Journal of Economics, Finance and Management Studies

ISSN (print): 2644-0490, ISSN (online): 2644-0504

Volume 07 Issue 01 January 2024

Article DOI: 10.47191/jefms/v7-i1-78, Impact Factor: 7.144

Page No: 780-792

Analyzing the Effect of Oil Price Fluctuation on East Africa's Foreign Exchange Ratevolatility

Kotut Cheruiyot Samel[1], Prof. Chepkwony Joel[2], Dr. Saina Ernest[3]

[1]School of Business & Economics, Department of Economics Moi University, Kenya,

[2]School of Business & Economics, Department of Marketing and Logistics Moi University, Kenya,

[3]School of Agriculture and Bio-Technology Department of Agricultural Economics & Resource Management, Moi University, Kenya

ABSTRACT: Oil is one of the major sources of energy in the world today, therefore many sectors of the economy are directly or indirectly dependent on oil as a source of energy. These has made oil price fluctuation to one of the most sort after macroeconomic variable due to its potential effects on the global economy. The primary objective of this paper was to investigate the effects of oil price shocks on foreign exchange rate of the three East African countries using SVAR analysis for the period from 1990 to 2022. Our empirical evidence confirmed that the increase in the price of crude oil in leads to a positive change in foreign exchange to the Dollar, the SVAR estimation confirmed positive significant effect of oil price fluctuation on foreign exchange trends, the results of the IRF pointed out oil price fluctuation positively affect the East Africa's foreign exchange performance and finally the FEVD of oil price fluctuation on foreign exchange reflected that there exist indirect effects of oil price fluctuation on foreign exchange as well as foreign exchange influencing oil price after the second period. Based on these findings we therefore conclude that crude oil price fluctuations contribute significantly to the foreign exchange variability in the East African countries and hence affecting other sectors of the economy inversely.It is on this ground that we recommend adoption of policies that will reduce this effect on this countries, to start with to reduce the burden the countries should look for alternative locally available source of power that include adoption of Bi-diesel, compressed methane that can be source from sugar cane give the un tapped potential of sugar can in the three countries. In addition, the countries can consider price hedging of oil purchases where the countries enter into contract with their oil supplies for a constant crude oil price over the contract period.

KEYWORDS: Oil Price Shocks, Foreign Exchange, Impulse Response Functions (IRF), Factor Error Variance Decomposition (FEVD)

1.0 BACKGROUND

Crude oil is one of the main pillars of economic development in the world today, it is considered as the most crucial raw material by economists and as well as being the primary source of energy. Petroleum Oil plays an important role in every part of the economy, including;- transportation, energy and industrial sectors (Nazir and Hameed, 2015, p.1). Just to mention a few, oil is needed to produce electricity, to operate production machines and to transport products to the market, as Rafiq et al., 2009, was putting it.

It is paramount to note that there exists a geographically unbalanced distribution of petroleum resources in the world. Therefore, the rise in oil prices brings about different results on the economic performance and stability of oil exporting and oil importing countries. For instance, the impact oil price fluctuation has on oil importing countries will always be different from those felt by oil exporting countries. Countries exporting oil may benefit from these increases, as oil importing countries tend to be in an economic downturn due to rising oil prices (Sek, 2017, p.204).

The current study focused on effect of oil price shocks onforeign exchange rate in three East Africa countries (Kenya, Uganda and Tanzania). These three countries are primarily oil importing countries as well as being oil dependent countries, since they dependent on oil driven production processes. The continuous fluctuation in the oil prices have generated a great deal of concern around the effects of oil price fluctuation and countries inflation rate and economic growth across the international community. It is imperative to note that while international oil prices have been unstable, the three east African countries have been struggling with slow economic growth perspectives as well as the unstable exchange rate in relation to the Dollar which has been an addition course to the worsening of oil prices in these countries which has greatly affected the countries price levels.

Several studies have been conducted on the impact of oil price fluctuation on macroeconomic variables and have reported varied results, studies done in 1970s up to 1990s reported positive relation between oil price fluctuations and inflation, however it is imperative to realize that current empirical evidence have showed varying conclusions, in fact several studies have reported conflicting evidences even from same economies

2.0 THEORETICAL FRAMEWORK AND LITERATURE

2.1Theoretical Framework

The Real Business Cycle Theory

The study adopted the recent/modern economic theory of real business cycle theory that suggested that economic fluctuations are a result of technological changes plus availability of resources in an economy, the two are believed to influence productivity and hence causes changes in the long-run aggregate supply in a given economy. This theory rejected the role of aggregate demand in influencing the economic cycle. It suggested that the governments intervention to influence demand in an economy is generally counterproductive hence the optimal policy to implement is concentration on supply side policy reforms that will make the economy more efficient and productive as well. This school of thought rejected the existing Keynessian and Monetarist school of thoughts and tends to be associated with Neo-classical and Chicago school of thoughts.

This theory evolved out of the American Neo classical school of 1980s. The scholars that included ;-Kydland and Prescott, Barro and King, Long and Plosser, and Prescott. Later, Plosser, Summers, Mankiw among other economists gave their views of the real business cycles.

According to them aggregate economic variations are the outcomes of the decisions made by many economic agents acting to maximize their utility subject to production possibilities and resource constraints. Their views mainly relate to technology shocks, labour market, interest rate, role of money, fiscal policy, prices and wages in business cycles.

But the path to a new steady state will not be smooth. With a permanent technological advance, consumption and investment increase in the next period. But the increase in total resources and output is smaller than in the initial period. In the Figure, R1R2 < R R1 and Y1Y2 <YY1.

A recession in the real business theory is just the reverse of the expansion. A shock of decline in-technology reduces Z and shifts the production function downward and decreases the available resources. This starts a process of decline in investment, consumption, output and employment. But the models of real business cycle do not explain a recession.

2.1 (a) Modification of the RBC Theory to Real Business Cycles

According to RBC Theory or Real Business Cycles, business cycle fluctuations to a large extent are subject to real shocks which affect market dynamics and that economic crisis and fluctuations are a consequence from an external shock, such as technology shocks. Previous research found out that many cyclical events cannot be explained by a model driven only by technology shocks. This lead to models where additional disturbances are included such periods of bad weather, natural disasters, oil shocks, stricter environmental and safety policies, etc (W.S., George 1994)

According to George, W.S (1994) another way to classify RBC models is through differentiating the strongest impulses driving the cycle: Do they arise from a demand shock or a supply shock in the economy? Some economist attributes the latest oil shock to OPEC supply constraints and some other to demand by Asian economies.

The basic idea that lies in RBC theory is that if an external shock occurs that directly changes the effectiveness of capital and/or labor. This in turn has an effect on workers and firms decisions, which in turn change their consumption and production patterns and thus eventually affect output in a negative way. (Finn, E.K., 1982)

This theory has some implication in the results in a sense that it supports that a prominent oil shock will affect growth. Business cycles vary tremendously in magnitude and duration therefore cycles does not appear to be alike. The magnitude of the price changes in the last oil shocks and the duration of it differ from the current oil shock being analyzed. The results in this study exhibit less correlation which can be explained by changes in economic fundamental that will be discussed in the conclusion.

2.2 Literature

In 2009, Kiptui studied the oil price pass-through mechanism into inflation in Kenya for over 30 years. In his study he adopted a Phillips curve approach in the estimation of the pass-through of oil price to inflation. He concluded that oil prices have significant effects on inflation with a pass through of 0.05 in the short run and 0 .1 in the long run. Exchange rates have a significant effect on inflation with a pass through of 0.32 in the short run and 0.64 in the long run.

In his master research Ndule M. A (2019, entitled time series analysis of oil price shocks and inflation in Tanzania, used ARDL and VAR Approaches to analyze the effect of oil price fluctuation in Tanzania economy and they established that based on ARDL there exist a significant Long-run positive relationship between inflation and oil price changes in Tanzania, significant negative relationship between oil prices and GDP, He also established based on VAR model that, oil prices and exchange rate have a positive impact on inflation but negatively impacts on GDP.

Gibson s. Massito A. and Abogust M, (2023) in their examination of the impact of oil price volatility on inflation and economic growth in Tanzanian economy, employing ARDL modeling they established that oil price volatility has negative impact on economic growth, oil price volatility has a positive impact on inflation in the long run situation. In addition they were able to establish that there exist no causality between economic growth and oil price volatility, that there was a Bi-directional causality between GDP and inflation in Tanzania and a one way Directional causality from oil price volatility to inflation implying that oil price volatility will enhance core inflation in Tanzania, it is imperative to note that in as much as the study offers a greater insight on the impact of Oil price volatility on inflation and economic growth the researchers focus on causality therefore difficult to ascertain the magnitude of the impact and determination of the effects.

Marris N, Liz S and Bwire T (2019) in their Bank of Uganda working paper, analyzed the impact of oil price shocks on selected macroeconomic variables in Uganda, they established that in the short run, net exports declined, the Ugandan shilling exchange rate to the dollar appreciated, the core inflation however increased and finally the treasury bill rate decline too. Their variance decomposition analysis indicated that oil price shock will produce the largest impact on net exports, followed by treasury bill and exchange rate but that shock has a minimal impact on core inflation in the long run. Based in this study it offers a stronger ground of reference in as much as the methodology of the study is not well captured there casting doubts on reliability of the document.

ObindahGerson et al (2019), examined the implications of oil price shocks on developing net oil-importing countries. In their study they tested for;-casual relationship, impulse response function, and vector decomposition between oil prices and macroeconomic variables using an unrestricted vector autoregressive (VAR) model. For the period 1980 to 2015. The results of the study were Mixed from the selected African countries of Cape Verde, Liberia, Sierra Leone, and Gambia. The granger causality test showed that oil prices cause GDPC in Liberia and Sierra Leone. The VAR model and Impulse response indicated that oil price increase temporarily increased GDP per capita in the short run for the selected countries

Gibson Sabayo, John Massito, Abogust Moshi, (2023), did a study on the Impact of Oil Price Volatility on Inflation and Economic Growth in Tanzania, using ARDL econometric analysis on Tanzanian time series data, The results of the study were that:-, after controlling the effect of export and import, the oil price volatility was found to be of negative impact on economic growth while after controlling the effect of exchange rate and Interest rate on the inflation rate it was realized that the oil price volatility had a positive impact on inflation in long run in the long run. This study provide a good empirical background but it lacks theory associate with the study and several econometric tests seem to be lacking making it very unreliable.

2.3(a)The Link between Foreign Exchange and Inflation

The value of a countries currency in relation to another country is its exchange rate, the frequent fluctuations in a countries domestic currency in relation to foreign currencies can have drastic effect on a countries core inflation. In that case the prices of imported goods tend to be expensive especially during depreciation of its currency relative to foreign currencies, this therefore implies that the fluctuation in foreign exchange is affecting the countries core inflation directly. This is also the imported inflation associated with increased prices of imports since a country's currency is depreciating and hence making prices of imports to be expensive relative to domestic prices. The local currency if valueless in comparison to foreign currencies. In addition, if the firms are importing raw materials and or capital this will at the end be transferred to the end consumers in terms of price increases.

2.4 Modeling

2.4 Research design

The objective of this study was to investigate the relationship between oil price shocks and inflation trends in the three East African countries. The researcher adopted a non-experimental group time series research design. Annual time series data of the three East African countries was collected for the period starting 1990 to 2022. The variables of the study included world crude oil price, inflation rate, real GDP growth and exchange rates. The Structural Vector Autoregressive (SVAR) Model framework was adopted in the estimation where the Granger Causality, Impulse Response Functions and Forecast Error Variance decomposition was analyzed.

2.5 Econometric Modelling

2.5(a)Heteroscedasticity

The current study adopted Breush-Pagan test and Non- Constant variance score test so as to be able to determine existence or otherwise of Heteroscedasticity in the.

The test hypothesis are

Ho Homoscedasticity is present

H_A Heteroscedasticity is present.

The rule of the thumb is reject the Null hypothesis if p-value for each test is less than 0.05. while if the p-value is grater than 0.05 we fail to reject the null hypothesis therefore implying presence of Homoscedasticity in the Model

2.5 (b)Cointegration Analysis

The Structural Vector Auto Regressive (SVR) Model used to test for cointergration is

$$B_0 X_{it} = c_0 + \sum_{i=1}^{k} B_i X_{it=i} + \varepsilon_{it} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad 1$$

Where Xt is the g-vector of I(1) variables, C is the g-vector of constants, and εit is the g-vector of white noise residuals at time t with zero mean and constant variance.

The current study adopted Johansen &juselius (1990) to test the existence of long run association and or relationship between oil price fluctuation and inflation changes in SVAR regression model. The Akaike information creteria was used to determines the lag length to implement the JJ procedure based on the vector autoregressive (VAR)

2.5 (b)Lag Length Selection

For the purpose of the current study, Wald test was used to determine lag exclusion the after which adopt the traditional lag order selection criterio byAkaike information criteria. In relation to the wald test, the idea is to test the Null hypothesis that the variables in the VAR are jointly zero at a given 24 lag. If the Null hypothesis is rejected, it implies that the lag should be included in the analysis. While on the other hand the lag order selection criteria suggests the optimal number of lags based on different predetermined methods/ critreria, in this case according to Verbeek (2008) the commonly used methods are information criteria of Akaike (Akaike information criteria (AIC)) and Schwarts information criteria (SIC).

2.5 (c)Akaike Information Criteria.

To start with, the Akaike Information Criterion is one of the most objective methods of determining the models lag length econometrically. For instance take a stationary series of the form

where t = 1,2,3,4,5,…………, n. the Akaike Information Creteria will involve minimization of the following function

. . . . 2

Where;-

P =1,2,3,4, ………… n represents the residual variance of the fitted VAR i.e AR(p) model, c(n) is the penalty term and is the number of observation in the series, while m represents the predetermined upper boundary of the Autoregressive order.

The AIC will be given by

$$AIC = In\overset{\Delta}{\sigma}_p{}^2 + \frac{2m}{T} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad 3$$

Where;-

$$\overset{\Delta}{\sigma}_p{}^2 = \frac{1}{T}\sum_{i=1}^{N}\left[X_i - \sum_{j=1}^{p}\phi_j X_{t-j}\right]^2 \quad \dots\dots\dots\dots\dots\dots\dots\dots \quad 4$$

Therefore in that instance the lag length will be determined by $AIC = \min\{AIC \quad (p)\}$, which is the model with the lowest AIC.

2.5 (d)The Schwarts Bayesian Criterion.

The Bayesian Information Criterion (BIC) is given by;-

$$SIC = In\sigma_p{}^2 + \frac{m}{T}InT \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad 5$$

Where the suitable lag length will be determined by considering the lowest SIC (p), where;-

$$SIC = \min\left(SIC(p)\right) \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad 6$$

2.6(e)Hannan-Quinnan Criterion.

This lag length selection criteria was propounded by Hannan and Quinn in 1979, in their criteria they proposed the lag length selection through

$$HQ = In\sigma_p{}^2 + 2\frac{m}{T}In(InT) \ldots\ldots\ldots\ldots\ldots\ldots\ldots 7$$

In that case the best lag length of the model will be achieved by considering the lowest HQ(p) such that the model will be

$$HQ = \min\left(HQ(p)\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots 8$$

2.5(f)Ordering of Variables

The ordering of the variables has to correspond to the mathematical formulation behind the VAR series and the theoretical formulation. In the current study, the VAR, equations are analyzed by Cholesky decomposition Matrix as proposed by Kilian, (2011). According to him, the variable selected first should be the one with the most potential immediate impact on the other variable following a shock in its residuals in the VAR used,

2.5(g)Granger Causality Test

The granger causality test (1969) is used to test if two variables X and Y can explain each other, Does variable X causes variable Y and how much of the present value of Y can be satisfactorily explained by past values of Y and again if adding past values of X can help improve the explanation of Y. in this case the variable X is said to Granger cause variable Y if the past Values of X help in the prediction of present values of Y in the model.

The granger causality analysis is used to check whether lagged variables have got an incremental effect on forecasting power on a univariate regression model. This is obtained through testing of F test of joint significance of other variables in a model with lagged variables of the dependent variable. Therefore, the NULL hypothesis being tested is that a variable Y does not granger cause Z. using wald test the coefficients of Y will be taken as zero in equation for Z.

2.5 (h)SVAR Model Specification

The current study adopted a structural Vector Auto-Regressive (SVAR) Model to investigate the effect of oil price fluctuation on inflation and economic performance of the three East Africa countries. According to Effiong 2014, The choice of the SVAR model is to allow combination of time series analysis and economic theory in the analysis i.e responses of macroeconomic variables to independent shocks

According to Wang et al, (2013), The Structural Vector Auto Regressive Model is used to examine the impact of oil price shocks on macroeconomic variables using the impulse response functions and variance decomposition. In their justification for the use of SVAR model "in their study results of the impulse response implied by VAR model can be affected by order of variables, SVAR model can help overcome the ordering problem by imposing restrictions on the system according to importance of the variables.

However, it should be noted that the Structural Vector Auto Regressive (SVAR) model according to Gottschalk, (2001), does not impose restrictions on the structural parameters of the SVAR matrix but instead it sets restrictions based on economic theory regarding macroeconomic variables into orthogonal shocks with structural interpretation when capturing the existing relationship between variables within a linear formulation

The study started with the reduced form of Vector Auto-regressive (VAR) formulation in order to determine the causation from Oil price shock to inflation and economic performance on selected African countries.

From the conceptual frame work four key explanatory variables (NPC, INF, Exchange and GDP) are captured in the VAR (k) model

$$X_{it} = c_0 + \sum_{i=1}^{k} A_i X_{it=1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

Xt is the vector of four by four matrix of the endogenous variables, xt=(GDPt, EXCHt, INFtNPCt)

µt represents the vector of residuals, used to estimate the structural restrictions of the model, this is the 4x1 vector of the serially and mutually uncorrelated structural innovations.

C0 and Ai are vector/matrix of coefficients which need to be estimated;

k is the number of lagged terms.

To convert VAR to SVAR, there is need to introduce the contemporaneous coefficients matrix B0 into the VAR model as structural restrictions:

The restrictions introduced to the VAR model are;-

i. Oil price is exogenous (only) at the contemporaneous period, that means GDPt, EXCHt, and INFt are not determinants of NPC at period t.

ii. INF is only determined by oil price and CPI itself, which means a change in Exchange rate and output (GDP) can only affect INF in the subsequent periods.

iii. Exchange rate does not respond to either GDP or CPI changes, because of the time lag.

iv. GDP change does not affect inflation and exchange rate immediately, but the inflation and exchange rate change affect GDP instantly.

Therefore based on the above restrictions on VAR model the SVAR model for the study is specified as :-

$$B_0 X_{it} = c_0 + \sum_{i=1}^{k} B_i X_{it=i} + \varepsilon_{it} \quad \ldots\ldots 10$$

Where :-

B0 is a 4x4 contemporaneous matrix

Xt is the 4x1 vector of the four endogenous variables, Xt=(GDPt,EXCHt, INFtNPCt)

Bi is the 4x4 Autoregressive coefficients matrix which represents contemporaneous relationships between variables.

K is the optimum Lag length

Co is the vector of constant terms

ε is the 4x1 vector of serially mutually uncorrelated structural innovations

2.5 (i)Impulse Response Function

According to Karimov (2011), the impulse response functions are used to explore the shocks or otherwise try to force the simulation of changes among endogenous variables in a VAR series. On the other hand as per Potter (1996) views, impulse response traces the responses of current and future values of each and every variable in the model to a one standard deviation shock in one of the variables in the series/model for example in a stationary VAR represented as AR(p) it has a moving average of MA(∞) representation, generally a stationary VAR(p) model can be represented as an Infinite Vector Moving Average (VMA (∞)) model.

Final impulse response function model shall be;-

$$z_t = \mu + \sum_{j=0} \Phi_j \varepsilon_{t-j} \quad \ldots\ldots 11$$

Where:-

Φ_j represents the responses of Zt on one standard deviation shock on each of the series variables on their residuals.

2.5(j)Variance Decomposition

The forecast error variance decomposition tries to estimate the contribution to the forecast error variance of each shock as a function of the forecast zone. Starting with the reduced Bivariate Autoregressive, VAR(1) the model equation is $z_t = c_0 + C_1 z_{t-1} + e_t$ the forecast error decomposition shall therefor be ;-

To forecast $E_t(z_{t+h})$ then the forecast error results (h-step) shall be;-

$$f_t(h) = z_{t+h} - E_t(z_{t+h}) = e_{t+1} + C_1 e_{t+h-1} + C_1^2 e_{t+h-2} + \ldots\ldots C_1^{h-1} e_{t+1} \quad \ldots\ldots 12$$

The structural disturbance equation will therefore be:-

$$f_t(h) = z_{t+h} - E_t(z_{t+h}) = e_{t+1} + \Phi_1 C_1 e_{t+h-1} + \Phi_1 C_1^2 e_{t+h-2} + \ldots\ldots \Phi_1 C_1^{h-1} e_{t+1} \quad \ldots\ldots 13$$

Therefore, the corresponding forecast variance of the $(e_{xt}, t \in Z)$ sequence shall be

$$\text{var}(f_t(h)) = \delta_{\varepsilon x}^2 \left[\phi_{11}^2(0) + \phi_{11}^2(1) + \ldots\ldots + \phi_{11}^2(1)(h-1)\right] + \delta_{\varepsilon y}^2 \left[\phi_{12}^2(0) + \phi_{12}^2(1) + \ldots\ldots + \phi_{12}^2(1)(h-1)\right]$$

. . . . 3 (44)

in that case, the h-step forecast error variance can therefore be decomposed to fit each of the structural shocks, therefore the proportions of $\text{var}[f_{xt}(h)]$ caused by shocks in the $(e_{xt}, t \in Z)$ and $(e_{yt}, t \in Z)$, sequence can be presented as;-

$$\frac{\delta_{\varepsilon x}{}^{2}\left[\phi_{11}{}^{2}(0)+\phi_{11}{}^{2}(1)+.....+\phi_{11}{}^{2}(1)(h-1)\right]}{\operatorname{var}\left[f_{xt}(h)\right]} \text{ and } \frac{\delta_{\varepsilon y}{}^{2}\left[\phi_{12}{}^{2}(0)+\phi_{12}{}^{2}(1)+.....+\phi_{12}{}^{2}(1)(h-1)\right]}{\operatorname{var}\left[f_{xt}(h)\right]} \quad \text{.....................................14}$$

Of the respective shocks on series elements.

3.0 RESULTS AND CONCLUSIONS

From the foregoing table 1, the p-value of (0.8644) as reported is higher than the significant level of 0.05 therefore, Accept the Null Hypothesis that the residuals variance of the variables is constant. This therefore infer that Heteroscedasticity is not Present. Hence Homoscedasticity.

In Conclusion therefore, the variables are Homoscedastic therefore suitable for hypotheses testing and forecasting

Table 1. Heteroskedasticity Results

VAR Residual Heteroskedasticity Tests (Levels and Squares)
Date: 07/10/23 Time: 06:45
Sample: 1 99
Included observations: 97

Joint test:

Chi-sq	df	Prob.
140.4978	160	0.8644

The correlation resultsindicated that there is strong positive association betweenOil price Fluctuation and Foreign exchangevolatility in the three east African countries, with a correlation matrix coefficients of 0.867 as showed in table 2 below;-

Table 2. Correlation Matrix Results

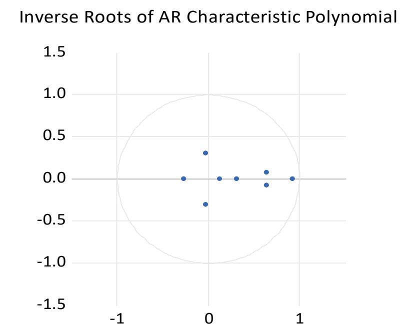
	GDP	CCRUDE	INFLATION	EXCHANGE...
GDP	1	0.08604754...	-0.2077006...	-0.1343686...
CCRUDE	0.08604754...	1	-0.2866965...	0.86677529...
INFLAT...	-0.2077006...	-0.2866965...	1	-0.3909965...
EXCH...	-0.1343686...	0.86677529...	-0.3909965...	1

The cointegration results as presented in Appendix 3: depicts that λ trace tests rejected the null hypothesis of no co-integration (r = 0) against the alternative; the results obtained shows that the test statistics are greater than critical values at 5 percent significance levels hence exitences of longrun relationship as suggested by Mackinnon –Haug (1999),. Futhermore the findings of Johansen co-integration approach established an existence of co-integrating vectors (relationships) in the regression equation. Moreover, the trace statistics and Max Eigen values accept the null hypothesis therefore implying there is at most four $r \leq 4$ integrating vectors (relationships), as showed by the test statistics which are smaller than their corresponding critical values at 5 percent level of significance. In conclusion therefore the results implied that there is a long-run relationship between the Oil price fluctuation, economic growth, inflation and exchange rate in the three East African countries.

The findings of the study were that the p-value (p-value =0.1861) for the test of autocorrelation was greater than 5 percent level of significance. The implication is therefore reject the alternative hypothesis and hence accept the null hypothesis. Therefore, conclude that the model is free of autocorrelation.

Based on results on Apendix 1 the SC and HQ criterion suggest use of one lag while according to the AIC the lag length should be 7, in as much as when we consider the coefficients the AIC is the least, we adopted 1 lag because of concurrence by the two selection information.

Model Stability



Stability of a VAR model was evaluated using the roots of the characteristic polynomial of the coefficient matrix B_1 as presented in the VAR model. The results of the Stability test using the AR roots indicated above shows that the VAR model is well identified and is a true representation of how the times series data has evolved over the study period. This conclusion is arived at since all the Blue dots are within the circle.

Granger Causality

In relation to causality between oil price fluctuation and exchange rate, the Null Hypothesis to test are H_{01} Exchange rate does not cause Oil price fluctuation, in table 4.7 reported p-value (0.1522) therefore reject the Null hypothesis and hence accept the alternative hypothesis. H_{02} Net oil price fluctuation does not granger cause exchange rate, reported p-value (0.1089) therefore, we reject the Null Hypothesis and hence accept the alternative hypothesis

The results of the study therefore, confirms the existence of Bi-directional causal relationship between Oil price fluctuation and exchange rate in the study This implies that world crude oil price shocks and exchange rate granger cause each other in the three East African countries combine. This results are in agreement to the findings of

Although, Jimenez-Rodriguez and Sanchez (2005) and Cunado and De-Gracia (2003) obtained contrary results in their studies in relation to the causality between exchange rate and Oil price fluctuation.

Table 5. Grange causality Test Results

Pairwise Granger Causality Tests
Date: 07/10/23 Time: 08:23
Sample: 1 99
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GDPGRT does not Granger Cause NPC	98	0.66817	0.4157
NPC does not Granger Cause GDPGRT		0.00799	0.9290
EXCHANGERATE does not Granger Cause NPC	98	2.08306	0.1522
NPC does not Granger Cause EXCHANGERATE		2.61922	0.1089
INFLATION does not Granger Cause NPC	98	6.00457	0.0161
NPC does not Granger Cause INFLATION		2.63467	0.1079
EXCHANGERATE does not Granger Cause GDPGRT	98	3.50750	0.0642
GDPGRT does not Granger Cause EXCHANGERATE		0.63106	0.4289
INFLATION does not Granger Cause GDPGRT	98	6.23905	0.0142
GDPGRT does not Granger Cause INFLATION		0.05663	0.8124
INFLATION does not Granger Cause EXCHANGERATE	98	0.86325	0.3552
EXCHANGERATE does not Granger Cause INFLATION		3.35760	0.0700

SVAR Modelling Estimation results

The structural VAR results offers the framework for analyzing and interpreting the iterations among the variables but so far it does not present anything definite in as to how the variables reacts towards each other in the series. These was analyzed through impulse response functions to determine the effect of one time shock on one variable in relation to responses by the other variables and further estimating the Forecast error variance decomposition, based on cholesky decomposition, the results of the variance decomposition are used to display the percentage of the error made forecasting a variance over time due to a specific shock, it actually establishes how much variability in the dependent variable is explained by its own shocks against the shocks in other variables in the series. In that case being able to determine the indirect linkages among the variables. The response of the Foreign exchange rates to the Oil price shocks where found to be statistically significant, the results indicated that oil price fluctuation is reported to have a positive effect on foreign exchange volatility, the implication therefore is that oil price fluctuations significantly affects foreign exchange fluctuation positively in East Africa as showed in Appendix 4.

Impulse Response Functions

The objective of the study was to Analyze the effect of oil price fluctuation on exchange rate of the three East African Countries, therefore the study sort to test the Null Hypothesis H_{01} that There is no significant effect of oil price fluctuation on the three east African countries exchange rate, the results of the SVAR model in Appendix 4 confirmed that Oil price fluctuation have a negative significant effect on east Africa's exchange rate to Dollar, additionally, Impulse Response Functions in Appendix 2 confirmed that One percent standard deviation in crude oil prices tends to generate a negative effect on exchange rate up to the 3rd period. After which exchange rate starts picking up. This shall be so up to the 7th period when it starts showing signs of decline.

Based on this finding we therefore reject the Null Hypothesis and accept the alternative hypothesis hence concluding that oil price fluctuation significantly affect the shilling exchange rate of the three east African countries. In fact, increase in oil price leads depreciation of the shilling, the results of this study agrees with those of Semboja (1994), Brini& Hatem (2016) and Marris N. et al (2019).

Variance Decomposition of Net Oil Price Change on Economic growth, Exchange rate and inflation rate shocks.

Table 6 presents the variance decomposition of Net Oil Price change on economic growth rate, exchange rate and inflation rate in the east African countries. The findings of the study is that during the initial period the three macroeconomic variables had no contemporaneous effect on oil price shocks, the is showed by the 0.00% effect on the table. It is also observed that variation in Net oil price change is associated to its own shock and the shocks from Exchange rate, inflation and economic growth rate, for example at the second period economic growth rate explains up to 2.1% of the changes in Net oil price change, Exchange rate during the same period explains up to 1% while Inflation accounts for 5.9% of the changes in oil prices. A close observation of the results indicates that with time inflation rate will contribute more on the changes in oil price with period 10 for example have 14% change in oil prices being due to inflation shocks followed by the economic growth rate which accounts for 6.6%

Table 6. Variance Decomposition of Net Oil Price change of Macroeconomic variable

Variance Decomposition of D(NPC): Period	S.E.	D(NPC)	D(GDPGRT)	D(EXCHA...	D(INFLATI...
1	16.54418	100.0000	0.000000	0.000000	0.000000
2	18.63189	91.89218	2.112903	0.090171	5.904751
3	19.68044	84.96269	3.631639	0.233677	11.17200
4	19.78209	84.29176	3.639296	0.331222	11.73772
5	20.28673	83.05418	3.571325	0.321689	13.05280
6	21.12350	79.95562	3.326128	2.296292	14.42196
7	21.69972	80.23721	3.275173	2.718370	13.76925
8	22.00753	79.96725	3.342990	2.644846	14.04491
9	22.58076	77.08515	5.801014	2.694281	14.41956
10	22.86445	76.32718	6.609357	2.879085	14.18438

Source: *Author Data Analysis 2023*

CONCLUSION

The current study examined the effects of oil price fluctuations on the three east African countries using time series data from 1990 to 2022 on SVAR formulation. The results of the series estimation of the IRF and FEVD are found to be consistent with one another, indicating a significant immediate effect of oil price fluctuation on countries foreign exchange volatility.

Policy Recommendation

To start with, government policies should focus on market power, in this case the governments should focus on ensuring the market is not affected by oil price shocks, in that case the following should be done ;- one adopt alternative productive systems that are low in oil energy consumption and the alternative energy supply adopted should be locally available and cheap as well, two start contractionary monetary policies targeting oil sectors should be adopted so as to curb inflationary pressures emanating from Period the increase in oil prices, Lastly but most importantly, the governments should establish energy price stabilization fund, the aim of this fund should be to stabilize oil prices hence reducing fluctuations by accumulating funds when the prices are low and compensating for high prices whenever prices sky rockets.

APPRECIATION: I do express my gratitude to Prof Sam Adaramola, Prof Augustine Makhoha and Prof. Lucy Rono for giving me an opportunity with NORPART project. It was a great opportunity to travel to Norway and complete my thesis writing in a conducive environment. To the entire NORPART under ***"Strengthening Education, Research and Innovation Capacity in Sustainable Energy for Economic Development"*** Project Number NORPART-2021/10373 Thank you very much for the financial support towards my thesis writing. To a greater extent I shall always be indebted to you people.

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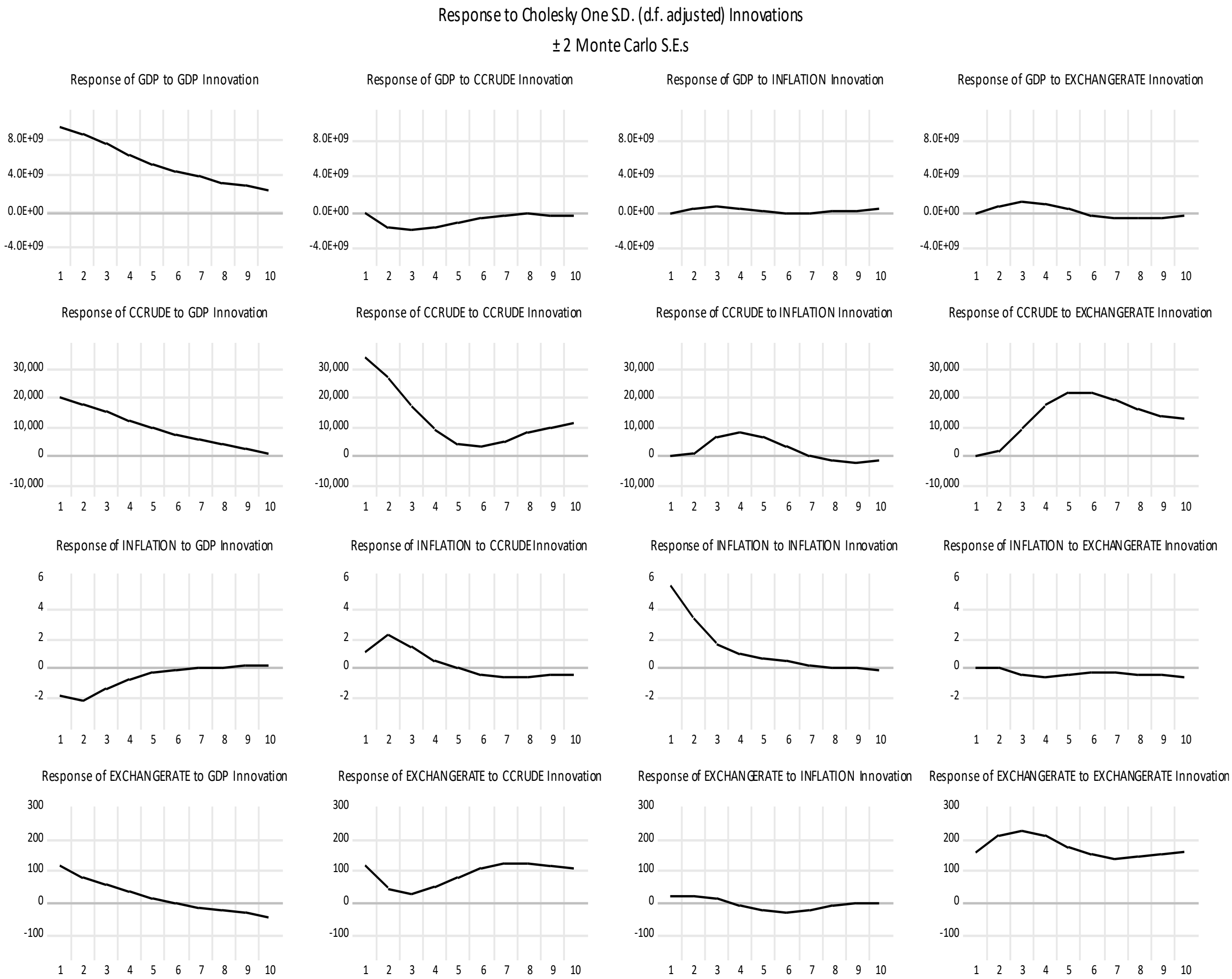
Appendix 1

VAR Lag Order Selection Criteria
Endogenous variables: NNPC INFLATION EXCHANGERATE GDPGRT
Exogenous variables: C
Date: 07/08/23 Time: 04:43
Sample: 1 96
Included observations: 88
*Note: selection calculation does not impose restricted VAR coefficient restrictions

Lag	LogL**	LR	FPE	AIC	SC	HQ
0	-2258.779	NA	2.54e+17	51.42679	51.53939	51.47215
1	-2087.077	323.8922	7.38e+15	47.88811	48.45114*	48.11494*
2	-2080.407	11.97495	9.14e+15	48.10016	49.11362	48.50846
3	-2068.371	20.51681	1.01e+16	48.19024	49.65412	48.78000
4	-2050.675	28.55437	9.79e+15	48.15170	50.06601	48.92293
5	-2022.438	42.99769	7.54e+15	47.87358	50.23831	48.82627
6	-2000.091	31.99598*	6.71e+15	47.72935	50.54450	48.86350
7	-1980.707	25.99308	6.45e+15*	47.65242*	50.91800	48.96804
8	-1971.167	11.92449	7.87e+15	47.79925	51.51526	49.29634

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix 2; Impulse response functions



Appendix 3

Date: 09/22/22 Time: 20:35
Sample (adjusted): 4 96
Included observations: 93 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP CRUDE INFLATION EXCHANGERATE
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.272497	51.97688	47.85613	0.0195
At most 1	0.157871	22.39015	29.79707	0.2773
At most 2	0.064927	6.410646	15.49471	0.6470
At most 3	0.001800	0.167508	3.841465	0.6823

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.272497	29.58673	27.58434	0.0273
At most 1	0.157871	15.97950	21.13162	0.2260
At most 2	0.064927	6.243138	14.26460	0.5822
At most 3	0.001800	0.167508	3.841465	0.6823

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix 4

Structural VAR Estimates
Date: 07/08/23 Time: 08:18
Sample (adjusted): 4 96
Included observations: 93 after adjustments
Restrictions: @VEC(L1) = "1, NA, NA, NA, 0, 1, NA, NA, 0, 0, 1, NA, 0, 0, 0, 1",
@VEC(L2) = "1, NA, NA, NA, 0, 1, NA, NA, 0, 0, 1, NA, 0, 0, 0, 1"
Iterated GLS convergence achieved after 74 iterations
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 48 iterations
Structural VAR is just-identified

Model: e = Phi*Fu where E[uu']=I
F =

C(1)	0	0	0
C(2)	C(5)	0	0
C(3)	C(6)	C(8)	0
C(4)	C(7)	C(9)	C(10)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	-38.12573	2.795515	-13.63818	0.0000
C(2)	-3.597893	0.557640	-6.451998	0.0000
C(3)	-480.9268	62.66574	-7.674478	0.0000
C(4)	0.702842	1.310227	0.536428	0.5917
C(5)	-4.737836	0.347395	-13.63818	0.0000
C(6)	254.1519	48.33448	5.258190	0.0000
C(7)	-6.195378	1.227876	-5.045604	0.0000
C(8)	-430.0837	31.53527	-13.63818	0.0000
C(9)	-0.632349	1.139812	-0.554783	0.5790
C(10)	-10.98285	0.805302	-13.63818	0.0000
Log likelihood	-1797.926			

Estimated S matrix:

38.12573	0.000000	0.000000	0.000000
-1.347564	4.737836	0.000000	0.000000
-196.9968	-23.18074	430.0837	0.000000
3.460135	-2.667835	-0.129300	10.98285

Estimated F matrix:

-38.12573	0.000000	0.000000	0.000000
-3.597893	-4.737836	0.000000	0.000000
-480.9268	254.1519	-430.0837	0.000000
0.702842	-6.195378	-0.632349	-10.98285