Asian Journal of Economics, Business and Accounting

16(3): 16-29, 2020; Article no.AJEBA.58138
ISSN: 2456-639X

Investigation of Global Crude Oil Price Shocks verses Exchange Rates Nexus: Evidenced from Tanzanian Shillings

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJEBA/2020/v16i330239
Editor(s):
(1) Dr. Maria Ciurea, University of Petroșani, Romania.
Reviewers:
(1) Olusegun Ebenezer Ojo, University of Ibadan, Nigeria.
(2) Rabia Najaf, Taylor S University, Malaysia.
(3) Kevin Wanjala, Egerton University, Kenya.
Complete Peer review History: http://www.sdiarticle4.com/review-history/58138

Original Research Article

Received 24 April 2020
Accepted 30 June 2020
Published 28 July 2020

ABSTRACT

This study investigated the nexus of crude oil price shocks and exchange rates of Tanzanian shillings (TSh) as an oil importing country. Using weekly series data for the period 01/01/2005 to 31/12/2015, Vector Autoregressive (VAR) model was employed to test the relationship of crude oil prices and Tanzanian exchange rates. In addition, Granger Causality was tested to check the causality of these two variables. The findings of this study show that oil prices granger causes the exchange rate of TSh while exchange rates of TSh cannot Granger cause the oil prices. Also, the impulse response functions revealed that crude oil price shocks initially had a significant negative effect on TSh, however, there was a slightly negative effect on crude oil starting from TSh as a granger causer. VAR results showed that all the coefficients of TSh do not significantly influence crude oil prices. Crude oil price coefficients had a negative significance towards explaining the variability of Tanzanian shillings' exchange rates (TZS).This revealed that a change in oil prices would precede changes in TSh movements.

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Keywords: Oil prices; exchange rates; nexus; VAR; granger causality.

1. INTRODUCTION

From the last decades, oil has become one of the main indicators of economic activity to many countries, through its importance as the main source of energy. Also, it is becoming more and more relevant for developing countries, which already account for more than half of the world's total oil consumption. The U.S. Energy Information Administration's recently released an *International Energy Outlook 2016* (IEO2016) which projects that the world's energy consumption will grow by 48% between 2012 and 2040. Most of this growth comes from countries that are not in the Organization for Economic Cooperation and Development (OECD), including countries where demand is driven by strong economic growth, particularly developing countries.

A large number of studies investigated the relationship between oil price changes and an exchange rate of both importing and exporting countries. Many studies have documented the effects of an increase or decrease in oil prices on the exchange rate. Krugman [1] and Golub [2] proposed three-country models (two oil-importing countries and one oil exporter) to explain the effects of oil price shocks on exchange rates. These models suggest that higher oil prices may transfer wealth from the oil importers to oil exporters which later on affect the currencies of the countries involved through trade balance, capital flow, and rational speculation. This means that when the oil price rises (fall), oil-exporting countries may experience an appreciation (depreciation) of their exchange rate and oil-importing countries may experience depreciation (appreciation) of their exchange rate. A rise or fall in oil prices is associated with wealth transfers from oil importers to the oil-exporting economy or vice versa, leading to account surplus or deficit and portfolio reallocation. However, its influence on the exchange rate depend on the asymmetries between the economies.

The simple intuition behind the relationship between exchange rates and oil prices is that oil price shock appreciates the dollar against oil countries' currencies, and depreciates it against oil-exporting countries' currencies and or vice versa. The US dollar is one of the main oil invoicing currencies of international trade in the world. Anoil price decrease or increase leads to either buying oil at a lower or higher price in the dollars. This results in extracting dollar money from oil-importing economies or injecting dollars into oil-exporting countries, which either depreciates or appreciates a country's currency against the US dollar [2].

Two separate statements are recommended namely: 1) How the increase in oil price affects the economy of oil-importing country, and 2) How the decrease in oil price affects the economy of the oil-importing country in relation to the oil-exporting country.

As a measure of import and export level, the exchange rate plays an essential role in any country's economy. The era of globalization has over the past several decades brought numerous opportunities to Tanzania towards extending its operation business and trading activities beyond the domestic market. The Tanzanian economy has continued to perform strongly, recording a growth of 6-7% over the recent years, driven by information and communications, construction, manufacturing and other services, with a growth projected to remain above 7%, supported by public investments in infrastructure, particularly in the transport and energy sectors. Any depreciation of shillings against other currencies particularly the US dollar considerably stimulates export value and declines import value. As a result, it facilitates growth and the balance of payment surplus which is seen as the driving force for economic growth. Many businesses, irrespective of being domestic or international, are influenced directly or indirectly by exchange rate movement.

It came in no surprise that any undesirable fluctuation of oil prices and TZS takes a drastic toll on Tanzania's economy. Both of the variables display dynamic behaviors that are difficult to be captured. Therefore, there is no doubt that the linkage between crude oil prices and Tanzania exchange rates is not only an interesting subject for studies but also practically important to a number of individuals, policymakers and organizations. The oil price-exchange rate relationship deeply involves multilateral economic interaction which definitely catches the interest of policymakers. More noticeably, if such a dependent relationship is demonstrated to be reliable and stable, the role of crude oil prices in analyzing the impact of the exchange rate on Tanzania's economy as an oil importer is undeniably crucial. Therefore, due to its importance to the economy, a number of studies such as Turhan, et al. [3] and Jammazi, et al. [4] examined the relationships of oil price shocks on the exchange rate of oil exporting and importing countries. The other related studies include those of Mohammadi and Jahan-Parvar [5], Brahmasrene, et al. [6] and Pershin, et al. [7]. Mundaca [8] investigated the effects of oil price shocks on the exchange rate volatility of Arab Monetary Fund countries.

The purpose of this study is to bring about the understanding of the nexus of oil price shocks and exchange rates by considering the case of TSh. Due to the importance of oil on the global economy, it is legitimate to investigate the relationship between crude oil price shocks and the TZS.

2. LITERATURE REVIEW

2.1 Theoretical Literature Review

In studying the determination of oil prices and exchange rates, theorists have traditionally relied on three-country models, which are two oil-importing countries and one oil exporter. Krugman [1] and Golub [2] proposed the three-country models to explain the relationships and effects of oil shocks on exchange rates. The models suggest that oil prices affect macroeconomic flows such as income, current account balances, trades, expenditures and savings. These flows in turn influence assets stock and their distribution among oil importers and exporters. This disturbs the assets market equilibrium [2]. The ise of oil prices may generate a current account surplus for oil exporters and current account deficit for oil importers through the transfer of wealth from the oil importers to oil exporters which later on affect the currencies of both countries through trade balance, capital flow and rational speculation. This means that when the oil price rises (fall), oil-exporting countries may experience an appreciation (depreciation) of their exchange rate and oil-importing countries may experience depreciation (appreciation) of their exchange rate. A rise or fall in oil prices is associated with wealth transfers from oil importers to the oil-exporting economy and visa versa leading to account surplus or deficit and portfolio re-allocation. However, their effects on the exchange rate depend on the asymmetries between the economies [1].

There are mainly two lines of research addressing the relationship between the crude oil prices and the dollar exchange rate. The first strand focuses on the capital flows, and the second on the balance of payments.

2.2 Capital Flows or Term of Trade

Krugman [1] introduced the possibility of capital movements. He used two internationally traded assets, marks and dollars, that is, the currencies of the oil importers. Also, he adjusted OPEC spending to its income with a lag. Although this gave rise to some dynamic complications, because the burden of oil payments may not fall where OPEC wants to invest, and import spending be divided in the same proportion between the oil importers. But in reality OPEC has a much higher marginal propensity to hold wealth in foreign assets than the oil importing countries. Also Zhou [9] proposed a model with two countries, both of which have tradable sector and non-tradable sector. If the home country is more dependent on imported oil, a real oil price rise may increase the prices of tradable goods in the home country by a greater proportion than in the foreign country, and thereby cause a real depreciation of the home currency. In order to improve competitiveness, the home country would have to raise the nominal exchange rate, which would lead to a further real depreciation. Amano and Van Norden [10] reasoned that higher oil prices lead to an appreciation of the U.S. dollar in the long run, because of an often-mentioned hypothesis of relative terms of trade effect. This effect posits that while the United States is a significant energy importer, it is less dependent on imports than most of its major trading partners. Therefore, while the dollar should depreciate in absolute terms, it should be expected to depreciate less than the currencies of its major trading partners. In other words, while higher oil prices lower the U.S. absolute terms of trade, it raises the U.S. terms of trade relative to its industrialized trading partners. Thus higher oil prices lead to an appreciation of dollar.

2.3 Balance of Payments

Golub [2] views a rise in oil prices as a wealth transfer from oil importing countries to oil-exporting ones. The impact on exchange rates then depends on the distribution of oil imports across oil-importing countries and on portfolio preferences of both oil-importing countries whereby whose wealth declines) and oil-exporting ones whereby whose wealth increases. In a three-country model, Krugman [1] argues that in the short run, the real dollar exchange rate depends on OPEC's portfolio choices. But since the spending of OPEC's accumulated wealth on imports of goods from industrial countries rises over time, in the long run the real exchange rate depends on the geographic distribution of OPEC imports. The trade flows of the industrial countries are determined by partial equilibrium, "elasticity" equations, while OPEC's imports depend explicitly on income.

Krugman [1] assumed that oil-exporting countries have a strong preference for dollar-denominated assets but not for U.S. goods, an oil price increase leads first to dollar appreciation and later to even greater dollar depreciation. Bénassy-Quéré, et al. [11] extend Krugman's model to the case of four countries (the United States, the Euro zone, OPEC and China) and only one exchange rate (the dollar against the euro) and achieve similar outcomes. The emergence of China in both oil and foreign exchange markets could strengthen the positive causality found from the oil price to the dollar in the short run but reverse its sign in the long run.

The above two theories seem to give contradictive predictions of the relationship between crude oil price changes and exchange rate. The first one indicates a positive causality relationship from oil price to exchange rate, while the third one shows that both positive and negative causality relationships may occur.

2.4 Empirical Review

Since the works of Krugman [1] and Golub [2], oil prices have been found to Granger-cause exchange rates of the exporting and importing countries. Many empirical studies have investigated the mechanism of oil price shocks to exchange rate effects such as in Pershin, et al. [7] investigated the relationship between oil prices and exchange rates in Botswana, Kenya and Tanzania using a Vector Auto Regressive (VAR) model from the period of 01/12/2003 to 02/07/2014. The findings suggest that the exchange rate of these countries behavior is different in the event of an oil price shock. They conclude that after an oil price peak, the Botswana pula clearly appreciates against the US dollar, the Kenyan and Tanzanian shilling. In addition Buetzer, et al. [12] examined the effects of oil shocks on global exchange rate using VAR model. Brahmasrene, Huang and Sissoko [6] examined the short-run and long-run dynamic relationship between the U.S. imported crude oil prices and exchange rates using VAR model. Empirical results indicate that the exchange rates Granger-caused crude oil prices in the short run while the crude oil prices Granger-caused the exchange rates in the long run.

The works by Tiwari, et al. [13] assessed the empirical influence of oil prices on the real effective exchange rate in Romania using a discrete wavelet transform approach and scale-by-scale Granger causality tests. The results found that oil prices have a strong influence on the real effective exchange rate in the short run, but also for large time horizons. Also they have discovered that mainly the positive shocks associated with an increase in oil prices have an impact upon the real effective exchange rate movements in the short and long runs. Turhan, Hacihasanoglu and Soytas [3] suggested that a rise in oil prices leads to significant appreciation of emerging economies' currencies against the U.S. dollar. Their findings suggest that oil price dynamics changed significantly in the sample period and the relationship between oil prices and exchange rates became more obvious after the 2008 financial crisis. Kutan and Wyzan [14] examined the determinants of real exchange rate in Kazakhstan; they suggested that the price of oil had a significant effect on the real exchange rate during 1996–2003.

Also, Mohammadi and Jahan-Parvar [5] examined the long-run relation and short-run dynamics between real oil prices and real exchange rates of 13 oil-exporting countries from the possibility of Dutch disease using tests of cointegration and momentum-threshold autoregressive (TAR and M-TAR) models. They suggested that oil prices have a long-run effect on the exchange rates. Beckmann and Czudaj [15] investigated the homogeneous causality pattern between oil prices and currencies of oil importers and exporters, while Benhmad [16] used a wavelet approach to study the linear and nonlinear Granger causality between the real oil price and the real effective U.S. Dollar exchange rate. The study suggested that there is a strong bidirectional causal relationship between the real oil price and the real dollar exchange rate for large time horizons. Tiwari, et al. [17] examined linear and nonlinear Granger causalities between oil price and the real effective exchange rate of the Indian currency. Lizardo and Mollick [18] stated that oil prices significantly explain movements in the value of the U.S. dollar against major currencies from the 1970s to 2008. Increases in real oil prices lead to a significant depreciation of the USD against net oil exporter currencies, such as Canada, Mexico, and Russia. On the other hand, the currencies of oil importers, such as Japan, depreciate relative to the USD when the real oil price goes up.

In addition, Coleman, et al. [19] examined the importance of real oil price as a determinant of real exchange rates for a pool of African countries. Using cointegration techniques and nonlinear dynamics they suggested that, shocks in the real price of oil are particularly important in determining the real exchange rates, even in the long run. Jiang and Gu [20] examined multiracial behavior in cross-correlation between oil prices and exchange rates. They recovered the structural oil shocks and then use these indicators to characterize the asymmetries along with oil price trend itself. Their empirical results show that their asymmetric degrees vary significantly. The sign of oil supply shock leads to the most significant asymmetry among them. Bal and Rath [21] examined the nonlinear causality between oil prices and exchange rates in the context of India and China. The study finds a significant bi-directional nonlinear Granger causality between oil prices and exchange rates in both countries. Further, to check robustness, the persistence in the variance of oil price and exchange rate is taken into account using a GARCH (1, 1) model. While the results consistently hold in the case of India, with respect to China, a unidirectional causality runs from exchange rate to oil price. However, the oil price in China does not Granger cause exchange rate.

3. METHODOLOGY

3.1 Sample Design

The study takes evidence from TZS as oil importer country to examine the nexus of crude oil price shocks and the exchange rate.

3.2 Data Source and Data Collection

The data which was used in the empirical analysis mainly are weekly secondary data which was collected from January 1, 2005 to December 30, 2015 for each variable. The data on exchange rate between the Tanzania shillings and the US dollar was used due to the dominance of the U.S. Dollar in Tanzania as well as in international transactions and has strong trade as well as financial relationship in the market. The shillings' exchange rate was expressed in terms of the price of US$1 in local currency. Hence, an increase in the exchange rate means depreciation of the local currency against the dollar.

To explore the decoupling behaviors properly, we solely keep the observations of the date when all variables are recorded. We decide to place our main focus on weekly data because it allows for the timing of announcement, flow and process of information, effect of news releases, and its capability to reduce time aggregation bias and capture both short and long run behaviors. All variables during empirical analysis was converted and expressed into log return. The reasons behind this transformation are, the exponential patterns with consistent upward fluctuation was easily visible in the whole raw data; such exponential feature is likely to blur crucial connection between variables and hence, should be diminished effectively by treating them in logarithm form, and converting data into logarithms was useful in turning substantially skewed data to be fairly symmetrical or normal, and therefore contributes considerably to eliminating heteroscedasticity.

3.3 Data Analysis Techniques

In this section, the researcher discussed the time series methodologies that were used in analyzing the dataset. The following tests was employed: Unit root test for stationary, Augmented Dickey-Fuller Test, Ordinary Least Square (OLS) method, Co-integration test, Granger Causality test, Vector error correction model, impulse response, etc. The study was conducted using EVIEWS 9.0 econometric software package, to test the casual relationship of crude oil price shocks and exchange rate. The implementation of these time series variables was discussed in this section and all statistical tests was carried out at 5% level of significance.

3.3.1 Exploratory data analysis

The techniques which were used in this section are mostly graphical and descriptive statistics. This procedure enables the researcher to gain an insight into the data set, extract important variables and their distributions, detects other anomalies.

Various empirical studies notice that it is common to transform times series data into natural logarithms. Benoit [22] stated that logarithmically transforming variables in a time series model is a very common way to handle situations where a non-linear relationship exists between the independent and dependent variables as well as logarithmic transformations are also a convenient means of transforming a highly skewed variable into one that is more approximately normal. Thus our variables were transformed into natural logarithms in order to interpret the coefficients of the co-integrating vector as long-term elasticity's.

The data distribution was examined using graphs and standard descriptive statistics namely mean median, standard deviation, skewness and kurtosis. Jarque and Bera [23] test was conducted to ascertain the normality of the data distribution. Under the null hypothesis of normal distribution, Jarque-Bera (J-B) is 0. As a result, J-B value greater than zero is said to have deviated from the normal distribution assumption. Similarly, skewness and kurtosis represent the nature of departure from normality. In a normally distributed series, skewness is 0 and kurtosis is 3. Positive or negative skewness indicate asymmetry in the series and less than or greater than 3 kurtosis coefficient suggest flatness and peakedness, respectively.

Also I have tested the assumption that the errors terms are linearly independent of one another (uncorrelated with one another). If the errors are correlated with one another, it would be stated that they are auto correlated. To test for the existence of autocorrelation or not, the popular Breusch-Godfrey Serial correlation LM test was employed. As noted in Brooks [24] the rejection/ non-ejection rule would be given by selecting the appropriate region

Furthermore, to test for the presence of heteroscedasticity, the popular white test would be employed in this study. This test involves testing the null hypothesis that the variance of the errors is constant (homoscedasticity) or no heteroscedasticity.

3.3.2 Unit root test

Most time series data are found to be non-stationary. A stochastic process is said to be stationary if its mean and variance are constant overtime, while the value of the covariance between two periods depend only on the gap between the periods and not the actual time at which this covariance is considered. If one or more of these conditions are not fulfilled then the process is said to be non-stationary (Charemza and Deadman, 1992).

I used two alternative unit root tests to investigate the property of time series data: Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller [25] and the Phillips-Perron test proposed by Phillips and Perron [26]. In order to check the stationary of the variables, three regression forms are generated:

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \varepsilon_t, \quad (None) \qquad (i)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \varepsilon_t, \quad (With\ Constant) \qquad (ii)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_1 t + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \varepsilon_t, \quad (With\ Constant\ and\ trend) \qquad (iii)$$

For all $t = 1,2, \ldots \ldots ,120\ and\ \varepsilon_t$is a white Noise.

Where Δ is the first lag operator, α the constant and β the coefficient of time trend and p is the lag order. The null hypothesis is $\rho = 0$ against the alternative $\rho < 0$. If the calculated ADF statistic is greater than I fail to reject the null hypothesis of presence of unit root. The additional lagged terms are included to ensure that the errors are uncorrelated.

3.3.3 Structural breaks

Tests for parameter instability and structural change in regression models have been an important part of applied econometric work dating back to Chow (1960). Structural break testing is a very important issue in time series analysis because if there are actual structural breaks, the series has to be de-trended in order to work with it [7].

In our study, I use the Least Squares with Multiple Breakpoints method of calculation proposed by Bai and Perron [27]. I also use sequential testing proposed by Bai and Perron [28], where they run extensive Monte Carlo simulations and conclude that the widely used Bayesian Information Criteria often fail to detect breaks.

3.4 Empirical Design (Model Specification and Estimation)

Usually when there is co-integration among the variables, Vector Error Correction Model (VECM) based causality test was employed while Vector Auto-regression (VAR) was used for the case of non-co-integration. Since our purpose is to check the nexus of crude oil price shocks and exchange rates, we defined all two models in our methodology based on co-integration test. The fundamental estimating equation in log-linear form is as follows:

3.4.1 Co-integration Test

Firstly, we have tested for stationary to prove that all variables are integrated at the same order (1) and second, our methodological process was co-integration test. To perform this we used Johansen co-integration test proposed by Johansen and Juselius [29] and Johansen [30,31] using both the trace and the maximum eigen value tests. The optimal lag length in this test was based using the Schwartz Information Criterion (SIC). Johansen's methodology takes its starting point in the vector auto regression (VAR) of order p. If the variables are found to be co integrated, the relationship may be interpreted as a long run relationship. Since the study investigates the relationship between crude oil price shocks and TZS, then the hypothesis for the co-integration vectors was stated. In order to test the hypothesis, the order of the co-integration vector needs to be determined first. The order (rank) of co-integration r was determined by constructing the trace statistics λ_{trace} and the estimated values of the characteristic roots or eigenvalues λ_{max} .

3.4.2 Error correction model

The purpose of Error correction model is to explore both short and long run behaviors between two variables. However, prior to implementation, we conducted some prerequisite tests to meet its requirements. At the first stage, the property of each sequence must be determined. The most important and reliable application to identify the order of integration was Augmented Dickey Fuller (ADF) test and Phillips-Perron (PP) test. Thereafter, next stage was to carry out Engle Granger residual test to examine the existence of co-integration between variables. Engle Granger points out that if two non-stationary series display the same order of integration and their liner combination results in stationary sequence, and then there should be co-integration between them. Having detected pair wise co integrating relationship, we have embarked upon developing Error correction model. The vector error correction model (VECM) was estimated to find out long-run causality and short-term dynamics if there is an evidence of co-integration relationship among the variables. The VECM is estimated as shown below.

$$\Delta lnCRO_t = \alpha + \lambda\varepsilon_{t-1} + \sum_{t=1}^{p} u_i \Delta lnCRO_{t-1} + \sum_{t=1}^{p} v_i \Delta lnTZS_{t-1} \qquad (3.1)$$

Where ε_t is the Error Correction Term which reflects the deviation from the long-run equilibrium path, CRO stands for crude oil prices and TZS stands for Tanzanian shillings exchange rate.

This allows causality to be determined in two ways, the first one is short run causality, which was determined by the lagged differences of the variables and the second is Long-run causality, which was determined by the significance of the coefficient of the error-correction term.

The null hypothesis that Crude oil Price does not Granger cause TZS is rejected if $v \; or \; w \neq 0$ or are jointly significant and / or the coefficient of the error-correction term λ is significant. The essential condition to judge the suitability of ECM representation is that estimated coefficient of the lagged level of residual series must have negative sign and statistically significant at conventional level.

3.4.3 Vector autoregressive model and granger causality test

It is admitted that error correction model can do a good job of pinpointing short and long run effect, however it is usually not stable and thus not very useful in prediction The vector autoregressive (VAR) model was estimated in first-difference when there is absence of co integrating relation among the variables by excluding the error correction term, $\lambda\varepsilon_{t-1}$as stated in equation (3.1) for Granger causality with a short-term interactive feedback relationship following Granger (1988). The empirical model in this study has already been used in the context of oil prices and economic activity by Hamilton [32], Cunado and De Gracia [33] and recently by Pershin, et al. [7] and Turhan, Hacihasanoglu and Soytas [3] among many others, A VAR model of order p, where the order p represents the number of lags, that includes k variables. For each currency the following was estimated:

$$Y_t = \alpha_i + \sum_{t=1}^{p} Y_{t-1} + \varepsilon_t, \qquad (3.2)$$

Where Y_t= $(Crude \; oil_t, X_t)$, and Crude oil and *X* are the log returns of the oil price and the exchange rate, respectively. In Equation (3.2), α is a vector of constants and ε denotes the white noise error terms. The optimum lag length, *p*, is determined using the Schwartz information criterion (SIC). A bivariate VAR is estimated for each country and diagnostic tests are run to check for serial correlation, heteroscedasticity, parameter instability, and structural breaks, and all tests are satisfied in a particular lag number under Schwartz information criterion (SIC).

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Summary statistics for the return series are presented in Table 1. Crude oil price return has negative mean while TSh has a positive mean. In the regards to the standard deviation, crude oil prices are more volatile than TSh due to higher standard deviation. In addition, the Jarque-Bera statistics reject the null hypothesis that the series are normally distributed for all indices since the probability of BJ test is equal to zero. All the signs of the skewness are negative. Moreover, all return series are leptokurtic, which indicates all underlying data have fatter tails and higher peakedness than normal distribution.

4.2 Unit Root Test Results

alternative unit root tests have been in use: Augmented Dickey-Fuller test [25] and Phillips-Perron test [26]. The choice of the lag length required for the test is based of Schwarz Information Criterion (SIC). The null hypothesis of ADF and PP testis that a series does contain a unit root (non-stationary process) against the alternative of stationary.

The results derived from ADF and Phillips Perron unit root test are presented at Table 2 below. Based on the test, in terms of ADF and PP test including constant and none term, at a level for all log return series, we cannot reject the null hypothesis of a unit root process. However, for all variables series under ADF and PP test including constant and none term, we strongly reject the null hypothesis of a unit root at the 1% level. Therefore, our tests suggest that all variables series have a unit root. In other words, all variables appear to be integration of the same order one, I (1).

4.3 Diagnostic Test

In order our results to avoid from spurious results; all assumptions of error terms were tested and residual diagnostic, as well as checking the stability of VAR model. Fig. 1 shows that the VAR satisfy stability condition as there is no root lies outside the unit circle. Table 3 reveals the residual test of the errors terms. To test for the existence of autocorrelation or not, the popular Breusch-Godfrey Serial correlation LM test has employed. The result noted that the null hypothesis can be rejected as errors term are linearly independent of one another. Furthermore, the result indicates that we cannot reject the null hypothesis that the variance of the errors is constant or no heteroscedasticity. In addition, the Jarque-Bera statistics reject the null hypothesis that the series are normally distributed for all indices since the probability of BJ test is equal to zero under the null hypothesis of normal distribution, Jarque-Bera (J-B) is 0.

4.4 Structural Break

In this study Least Squares with Multiple Breakpoints method of calculation proposed by Bai and Perron [27] has been used. We also used sequential testing proposed by Bai and Perron [28], where they run extensive Monte Carlo simulations and conclude that the widely used Bayesian Information Criteria often fail to detect breaks. Table 4, reports the results of the structural break testing estimation, and clearly can be seen that the number of breaks goes from one to three for both variables. However, are not taken into account because no common trend in those breaks were observed and they did not capture the major oil price peak of the previous decade that occurred in July of 2008 and June 2013 as the study conducted by Pershin, et al. [7]. This shock can be clearly seen in Fig. 2.

4.5 Co-integration Test

It is tested and proved that all variables are integrated at the same order I (1). Thus evidence to test co-integrationtest in order to find, whether crude oïl prices and TSh have long run relationship. To perform this I use Johansen co-integration test proposed by Johansen and Juselius [29] and Johansen [30,31]. The results reported in Table 5 shows that no evidence of co-integration for both test of Trace statistics and Max Eigen statistics. Both test show that the Null hypothesis cannot be rejected at 5%significance level. This result indicates that, there is no long run association between crude oil prices and TZS. Also the result suggests that no long-run relationship has been found between TZS and crude oil prices. The same result of no cointegration found by Pershin, et al. [7].

Table 1. Descriptive statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	Jarique-Bera	Probability
Oil	-0.000356	0.002778	0.241221	-0.312180	0.050074	-0.741683	8.689552	825.3915	0.000000
TZS	0.001261	0.001203	0.079104	-0.068181	0.013288	-0.175350	11.10904	71.78827	0.000000

Table 2. Unit root test

Constant variable	ADF			P. Perron		
	Constant and None	Trend	Constant	Constant and None	Trend	Constant
At level						
Oil prices	-2.416	-2.215	-0.283	-1.994	-1.665	-0.284
TZS	0.006	-1.883	2.490	-0.147	-1.974	2.586
First differences						
Oil prices	-6.470***	-25.572***	-6.471***	-25.481***	-25.559***	-25.499 ***
TZS	-27.260***	-27.256***	-27.023***	-27.423***	-27.422***	-27.072***

*Note: *, ** and *** indicate significance level at 10%, 5% and 1%, respectively*

Table 3. Diagnostics test

Serial correlation LM tests			
Lags		**LM-Stat**	**Prob**
1		5.266736	0.2610
2		4.093202	0.3935
Heteroscedasticity Test			
Chi-sq		**Df**	**Prob.**
51.29088		42	0.3205
Normality Test			
	Jarque-Bera	**Df**	**Prob.**
1	652.1189	2	0.0000
2	1299.601	2	0.0000
Joint	1951.719	4	0.0000

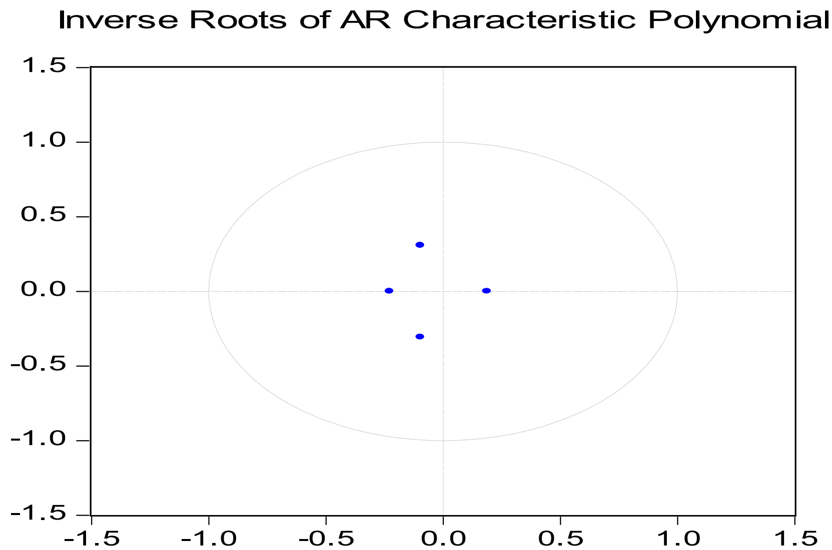

Fig. 1. VAR Stability condition

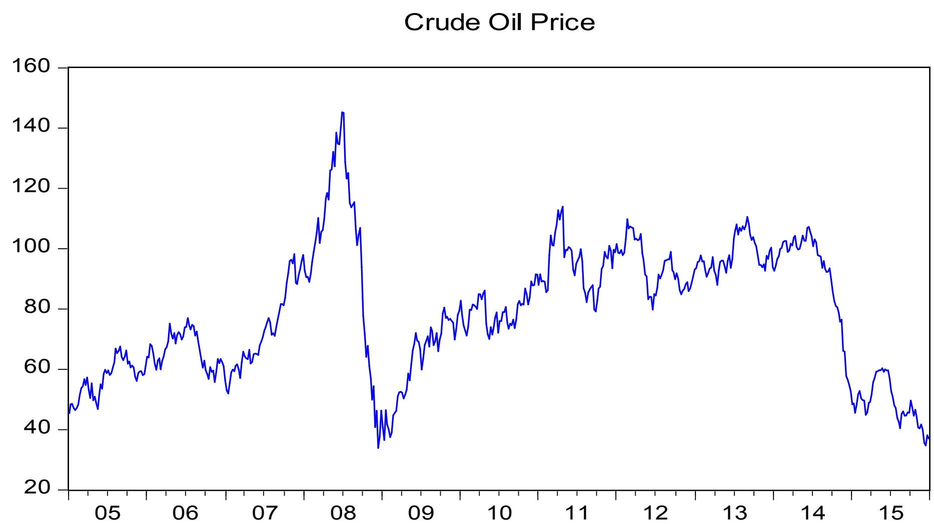

Fig. 2. Oil structural break

Table 4. Structural break dates

	Break 1	Break 2	Break 3
Oil prices	01/07/2007	19/12/2010	11/05/2014
TZS	19/10/2008	13/06/2010	11/05/2014

Table 5. The Johansen-Juselius cointegration tests

Johansen cointegration test result				
Lags	**Hypothesis**	**Trace stat**	**Max eigen stat**	**Summary**
2		$r = 0$6.046270	5.556035	No Cointegration
2		$r \leq 1$0.490234	0.490234	

*Note: *, ** and *** indicate significance level at 10%, 5% and 1%, respectively*

4.6 Relationship between Global Crude Oil Prices and Exchange Rate of Tanzania

Based on VAR model, examined the relationship between crude oil prices and TSh as importing country by examining cointegration result, VAR results as well as impulse response functions. Based on co integration results Table 5 no evidence of cointegration for both test. This indicates that there is no long run relationship between global crude oil prices and TZS.

The impulse response functions analyze the time profile of the effects of current shocks on the future behavior of exchange rates and oil prices. Fig. 3 shows the impulse response functions of exchange rates to aone-standard deviation structural shocks or innovation on oil price to exchange rate. Starting for TZS in Fig. 3 reveal that, crude oil price shocks initially has a significance negative effect on TSh.

The negative effects are increasing to the second month, however from fifth month the effect becomes stable. It illustrates the strong depreciation of TSh against the U.S. dollar while oil prices are in the downward trend. As the study conducted by Mohammadi and Jahan-Parvar [5] and Beckmann and Czudaj [15] revealed the same results. On the hand of TSh shock on crude oil, the figure indicates that there is slightly negative effect on crude oil starting from the second month and become stable from the fourth month.

Therefore, there is significance negative effective from crude oil price on TSh. The price of oil typically has the largest effect on countries with floating exchange rates such as Tanzania. Over the last 10 years, TSh had large negatives correlations in exchange rates against the price of oil.

On the other hand, VAR results in Table 6 and 7indicates the relationship between Crude oil prices and on TSh. Table 6shows that all coefficients of on TSh do not significantly influence crude oil price at 5% level. While the Table 7 reveals that all crude oil price coefficients are negative significance at 5% level to explain the variability of TZS except c (10) are positively significance. As the study conducted by Lizardo and Mollick [18] and Beckmann and Czudaj [15].

4.7 The Granger Causality of Global Crude Oil Prices on Exchange Rates of Tanzania

Table 8 shows the results of Granger Causality Tests of exchange rates corresponding to oil prices. In case of oil price changes to exchange rate fluctuation the null hypothesis is rejected for the Tanzania shillings currency. The oil price changes granger causes the exchanges rate of Tanzania as probability value is significance at 5% level. The study conducted by Brahmasrene, Huang and Sissoko [6] and Tiwari, Mutascu and Albulescu [13] found that the oil prices granger cause exchange rate. As the importation of oil to Tanzania has been increasing tremendously, any crude oil prices change will affect TSh. According to the Global economy Indicator, the average value for Tanzania during 1980s was 20.79 per day with a minimum of 13.4 thousand barrels per day and during 2013 maximum of 35 thousand barrels per day[1]. Therefore, when the crude oil price is increasing, Tanzania demands more dollars to import oil, thus depreciating Tanzania exchange rate. However, we cannot reject Null hypothesis of TZS to crude oil prices. These results indicate that when oil is used as the price series then the exchange rate of Tanzania cannot Granger causes the oil prices.

[1] *The Global economy.com. Tanzania: Oil consumption. Available:http://www.theglobaleconomy.com/Tanzania/oil_consumption/*

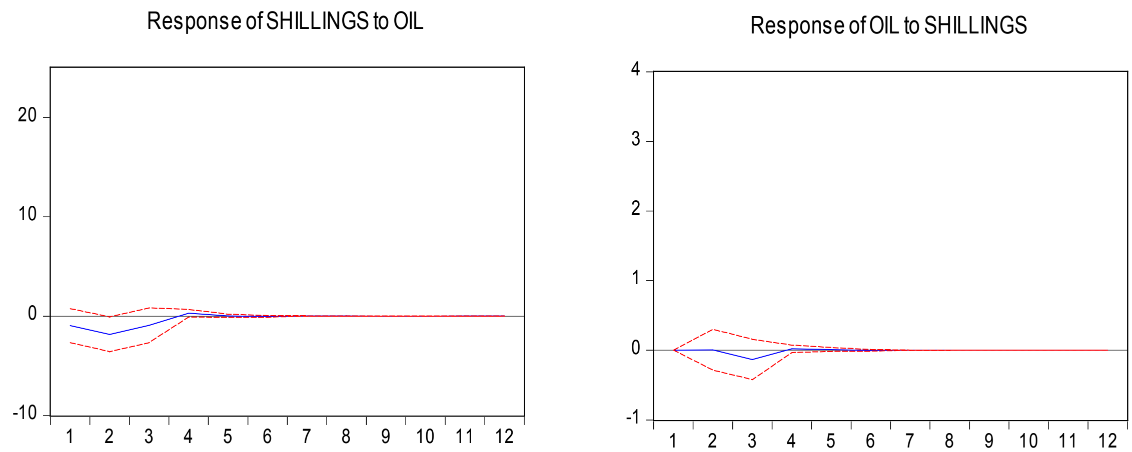

Fig. 3. Impulse response function

Table 6. VAR results

	Coefficient	Std. error	t-Statistic	Prob.
C(1)	-0.062962	0.042033	-1.497914	0.1347
C(2)	0.028985	0.042358	0.684290	0.4941
C(3)	-0.114076	0.160736	-0.709712	0.4782
C(4)	-0.093058	0.159240	-0.584388	0.5592
C(5)	-0.000233	0.002117	-0.110039	0.9124

Dependent Variable: Crude OIL
*Crude OIL = C(1)*Crude OIL(-1) + C(2)*Crude OIL(-2) + C(3)*TZS(-1) + C(4)*TZS(-2) + C(5)*

Table 7. VAR results

	Coefficient	Std. error	t-Statistic	Prob.
C(6)	-0.033194	0.010858	-3.057115	0.0023
C(7)	-0.019292	0.010942	-1.763099	0.0784
C(8)	-0.160416	0.041521	-3.863472	0.0001
C(9)	-0.090374	0.041135	-2.197020	0.0284
C(10)	0.001444	0.000547	2.640650	0.0085

Dependent Variable: TZS
*TZS = C(6)*Crude OIL(-1) + C(7)*Crude OIL(-2) + C(8)*TZS(-1) + C(9)*TZS(-2) + C(10)*

Table 8. Granger causality test

Hypothesis	Lag	F statistics	P-value
TZS does not Granger Cause OIL	2	0.37390	0.6882
OIL does not Granger Cause TZS	2	5.89875	0.0029

4.8 The Contribution of Tanzania Exchange Rate as Oil Importer on the Fluctuation of Global Crude Oil Prices

Based on Table 6 of the VAR results, it is clear how TZS contributes on global crude oil prices fluctuation. The coefficients result reveal that TSh do not influence the fluctuation of global crude oil prices. All exchange rate coefficients do not significantly influence crude oil price at 5% level. As Tanzania is less developed country and imports less global crude oil compare than other countries, TSh has no any impact or contribution to the crude oil prices shocks. According to Bank of Tanzania, imports in Tanzania increased to 1030.40 USD Million in April from 878.10 USD Million in March of 2016. Imports in Tanzania averaged 834.65 USD Million from 2006 until 2016, reaching an all-time high of 1399.30 USD Million in December of 2011 and a record low of

89.30 USD Million in March of 2006[2]. Based on above evidence, Tanzania imports less oil per annual and global crude oil is not invoiced in TSh therefore TSh cannot affect the fluctuation of global crude oil price.

5. CONCLUSION

From the results above we can infer that global crude oil prices shocks are one among major factor that affect the change in crude oil price change is usually very sensitive to events around the world and tension not only in the oil producing areas but also in the oil consuming areas. Tanzanian exchange rate too affected by the price change of crude oil by increasing or decreasing the allocations of fund to finance oil. The activities of oil speculators too have come to greatly affect the price of crude oil, and it will be interesting to examine the impact speculators have on the change in price of crude oil against the normal drivers of crude oil price.

The is quite peculiar. There have been dramatic changes in the price of one barrel of crude from around $42 in January 2005 to around $150 in June 2008 and drop sharply to around $30 in January 2016. During the same period TZS has been depreciated from around TZS 1,100/$ in January 2005 to around TZS 2,160/$ in December 2015. Negative shocks on oil prices are obviously correlated with financial instability. Tanzania is a largely consuming economy, and most of these importations are done in US dollars, this also puts pressure on the dollar. Monthly allocations of the three tiers of government are also done in US dollars, all these factors affect the exchange rate of the shillings via the dollar in one way of the other.

We expected some level of relationship between the crude oil price and TZS especially since Tanzania is increasing share of imported oil every year; our results suggest the crude oil price changes have a significance negative effect to the Tanzania shillings through impulse response as well as VAR results coefficient. The findings of this study suggest that the Tanzania government should manage the economy, oil stocks reserve and foreign reserve in order to have better oil reserve stock by showing a strong emphasis on oil markets' conditions. Long term forecasting of oil prices will be essential for forecasting purposes related with its national economy, TZS and Forex markets in general.

Results of this research also suggest that Tanzania shillings probably will continue to be affected by global oil markets shocks especially. Therefore, macroeconomic policies related with oil markets will be also a major determinant of volatility of TSh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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[2] *For more information available from http://www.tradingeconomics.com/tanzania/imports*

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