



Transmission of oil price shocks in the East African Stock market

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Proposal contains no material previously published or written by another person except where due reference is made in the Research Proposal itself.

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7/12/2015

This Research Proposal has been submitted for examination with my approval as the Supervisor.

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Abstract.

The main objectives of this paper were to find out if shocks from oil prices affect the East Africa's securities market and these shocks are transmitted across the three countries; Kenya, Uganda and Tanzania. Stock prices from the three countries were used in coming up with the results. Based on the empirical results, there is a negative and significant transmission of crude oil price shocks to the East African securities market. There is also some transmission of shocks across the three East African countries. The Vector Autoregressive model was used in coming up with these empirical results. The main advantage of this model is that it is flexibility whereby it is not necessary to specify which variables are exogenous or endogenous since they are all endogenous and the "exogenous" variables are the lags. Key limitation is the determination of the appropriate lag length since each lag can be very sensitive to the results. Further research needs to be done to ascertain whether these shocks are transmitted to other financial markets other than the stock market.

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List of abbreviations

NSE	Nairobi Securities Exchange
NSE-20	NSE-20 Share index
USE	Uganda Securities Exchange
DSE	Dar es Salaam Securities Exchange
WTI	West Texas Intermediate
VAR	Vector Autoregression
AIC	Akaike's Information Criterion
BIC	Bayesian Information Criterion
RSS	Residual Sum of Squares
ADF	Augmented Dickey-Fuller
ARMA	Autoregressive Moving Average
IR	Interest rates
ER	Exchange rates
RCOP	Real crude oil prices
DLIR	Difference of natural logarithm of short term interest rate
DLCOP	Difference of natural logarithm of real crude oil prices
DLER	Difference of natural logarithm of exchange rates

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1 Chapter 1 Introduction

1.1 Background Information

This study examines the dynamic linkages between crude oil price shocks and stock market returns in the East African countries which include Kenya, Tanzania and Uganda. Although the bulk of the empirical studies focus on the relation between economic activity and oil price changes, it is surprising that few studies have been conducted on the relationship between financial markets and oil price shocks and those mainly for a few industrialized countries such as the United States, United Kingdom, Japan, and Canada.

Oil is the major source of energy and most companies depend on it in their production activities. Since oil plays a prominent role in an economy, one would expect changes in oil prices to be correlated with changes in stock prices. Specifically, it can be argued that if oil affects real economic activity, it will affect earnings of companies through which oil is a direct or indirect cost of operation. Thus, an increase in oil prices will cause expected earnings to decline, and this would bring about an immediate decrease in stock prices if the stock market effectively capitalizes the cash flow implications of the oil price increases. This in turn has an impact on overall profitability of organizations. On theoretical grounds, oil-price shocks affect stock market returns or prices through their effect on expected earnings (Jones, 1996). Due to the dynamic movements in the price of oil, a lot of researchers have found it interesting to analyze the dynamic relationships between the oil price shocks and the major macroeconomic variables. But, only a few studies were conducted to observe how oil price could affect the stock market and subsequently transmit to other interlinked financial markets. Among the few researches that were recently conducted such as the study of (Cunando & Perez de Gracia, 2014), it was evident that stock market returns are influenced by oil price movements. However, oil price is not the only factor in determining the stock market returns. Other factors that could affect the stock returns are interest rates, exchange rates, inflation rates, and industrial production. In this respect, the pioneering study of (Hamilton, 1983), which concludes that there is significant correlation between increase in crude oil prices and US recessions, has been accepted as the fundamental basis for the subsequent studies on the effects of crude oil price shocks on macroeconomic indicators such as GDP growth rate, inflation, and industrial activity. According to these studies,

the price of crude oil, which is the primary fuel of industrial activity, plays a significant role in shaping the countries' economic and political developments, not only by directly affecting the aggregate indicators, but also by influencing companies' operational costs, and thus their revenues.

When the stock market is efficient, positive crude oil price shocks would negatively affect the cash flows and market values of companies, causing an immediate decline in the overall stock market returns. A large number of companies consume oil as the energy in production and manufacturing of goods and services. If the oil price increases, the production costs for the oil dependent companies should also increase. Thus, the tendency of the oil price increase may affect the investors' decision to invest in a particular company, leading to a fall in the demand for that particular stock. If the demand for stocks goes down, the price of the stocks go down accordingly, thus resulting in a lower stock market returns. When companies maintain high stock returns they attract business investment opportunities and vice versa.

A lot of studies have been carried out to investigate the relationship between oil prices and the stock market return but a consensus has not been arrived at concerning this relationship as it will be shown in the next chapter. This has led to debates on whether the stock market is affected by crude oil shocks and if so what is the effect to the these oil shocks to the stock market. In answering these questions it is hoped that some light may shed on the importance of the crude oil on economic output in these East African Countries.

An additional perspective to evaluating the causal effect of oil price shocks to stock market returns is the increasing integration of trade markets. Under globalization, world financial markets and economies are increasingly integrated due to free flow capital and international trade. Further, globalization has increased co-movement in stock prices across international markets (Park & Ratti, 2008).

This co-movement stimulates vulnerability to systematic market shocks. Therefore, shocks originating in one market not only affected its own market but are also transmitted to other equity markets. Hence, any information regarding the economic fundamentals of one country gets transmitted to other markets and thus affects the other's stock markets. (Park & Ratti, 2008) suggest that there would, at least, be some sort of spillover from US or global financial markets to that of developed, mostly European, countries. It would therefore be plausible to consider this

interrelationship when studying stock markets of emerging economies, which trade with one another.

Understanding the impact of crude oil shocks on the East African stock market is potentially beneficial for investors, market participants, regulators and researchers, as it is likely to exhibit characteristics different from those observed in well-documented developed markets. Thus, our study explores an underexploited area of potentially valuable research in East Africa.

The remainder of this paper is organized as follows. The next section provides relevant literature about the relationship between financial markets and oil price shocks. Section 3 outlines the econometric methodology concerning data analysis. Section 4 provides the results of our data analysis. Section 5 provides the analysis of our results and shows if the results are consistent or inconsistent with past researches that have been done. Section 6 outlines the conclusions of our study.

1.2 Problem Statement

A large number of studies have been undertaken on the transmission of crude oil price shocks on the stock market returns and various researchers have come up with varying results. There are those that have come up with the conclusion that there is a positive impact from crude oil shocks on the stock market returns. (Sadorsky, 2001) indicated that stock returns of Canadian oil and gas companies are positively sensitive to oil price increases. There are also researchers who have made the conclusion that oil price shocks negatively impact the stock market returns. (Park & Ratti, 2008) reported that oil price shocks had a negative impact on stock markets in US and many European countries. Some studies have also confirmed that there is both a positive and a negative response stock market returns from crude oil shocks. (Kilian & Park, 2009) demonstrated that positive/negative responses of U.S. stock market returns depend on the sources of oil shocks in the global market for crude oil; on one hand, the precautionary demand shocks negatively affect the stock market returns. On the other hand, aggregate demand shocks have persistent positive effects on cumulative stock returns.

Most studies have been done for the developed countries and the major crude oil markets and the effect of these crude oil prices on the stock markets of these developed nations. However, the developed economies operate in a different social, economic and political environments. This

study therefore seeks to find out the transmission of oil price shocks to the East African stock market. It also seeks to find out whether these shocks are transmitted among the three East African countries, that is, Kenya, Uganda and Tanzania.

1.3 Research Objectives

The study's objectives are:

- i. To determine the transmission of crude oil prices shocks on the stock market returns
- ii. To determine whether the shocks are transmitted across the three East African countries

1.4 Research Questions

- i. Do the oil price shocks impact the stock market returns and if so what is the impact of this oil price shocks to the stock market returns
- ii. Are such shocks due transmitted across the three East African countries?

1.5 Significance of the Study

The results of this study might be useful to investors since having positive shock transmissions reflect most risky assets and more attractive than in a bull crude oil market state where the transmission is insignificant or smaller in magnitude. Energy policy makers from the three East African nations may find the study relevant since the stock market may be vulnerable to a particular source of crude oil than another source that it is dependent on. The governments should import little or none from these crude oil markets that the nations are vulnerable to and diversify their sources and promote incentives for alternative energy source so that it is not dependent on any one area.

2 Chapter 2 Literature Review

2.1 Introduction

There have been a large number of studies carried out on the interrelation between macroeconomic activity and oil price changes. Moreover, a number of researchers have examined the role of crude oil prices in monetary policy e.g. (Hamilton & Herrera, 2004) and impacts of oil prices on exchange rates (e.g., (Chen & Chen, 2007); (Coudert, Mignon, & Penot, 2008).

2.2 Empirical Evidence

These studies have come up with varying results concerning this topic. The first includes papers that empirically support the existence of significant and positive relationship between oil and stock market returns starting from the study of (Chen, Roll, & Ross, 1986) to the most recent works of (El-Sharif, Brown, Burton, Nixon, & Russel, 2005), (Narayan & Narayan, 2010) or (Aroui & Rault, 2012). (Sadorsky, 2001) indicated that stock returns of Canadian oil and gas companies are positively sensitive to oil price increases. (Boyer & Filion, 2009) employed a multifactor framework to analyze the determinants of Canadian oil and gas stock returns, finding similar results to (Sadorsky, 2001). (Huang, Hwang, & Hsiao-Ping, 2005) investigated the effect of oil price change and its volatility on economic activities in the US, Canada and Japan. They indicated that when exceeding a certain threshold, oil price change and volatility possess significant explanatory power for the outcome of economic variables such as industrial production and stock market returns. (Henriques & Sadorsky, 2008) measured the sensitivity of the financial performance of alternative energy companies to changes in oil prices using Vector Autoregressive model in order to investigate the empirical relationship between alternative energy stock prices, technology stock prices, oil prices, and interest rates. They indicated that technology stock price and oil price each individually causes the stock prices of alternative energy companies to increase. Theoretically, in oil exporting countries, stock market prices are expected to be positively affected by oil price changes through positive income and wealth effects. In an analysis of the effects of oil price shocks on stock markets in Norway, (Bjørnland, 2009) argued that higher oil prices represent an immediate transfer of wealth from oil importers

to exporters, stating that the medium to long-term effects depend on how the governments of oil producing countries dispose of the additional income. If used to purchase goods and services at home, higher oil prices will generate a higher level of activity, and thus improve stock returns.

The second category includes papers that support the existence of significant and negative relationship between oil prices and stock market returns. Some of these papers include the studies of (Jones, 1996), (Chiou & Lee, 2009) and (Jammazi & Aloui, 2010). (Nandha & Faff, 2008) examined global equity indices with 35 industrial sectors, showing that oil price rises have a negative impact on stock returns for all sectors except the mining, and oil and gas industries. (O'Neill, Penm, & Terrell, 2008) found that oil price increases led to reduced stock returns in the US, the UK and France. In a study of the connection between oil price shocks and the stock market for the US and 13 European countries, (Park & Ratti, 2008) reported that oil price shocks had a negative impact on stock markets in US and many European countries, while the stock exchange of Norway showed a positive response to the rise in oil prices. These authors also provided evidence that stock markets in oil exporting countries are less affected by oil prices relative to oil importing countries.

The third category gives some studies that confirm the existence of either positive or negative impacts of oil prices on stock market returns depending on various determinants. (Park & Ratti, 2008) argued that the stock market response to an oil shock depends on whether a country is a net importer or exporter of oil. (Kilian & Park, 2009) demonstrated that positive/negative responses of U.S. stock market returns depend on the sources of oil shocks in the global market for crude oil; on one hand, the precautionary demand shocks negatively affect the stock market returns. On the other hand, aggregate demand shocks have persistent positive effects on cumulative stock returns.

The final category of studies seems to counter these findings by demonstrating that there is no significant relationship between oil shocks and stock market returns. (Apergis N, 2009) and (Miller & Ratti, 2009) support this finding. (Maghyereh, 2004) studied the relationship between oil prices changes and stock returns in 22 emerging markets, conducting VAR model from 1998 to 2004, without finding any significant evidence that crude oil prices have an impact on stock index returns in these countries.

(Aloui & Jammazi, 2009) study focused on two major crude oil markets, namely WTI and Brent, and three developed stock markets, namely France, UK and Japan and was based on the relationship between crude oil shocks and stock markets from December 1987 to January 2007. The results indicated that the net oil price increase variable plays an important role in determining both the volatility of real returns and the probability of transition across regimes. Contrary to the work done on developed markets, relatively little research has focused on the relationship between oil prices and emerging stock markets. (Basher & Sadorsky, 2006) analyzing the impact of oil price changes on a large set of emerging stock market returns for the period 1992 to 2005, proposed that emerging economies are less able to reduce oil consumption and thus are more energy intense, and more exposed to oil prices than more developed economies. Therefore, oil price changes are likely to have a greater impact on profits and stock prices in emerging economies.

Employing an error correction representation of a VAR model, (Papapetrou, 2001) concluded that oil price is an important factor in explaining the stock price movements in Greece, and that a positive oil price shock tends to depress real stock returns. (Hammoudeh & Aleisa, 2004) examined the relationship between oil prices and stock prices for five members (Bahrain, Kuwait, Oman, Saudi Arabia, and the United Arab Emirates) of the Gulf Cooperation Council (GCC) for the period 1994-2001, while (Zarour, 2006) investigated the same countries during 2001 to 2005. (Hammoudeh & Aleisa, 2004) suggested that most of these markets react to the movements of the oil futures price, with only Saudi Arabia having a bidirectional relationship. (Arouri & Fouquau, 2009) investigated the short-run relationships between oil prices and GCC stock markets. To examine the phenomena of stock markets' occasional nonlinear response to oil price shocks, they examined both linear and nonlinear relationships.

Their findings pointed to a significant positive relation between oil prices and the stock index of Qatar, Oman and United Arab Emirates, but for Bahrain, Kuwait and Saudi Arabia, they found no such influence.

Although most of these studies recognize the importance of causal relationships between oil prices and stock market returns in some industrial countries, the results from such studies cannot be generalized to other countries. Consequently, this paper extends the understanding on the

dynamic relationship between oil prices and stock market return by using data from three East African Stock markets, which helps to fill in the gap since these are developing countries.

3 Chapter 3 Research Methodology

This section outlines the methodology and the empirical tests performed in our analysis. The choice of empirical models is based upon previous research on oil price shocks and stock market returns. All regressions for this study will be done using the econometric software E-Views.

3.1 Research Design

As evidenced by the literature in the chapter above, most research has been done on the transmission of oil price shocks to the stock market returns. This study seeks to apply the Vector Autoregressive approach. The study will also utilize quantitative methods. The data that will be analyzed are monthly values of NSE-20, USE and DSE from January 2005 to November 2014. This 10-year period was chosen for the study based on availability of data. For the crude oil data, it is appropriate that we use the Dubai crude oil data since Dubai crude oil together with Brent oil and West Texas Intermediate (WTI) serve as benchmarks to the world crude oil prices. The Middle East crude oil grades that are usually imported to East Africa use the Dubai crude oil as the benchmark. Even though price differences do exist, crude oil prices tend to move very closely together. Since Dubai oil serves as a benchmark in the crude oil market, daily closing prices of crude oil Dubai are used as our primary proxy for the world price of crude oil. The daily closing prices for Dubai crude oil for the period from 1 January 2005 to 31 November 2014 are obtained from the World bank website.

In accordance with economic theory and previous empirical studies we include the following variables in our empirical analysis: short term interest rates and exchange rates. The data for these variables are obtained from the national bureau of statistics of the three countries.

In this study real stock prices will be used for analysis. In line with previous empirical literature, for example (Park & Ratti, 2008), (Cunando & Perez de Gracia, 2014) and (Sadorsky, 1999), we define real stock market returns as the difference between continuously compounded returns on stock price index and the log difference in the consumer price index as a proxy for inflation. The variable, real stock return, measures the return on investment after taking inflation into account.

$$Real\ Stock\ Return = \ln\left(\frac{Stock\ Price\ Index_{t+1}}{Stock\ Price\ Index_t}\right) - \ln\left(\frac{Consumer\ Price\ Index_{t+1}}{Consumer\ Price\ Index_t}\right)$$

3.2 Population and Sampling

Daily values of the NSE-20, USE and DSE stock markets will be used to estimate monthly returns from January 2005 through November 2014 by picking end values of every month. The study will also analyze monthly returns of the variables since this is the most popular frequency in the literature. Daily returns are avoided because of unnecessarily too much noise that accompanies them, and the complexity of dealing with weekends and public holidays.

Daily values also for Dubai crude oil prices are also used to estimate monthly returns from January 2005 through November 2014 by picking end values of every month.

Time series does not lend itself naturally to probability sampling techniques, whereby each value has an equal chance of selection. Instead, the dominating concern is the trend of changes in returns over time, and how in turn, this affects conditional volatility. The population of interest in this study are the daily values of the NSE-20, USE and DSE from January 2005 to November 2014. Since the regression is based on monthly returns, the sample that represents these values in the analysis is calculated for every last trading day in each month.

3.3 Data Collection

In this study we will consider only the following three East African countries: Kenya, Uganda and Tanzania. The sample period is chosen from January 2005 to November 2014 due to the availability of data.

The reason behind choosing these countries is the fact that the members of the East African community have close trade relations which is evident from the Economic Partnership Agreement which was signed in 2014. Uganda being a landlocked country depends on Kenya for almost all the commodities that are transported from overseas. Most of the oil for example that is imported to Uganda goes through Kenya and a small percentage goes through Tanzania.

The data used for this study will be mainly from secondary sources.

3.4 Data Analysis

Reliability

To ensure reliability of the empirical model and the data used in the model we will take into consideration the ordering of the variables in the VAR model and selection of the lag lengths in the VAR. In both (Sadorsky, 1999) and (Park & Ratti, 2008), the authors have argued and proven that the results are not sensitive to the selection of the number of lags and the ordering of the variables in the VAR model. This measure gives robustness to the model used in the study.

Validity

The choice of empirical models and data sources for the analysis of the relationship between oil price shocks and real stock returns is based upon previous researches on this area. To be specific, Vector Autoregressive Models, Impulse Response and variance decomposition have also been commonly applied in the previous studies and are well established as a measure to capture the dynamic relationships between the variables of our interest.

3.5 Lag Length Selection

In order to implement Vector Autoregressive model, firstly, it is necessary to define lag length of the model. It is not easy to determine lag length in VAR model and lag length selection choice may be done according to the Akaike or Schwarz Information criteria or basis of statistical significance. There are two common approaches in selecting the lag length: cross-equation restrictions and information criteria.

With the aim of VAR modeling, VAR models should be formed as unrestricted as possible. In the case where equations have different lag lengths, the VAR model becomes restricted and some coefficients, which exceeds number of lags in the shortest equation, are equalized to zero. An alternative approach would be to specify the same number of lags in each equation and to test if restricted VAR has better or worse fit than the unrestricted one. It is possible to do so by using Likelihood ratio test which works as F-test. If the restricted model has much larger error than unrestricted one, then the t-statistic is larger and thus we should reject null hypothesis that restricted model works just as well. (Verbeek, 2012) suggests the use of Akaike's information criterion (AIC) or the Schwarz's Bayesian information criterion (BIC) when deciding the appropriate lag length. Information criteria includes two factors: a term that is a function of the residual sum of squares (RSS) and a penalty term which is the loss of degrees of freedom from

adding extra parameters (Brooks, 2008). Hence, adding a new variable or an additional lag to the model will have to effect on the information criterion where the RSS will fall but the value of the penalty term will increase. Therefore, the object is to choose the number of parameters that minimizes the value of the information criteria. In general, the model with the lowest AIC or BIC will be preferred.

Akaike (1974) information criterion (AIC)

$$AIC = \log \frac{1}{N} \sum_{i=1}^N e_i^2 + \frac{2k}{N}$$

Schwarz Bayesian (1979) information criterion (BIC)

$$BIC = \log \frac{1}{N} \sum_{i=1}^N e_i^2 + \frac{K}{N} \log N$$

BIC tends to favor a more parsimonious model since it gives a bigger “penalty” than AIC does. According to (Brooks, 2008), BIC is strongly consistent, but AIC is generally more efficient. Moreover, the BIC will be consistent to show the true model in the data set (Verbeek, 2012) However, one can also argue that AIC is a more preferable in smaller samples due to the fact that extra parameters may approximate misspecifications in the model (Verbeek, 2012). We will apply both of these information criteria and compare the results in order to choose the appropriate number of lags for our model.

3.6 Empirical Models

3.6.1 Unit Root Test

At the beginning of this data analysis, we perform Unit root test to check for the stationarity of the time series data of stock return prices and crude oil prices at their log levels. The reason for such test is that in Vector Autoregressive model (VAR) we can use only stationary variables. In a VAR model, if we use non-stationary data there is a possibility that it might lead to spurious regressions. Considering a time series, Y_t , the series is said to be stationary if the distribution of the variable does not depend upon time, that is the mean and the variance of the time series are constant over time (Verbeek, 2012).

There are several methods to test for stationarity in time series. In this study, we will apply the Augmented Dickey-Fuller (ADF) test. The ADF test is based on the Dickey-Fuller test introduced in the 1970s by David Dickey and Wayne Fuller. The basic test was employed to investigate the presence of unit roots in first-order autoregressive models. Considering an AR(1) process:

$$y_t = \rho y_{t-1} + \varepsilon_t$$

For ease of computation and interpretation, the process is transformed to the following expression where $\gamma = \rho - 1$

$$\Delta y_t = \gamma y_{t-1} + \varepsilon_t$$

Testing for stationarity implies to test the null hypothesis that states that the time series is non-stationary, against the alternative hypothesis. That is:

$$H_0: \gamma = 0 \text{ and } H_1: \gamma < 0$$

Since the Dickey-Fuller test is restricted to include only one lag, the Augmented Dickey-Fuller (ADF) test was introduced to test for stationarity in models with more complicated dynamics. The hypothesis for stationarity is the same as for the original DF test. The extended test equation is now expressed by:

$$\Delta y_t = \beta + \gamma y_{t-1} + \sum_i^n a_i \Delta y_{t-1} + \varepsilon_t$$

Depending on the results from the unit root testing, that is, if we find unit roots in the variables, we conduct cointegration test (Johansen test, 1988) to check for common stochastic trend. In each case, the null hypothesis is that the variables have no cointegration at 5% level of significance.

If the variables have unit roots at their log levels, we need to take the first difference of the log level of the variables to induce stationarity.

3.6.2 Cointegration Test

Once the stationarity check is done, we conduct a Johansen cointegration test for the variables with a unit root to check for any common stochastic trend. Johansen test allows us to test a hypothesis about one or more coefficients in the cointegrating relationship.

The Johansen and Juselius framework applied allows for the testing of more than one cointegrating vectors in the data by estimating the maximum likelihood estimates on these vectors. Two test statistics, trace statistic (λ_{trace}) and max-eigenvalue (λ_{max}), are used to determine the number of cointegrating vectors (Brooks, 2008). The two test statistics are expressed as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^g \ln(1 - \hat{\lambda}_i)$$
$$\lambda_{max}(r, r + 1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

where r is the number of cointegrating vectors under the null hypothesis, g is the number of variables and are the ordered eigenvalues. For each value of r , for the given orders: ($r=0, 1, 2, 3 \dots g-1$), the test statistic is compared to the critical value to determine the number of cointegrating vectors. If the test statistic is greater than the critical value, then the null hypothesis of $r=0$ cointegrating vector is rejected in favor of the alternative hypothesis and one check the critical value for $r=1$. If the test statistic is lower than the critical value, however, the null hypothesis of no cointegrating vectors is not rejected. For the λ_{trace} test, the null hypothesis is that the number of cointegrating vectors is less than or equal to r , against an unspecified or general alternative that there are more than r (Brooks, 2008). For the λ_{max} test, the null hypothesis is that there is r cointegrating vectors, against the alternative of $r+1$.

3.6.3 Vector Autoregressive Model

This study employs VAR approach in order to examine the dynamic interactions between oil price shocks and the East African Stock market. In this study, the unrestricted Vector Autoregressive (VAR) model developed by (Sims, 1980) to investigate the interactions between oil price shocks and stock market return will be applied. VAR model allows a multivariate framework where each variable is dependent on the changes in its own lags and the lags of other variables. After the macroeconomic chaos of the 1970 which was mainly caused by oil shocks,

the Vector Autoregressive model developed by (Sims, 1980) came into place to bridge the gap that the other models had not met. These tasks include data description, forecasting and structural inference. This methodology has also recently gained widespread use in empirical business cycles analysis, as it has proved to be a flexible and tractable way to analyse economic time series. In particular, vector autoregression (VAR) models have been capable of describing the rich dynamic structure of the relationships between economic variables.

The following is one equation from the model. In the VAR model we have the following variables: Crude Oil Price Shock (*cops*), interest rates (*int*), exchange rates (*er*) and Real Stock Return (*rsr*). For instance, we can express oil price shock in term of its own lags and lags of real stock returns.

$$y_{1t} = \beta_{10} + \beta_{11}y_{1t-1} + \dots + \beta_{1k}y_{1t-k} + \alpha_{11}y_{2t-1} + \dots + \alpha_{1k}y_{2t-k} + \delta_{11}y_{3t-1} + \dots + \delta_{1k}y_{3t-k} + \varepsilon_{1t}$$

$$y_{2t} = \beta_{20} + \beta_{21}y_{1t-1} + \dots + \beta_{2k}y_{1t-k} + \alpha_{21}y_{2t-1} + \dots + \alpha_{2k}y_{2t-k} + \delta_{21}y_{3t-1} + \dots + \delta_{2k}y_{3t-k} + \varepsilon_{2t}$$

$$y_{3t} = \beta_{30} + \beta_{31}y_{1t-1} + \dots + \beta_{3k}y_{1t-k} + \alpha_{31}y_{2t-1} + \dots + \alpha_{3k}y_{2t-k} + \delta_{31}y_{3t-1} + \dots + \delta_{3k}y_{3t-k} + \varepsilon_{3t}$$

For the case of this study, we only have two variables which are oil price shocks (*cops*), real stock returns (*rsr*), interest rates (*int*) and exchange rate (*er*)

$$OPS_t = \beta_{11}OPS_{t-1} + \dots + \beta_{1k}OPS_{t-k} + \alpha_{11}rsr_{t-1} + \dots + \alpha_{1k}rsr_{t-k} + \sigma_{11}int_{t-1} + \dots + \sigma_{1k}er_{t-k} + \gamma_{11}er_{t-1} + \dots + \gamma_{1k}er_{t-k} + \varepsilon_t$$

VAR treats all the variables as jointly endogenous and imposes no priori restrictions on the structural relationships between the variables in the model. Additional variables are included to get a more detailed picture of the interaction of all the variables in the model. Thus we include stock market return, crude oil prices, interest rates and exchange rates as variables in VAR model.

In order to select the best lag length k for VAR model, information criteria approach is utilized. E-views performs the lag length selection tests automatically and shows an optimum result.

In order to achieve our second objective, we apply the panel VAR model which is closely related to the VAR model that is mentioned above. Panel VARs have the same structure as VAR models, in the sense that all variables are assumed to be endogenous and interdependent, but a cross sectional dimension is added to the representation. The panel VAR allows us to see how shocks are transferred across the three East African countries. In this paper we shall apply the panel VAR model which was pioneered by (Ramey & Shapiro, 1998). A panel VAR is represented as:

$$Y_t = A_0(t) + A_1 Y_{t-1} + \mu_t \sim iid(0, \varepsilon_\mu)$$

Vector Autoregressive model has both advantages and drawbacks (Brooks 2008)

There are three different techniques to facilitate the interpretation and structure the results under this model and they include Granger causality tests, impulse responses and variance decomposition. For this study however, the technique that will be applied is the impulse response and variance decomposition.

3.6.4 Impulse Response

An impulse response function examines the responsiveness of the endogenous variables in the VAR to shocks to each of the variables (Brooks, 2008). That is, for each variable from each equation separately, a unit shock is applied to the error and the effects upon the VAR over time is demonstrated. A shock to the i -th variable will have a direct effect on the i -th variable, but is also transmitted to the other endogenous variables through the dynamic structure of the VAR model. Given that the system is stable, the shock should gradually die away. A shock to each of the n variables in the VAR system results in n impulse response functions and graphs, giving a total of $n \times n$ graphs showing these impulse response functions (Wang, 2003).

3.6.5 Variance Decomposition

The other test used to interpret VAR models is the forecast error variance decomposition. According to (Brooks, 2008), variance decompositions give the proportion of the movements in the endogenous variables that are caused by their own shocks versus shocks to the other variables in the model. Hence, the variance decompositions provides evidence about the relative importance of each random innovation in affecting the variation of the variables in VAR.

Furthermore, it is generally observed that own series shocks explain the larger fraction of the forecast error variance of the series in the VAR.

3.6.6 Ordering of Variables

When calculating impulse responses, it is important to choose the right order of variables in the system because, in practice, errors are generally not totally independent although impulse response assume that VAR error terms are statistically independent. Ordering can be checked by orthogonalizing or recalculating results with different orders. Due to the finding of previous researches of (Sadorsky, 1999) and (Park & Ratti, 2008) that different orders do not affect the results of Impulse response. The following order will be used: real oil price, inflation interest rates and real stock return.

4 Chapter 4 Results

4.1 Unit Root Test

To perform unit root tests, firstly, we transform interest rates, real crude oil prices, exchange rates in natural logarithm form because relative changes are better to analyze. As a result of the ADF test most of the variables in natural logarithm forms are non-stationary for all countries. In order to avoid non-stationarity we induce first difference transformation to all the non-stationary variables and then apply the three unit root tests again. Once the first differencing is applied we observe stationarity for interest rates, real crude oil prices and exchange rates in first difference form. Since only stationary variables can be used in Vector Autoregressive Model the following variables are included in the VAR model:

ir	first difference of natural logarithms of short term interest rate
rcop	first difference of natural logarithms of real crude oil prices
er	first difference of natural logarithms of exchange rates per US dollar
rsr	first difference of natural logarithms of real stock returns

For ADF test we observe rejection of null hypothesis about non-stationarity if t-statistic is more negative than critical value.

Table 1: ADF Unit Root test results

Country	Interest Rates		Real Crude Oil Prices		Exchange Rates		Real Stock Returns	
	<i>log level</i>	<i>first log difference</i>	<i>log level</i>	<i>first log difference</i>	<i>log level</i>	<i>first log difference</i>	<i>log level</i>	<i>first log difference</i>
Kenya	-2.72211	-4.31855	-4.31645	-5.5165	-3.1177	-7.50539	-1.5847	-9.0756
Uganda	-2.25224	-13.63810	-5.11778	-9.6493	-3.0422	-6.55739	-5.6815	-10.9944
Tanzania	-2.71768	-6.92446	-4.23141	-13.6734	-6.5099	-16.2810	-2.8745	-10.9673

Critical Values:

1% level	-4.049586
5% level	-3.454032
10% level	-3.152652

Notes: In order to test for stationarity, we compare the values at the log level and the first difference with the critical values. If those values are greater than the critical values in absolute terms, then the variables are stationary.

After performing unit root tests for the first time and discovering non-stationarity for interest rate, real crude oil price, and exchange rate in logarithm form we apply Johansen test to check for cointegration in order to examine if there is common stochastic trend among the non-stationary variables. The null hypothesis is that the variables have no cointegration at 5% level of significance.

Then we discuss the results from cointegration test. To detect the presence of cointegration it is necessary to compare Trace statistic or Max-Eigen statistic with critical value. If in the first row Trace statistic exceeds the critical value the null hypothesis of no cointegrating vectors is rejected thus there is at least one cointegrated vector since alternative hypothesis is the presence of 1 cointegrated vector. Then we consider second row and compare Trace statistic or Max-Eigen statistic with critical value in the same way but now null hypothesis is presence of one cointegrated vector and alternative hypothesis is existence of 2 cointegrated vectors. If Trace statistic or Max-Eigen statistic is smaller than critical value we do not reject null hypothesis. It means that only one cointegrated vector exists.

As a result of implementing Johansen test we found that there is no cointegration among interest rates, real crude oil prices and exchange rates in Kenya, Uganda and Tanzania.

Table 2: Johansen cointegration test for the 3 countries

Country		Trace statistic	0.05 Critical value	Max-Eigen statistic	0.05 Critical value
Kenya	None	41.81242	47.85613	18.27908	27.58434
Uganda	None	28.5526	47.85613	16.00649	27.58434
Tanania	None	45.51129	47.85613	27.46509	27.58434

Notes: variables included are interest rates, real oil price and exchange rates in log levels. We compare the trace statistic or max-eigen statistic with the 0.05 critical value. If the 0.05 critical values are greater than both the trace statistic and max-eigen values then there is no cointegration.

Table 3: Cointegration Kenya

Pair		Trace statistic	0.05 Critical value	Max-Eigen statistic	0.05 Critical value
ir & er	None	11.49685	15.49471	9.568344	14.2646
ir & rcop	None	13.85428	15.49471	9.287741	14.2646
er & rcop	None	14.40163	15.49471	13.76761	14.2646

Table 4: Cointegration Uganda

Pair		Trace statistic	0.05 Critical value	Max-Eigen statistic	0.05 Critical value
ir & er	None	6.104338	15.49471	5.723211	14.2646
ir & rcop	None	18.03149	15.49471	13.39397	14.2646
er & rcop	None	13.88034	15.49471	13.52852	14.2646

Table 5: Cointegration Tanzania

Pair		Trace statistic	0.05 Critical value	Max-Eigen statistic	0.05 Critical value
ir & er	None	6.440659	15.49471	4.888365	14.2646
ir & rcop	None	15.05405	15.49471	12.88946	14.2646
er & rcop	None	15.6433	15.49471	14.25059	14.2646

4.2 Vector Autoregressive model

The VAR model is then applied to capture the dynamic relationship between the variables. Thereby, there is one equation for each dependent variables and each variable depends on its own lags and lags of the other variable(s) in the system (Brooks, 2008).

The ordering of the variables is in line with earlier studies by (Sadorsky, 1999) and (Park & Ratti, 2008). We have employed the following ordering: first difference of short-term interest

rates ($d(ir)$), first log difference of real crude oil price ($dlog(rcop)$), first log difference of exchange rates ($dlog(er)$) and first log difference of real stock returns ($dlog(rsr)$). Hence we are estimating the following model: VAR ($d(ir)$, $dlog(rcop)$, $dlog(er)$, $dlog(rsr)$).

In order to be able to interpret the VAR model it is necessary to estimate impulse response and variance decomposition functions, we therefore employ these analyses in order to investigate the effect of oil price shocks on stock returns in our sample countries. We will also look at how the other variables affect real stock returns by looking at their impulse responses and variance decomposition functions as well.

In order to select the best lag length k for VAR model, information criteria approach is utilized. E-views performs the lag length selection tests automatically and shows an optimum result. Performing VAR estimates in E-views in addition to lag length selection we know the sign and size of coefficients in VAR model equations for each country.

The results of VAR estimates are presented in the appendix.

4.3 Impulse Response

In this section we analyze the results from the impulse responses to assess the impact of real crude oil price shock on real stock returns. The ordering of the variables to analyze the oil price shock on real stock returns has been chosen on the basis of (Sadorsky, 1999) and (Park & Ratti, 2008). The order is as following sequence: interest rate, real crude oil price, exchange rate, real stock return. The order of the variables in the VAR model is indicated by the following notation: VAR ($ir,rcop,er,rsr$). They found that different orders give the same results.

The results for the impulse responses of real stock returns resulting from a one standard deviation shock to interest rate, real crude oil price shock and exchange rate disturbances. Monte Carlo constructed 95% confidence intervals are provided to judge the statistical significance of the impulse response functions.

The results from the impulse response graphs for the 3 countries are tabulated to have a better glimpse of the cross country comparison.

Statistically significant impulse response of real stock returns to world oil price shocks, interest rate shocks and exchange rate shocks (in summarized form).

Table 6: Statistically significant impulse response of real stock returns to real crude oil price shocks, interest rate shocks and exchange rate shocks (in summarised form)

	Kenya	Uganda	Tanzania
Short term interest rates	n	n	n
Real Crude Oil prices	n	n	n
Exchange Rates	n	n	n

Notes: n indicates negative statistically significant impulse response at 5% level of significance of interest rate shocks, real crude oil price shocks, exchange rate shocks in the same period or in a lag of one month.

We notice that for all the three countries, an oil price shock has negative and statistically significant impact on the real stock returns at 5% level in the same month and/or within one month.

In case of an interest rate shock, the real stock returns are negatively affected for all the countries at 5% significance level. A unit shock of the exchange rate to the real stock returns is negative for Kenya and Uganda and Tanzania.

Impulse response results from Eviews are tabulated in the appendices.

4.4 Variance Decomposition

In this section, we discuss the results from the forecast error variance decomposition of real stock returns due to the oil price, interest rate shocks and industrial production shocks.

Table 7: Variance decomposition in real stock returns due to interest rate shocks, real crude oil price shocks and exchange rate shocks.

Country	Due to DLIR	Due to DLCOP	Due to DLER
Kenya	0.041019 (1.03662)	5.778754 (4.66737)	1.351585 (2.53955)
Uganda	0.996782 (2.35723)	1.275838 (2.56631)	4.1511 (3.43922)
Tanzania	1.641946 (2.96406)	72.72361 (4.84231)	0.059212 (0.37173)

The table demonstrates the forecast error variance decomposition of real stock returns due to the interest rate, crude oil price and exchange rate shocks. Each value in the table are in percentage which shows how much of the unanticipated changes in the real stock returns are due to interest rate shocks, how much due to crude oil price shocks and how much are due to exchange rate shocks. The contribution of crude oil price shocks in the variability of real stock returns varies from 1.12% (for Uganda) to 72.72% (for Tanzania). In case of interest rate, the contribution ranges from 0.04% for Kenya to 1.64% for Tanzania. Lastly, for exchange rate the contribution varies from 0.06% (for Tanzania) to 4.15% (for Uganda).

For instance, if we consider the case of Kenya, 0.04% of the variability of stock returns is due to interest rate shocks, 5.78% due to crude oil price shocks and 1.35% due to exchange rate. This implies that crude oil price shock has more impact on real stock returns.

Similarly if we consider the results for Tanzania, it is seen that oil price shocks have higher variability in real stock returns (compared to industrial production shocks and interest rate shocks) in Netherlands only. For Uganda, we see that exchange rate shock has more impact compared to crude oil price shock and interest rate shock.

These results are inconsistent with previous studies where oil price shocks played the main influence in proportion of variation in real stock returns except for Uganda where exchange rate come out on top.

5 Panel Results

5.1 Unit root test

To check the stationarity of our data we perform the panel unit root tests. As common unit root process we use Levin, Lin and Chu panel unit root test and for individual unit root process we use three type of panel unit root tests, first one is Im, Pesaran and Shin panel unit root test, second is Fisher type test, the ADF-Fisher chi-square test and last one is also a fisher type test, the PP-Fisher Chi square panel unit root test.

Table 8: Results of Panel Unit Root Test

Method	D(Exchange_rates)		D(Interest_Rates)		Real_Crude_Oil_Prices		D(Real_Stock_Prices)	
	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**	Statistic	Prob.**
Levin, Lin & Chu t*	-19.0262	0.0000	-9.93986	0.0000	-1.92204	0.0273	-12.743	0.0000
Im, Pesaran and Shin W-stat	-17.377	0.0000	-9.68573	0.0000	-3.34096	0.0004	-19.337	0.0000
ADF - Fisher Chi-square	148.925	0.0000	93.6142	0.0000	24.4514	0.0004	188.401	0.0000
PP - Fisher Chi-square	82.142	0.0000	117.816	0.0000	24.7254	0.0004	157.628	0.0000

In case of exchange rates, short term interest rates, and real stock prices, the result shows that at 5% level of significance we accept null hypothesis that means the series are not stationary. After taking the first difference at 5% level of significance we reject null hypothesis, so first difference of the series is stationary. The real crude oil prices are stationary at the 5% level of significance.

5.2 Panel Cointegration test

We then perform the panel cointegration test to check for any common trend among the variables of the three East African countries.

Table 9: Results of Panel Cointegration test

	t-Statistic	Prob.
ADF	-2.355945	0.0092
Residual variance	1.907811	
HAC variance	0.171494	

From the results, we see that at 5% level of significance we reject the null hypothesis of no cointegration. This means the variable has a long run relationship.

5.3 Granger Causality Test

In this section we perform the granger causality test to see whether each of the variable causes the other variables in the series. We use the differenced data for exchange rates, short term interest rates and real stock prices since this is the level at which they are stationary. For the real crude oil prices we use the data at the 5% level of significance since they are stationary at this state.

Table 10: Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
DIR does not Granger Cause DER DER does not Granger Cause DIR	312	2.54687 2.33569	0.08 0.0985
DRSP does not Granger Cause DER DER does not Granger Cause DRSP	312	0.49799 0.34169	0.6082 0.7108
REAL_CRUDE_OIL_PRICES does not Granger Cause DER DER does not Granger Cause REAL_CRUDE_OIL_PRICES	312	1.76549 0.3546	0.1728 0.7017
DRSP does not Granger Cause DIR DIR does not Granger Cause DRSP	312	2.82699 0.70135	0.0607 0.4967
REAL_CRUDE_OIL_PRICES does not Granger Cause DIR DIR does not Granger Cause REAL_CRUDE_OIL_PRICES	312	0.08229 0.64536	0.921 0.5252
REAL_CRUDE_OIL_PRICES does not Granger Cause DRSP DRSP does not Granger Cause REAL_CRUDE_OIL_PRICES	312	6.0721 0.75518	0.0026 0.4708

From table 10 we can see that we accept the null hypothesis for all the variables except for the real crude oil prices and the real stock prices where we reject the null hypothesis. We can see that the probabilities for the two are less than 5% meaning that real crude oil prices cause real stock prices and vice versa.

5.4 Panel Impulse Response

In this section, we perform the impulse response to see transmission of shocks across the three East African countries. From the results in the appendices we can see that there was some transmission of shocks across the three East African countries. The response of the security market to this shock transmission is positive from exchange rates and negative from both short term interest rates and real crude oil prices.

6 Analysis

Analyzing the results we see that oil price shocks have negative impact in the real stock returns for all the three countries. The finding is consistent with that of (Sadorsky, 2001) who indicated that the stock returns of Canadian oil and gas companies are positively sensitive to oil price increase.

In the previous chapter we discussed that for all the three countries (Kenya, Uganda and Tanzania) real crude oil price shock has greater impact on the real stock returns compared to the other shocks. This finding is consistent with the findings of (Park & Ratti, 2008). They found that after 1986, oil price shocks have greater impact on the real stock returns in comparison to interest rate shocks.

As a summary of results for the period from 01.2006 till 11.2014 we find that movements in oil price do not appear to lead those of real stock return for all countries except. We also find that oil price shocks have negative influence on real stock returns for all the countries. Real crude oil price shocks affect real stock returns more than interest rate shocks and exchange rate shocks for all the countries.

After analyzing the results and comparing them with the previous studies, we are now in a position to answer our research questions. Our first question to be answered is whether oil price shocks impact the stock market returns and if so what is the impact of this oil price shocks to the stock market returns. From the results it is seen that the oil price shocks do have negative impacts on all the countries.

Our second research question is whether the shocks are transmitted across the three East African countries. From our results we find that there was some transmission of this shocks across the three East African countries in the second period and none in the other periods. The fact that there is some transmission of shocks in one period and none in the other periods could be probably due to the fact that Tanzania does not have close trade links with the other two East African countries. The countries that could have some transmission of shocks across their borders are Kenya and Uganda since they usually have trade relationships between each other. The crude oil that is used in Uganda usually passes through Kenya.

7 Conclusion

In concluding remarks, based on the results, it could be stated that oil price shocks have negative impacts on real stock market returns and that there is some transmission of shocks across the three East African countries. Our results are consistent with the stated notion. However, to generalize the idea that developing countries' stock returns are affected positively, it is subject to further research considering some more developing countries.

For further research, we recommend similar study on a different set of countries and how the shocks are transmitted from one country to another. In addition to that, some further interesting studies could on how the other financial markets (bond, derivatives, etc), other than the stock markets, behave in case of oil price shocks.

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Appendices

Appendix A: VAR coefficients for the period (Jan 2006-Nov 2014)

Table 11: Kenya VAR coefficients

	DLIR	DLCOP	DLER	DLSP
DLIR(-1)	0.395869	0.060421	-0.003176	-0.031014
DLCOP(-1)	0.05105	0.267734	-0.075129	-0.001023
DLER(-1)	-0.716782	-0.610105	0.36048	-0.611139
DLSP(-1)	-0.238672	0.030515	-0.069279	0.060147
C	0.001201	0.002938	0.002154	0.002633

Table 12: Uganda VAR coefficients

	DLIR	DLCOP	DLER	DLSP
DLIR(-1)	0.40808	-0.044697	-0.043989	0.058504
DLCOP(-1)	0.119834	0.080901	-0.00241	0.126702
DLER(-1)	0.45127	-0.767647	0.40116	0.186724
DLSP(-1)	-0.003762	0.922354	-0.002796	-0.40371
C	-0.001105	-0.000207	0.002625	0.018185

Table 13: Tanzania VAR coefficients

	DLIR	DLCOP	DLER	DLSP
DLIR(-1)	0.415177	-0.06714	0.005587	-0.004764
DLCOP(-1)	-0.05931	0.134869	-0.114255	-0.315886
DLER(-1)	0.270253	0.210749	-0.552797	0.08189
DLSP(-1)	0.280599	-0.68103	0.128791	-0.241151
C	-0.004634	0.011912	0.004962	0.017466

Appendix B: Impulse response

Table 14: Impulse response Kenya

Impulse Response Kenya				
Response of DLSP:				
Period	DLIR	DLCOP	DLER	DLSP
1	-0.00140	0.01656	-0.00801	0.06638
	-0.00676	-0.0066	-0.00653	-0.00460
2	-0.00540	0.00423	-0.01271	0.00399
	-0.00674	-0.0070	-0.00643	-0.00698
3	-0.00935	0.00753	-0.00508	-0.00350
	-0.00647	-0.0065	-0.00634	-0.00700
4	-0.00089	0.00117	0.00145	0.00177
	-0.00391	-0.0039	-0.00402	-0.00317
5	0.00209	-0.0009	-0.00049	0.00176
	-0.00217	-0.0029	-0.00295	-0.00254
6	0.00034	0.00041	-0.00125	0.00007
	-0.00103	-0.0020	-0.00188	-0.00158
7	-0.00039	0.00041	0.00010	-0.00048
	-0.00066	-0.0010	-0.00096	-0.00087
8	-0.00004	-0.0001	0.00051	-0.00023
	-0.00039	-0.0005	-0.00057	-0.00049
9	0.00010	-0.0001	0.00008	0.00002
	-0.00023	-0.0003	-0.00029	-0.00028
10	0.00001	0.00003	-0.00013	0.00006
	-0.00013	-0.0001	-0.00019	-0.00016

Table 15: Impulse Response Uganda

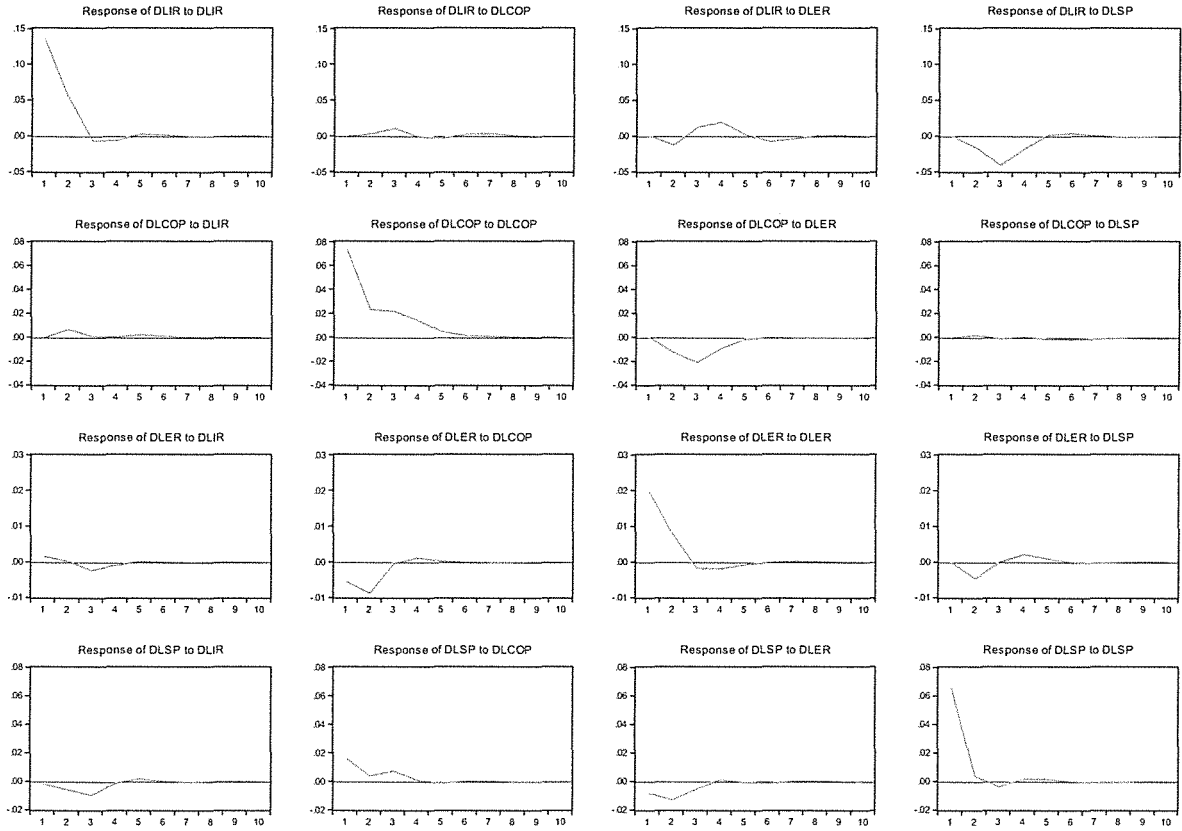
Impulse response Uganda				
Response of DLSP:				
Period	DLIR	DLCOP	DLER	DLSP
1	-0.02575	0.02913	-0.05255	0.24951
	-0.02523	-0.02508	-0.02474	-0.01730
2	0.01256	-0.00041	0.02573	-0.10073
	-0.02792	-0.02822	-0.02828	-0.02682
3	-0.02462	-0.01641	0.00162	-0.04874
	-0.02654	-0.01480	-0.02637	-0.02720
4	-0.00148	0.00007	-0.01003	0.03286
	-0.00851	-0.00903	-0.01094	-0.02749
5	0.00465	0.00543	-0.00598	0.01705
	-0.00754	-0.00599	-0.00897	-0.02260
6	0.00045	-0.00056	0.00203	-0.01422
	-0.00363	-0.00360	-0.00380	-0.01179
7	-0.00180	-0.00177	0.00037	-0.00398
	-0.00297	-0.00278	-0.00316	-0.01135
8	0.00033	0.00042	-0.00112	0.00510
	-0.00145	-0.00134	-0.00151	-0.00571
9	0.00068	0.00059	-0.00016	0.00088
	-0.00109	-0.00119	-0.00142	-0.00559
10	-0.00010	-0.00019	0.00042	-0.00188
	-0.00063	-0.00053	-0.00059	-0.00261

Table 16: Impulse Response Tanzania

Tanzania Impulse Response				
Response of DLSP:				
Period	DLIR	DLCOP	DLER	DLSP
1	-0.01714	0.11409	0.00326	0.06766
	-0.01306	-0.01033	-0.00664	-0.00469
2	0.01307	-0.07672	0.00429	-0.01632
	-0.01566	-0.01465	-0.01342	-0.01317
3	-0.00286	-0.00235	-0.00641	0.00809
	-0.01470	-0.01543	-0.01491	-0.01438
4	-0.00076	0.01278	0.00059	0.00733
	-0.00524	-0.01299	-0.01340	-0.00587
5	0.00333	-0.01057	0.00136	-0.00208
	-0.00379	-0.00658	-0.00645	-0.00374
6	0.00001	0.00082	-0.00116	0.00177
	-0.00203	-0.00361	-0.00265	-0.00269
7	-0.00004	0.00110	0.00029	0.00089
	-0.00103	-0.00322	-0.00235	-0.00153
8	0.00039	-0.00153	0.00012	-0.00019
	-0.00053	-0.00172	-0.00145	-0.00088
9	-0.00005	0.00021	-0.00020	0.00032
	-0.00036	-0.00075	-0.00053	-0.00050
10	0.00002	0.00005	0.00007	0.00010
	-0.00021	-0.00061	-0.00031	-0.00032

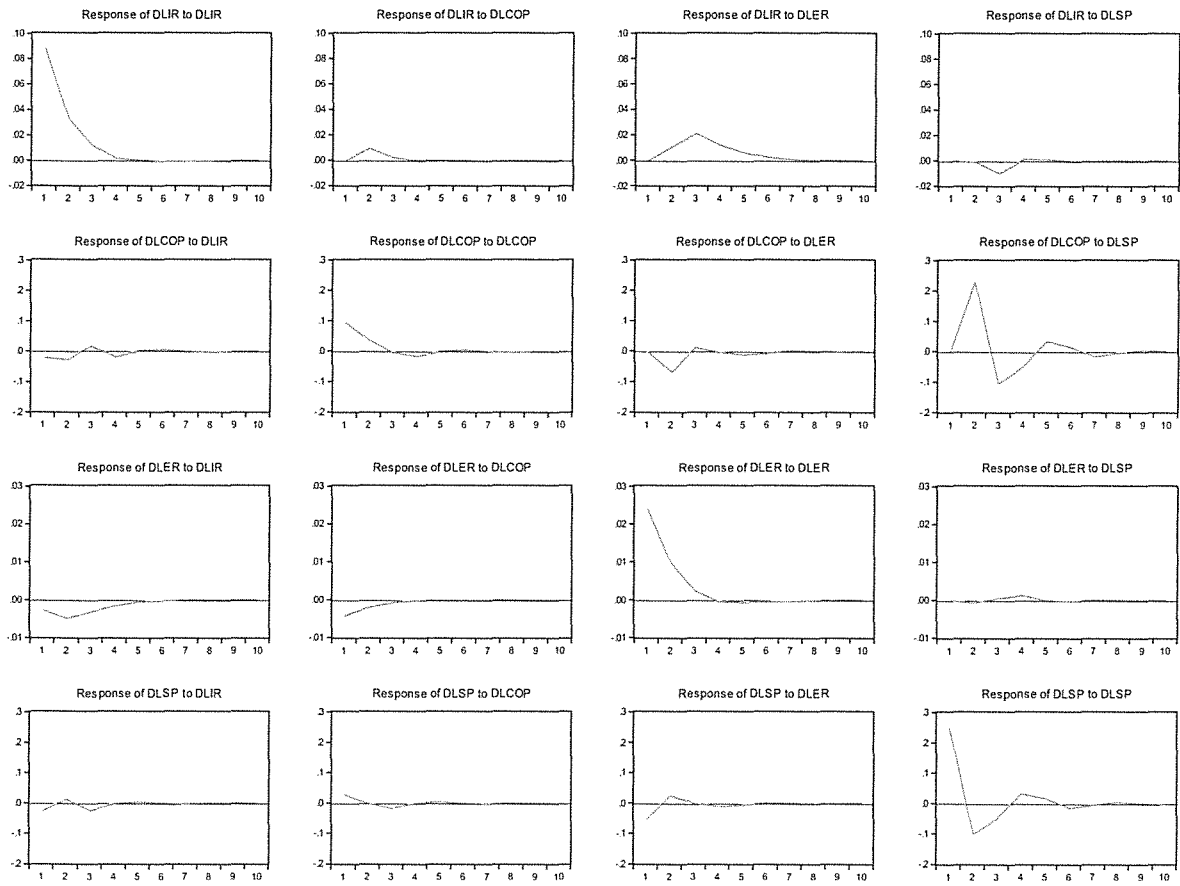
Kenya Impulse Response

Response to Cholesky One S.D. Innovations



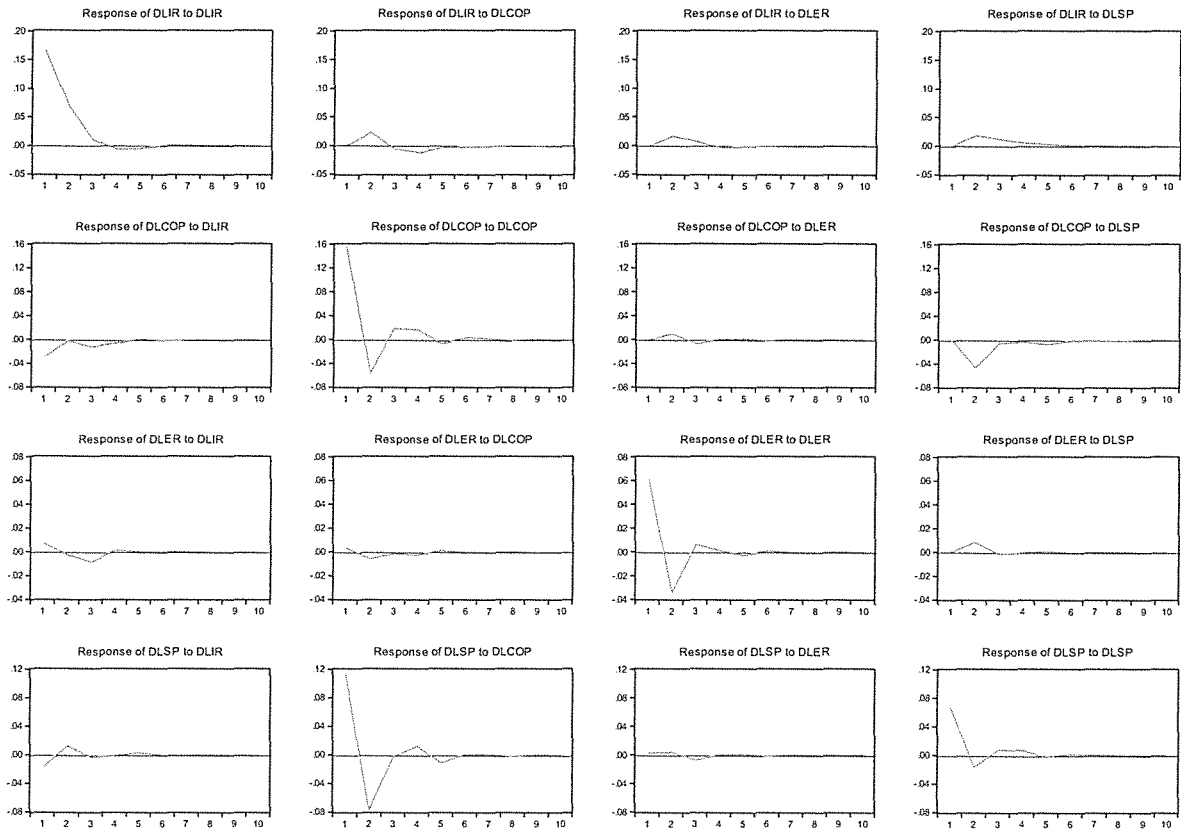
Uganda Impulse Response

Response to Cholesky One S.D. Innovations



Tanzania Impulse Response

Response to Cholesky One S.D. Innovations



Panel Impulse Response

