



## Analysis of the Impact of Crude Oil Price Changes on Economic Growth in Tanzania: ARDL Econometric Model

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### ABSTRACT

*Crude oil is a valuable resource for boosting global economic growth. In this regard, this study examined the effect of crude oil price fluctuations on Tanzania's economic growth from 1989 to 2022. Empirically this study utilized time-series data extracted from World Bank in particular; GDP per capita from World Development Indicators (WDI) as proxy of economic growth and Statistical Review of World Energy for Crude Oil prices. In this study, Renaissance growth theory, Autoregressive distributed lag model (ARDL), Dickey and Fuller tests, The Johansen test for cointegration, Breusch- Godfrey test for Serial correlation LM, Breusch-Pagan heteroscedasticity test, Jarque-Bera normality test, Error Correction Model (ECM), Granger Causality test, CUSUM and CUSUMSQ curves tests were used to analyse the data. This study revealed that crude oil price changes have positive and significant impact on Tanzania's economic growth. A dollar increase in crude oil prices brings about 0.23279 unit increase Tanzania's economic upturn in the short run. The ARDL results also shows that error correction model (ECM) of -0.1000 ( $p=0.0025$ ) is significant with its value, suggesting a moderate speed of convergence to equilibrium after shock. Thus, this study recommends to policy maker and the government to ensure that they use fiscal policies that will reduce the adverse impact of the world crude oil prices hikes, finding other sources of energy and promoting research and development to explore and harness the oil fossils to produce oil and reduce oil importations and increase oil exportations to further increase economic growth.*

**Keywords:** ARDL, Crude Oil Price, Economic Growth, Tanzania

### I. INTRODUCTION

Crude oil is an essential commodity for the growth of an economy because of its substantial use as a source of energy in numerous production and operation processes (Muthalib et al., 2019). This influences the world demand for crude oil (Adam et al., 2021). For instance, world's oil consumption has increased from 84.56 million barrels every day 2016 to 100.02 million barrels every day in 2019 (Rumbia & Azis, 2020). According to Rumbia & Azis (2020), demand for crude oil is expected to increase from 103.78 million barrels every day by 2024 to 109.67 million barrels every day by 2035. In this regard, demand for crude oil is increasing while the supply remains short. This causes a rise in price of crude oil approximately \$86.04 per barrel in 2024 succeeding Covid-19 pandemic and Russia-Ukraine conflict, resulting from the embargoes imposed against Russia by European Union (EU). This unpredictable tendency of changes in crude oil prices is anticipated to rise further over the next years (African Energy Chamber, 2023).

In Africa, the main crude oil-producing countries includes Nigeria, Libya, Algeria, and Angola. However, they produce a small percentage of the world's crude oil, which cannot accommodate Africa's oil demand (African Energy Chamber, 2023). Following the Covid-19 outbreaks and trade embargoes imposed by the European Union (EU) against Russia after the Ukraine-Russia conflict, the world crude oil supply was reduced since Russia produces approximately one-third of the total oil production. The increase in crude oil prices has also impacted African countries, particularly those in Eastern Africa that import oil from the rest of the world, leading to inflationary pressures and increased transportation costs. Consequently, investors and producers raise the prices of commodities to cover increased production costs, leading to decreased investments and lower net exports, which subsequently affects the economic growth of these countries (African Energy Chamber, 2023).



In Tanzania on average approximately 35,000 barrels of crude oil are demanded every day from which all are imported (Gasper & Mbwambo, 2023). This cultivates an increase in crude oil prices as publicized by Energy and Water Utilities Regulatory Authority (EWURA) of Tanzania from time to time. This is anticipated by increased tariff rates and transportation costs which subsequently leads to high inflationary pressures, high rate of unemployment, lack of confidence on saving and investments leading to low production and hence reducing overall economic growth (Gasper & Mbwambo, 2023).

High oil prices have significant benefits to OPEC as it increases their trade values which are made with large prices, hence boosting their profit margins which increase economic prosperity as determined by GDP (Gross Domestic Product) (Dinh, 2022). Additionally, OPEC earns foreign reserves and revenues which increases domestic productivity necessary for participating in international trade and spurs their GDPs (Nwana & Eyedayi, 2016).

However, the effects of increasing crude oil prices has significant cost for oil importing countries all over the world, since it manipulates the prices of commodities through increase of cost inputs, transportations, increasing the consumption spending, reducing level of investments ultimately affects the economic growth of the countries adversely (Muthalib et al., 2019).

Changes in the price of fossil fuels have a significant effect on both supply and demand sides of all sectors of the economy (Ali et al., 2017). As per International Energy Agency (IEA) (2023), increased price of crude oil affects the price of gasoline, manufacturing, electricity power production and domestic cooking oil. In Tanzania particular, high oil prices negatively affected consumption of individual households, rural and urban transportation streams (Gasper & Mbwambo, 2023). Moreover, high crude oil price has accelerated unemployment patterns especially from the private sector which abstain from high crude oil prices by reducing their employment patterns and consequently affecting economic growth (Gasper & Mbwambo, 2023). To date, researchers are interested to examine a linkage between the price of unrefined oil and expansion of economies (Rumbia & Azis, 2020). Number of empirical findings shows the presence of relationship between price of unprocessed oil and growth of the economy (Adam et al., 2021).

This study aims to investigate the impact of crude oil prices on economic growth of Tanzania as empirical evidence on existing linkages between these variables. Since many studies have been conducted in Africa especially Crude oil producing countries like Nigeria, Libya, South Sudan, Ghana and Congo by Awunyo-vitor et al. (2018), Anthony (2020), Nwana & Ayanajeh Eyedayi (2016), Msafiri & Yurievich, (2018), Ftiti et al. (2016) and (Ogboru et al., 2017), only few studies have been done in oil-importing nations like Tanzania. Thus, the fundamental goal of this research is to make analysis on the impact of fluctuation in crude oil prices towards economic expansion in Tanzania. Specifically, the investigation aims to: (i) determine whether fluctuations in price of unrefined oil affects economic upswing of Tanzania and (ii) determine whether there exists a long run relationship between economic growth and price of crude oil.

### 1.1 Research Hypotheses

H0: Changes on crude oil prices has no effect on economic growth

H1: Changes on crude oil prices has effect on economic growth

H0: No long run association between prices of crude oil and economic expansion.

H1: There's long run association between prices of crude oil and economic expansion

## II. LITERATURE REVIEW

### 2.1 Theoretical Review

#### 2.1.1 Renaissance Growth Theory

Renaissance growth theory was developed in the early 1980s. According this theory, shocks to the price of crude oil have unfavorable impact on economic growth. The theory further suggests that oil prices impacts both advanced economies and growing economies in different ways varies from one country to another due to the available stabilization policies toward oil price shocks (Ogboru et al., 2017). According to Oriakhi & Osaze (2013), changes in price of fossil oil and volatileness on price of fossil oil both have an adverse impacts on economic prosperity, while fossil oil price fluctuation present a gradual effect on economic growth, volatileness has instantaneous negative and remarkably impact on it. This study therefore is built on the Renaissance model of growth. The selection of this model is of paramount importance due to clear relationship between changes in crude oil price and economic growth which is the key concern of this study. This theory was developed from the symmetry and asymmetry effects on economic growth which cause an ambiguity on how asymmetry changes on government policy and controlled variables that affects the economy (Smets



& Wouters, 2007) and (Stiglitz, 1989). Since renaissance put clear relationship between changes in fossil oil prices and economic hike of the country, this approves its superiority over the two theories (Ogboru et al., 2017).

## 2.2 Empirical Review

Awunyo-vitor et al. (2018) investigated the nexus between changes in the price of crude oil and economic expansion. Secondary data from International Financial Statistics and World Development Indicators were used in this investigation. Furthermore, descriptive statistics, Granger causality test, Johansen cointegration test and unit root test were employed for data analysis. The study findings showed that changes in oil prices and Ghana's economic growth are negatively correlated. Likewise, Benli et al. (2016) explored the impact of variations in crude oil prices against Turkey's real economic productivity. Nonlinear Autoregressive Distributed Lags (NARDL) model was used for this study, allowing us to evaluate the corresponding response of economic growth to changes in its regressors and to examine the long-run and short-run asymmetries simultaneously. The divergent impact of fluctuations in oil prices on economic growth is supported by the empirical findings. In particular, rising oil costs have a sustained detrimental impact on economic expansion.

Conversely, Ogboru et al. (2017) determined how Nigeria's economic growth was affected by fluctuations in crude oil prices between 1986 and 2015. Data from secondary source were employed. Johansen's co-integration Test, Zivot-Andrews Tests, the Vector Error Correction Model and Granger Causality Test were employed to analyse the data. The study revealed that Crude oil prices affect positively the economic growth of Nigeria. Correspondingly, Berument et al.(2010) explored how shocks in oil prices affects the growth of country aggregate output among selected MENA nations. Data from World Bank was used. Vector Autoregressive, Unit root test using Dicky Fuller and Granger causality were used as the methods of data analysis. The analysis showed that price of unrefined oil has a substantial impact on economic growth in selected countries (United Arab Emirates, Iraq, Oman, Libya, Iran and Algeria). In line with, Mhamad & Saeed (2016) investigated the adverse impact of price of fossil oils on economic upturn. It employed different channels like spending level, inflation rate and unemployment which consequently affects the economic expansion of Iraq as the oil producing country. The study used Ordinary Least Square (OLS) and secondary data running from 2000-2015. Multiple linear regression together with its assumption was used to analyze the data. Study showed that oil price and oil exports positively determine the economic growth of Iraq.

Antagonistically, Awunyo-vitor et al.(2018) investigated the relationship between variations in oil prices and Ghana's economic expansion. Secondary data from International Financial Statistics (IFS) and World Development Indicators (WDI) were used in the study. Further, data was analyzed using descriptive statistics, unit root test, Granger causality test, and Johansen cointegration test. The investigation showed that fluctuations in oil prices had no effect on Ghanaian economic growth. Furthermore, Dinh (2022) investigated the linkage between the price of crude oil and the GDP (Gross Domestic Product) of various countries. Time series running from 1991 to 2020 was used to determine this relationship. The Autoregressive Distributed Lag model (ARDL), Unit root test, Pearson's correlation (two tailed) was employed to analyse the data. The study found that Crude oil prices affect Vietnam, China, South Korea highly negatively while it has a minimal negative effect on Thailand, Singapore, Malaysia Japan and America. The investigation showed that in Indonesia, prices of fossil oil influence positively economic upswing. Additionally, Ftiti et al.(2016) examined how shock in crude oil prices has affected the economic growth of Nigeria. The research employed second hand data from different source from 1980 to 2014. Multiple regression was used to analyze the data. According to the study, there is positive and substantial correlation between rising oil prices and economic expansion.

Separately, Ali et al.(2017) investigated how Pakistan's household spending, political stability, and remittances affected the country's economic growth. The study examined how 2008 oil price shock, both before and after, and its destructive effects on general output. The study compared the influence of the oil price shock and economic upswing before and after shocks. The findings showed that there is a negative association between economic expansion and prices of crude oil. Additionally, structural break dummy confirms undetectable shift in economic growth before and after shocks to oil prices. Conclusively, Brucal et al.(2018) explored the power of price volatility of fossil oil toward state-level towards economic prosperity. The study employed 48 contiguous states for the period 1973-2013 and Structural decomposition of supply and demand factors that drives the real crude oil prices. Heterogeneity of neighboring state in production and consumption of crude oil and natural gases were used to analyze this relationship. The study showed that oil-exporting states are more vulnerable to unanticipated changes in oil prices, and the direct effect of oil price shocks can also effect on neighboring states through production and consumption sensitivity to crude oil prices through supply shocks.



### III. METHODOLOGY

#### 3.1 Data

This study utilized series of chronological data of about 34 years running from 1989 to 2022 which were sourced from the secondary data sources. The data on annual GDP per capita was sourced from World Bank Development Indicators and data on Crude oil prices were sourced from Statistical Review of World Energy, 2023. Software Package of EViews 12 was employed to analyse this time series data. The credibility of the information from World Bank statistics and Statistical Review of World Energy remains worthwhile. These sources have established numerous data collection and verification procedures over time, ensuring data is of better quality and consistence. This ensures that research findings are robust. However, the shortcomings of this data source includes but not limited to data gaps particularly countries with low and medium incomes (Utouh et al., 2024).

#### 3.2 Empirical model

Regression analysis involve analyzing of endogenous variable in relation to several predictor variables, also known as explanatory variables, in order to determine parameter estimates (Utouh et al., 2024). The independent variable in this study is crude oil prices (COP), and the dependent variable is economic growth (PCGDP) and the regression equation can be written:

$$PCGDP_t = \hat{\alpha} + \hat{\beta} COP_t + \omega_t \dots \dots \dots (1)$$

Where  $PCGDP_t$  = GDP per capita as proxied of economic growth and  $COP_t$  = Crude oil price and  $\omega_t$  = error term

In this study, Autoregressive distributed lag model (ARDL) as developed by Pesaran et al. (2001) is utilized to prevent spurious regression (Pesaran et al., 2001). ARDL is also employed due the tendency of some macroeconomic variables been correlated with its lag and the lags of its independent variables (Ogboru et al., 2017).

Dickey, D. and Fuller, W. (1981) tests for stationarity of the variables was conducted (Said & Dickey, 1984). The Phillip Perron Test (PP) was also employed to comply with the results from the ADF. The ADF & PP test is carried out to find out the unit root from equation (1) as follows:

$$\sum_{i=1}^n \beta_i \text{Log}(PCGDP)_t = \sum \alpha_i \text{Log}(COP)_{t-i} + \sum \beta_i \text{Log}(PCGDP)_{t-i} + \varepsilon_t \dots \dots \dots (2)$$

$$\Delta x_t = \beta_0 + \partial_t + \delta x_{t-1} + \sum_{j=1}^s \sigma_j \Delta x_{t-j} + \varepsilon_t \dots \dots \dots (3)$$

Where:  $\Delta x_t = x_t - x_{t-1}$ ,  $x_t$ : is time-series;  $s$ : is optimal lag selected by AIC criterion;  $\varepsilon_t$ : is disturbance term and it is Independently and Identically Distributed (IID)  $\sim N(0, \sigma^2)$

From the equation three (3) introduce trend variable  $t$  time called  $(\partial t)$ , which has values ranging from 1 to  $n$ , where  $n$  is last observation in the data series and 1 is the initial observation in the data. Disturbance term is random, Independently and Identically Distributed (IID)  $\sim N(0, \sigma^2)$ . Akaike information criterion (AIC), Schwarz Information Criterion (SIC), Hanna-Quinn Criterion (HQC), and Final prediction error (FPE) were used to determine the optimal  $k$  of lags for the ARDL model.

The Johansen test for cointegration was employed to determine the existing relationship between Gross Domestic Product Per Capita (PCGDP) and Crude Oil Prices (COP) are stationary time series at their first differences. The test for cointegration through Johansen method is used to establish the substantial correlation between variables. Therefore, its necessary to determine whether variables are stationary  $I(0)$ , or become stationary after the first difference  $I(1)$ , which is the prerequisite for ARDL model. ARDL model of lag  $(p, q)$  is as follows:

$$Y_t = BY_{t-1} + \dots + B_n Y_{t-n} + \beta X_t + \varepsilon_t \dots \dots \dots (4)$$

$Y_t$  is one dimensional matrix  $(m \times n)$  of  $(1 \times 1)$  between the predictor and response variable,  $X_t$  is a known variable and  $\varepsilon_t$  is the speed of predictor variables to arrive back to equilibrium.

Employing the autoregressive distributed lag (ARDL) model, the impact of fossil oil prices on growth of Tanzania's economy was estimated. ARDL model for COP and PCGDP is as follows:

$$\sum_{i=1}^n \beta_i \text{Log}(PCGDP)_t = \sum_{i=1}^n \alpha_i \text{Log}(COP)_{t-i} + \sum_{i=1}^n \beta_i \text{Log}(PCGDP)_{t-i} + \varepsilon_t \dots \dots \dots (5)$$

$$\text{Log}(COP)_t = \sum_{i=1}^n \beta_i \text{Log}(PCGDP)_{t-i} + \sum_{i=1}^n \alpha_i \text{Log}(COP)_{t-i} + \varepsilon_t \dots \dots \dots (6)$$

The response variable in the ARDL model  $(p, q)$  is PCGDP (Y) and predictor variable is COP (X). The model is presented below:

$$\text{Log}(PCGDP)_t = \alpha_{0i} + \sum_{i=1}^q \varphi_i \text{Log}(PCGDP)_{t-i} + \sum_{i=1}^p \beta_i \text{Log}(COP)_{t-i} + u_{1t} \dots \dots \dots (7)$$

Where PCGDP depends on crude oil price variable and it is expected to be  $I(0)$  and  $I(1)$ ,  $\varphi_i$  and  $\beta_i$  represent the value of the estimates;  $\alpha_0$  is the constant term,  $i$  is the number of observations,  $(p, q)$  represent the desirable lag and  $u$  express unobserved variables outside the model and its white noise.

ARDL bounds test justifies the existing relationship between variables. Thus, estimating the long run form by Error Correction Model (ECM) is as follows:



$$\Delta \text{Log}(\text{PCGDP})_t = \alpha_{0i} + \sum_{i=1}^q \varphi_i \Delta \text{Log}(\text{PCGDP})_{t-i} + \sum_{i=1}^p \beta_i \Delta \text{Log}(\text{COP})_{t-i} + \gamma_1 \text{Log}(\text{PCGDP})_{t-i} + \gamma_2 \text{Log}(\text{COP})_{t-i} + u_{1t} \dots \dots \dots (8)$$

**IV. FINDINGS & DISCUSSIONS**

**4.1 The Description of the Variables**

This section provides an overview of the variables used in this study, specifying their definitions, measurements, sources and expected signs as indicated in Table 1.

**Table 1**

*Summary of the Variable, Measurement, Sources of Data and Expected sign*

Variable	Measurement	Source	Expected sign
Economic growth (PCGDP)	Gross domestic product per capita (PCGDP) (Current US\$) as a proxy of the economic growth	World Bank	NA
Crude oil price (COP)	World crude oil prices in (Current US\$)	Statistical Review of World Energy, 2023	+/-

**4.2 Descriptive Statistics**

Table 2 portrays summarized descriptive statistics. The results shows that LogPCGDP has equal mean and median and nearly zero skewness indicating that the distribution is symmetric. It may be observed that LogCOP has also approximate equal mean and median indicating that the distribution is symmetric. The standard error is small about 0.30 for LogPCGDP and LogCOP suggesting that the data set does not deviate from their mean, data has a linear trend around their mean value. Kurtosis is positive and small indicating a mesokurtic between LogPCGDP and LogCOP and there is no presence of outliers in the data set. Jarque-Bera coefficient of 4.1016192 and 2.928053 respectively and their probabilities of 0.134244 and 0.231303 which are greater than 5% significant level, signifying that the model conforms to normality distribution assumptions.

**Table 2**

*Summary Statistics of the Variables Used in the Regression Analysis*

	LogPCGDP	LogCOP
Mean	3.330194	2.403597
Median	3.297164	2.429835
Maximum	3.764283	2.846572
Minimum	2.916361	1.902976
Standard deviation	0.301484	0.300766
Skewness	0.061520	-0.000284
Kurtosis	1.320768	1.562353
Jarque-Bera	4.1016192	2.928053
Probability	0.134244	0.231303
Sum	113.2266	81.72229
Sum sq. Dev	2.999451	2.985189
Observations	34	34

*Notes: Descriptive statistics performed to analyze the data set*

**4.3 Test for Unit Root**

Table 3 presents the summary of the results of unit root test using Augmented Dickey Fuller (ADF) test and Phillips- Perron (PP) test for unit root. The results show that LogPCGDP and LogCOP are not stationary at level. However, at first difference, I (1) variables has no unit root, supported by t-statistic which is greater than 5% critical values for both ADF test and PP test. Given that both variables are integrated of paired order I (1), the study uses Autoregressive Distributed Lags (ARDL) model and Johansen cointegration technique of estimating short run and long run relationship between variables.

**Table 3***Unit Root Test Results*

Augmented Dickey Fuller (ADF) test				Phillips-Perron (PP) test			
Variable	t-statistic	5% critical value	Prob.	t-statistic	5% critical value	Prob.	Order of integration
LogPCGDP	-4.04652	-2.95711	0.0003**	-4.11710	-2.95711	0.0031**	I (1)
LogCOP	-5.11859	-2.96041	0.0002**	-5.05481	-2.95711	0.0003**	I (1)

Notes: Unit root test performed by using ADF and PP test at 5% significant level: Sign code \*\*  $P < 0.05$

**4.4 Optimal Lag Selection**

Table 4 shows that optimal lag for estimation of ARDL model is lag 1 which was selected by all criteria.

**Table 4***Lag Selection Criteria and Results.*

Lag	0	1	2
LR	NA	166.9077*	5.439242
FPE	0.0001926	7.84e-06*	8.26e-06
AIC	-0.576652	-6.082090*	-6.033544
SC	-0.485043	-5.807265*	-5.575501
HQ	-0.546286	-5.990994*	-5.881716

Notes: Lag selection Criteria performed by Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hanna-Quinn Criterion (HQC), Final prediction error (FPE): \* = the smallest optimal lag selected by criterion.

**4.5 Test for Residual Diagnostic**

The Breusch- Godfrey Serial correlation LM Test in Table 5 indicates the absence of serial correlation in residuals. Implicitly, probability of Chi-square is 0.4976 which exceeds 0.05 significant level.

**Table 5***Autocorrelation Test: Breusch-Godfrey LM*

F-statistic	0.570119	Prob. F (2,25)	0.5726
Obs*R-square	1.395840	Prob. Chi-Square (2)	0.4976**

Notes: Breusch-Godfrey test for autocorrelation: \*\*means no correlation between variables and error term at 5% significant level

**4.6 Test for Heteroscedasticity**

The results of heteroscedasticity presented in Table 6 indicate that residuals are homoscedastic as specified by probability of Chi-square (0.2092) which exceeds 5% significant level.

**Table 6***Heteroscedasticity Test: Breusch-Pagan- Godfrey*

F-statistic	1.515699	Prob. F (4, 27)	0.2256
Obs*R-square	5.867909	Prob. Chi-Square (4)	0.2092**
Scaled explained SS	6.659914	Prob. Chi-Square (4)	0.1550

Notes: Breusch-Godfrey test for Heteroscedasticity: \*\*means no heteroscedasticity at 5% significant level

**4.7 Test for Normality**

Table 7 shows that error term is normally distributed since the probability of Jarque-Bera test (0.0526) is greater than 0.05 significant level.

**Table 7***Result of Normality*

Normality test	
Jarque-Bera	5.882803
Probability	0.052592



Notes: Normality test for residuals using Jarque-Bera at 5% significance level

#### 4.8 Long Run Relationship

From Table 8, the trace statistic is smaller than the 5% critical value. Thus, LogPCGDP and LogCOP have single cointegrating equation. Therefore, long-run equilibrium of the ARDL can be measured.

**Table 8**

*Johansen Cointegration Test*

Number of Cointegrating equation	Eigenvalue	Trace statistics	5% Critical value
None	0.337336	13.30681	15.49471
At most 1	0.004341	0.139199	3.841465

Notes: Johansen Cointegration Test

#### 4.8 Autoregressive Distributed Lags Results

Table 9 shows ARDL short-run estimates. The Error Correction Model shows that there is moderate speed of adjustment between variables with a negative and significant value of -0.100042 ( $p = 0.0025$ ). This shows that economic growth will adjust to equilibrium at a speed of 10% each year due to shocks in crude oil price.

Furthermore, in short run it is exposed that price of crude oil (COP) has significant and substantial impact on growth of Tanzania's economy. A unit increase in COP will increase the economic growth of about 0.232791 units. Also,  $R^2$  in the model show 66.73% of the variation of economic growth (PCGDP) can be explained by the crude oil prices and 33.27% variation of economic growth (PCGDP) can be explained by other external factors. Also, F-statistic is approximately 18.72448 with its probability of 0.000001 provides us with confidence to conclude that overall results obtained from ARDL are statistically significant.

**Table 9**

*Error Correction Model with Short-run Result.*

Dependent variable LogPCGDP	Coefficient	Standard Error	Test Statistic	Probability
ECM (-1)	-0.100042	0.029973	-3.337718	0.0025**
D(LogCOP)	0.232791	0.032640	7.132161	0.0000***
$R^2 = 0.6673$	Adj $R^2 = 0.6317$	F-statistic = 18.72448	Prob. F-statistic = 0.000001	

Notes: Short run results and ECM from ARDL: \*\*\* and \*\* significant at 1% and 5% level of significance respectively

Table 10 shows the long run coefficient of ARDL model with optimum of lag is ARDL (1, 2). This optimal lag is selected by AIC. This shows that crude oil price has negative and significant effects on economic growth of Tanzania of approximately -1.15772 percent for each 1 dollar rise in crude oil price.

**Table 10**

*ARDL Long Run Relationship Result*

Dependent variable LogPCGDP	Coefficient	Standard Error	test-statistic	Probability
LogCOP	-1.157722	0.029973	-3.337718	0.0000***
C	0.076454	0.014798	5.166443	0.0000***

Notes: ARDL estimation of the long run relationship: \*\*\*significant at 1% significance level

#### 4.9 Granger Causation Test

The null hypothesis of LogCOP forecast LogPCGDP and LogPCGDP forecast LogCOP at 5% significant level is rejected. Thus, no bidirectional relationship between PCGDP and COP.

**Table 11**

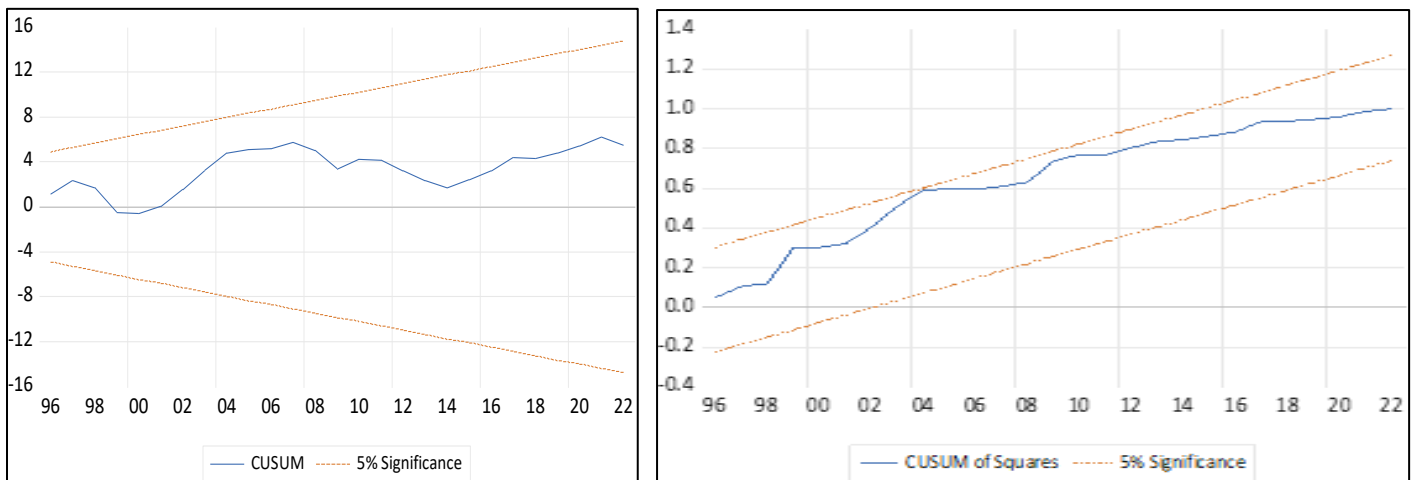
*Granger Causation Test*

	Observation	F-statistic	Probability
LogCOP has no Granger Causation to LogPCGDP	32	0.43981	0.6487
LogPCGDP has Granger Causation to LogCOP		1.60813	0.2189

Notes: Granger Causation test: at 5% significance level

#### 4.10 Model Stability

Figure 1 shows that CUSUM and CUSUMSQ curves remain within 5% range (bound), which justifies the long run connection between variables. Therefore, the model is stable and errors generated from all-time series were relatively stable and suggests that no structural break.



**Figure 1**  
*CUSUM and CUSMSQ at 5% Significance Level.*

#### 4.11 Discussions

The study on the influence of fluctuations in price of crude oil on economic growth has revealed that changes in price of crude oil has a significant and productive impact on Tanzania's economic upswing. One-dollar rise in price of crude oil brings about 0.232791 unit rise in level of Tanzania's economic growth in short run. This result is conforming with Ogboru et al. (2017), Dinh (2022), Ftiti et al. (2016), Odhiambo & Nyasha (2019), and (Kibunyi and Wanjala, 2018). This can be caused by an increase in revenues from port charges and import levies from Dar es Salaam, Tanga, and Mtwara ports through transportation of oil tankers for both domestic and transit goods for other landlocked countries like Congo, Zambia, and Malawi (Gasper & Mbwambo, 2023). This increases revenue to the country, which could be invested in production units, resulting in a boost in the economic growth of Tanzania (Kibunyi and Wanjala, 2018). Additionally, increases in income through employment in the transport sector and fuel stations also increase income investment and hence economic growth (Utouh et al., 2024). The study further showed that in the long run, crude oil prices have a negative and significant impact on Tanzania's economic growth. The investigation showed that, one percent increase in crude oil prices brings about -1.15772 percent fall in economic growth of Tanzania. The ARDL results also shows that error correction model (ECM) of -0.1000 ( $p=0.0025$ ) is significant with its value, suggesting a moderate speed of convergence to equilibrium after shock. This is concurrent to Adam and Pasrun (2021), Dinh (2022), Ftiti et al. (2016) and Gasper and Mbwambo (2023) who found that as crude oil price increases consequently, the importation of crude oil becomes very expensive, leading people to find alternative sources of energy like electric cars and motorcycles. This reduces revenue to the government, lowers employment in the energy sector and other linked sectors. Further, it reduces consumption, pushes up overall prices, and eventually slows down the rate of economic expansion.

## V. CONCLUSIONS & RECOMMENDATIONS

### 5.1 Conclusions

The purpose of this study is to explore the effect of crude oil price volatility and economic growth of Tanzania running from 1989 to 2022. An autoregressive distributed lag model is employed because it can estimate both short-term and long-term relationships between variables while still providing unbiased estimates and significant t-statistic regardless whether some independent variables are endogenous. Granger-Causality tests showed that there is unidirectional granger-causality from economic growth to crude oil prices and vice versa in the study country. Also, crude oil price volatility has been proved to have substantial influence on the economic progress in Tanzania. This implies that an increase in crude oil price will increase the government revenues and income consequently increases the





economic activities and hence economic prosperity in short-run. However, if the volatility of crude oil prices persists, it will in the long run dampen the level of economic growth due to high cost of transportation, searching for alternative source of energy which consequently, lower investment, increase general price levels, reduces consumption, and economic growth of Tanzania. Finally, this study concludes that among other thing, economic growth of Tanzania is affected by changes in crude oil prices.

## 5.2 Recommendations

There has been great discussion among academicians, researchers and politicians about the effect of fluctuations in fossil fuel prices on economic expansions worldwide. This study shows that changes in price of unrefined oil negatively strike economic prosperity of Tanzania in long-run. This negative effect calls for attention to policy makers and the government to ensure effective use of fiscal policies that will reduce the adverse impact of the world crude oil prices hikes, but also searching for alternative sources of energy that will reduce depending on the crude oil. Additionally, research and development should be enhanced so as to explore and harness the oil fossils that have been found in along the coast of Indian ocean. This will reduce the importation of crude oil and Tanzania will export the rest of oil to the world and hence, expand its economy.

## REFERENCES

- Adam, P., & Pasrun, Y. P. O. (2021). Effects of Crude Oil Prices Volatility , the Internet and Inflation on Economic Growth in ASEAN-5 Countries : A Panel Autoregressive Distributed Lag Approach. *International Journal of Energy Economics and Policy*, 11(1), 15–21.
- African Energy Chamber. (2023). *The State of African Energy 2023 Outlook*. African Energy Chamber.
- Ali, K., Ali, S., & Kiran, A. (2017). Crude Oil Prices and Its Effect on Economic Growth ; Analyzing Pre and Post Oil Prices Shocks : A Case Study of Pakistan Economy Oil Prices Since 1986-2015. *Journal of Energy Technologies and Policy*, 7(3), 2013–2018.
- Anthony, N. (2020). Global Oil Price Shocks and Effects on Economic Growth : An Econometric Investigation of Nigeria. *International Journal of Innovation and Economic Development*, 6(4), 7–26. <https://doi.org/10.18775/ijied.1849-7551-7020.2015.64.2001>
- Awunyo-vitor, D., Samanhya, S., Bonney, E. A., Awunyo-vitor, D., Samanhya, S., & Bonney, E. A. (2018). Do oil prices influence economic growth in Ghana ? An empirical analysis. *Cogent Economics & Finance*, 6(1), 1–14. <https://doi.org/10.1080/23322039.2018.1496551>
- Benli, M., Altıntaş, H., & Kaplan, M. (2016). Asymmetric effect of oil prices on economic growth: Evidence from Turkey. In *Proceedings of the International Congress of Management Economy and Policy* (pp. 2767–2778). Istanbul, Turkey.
- Berument, M. H., Ceylan, N. B., & Dogan, N. (2010). The Impact of Oil Price Shocks on the Economic Growth of Selected MENA 1 Countries. *The Energy Journal*, 31(1), 149–176.
- Brucal, A., & Roberts, M. J. (2018). *Not all regions are alike: Evaluating the effect of oil price shocks on local and aggregate economies* (Working Papers 2018-4). University of Hawaii Economic Research Organization, University of Hawaii at Manoa.
- Dinh, D. Van. (2022). Crude Oil Price Fluctuation and Economic Growth : A RDL Model Approach. *International Journal of Energy Economics and Po*, 12(4), 240–248. <https://doi.org/https://doi.org/10.32479/ijjep.13177>
- Ftiti, Z., Guesmi, K., & Chouachi, S. (2016). Relationship Between Crude Oil Prices And Economic Growth In Selected OPEC Countries. *The Journal of Applied Business Research*, 32(1), 11–22.
- Gaspar, L., & Mbwambo, H. (2023). Forecasting Crude Oil Prices By Using ARIMA Model: Evidence From Tanzania. *Journal of Accounting, Finance and Auditing Studies*, 10(32602), 158–175. <https://doi.org/10.32602/jafas.2023.017>
- International Energy Agency (IEA). (2023). *World Energy Outlook 2023*. International Energy Agency. <https://www.iea.org/reports/world-energy-outlook-2023>
- Kibunyi, A., C, C., & Wanjala, K. (2018). Effect of Crude Oil Prices on GDP Growth and Selected Macroeconomic Variables in Kenya. *Journal of Economics and Business*, 1(3), 282–298. <https://doi.org/10.31014/aior.1992.01.03.27>
- Mhamad, S. H., & Saeed, S. T. (2016). The Impact of Oil Price on Economic Growth : Empirical Evidence from Iraq. *Journal of Economics and Sustainable Development*, 7(14), 156–161. [https://doi.org/ISSN 2222-1700 \(Paper\)](https://doi.org/ISSN 2222-1700 (Paper))
- Msafiri, A., & Yurievich, A. (2018). Correlation of oil prices and gross domestic product in oil producing countries. *International Journal of Energy Economics and Policy*, 8(5), 42–48.



- Muthalib, A. A., Adam, P., Nur, M., Saenong, Z., Suriadi, L. O., & Baso, J. N. (2019). The Effect of Crude Oil Prices on Inflation, Interest Rates and Economic Growth in Indonesia. *International Journal of Energy Economics and Policy*, 9(5), 14–19. <https://doi.org/10.32479/ijeeep.7829>
- Nwanna, I., & Ayenajeh Eyedayi. (2016). Impact of Crude Oil Price Volatility on Economic Growth in. *Journal of Business and Management (IOSR-JBM)*, 18(6), 10–19. <https://doi.org/10.9790/487X-1806011019>
- 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(2), 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*, 8(12), 78–89.
- Oriakhi, D. E., & Osaze, I. (2013). Oil Price Volatility and its Consequences on The Growth of the Nigerian Economy: An Examination (1970-2010). *Asian Economic and Financial Review*, 3(5), 683–702.
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326. <https://doi.org/10.1002/jae.616>
- Rumbia, W. A., & Azis, A. (2020). Crude oil prices, household spending and economic growth in the ASEAN-4 region : an analysis of nonlinear panel autoregressive distributed lag Crude Oil Prices, Household Spending and Economic Growth in the ASEAN-4 Region: An Analysis of Nonlinear Panel. *International Journal of Energy Economics and Policy*, 10(4), 437–422. <https://doi.org/10.32479/ijeeep.9293>.
- Said, S. E., & Dickey, D. A. (1984). Testing for unit roots in autoregressive-moving average models of unknown order. *Biometrika*, 71(3), 599–607. <https://doi.org/10.1093/biomet/71.3.599>
- Smets, F., & Wouters, R. (2007). Shocks and frictions in US business cycles: A Bayesian DSGE approach. *American Economic Review*, 97(3), 586–606. <https://doi.org/10.1257/aer.97.3.586>
- Stiglitz, J. E. (1989). Imperfect information in the product market. In R. Schmalensee & R. D. Willig (Eds.), *Handbook of Industrial Organization: Vol. I* (pp. 769-847). Elsevier Science Publishers B.V. [https://doi.org/10.1016/S1573-448X\(89\)01016-2](https://doi.org/10.1016/S1573-448X(89)01016-2)
- Utouh, H., Mchukwa, E., & Tibuhinda, R. (2024). The Effects of Foreign Direct Investment on Economic Growth (Gross Domestic Product) in Tanzania. *Economic Insights – Trends and Challenges*, 2024(2), 89–100. <https://doi.org/10.51865/eitc.2024.02.07>