | | | | |
|---|---|---|---|---|---|
| **Variable** | **Level** | | **First difference** | | **Order of integration** |
| | Test statistics | Critical value | Test statistics | Critical value | |
| **GDP** | -0.641 | -2.978 | -3.833 *** | -2.980 | I (1) |
| **CP** | -1.109 | -2.978 | -5.234 *** | -2.980 | I (1) |
| **INF** | -1.853 | -2.978 | -5.813 *** | -2.980 | I (1) |
| **ER** | -0.275 | -2.978 | -4.437 *** | -2.980 | I (1) |
| **IR** | -1.521 | -2.978 | -3.781 *** | -2.980 | I (1) |
| **The PP Test** | | | | | |
| **Variable** | **Level** | | **First difference** | | **Order of integration** |
| | Test statistics | Critical value | Test statistics | Critical value | |
| **GDP** | -0.007 | -2.975 | -4.750 *** | -2.978 | I (1) |
| **CP** | -1.212 | -2.975 | -5.153 *** | -2.978 | I (1) |
| **INF** | -1.779 | -2.975 | -5.323 *** | -2.978 | I (1) |
| **ER** | -0.294 | -2.975 | -5.685 *** | -2.978 | I (1) |
| **IR** | -1.279 | -2.975 | -5.023 *** | -2.978 | I (1) |

Table 4 findings reveal that all the variables were non-stationary at their level form, as evidenced by the presence of test statistics for both ADF and PP tests, which were less in absolute values than their corresponding critical values at a 5% level of significance employed.

However, after applying the first difference transformation to all-time series variables used in this study, the findings depict that all the variables are stationary, as evidenced by the presence of test statistics for both ADF and PP tests, were greater in absolute values than their corresponding critical values at 5% level of significance employed. This finding implies that these time series variables all have one order of integration.

### 4.4 Co-integration Test

The analytical test that describes the long-term relationship between the time series variables is known as Johansen co-integration (Akaike, 1974; Johansen, 1988). In this test, the maximum likelihood estimation method is commonly used. The eigenvalue statistic and the maximum statistic are the two main statistics that are included in the Johansen co-integration test (Gujarati, 2011; Hjalmarsson & Österholm, 2007).

**Table 5**

*Show the Findings of the Johnsen Co-Integration Test*

| Null Hypotheses | Trace statistic | Critical value | Max-Eigen statistic | Critical Value |
|---|---|---|---|---|
| $r = 0$ | 170.1626 | 68.52 | 78.1355 | 33.46 |
| $r \leq 1$ | 92.0271 | 47.21 | 49.1177 | 27.07 |
| $r \leq 2$ | 42.9094 | 29.68 | 25.7297 | 20.97 |
| $r \leq 3$ | 17.1797 | 15.41 | 9.9164 | 14.07 |
| $r \leq 4$ | 7.2633 | 3.76 | 7.2633 | 3.76 |

Table 5 shows that when the null hypothesis was $r = 0$, the test statistic for both trace statistic and Max-Eigen statistic were greater than their corresponding critical values. thus, we reject the null hypothesis of no co-integration. This implies that the variables employed have a long-run relationship. Moreover, the findings show that at all null hypotheses, the test statistics for both trace statistic and Max-Eigen statistic were greater than their corresponding critical values at a 5% level of significance employed. This provides evidence of the existence of at least one co-integration vector suggesting a strong long-term relationship among variables.

### 4.5 Long-Run Relationship Between Crude Oil Price Fluctuation and Tanzania's Economic Growth

The study examined the long-run relationship between the price of crude oil fluctuation and Tanzania's economic growth. Since there is a presence of cointegration among variables, the study applied the long-run equation using least squares to reveal the variables' long-run relationship. The results from estimating long-run equation using least squares are shown in Table 6

**Table 6**

*Estimate Long-Run Equation with Least Squares*

| Beta | Coef. | Std. Err. | z | P>z | Lower CI | Upper CI |
|---|---|---|---|---|---|---|
| **_ce1** | | | | | | |
| **GDP** | 1 | . | . | . | . | . |
| **CP** | -2.860563 | 0.26717 | -10.71 | 0.000 | -3.3842 | -2.33692 |
| **INF** | 0.1352048 | 0.01665 | 8.12 | 0.000 | 0.102578 | 0.167832 |
| **ER** | -0.000202 | 0.00019 | -1.09 | 0.277 | -0.00057 | 0.000162 |
| **IR** | -0.345385 | 0.03028 | -11.41 | 0.000 | -0.40472 | -0.28605 |
| **_cons** | -5.722023 | . | . | . | . | . |

RMSE= 0.052681, R square= 0.9284, Number of observations=35

*** p<0.01, ** p<0.05, * p<0.1

Table 6 indicates that crude oil prices have a strong impact on economic growth. This is evidenced by the significant negative long-term coefficient of crude oil prices. This implies that assuming other things remain constant, a one-percent rise in crude oil price reduces GDP growth by 2.8% on average throughout the sample period. Similarly, the finding reveals that the interest rate affects economic growth negatively with a significant negative long-term coefficient of 0.35%. This suggests that with other factors remaining unchanged, one percentage increase in interest rate, on average, the GDP growth decreases by 0.35% over the sample period.

However, the finding reveals that the inflation rate plays a key role in promoting economic growth. This is evidenced by the significant positive long-term coefficient of the inflation rate. This implied that when other factors held constant when the inflation rate rose by one percentage, the GDP growth rose by 0.1352048% on average over the sample period. In contrast, reveals an inverse relationship between the exchange rate and gross domestic product, which was not statistically significant, as evidenced by the p-value (0.277) greater than the 0.05 significance level employed in this study.

The model explains 92.84% of the variability in GDP, whereby $R^2$= 0.9282, indicating a good fit and suggesting that the independent variables included can explain GDP variability observed by 92.82% over the analyzed period.

The findings in this study are consistent with empirical literature, notably among them is the work of Dinh (2022) concluded that the crude oil prices influence the economy of China, Vietnam, and South Korea, and are negatively impacted by global oil prices in the long run. However, except for Indonesia, crude oil prices negatively impact all countries. Similarly, the study of Sabayo *et al.* (2023) concluded a negative correlation between oil price volatility and economic growth in Tanzania, with a positive impact on volatility in oil price on inflation in the long run. Odhiambo & Nyasha (2019) and Onono *et al.* (2020) on their findings, several studies such as of Deyshappriya *et al.* (2023), Akinsola & Odhiambo (2020), Asaleye *et al.* (2019); Chang & Wong (2003); Charfeddine *et al.* (2020) and D. Gonzalez (2014) also found that for net oil importing countries, fluctuation in oil prices inversely correlate with economic growth in long run. The consistent findings across multiple studies reinforce the strength of the negative relationship observed in the study over the long run.

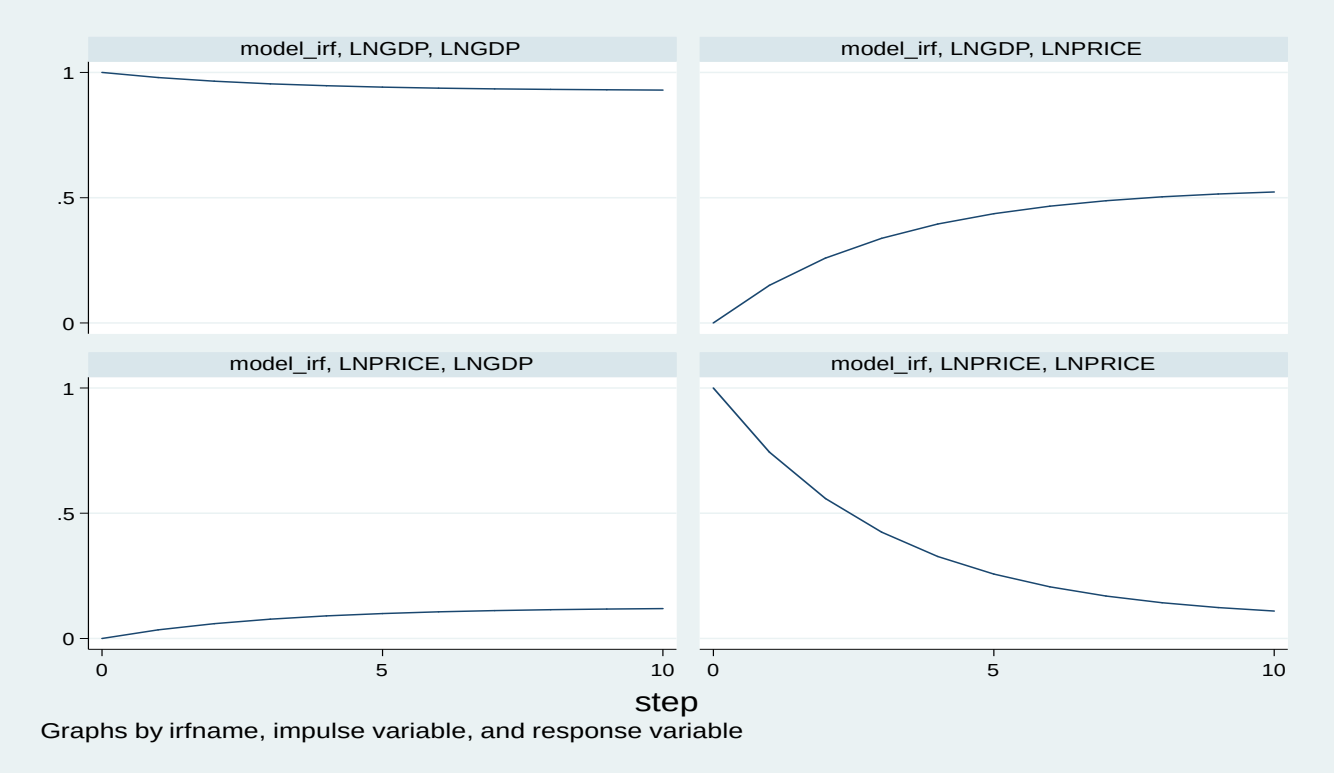


**Figure 2**
*Impulse Response of Gross Domestic Product and Crude Oil*

The impulse response reveals that GDP and crude oil prices respond to shock over time. Figure 2 indicates that an impulse (shock) of GDP to GDP at time zero has big effects on the next period, but becomes smaller and smaller as time passes. However, the impulse response of GDP to crude oil shows that at time zero has lower effects, but the effects become larger and larger as time passes.

Similarly, the crude oil price impulse response to GDP shows that time zero has lower effects, but the effects become larger and larger as time passes. Lastly, the impulse (shock) of crude oil price to crude oil price at time zero has large effects on the next period, but as time passes becomes smaller and smaller. These findings imply that the shock imposed by crude oil prices due to different events affects economic growth significantly, as evidenced by the upward increase in the impulse response of GDP and crude oil prices.

**Table 7**
*Impulse Response of Gross Domestic Product and Crude Oil*

| Step | Gross domestic product | | Crude oil price | |
|---|---|---|---|---|
| | GDP | Crude oil price | GDP | Crude oil price |
| 0 | 1 | 0 | 0 | 1 |
| 1 | 0.979838 | 0.150431 | 0.034321 | 0.743926 |
| 2 | 0.965246 | 0.259307 | 0.059161 | 0.558588 |
| 3 | 0.954685 | 0.338108 | 0.077139 | 0.424448 |
| 4 | 0.947041 | 0.395141 | 0.090151 | 0.327362 |
| 5 | 0.941508 | 0.43642 | 0.099569 | 0.257094 |
| 6 | 0.937504 | 0.466296 | 0.106385 | 0.206237 |
| 7 | 0.934606 | 0.487919 | 0.111318 | 0.169429 |
| 8 | 0.932509 | 0.503569 | 0.114889 | 0.142788 |
| 9 | 0.93099 | 0.514896 | 0.117473 | 0.123507 |
| 10 | 0.929892 | 0.523094 | 0.119343 | 0.109551 |

Through impulse response analysis findings, it shows that about 100% of the economic growth variations are explained by shocks to economic growth in the short run, while about 92.9% and 52.3% variations in the long run are explained by economic growth and crude oil prices respectively. Notably, the impact of Crude oil price on GDP is relatively smaller than the impact of GDP on crude oil. Also, the crude oil price variation is explained by shocks in the

short-run to crude oil price (about 100%), while the variations are explained by crude oil price (10.9%) as well as economic growth (11.9%) in the long run. The variations in economic growth are caused by crude oil prices in the long run.

### 4.6 The Short-Run Relationship Between Crude Oil Price Fluctuation and Tanzania's Economic Growth

An error correction model was employed in this study to ascertain whether there was a short-run relationship or not between crude oil price fluctuation and Tanzania's economic growth. The results from estimating the short-run error correction model are illustrated in Table 8

**Table 8**

*Estimate Short-Run Error Correction Model*

| Beta | Coef. | Std. Err. | Z | P>z | Lower CI | Upper CI | SIGN |
|---|---|---|---|---|---|---|---|
| **_ce1** | | | | | | | |
| **L1.** | -0.1357523 | 0.02571 | -5.28 | 0.000 | -0.18614 | -0.08536 | *** |
| | | | | | | | |
| **GDP** | | | | | | | |
| **LD.** | -0.2965183 | 0.175474 | -1.69 | 0.091 | -0.64044 | 0.047404 | |
| **L2D.** | 0.0329904 | 0.184566 | 0.18 | 0.858 | -0.32875 | 0.394733 | |
| **L3D.** | -0.1523075 | 0.126874 | -1.20 | 0.230 | -0.40098 | 0.09636 | |
| | | | | | | | |
| **CP** | | | | | | | |
| **LD.** | -0.1063066 | 0.06549 | -1.62 | 0.105 | -0.23467 | 0.022052 | |
| **L2D.** | 0.0106393 | 0.045781 | 0.23 | 0.816 | -0.07909 | 0.100368 | |
| **L3D.** | -0.0170162 | 0.054053 | -0.31 | 0.753 | -0.12296 | 0.088926 | |
| | | | | | | | |
| **INF** | | | | | | | |
| **LD.** | 0.0089775 | 0.003402 | 2.64 | 0.008 | 0.00231 | 0.015646 | *** |
| **L2D.** | 0.0132227 | 0.003625 | 3.65 | 0.000 | 0.00612 | 0.020328 | *** |
| **L3D.** | -0.0049171 | 0.004169 | -1.18 | 0.238 | -0.01309 | 0.003254 | |
| | | | | | | | |
| **ER** | | | | | | | |
| **LD.** | -0.0002467 | 0.000142 | -1.74 | 0.082 | -0.00052 | 3.14E-05 | |
| **L2D.** | 0.0003131 | 0.000163 | 1.92 | 0.055 | -0.00001 | 0.000633 | |
| **L3D.** | 0.0001813 | 0.000154 | 1.17 | 0.240 | -0.00012 | 0.000484 | |
| | | | | | | | |
| **IR** | | | | | | | |
| **LD.** | -0.0478735 | 0.007900 | -6.06 | 0.000 | -0.06336 | -0.03239 | *** |
| **L2D.** | -0.0302735 | 0.00983 | -3.08 | 0.002 | -0.04954 | -0.01101 | *** |
| **L3D.** | -0.0095026 | 0.007056 | -1.35 | 0.178 | -0.02333 | 0.004327 | |
| | | | | | | | |
| **_cons** | 0.3440303 | 0.072721 | 4.73 | 0.000 | 0.201501 | 0.48656 | |

RMSE= 0.052681, R square= 0.9284, Number of observations=31

*** p<0.01, ** p<0.05, * p<0.1

Table 8 illustrates the findings of the estimated short-run error correction model, which revealed the following: The coefficient of speed adjustment was -0.1357523 statistically significant at a 5% level of significance employed. This suggests that the adjusting rate is 13.575% toward the long-term equilibrium.

The findings in Table 8 revealed the lag differences in crude oil prices—first, second, and third do not statistically significantly influence economic growth in the short run. The first and second lag differences of the inflation rate both show positive and statistically significant regression coefficients, thus, the percentage increase in the inflation rate, and economic growth increases, holding other factors constant. Conversely, the first and second lag differences of the interest rate exhibit statistically significant negative coefficients, suggesting that economic growth decreases when interest rates increase these rates, controlling for other variables. Therefore, these finding implies that in the short run, the crude oil price, and exchange rate do not affect economic growth, only the inflation rate, which affects positive economic growth, while the interest rate negatively affects economic growth.

The findings in this study are consistent with empirical literature, notably among them are the works of Odhiambo & Nyasha (2019) and Onono *et al.* (2020) conducted on Kenya's economic growth revealed in the short run, real GDP performance cannot be affected with changes in oil price. This suggests a common regional trend where

short-run oil price fluctuations have minimal immediate economic impact on economic growth. Moreover, the study by Dinh (2022) was conducted in nine countries which concluded that the crude oil prices affected China, Vietnam, and South Korea, while other countries including Thailand, Indonesia, Singapore, Malaysia, America, and Japan had a minimal impact. This mixed impact indicates that the influence of oil prices in the short run can vary significantly based on a country's specific economic structure, energy dependency, and mitigation policies.

### 4.7 Model Diagnostic Check

#### 4.7.1 Model Stability Tests

The model's recursive estimations were tested for stability by the last step, which was to put the derived equations through the paces.

**Table 9**

*Eigenvalue Stability Condition*

| Eigenvalue | Modulus |
|---|---|
| 1 | 1 |
| 1 | 1 |
| 1 | 1 |
| 1 | 1 |
| .4505526 + 0 .7359766i | 0.862936 |
| .4505526 - 0.7359766i | 0.862936 |
| .00530659 + 0 .8116237i | 0.811641 |
| .00530659 - 0 .8116237i | 0.811641 |
| .2989888 + 0 .747522i | 0.805098 |
| .2989888 - 0 .747522i | 0.805098 |
| 0.7952131 | 0.795213 |
| .6013485 + 0.5058026i | 0.785784 |
| .6013485 - 0.5058026i | 0.785784 |
| .5985022 + 0.3238808i | 0.680517 |
| .5985022 - 0.3238808i | 0.680517 |
| 0.5442078 | 0.544208 |
| .2966699 + 0.4111571i | 0.507014 |
| .2966699 - 0.4111571i | 0.507014 |
| .4287777 + 0.1920799i | 0.469835 |
| .4287777 - 0.1920799i | 0.469835 |

Table 9 shows the finding of model stability or eigenvalue stability condition. The findings reveal that the presence of unit modulus after applying VECM imposes four-unit moduli, which implies that there are four-unit roots (stochastic trends) in the system. This corresponds to 4 characteristic roots equal to 1, indicating the presence of four stochastic trends.

This implies that the model meets eigenvalue stability and cointegration conditions ensuring the model is stable. For the VECM to be stable, any remaining characteristic roots (other than those associated with the unit roots) must lie inside the unit circle.

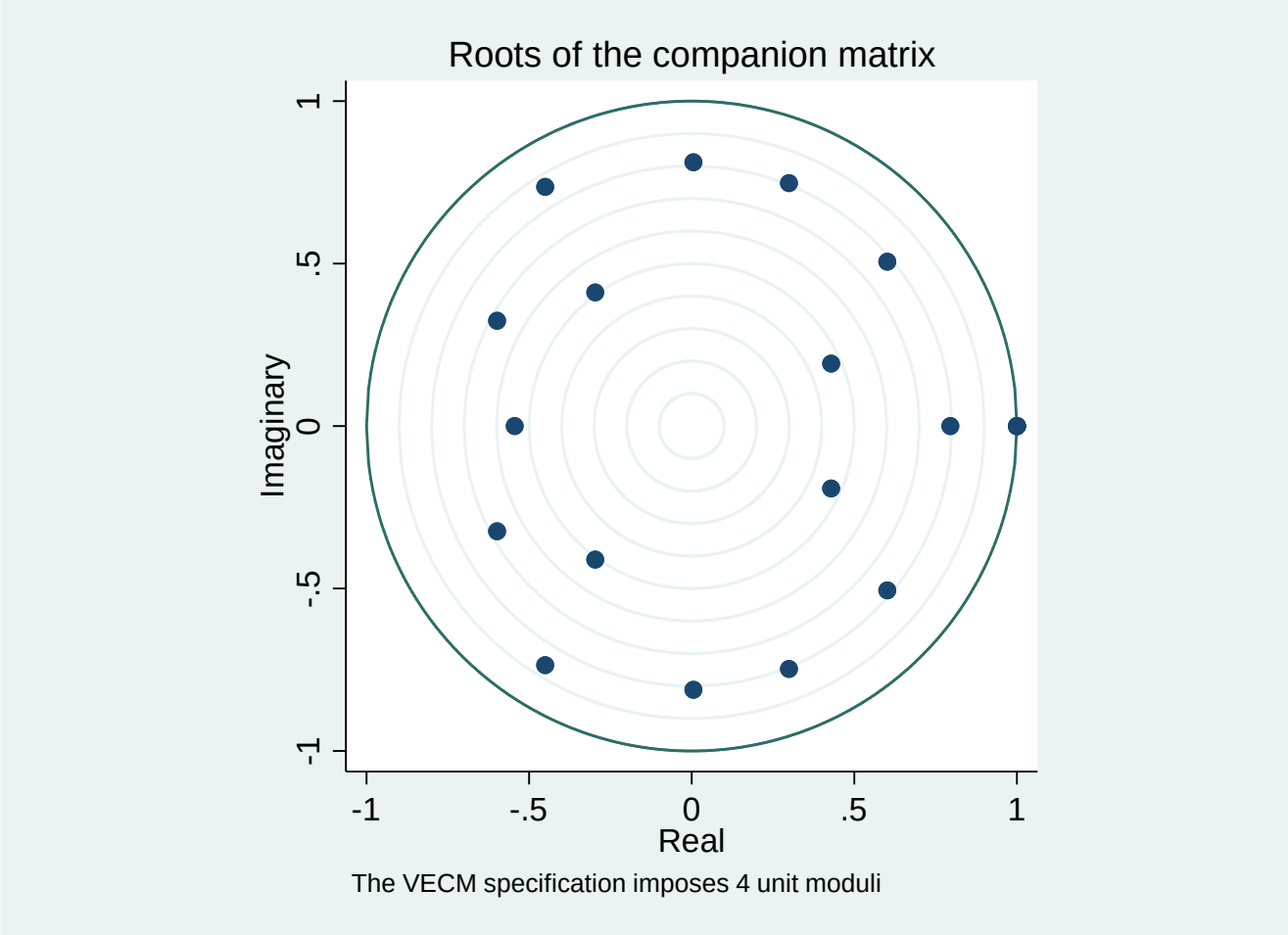


**Figure 3**
*Eigenvalue Stability Condition*

In Figure 3, the unit circle chart is utilized to assess the stability of the model by assessing the points that lie within the unit circle. Figure 3 shows that all the points lie inside except four points that touch the line, implying that only four-unit roots are in the system. In addition to that, the finding also implies the model is stable since all other points remaining are within the unit of circle.

### 4.7.2 Test of the Normality Assumption

To test for normality, the Bere-Jaque test was employed, which is a commonly used test in similar studies (Thadewald *et al.*, 2004). Given that the p-value is more than 0.05, the residuals for the GDP, crude oil price, inflation rate, interest rate, exchange rate, and interest rate as well as the combined residuals for all variables are normally distributed. This implies that the model's error term adheres to the characteristics of a normal distribution.

**Table 10**
*Jarque-Bera test*

| Equation | chi2 | df | Prob > chi2 |
|---|---|---|---|
| D_Gross domestic product | 1.196 | 2 | 0.54987 |
| D_Crude oil price | 0.297 | 2 | 0.86190 |
| D_Inflation rate | 0.339 | 2 | 0.84426 |
| D_Exchange rate | 1.330 | 2 | 0.51417 |
| D_Interest rate | 0.481 | 2 | 0.78637 |
| **ALL** | 3.643 | 10 | 0.96202 |

### 4.7.3 Autocorrelation Test

The values at lag 1 and lag 2 were greater than the 5% significance level utilized in this study, indicating that the model is free from the autocorrelation problem. The Lagrange-Multiplier test was performed to assess for the presence of autocorrelation in the residuals.

**Table 11**

*Lagrange-Multiplier Test*

| Lag | chi2 | df | Prob > chi2 |
|---|---|---|---|
| 1 | 18.9187 | 25 | 0.801 |
| 2 | 19.049 | 25 | 0.79477 |

### 4.7.4 Optimal Lag Selection

Table 12 shows that all the variables interest rate, inflation rate, economic growth, crude oil price, and exchange rate together have maximum lags of four. At this number of lags, all the variables—aside from the Schwarz Bayesian Information Criterion (SBIC)—have the lowest values for the final predictive error (FPE), the Akaike Information Criterion (AIC), and the Hannan Quinn Information Criterion (HQIC).

**Table 12**

*Optimal Lag Selection*

| **Lag** | **FPE** | **AIC** | **HQIC** | **SBIC** |
|---|---|---|---|---|
| **0** | 580852 | 27.4615 | 27.5369 | 27.6928 |
| **1** | 386.46 | 20.1217 | 20.5741 | 21.5094* |
| **2** | 149.397 | 19.0347 | 19.864 | 21.5789 |
| **3** | 78.3574 | 18.0015 | 19.2078 | 21.7021 |
| **4** | 51.6517* | 16.6648* | 18.2481* | 21.5219 |

The findings in Table 12 show that the optimal number of lags is four as supported by the FPE, AIC, and HQIC criteria, except SBIC which suggests the maximum number of lags is one. Since AIC and HQIC are more than powerful in the selection of the maximum number of lags especially when there are a small number of observations so for this case the maximum number of large is four.

### 4.8 The Causal Relationship Between Oil Prices and Economic Growth

To ascertain whether one time series can predict the other the Granger causality test was used. The test is based on the impression if one variable Granger causes another variable, then the variable past values contain useful information to predict the other beyond what is already contained in the past value of the other variable. The Granger causality test findings illustrated in Table 13 below provide insights into the directional influence between various economic variables: crude oil price, gross domestic product (GDP), interest rate, currency exchange rate, and inflation rate.

**Table 13**

*Granger Causality*

| **Null Hypothesis** | **chi2** | **Prob > chi2** |
|---|---|---|
| The crude oil price does not Granger that the gross domestic product | 9.7638 | 0.002 |
| The inflation rate does not Granger cause the gross domestic product | 10.313 | 0.001 |
| The interest rate is not Granger cause the gross domestic product | 5.7802 | 0.016 |
| The exchange rate does not Granger cause the gross domestic product | 7.5225 | 0.006 |
| The exchange rate, crude oil price, interest rate, and inflation rate jointly do not Granger cause the gross domestic product | 28.7100 | 0.000 |
| The gross domestic product does not Granger that crude oil price | 2.0732 | 0.150 |
| The inflation rate does not Granger cause the crude oil price | 27.236 | 0.000 |
| The interest rate is not Granger cause the crude oil price | 0.47499 | 0.491 |
| The exchange rate does not Granger cause the crude oil price | 2.7235 | 0.099 |
| The exchange rate, gross domestic product, interest rate, and inflation rate jointly do not Granger cause the crude oil price | 60.9430 | 0.000 |
| The gross domestic product does not Granger the inflation rate | 8.1759 | 0.004 |
| The crude oil price does not Granger cause an inflation rate | 4.2052 | 0.040 |

| | | |
|---|---|---|
| The interest rate is not Granger cause the inflation rate | 1.5258 | 0.217 |
| The exchange rate does not Granger cause the inflation rate | 17.0110 | 0.000 |
| The exchange rate, crude oil price, interest rate, and gross domestic product jointly do not Granger cause the inflation rate | 30.0570 | 0.000 |
| The gross domestic product does not Granger the exchange rate | 21.455 | 0.000 |
| The crude oil price does not Granger cause the exchange rate | 5.9561 | 0.015 |
| The inflation rate is not Granger cause the interest exchange rate | 3.0853 | 0.079 |
| The interest rate does not Granger cause the exchange rate | 6.3228 | 0.012 |
| The interest rate, crude oil price, gross domestic product, and inflation rate jointly do not Granger cause the exchange rate | 65.8810 | 0.000 |
| The gross domestic product does not Granger the interest rate | 1.2029 | 0.273 |
| The crude oil price does not Granger cause the interest rate | 0.0021 | 0.964 |
| The inflation rate is not Granger cause the interest rate | 15.4840 | 0.000 |
| The exchange rate does not Granger cause the interest rate | 0.74042 | 0.390 |
| The exchange rate, crude oil price, gross domestic product, and inflation rate jointly do not Granger cause the interest rate | 34.7120 | 0.000 |

The findings in Table 13 show that there is unidirectional causality from crude oil price to the GDP suggesting that past values of crude oil prices contain useful information for predicting GDP while past GDP values do not help in predicting crude oil prices. The findings also revealed a unidirectional causality from interest rates. While GDP and inflation rates Granger cause each other, exchange rate and GDP Granger cause each other indicating a bidirectional relationship. Furthermore, there is bilateral causality between the exchange rate and crude oil prices. Jointly, the exchange rate, crude oil prices, GDP, and inflation rates significantly impact GDP, while these same variables, along with interest rates, also influence inflation rates. These findings underscore the complex interdependencies among crude oil prices, interest rates, inflation rates, and exchange rates in predicting economic growth in Tanzania.

The results of a study by Musa *et al.* (2019) on the impact of exchange rates and crude oil prices on economic growth indicate a unidirectional causal relationship between the two variables. Additionally, Nuhu (2017) study on the role of oil price instability in economic growth concludes that oil price is a significant variable in explaining economic growth, which lends credence to the findings. Analogously, the research conducted by Sabayo *et al.* (2023) examined how fluctuations in oil prices affect inflation and economic growth in Tanzania. The study found that the relationship between the inflation rate and economic growth is bidirectional, meaning that both the inflation rate and the economic growth are stimulated by each other.

## V. CONCLUSIONS & RECOMMENDATIONS

### 5.1 Conclusions

In this study, the relationship between crude oil price fluctuation on the economic growth of Tanzania was examined from 1988 to 2022. The empirical results revealed the relationship between crude oil price fluctuation and economic growth. Mainly, there is a negative relationship between crude oil price fluctuation and economic growth in the long run, while in the short run, the relationship was found to be statistically insignificant.

### 5.2 Recommendations

The study recommends the government invest in the development of renewable energy sources, such as gas, solar, wind, and hydroelectric power to reduce heavy reliance on oil importation, which exposes the country to global oil price fluctuation. Also, the government should broaden the economic base so that it includes sectors that are less reliant on oil imports. The study recommends policymakers and regulators to incorporate crude oil price trends into economic forecasts, enabling more informed decision-making. Although the study found in the short run, the impact of crude oil price fluctuations on economic growth is statistically insignificant, policymakers are recommended to remain vigilant and proactive in their economy by introducing and maintaining strategic oil reserves as a proactive measure to buffer short-term supply disruptions and price spikes. Introducing financial instruments such as hedging and futures contracts which can be used to manage the risk associated with crude oil price fluctuations.

## REFERENCES


Abdelmoula, M., & Abdelsalam, M. (2019). Oil price fluctuations and economic growth : the case of MENA countries. *Review of Economics and Political Science*. https://doi.org/10.1108/REPS-12-2019-0162

Ahmad, I., Iqbal, S., Khan, S., Han, H., Vega-Muñoz, A., & Ariza-Montes, A. (2022). Macroeconomic effects of crude oil shocks: Evidence from South Asian countries. *Frontiers in Psychology*, *13*(August). https://doi.org/10.3389/fpsyg.2022.967643

Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control*, *19*(6), 716–723.

Akinsola, M. O., & Odhiambo, N. M. (2020). Oil price and economic growth of oil-importing countries: A review of international literature. *Applied Econometrics and International Development*, *20*(1), 129–151.

Asaleye, A. J., Aremu, C., Lawal, A. I., Ogundipe, A. A., Inegbedion, H., Popoola, O., Sunday, A., & Obasaju, O. B. (2019). Oil price shock and macroeconomic performance in Nigeria: Implication on employment. *International Journal of Energy Economics and Policy*, *9*(5), 451–457. https://doi.org/10.32479/ijeep.7768

Benli, M., Altintas, H., & Kaplan, M. (2019). Petrol Fiyatlarının İktisadi Büyüme Üzerindeki Asimetrik Etkisi: Türkiye Örneği. *Bilecik Şeyh Edebali Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *June*, 266–279. https://doi.org/10.33905/bseusbed.480869

Chang, Y., & Wong, J. F. (2003). Oil price fluctuations and Singapore economy. *Energy Policy*, *31*(11), 1151–1165. https://doi.org/https://doi.org/10.1016/S0301-4215(02)00212-4

Charfeddine, L., Klein, T., & Walther, T. (2020). Reviewing the oil price–GDP growth relationship: A replication study. *Energy Economics*, *88*. https://doi.org/10.1016/j.eneco.2020.104786

Deyshappriya, N. P. R., Rukshan, I. A. D. D. W., & Padmakanthi, N. P. D. (2023). Impact of Oil Price on Economic Growth of OECD Countries: A Dynamic Panel Data Analysis. *Sustainability*, *15*(6), 4888. https://doi.org/10.3390/su15064888

Digha, M. E. (2022). *Analysis of Oil Prices and Its Impact on Tanzania Economy: Time Series analysis*. Institute of Accountancy Arusha.

Dinh, D. Van. (2022). Crude Oil Price Fluctuation and Economic Growth: ARDL Model Approach. *International Journal of Energy Economics and Policy*, *12*(4), 240–248. https://doi.org/10.32479/ijeep.13177

Engle, R. F., & Granger, W. J. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. Econometrica, 55(2), 251-276. https://doi.org/10.2307/1913236

EWURA. (2023). *The Mid and Downstream Petroleum Sub Sector Performance Review Report for Year 2022* (Vol. 255, Issue 0).

Gershon, O., Ezenwa, N. E., & Osabohien, R. (2019). Implications of oil price shocks on net oil-importing African countries. *Heliyon*, *5*(8), e02208. https://doi.org/10.1016/j.heliyon.2019.e02208

Gonzalez, A., & Sherzod, N. (2009). *Oil price fluctuations and its effect on GDP growth* (Issue January). Jonkoping University.

Gonzalez, D. (2014). *Managing Online Risk Apps, Mobile, and Social Media Security*. Butterworth-Heinemann.

Gujarati, D. N. (2011). *Econometrics by example* (Vol. 1). Palgrave Macmillan New York.

Hamilton, J. D. (1983). Oil and the Macroeconomy since World War II. *Journal of Political Economy*, *91*(2), 228–248. https://doi.org/10.1086/261140

Hill, R. C., Griffiths, W. E., & Lim, G. C. (2011). *Principles of Econometrics* (4th Editio).

Hjalmarsson, E., & Österholm, P. (2007). *Testing for cointegration using the Johansen methodology when variables are near-integrated*.

International Monetary Fund. (2022). World Economic Outlook: War Sets Back The Global Recovery. In *World Economic Outlook*. https://www.imf.org/en/Publications/WEO/Issues/2022/04/19/world-economic-outlook-april-2022

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, *12*(2–3), 231–254.

Korley, M., & Giouvris, E. (2022). The Impact of Oil Price and Oil Volatility Index (OVX) on the Exchange Rate in Sub-Saharan Africa: Evidence from Oil Importing/Exporting Countries. *Economies*, *10*(11). https://doi.org/10.3390/economies10110272

Mati, S., Radulescu, M., Saqib, N., Samour, A., Ismael, G. Y., & Aliyu, N. (2023). Incorporating Russo-Ukrainian war in Brent crude oil price forecasting: A comparative analysis of ARIMA, TARMA and ENNReg models. *Heliyon*, *9*(11), e21439. https://doi.org/10.1016/j.heliyon.2023.e21439

Musa, K. S., Maijama'a, R., Shaibu, H. U., & Muhammad, A. (2019). Crude Oil Price and Exchange Rate on Economic Growth: ARDL Approach. *Open Access Library Journal*, *06*(12), 1–5. https://doi.org/10.4236/oalib.1105930

Nuhu, A. B. (2017). *Impact of Oil Price Instability on Economic Growth (A Case of Nigeria)* [Near East University]. http://docs.neu.edu.tr/library/6525615986.pdf

Odhiambo, N. M., & Nyasha, S. (2019). Oil price and economic growth in kenya: A trivariate simulation. *International Journal of Sustainable Energy Planning and Management*, *19*, 3–12. https://doi.org/10.5278/ijsepm.2019.19.2

Ogboru, I., Rivi, M. T., & Idisi, P. (2017). The Impact of Changes in Crude Oil Prices on Economic Growth in Nigeria: 1986-2015. *Journal of Economics and Sustainable Development Www.Iiste.Org ISSN*, *8*(12), 78–89. www.iiste.org

ONONO, P., Mutuma Kiambi, B., & Maingi, J. (2020). Effect of Crude Oil Prices on Economic Growth in Kenya in the Period 1981 To 2018. *Advances in Social Sciences Research Journal*, *7*(10), 340–349. https://doi.org/10.14738/assrj.710.9209

Pierru, A., Smith, J. L., & Zamrik, T. (2018). OPEC's Impact on Oil Price Volatility: The Role of Spare Capacity. *Energy Journal*, *39*(2), 103–122. https://doi.org/10.5547/01956574.39.2.apie

Sabayo, G., Massito, J., & Moshi, A. (2023). The Impact of Oil Price Volatility on Inflation and Economic Growth in Tanzania. *Economics*, *12*(2), 32–43. https://doi.org/10.11648/j.eco.20231202.11

Tehranchian, A. M., & Abdi Seyyedkolaee, M. (2017). The impact of oil price volatility on the economic growth in Iran: An application of a threshold regression model. *International Journal of Energy Economics and Policy*, *7*(4), 165–171.

Thadewald, T., Büning, H., Thadewald, T., & Herbert, B. (2004). Diskussionsbeiträge des Fachbereichs Wirtschaftwissenschaft der Freien Universität Berlin Jarque-Bera Test and its Competitors for Testing Normality - A Power Comparison Jarque-Bera Test and its Competitors for Testing Normality - A Power Comparison. *Diskussionsbeiträge*, *9*, 0–23.

World Bank. (2024). Overcoming Demographic Challenges while Embracing Opportunities. *Tanzania Economic Update*, *20*.

Zhang, Q., Hu, Y., Jiao, J., & Wang, S. (2024). The impact of Russia–Ukraine war on crude oil prices: an EMC framework. *Humanities and Social Sciences Communications*, *11*(1). https://doi.org/10.1057/s41599-023-02526-9