



**Strathmore**  
UNIVERSITY

**Modelling the Impact of Oil Prices on Stock Prices in  
Kenya**

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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 Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

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4<sup>th</sup> December 2015..... **Date**

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## **Abstract**

The purpose of the study is to model the impact of oil prices on stock prices in Kenya using monthly data for between 2003 and 2015. The study uses the Johansen's multivariate cointegration test and the vector error correction model (VECM). The Johansen's cointegration test shows that the variables are cointegrated with at most one cointegrating vector and the cointegration estimate reveals that oil prices have a significant relationship with stock prices in the long-run in Kenya. The VECM model reveals that in the short-run, oil prices have a significant influence on stock prices. Similarly, in the long-run, the study finds that oil prices have a negative effect on stock prices in Kenya. To address the impact of oil price shocks on stock prices, the study uses impulse response and variance decomposition analysis. The impulse response results show that oil price shocks cause an immediate decline in stock prices. On the other hand, the cumulative effects of oil price shocks account for 9.02% of the variation in stock prices in the long-run. The study recommends policymakers, financial analysts and shareholders to take into consideration the effects of oil prices in their financial decisions given the significant impact of oil prices on stock prices in Kenya.

**Key words:** Stock prices, Oil prices, Cointegration, Impulse Response, Variance decomposition

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## List of Abbreviations

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
CPI	Consumer Price Index
ECT	Error Correction Term
FTSE	Financial Times Stock Exchange
GDP	Gross Domestic Product
IRF	Impulse Response Function
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
NASI	NSE All Share Index
NSE	Nairobi Securities Exchange
NSE-20	NSE 20-Share Index
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
ORB	Organization of the Petroleum Exporting Countries Reference Basket
PP	Philips-Perron
SBIC	Schwarz's Bayesian Information Criterion
VAR	Vector Autoregressive
VECM	Vector Error Correction Model

## **Chapter 1 Introduction**

### **1.1 Background Information**

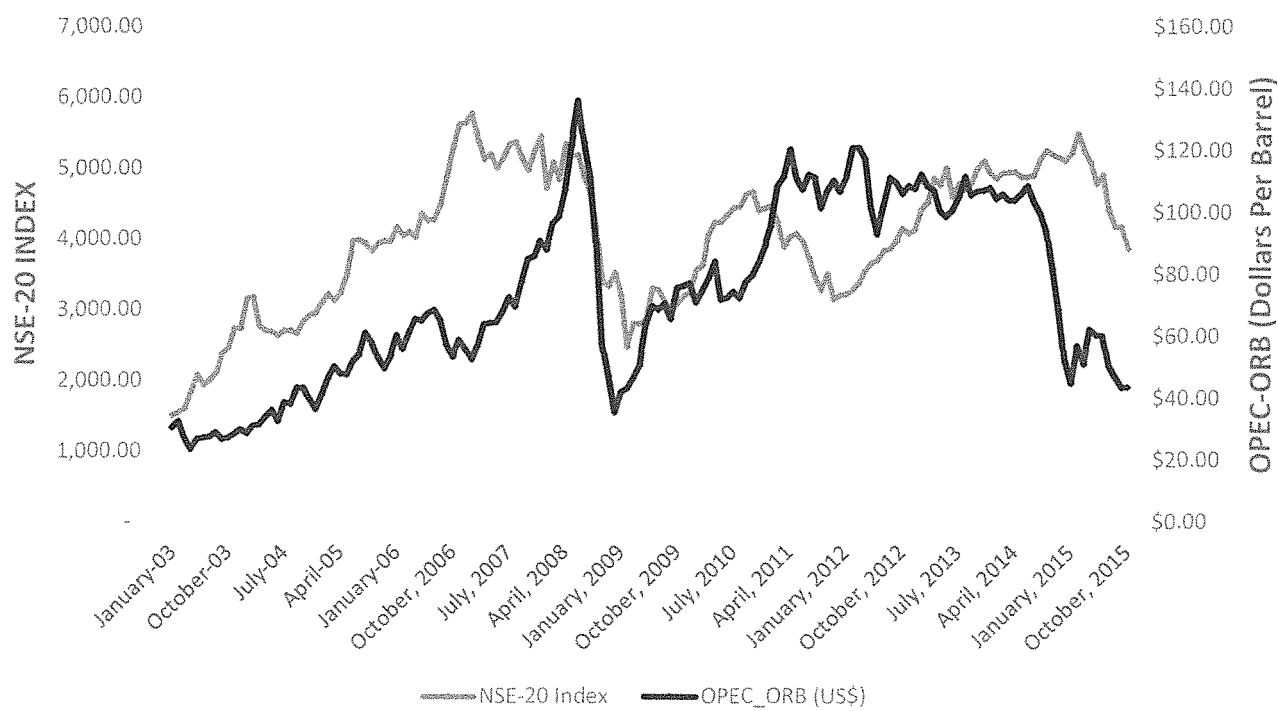
The recent drop in oil prices from USD 108.64 in July 2014 to USD 43.66 in October 2015 has reinvigorated the debate on the relationship between oil prices, financial markets and the economy. In addition, the widespread use of oil has increased dependency on this product within the supply-demand equilibrium and as a result, oil has gained a strategic position in the world (Kapusuzoglu, 2011). Given the importance of oil to the world economy, it has become crucial and to a certain extent pertinent to research on the stock market's ability to evaluate the real effects of events (such as oil shocks) that exogenously affect the economy (Jones & Kaul, 1996).

Oil price changes are assumed to affect stock price through the future cash flows of companies and through the discount rate (Basher, Haug, & Sadorsky, 2012). From a microeconomic standpoint, if oil prices rise and the firms are unable to fully pass this cost increase to their consumers, the firms' profits and dividends which are key drivers of stock prices will decline (Al-Fayoumi, 2009). The effect on stock price depends on the efficiency of the stock market. The overall impact of changes in oil prices on stock prices depend on whether a company is a consumer or producer of oil or oil related products (Basher & Sadorsky, 2006). Since there are more companies in the world that consume oil than produce oil, the overall impact for instance of rising oil prices on stock markets is expected to be negative.

Given that Kenya is a net importer of oil, it implies that changes in the crude oil prices, in which Kenya has no role to play, always interferes with the dynamics of inflation (Misati, 2013). Since a higher expected inflation raises the discount rate, a rise in oil price has a negative impact on stock market returns (Huang, 1996). These statements support that oil price movements are an important and interesting topic to study because increases in oil prices are often indicative of inflationary pressure in the economy which in turn could indicate the future of interest rates and investments of all types (Sadorsky, 1999).

In order to understand and contextualize the oil price-stock price interaction, it is important to determine whether the stock market is a potential channel through which oil shocks are transmitted to the Kenyan economy. Figure 1 below shows the trend of monthly NSE-20 values and ORB prices between the periods of 2003 to 2015. The lowest NSE-20 index value was 1510.63 and the highest was 5774.27. Similarly, the lowest ORB price was 23.72 US dollars and the highest was 136.03 US dollars. An important observation from the two data series is

that both stock prices and oil prices were gradually increasing from 2003. However, there was a sharp decline in stock prices and oil prices in 2008 as a result of the global financial crisis. In addition, from mid-2014, there was a sharp decline in oil prices and from early 2015, stock prices have been gradually declining.



**Figure 1: Monthly NSE-20 Index values and ORB Prices from 2003 to 2015. The graph shows a gradual increase in oil prices and share prices from 2003, then a sharp decline in both prices in mid-2008. In 2015, the graph shows a significant drop in oil prices and stock prices.**

## 1.2 Problem Statement

Different studies have been conducted to empirically examine the effect of oil prices on stock prices in both developed countries and emerging markets, however their results can best be described as inconclusive. Studies by Le & Chang (2011), Narayan & Narayan (2010) and Masih et al. (2011) find a positive relationship between oil price and stock price. On the other hand, studies by Sadorsky (1999), Park & Ratti (2008), Oberndorfer (2009) and Filis (2010) observed a significant negative relationship between oil price and stock returns. Nevertheless, Maghyereh (2004), Huang (1996) and Cong (2008) do not observe any relationship between oil price and stock market return.

There are various studies covering the oil-stock price relationship in Africa (see for instance Effiong, 2014; Hamma, 2014) and studies investigating the effects of oil prices on macroeconomic factors such as inflation particularly in Kenya (see for instance Misati, 2013), however in the Kenyan context there lacks a study that explicitly focuses on the effects of oil

prices on stock prices especially, the long-run effects. Therefore, this study attempts to investigate the nature of the oil-stock price relationship by determining the short-run and long-run effects of oil prices on stock prices in Kenya.

### **1.3 Research Objectives**

The study focuses on the following objectives:

- i. To determine whether there are short-run effects of oil prices on stock prices in Kenya.
- ii. To determine whether there are long-run effects of oil prices on stock prices in Kenya.

### **1.4 Research Questions**

The study's research questions are:

- i. Do oil prices have short-run effects on stock prices in Kenya?
- ii. Do oil prices have long-run effects on stock prices in Kenya?

### **1.5 Significance of the Study**

This study is important as it aids in understanding the relationship between oil price and stock price which would provide relevant information for shareholders, foreign investors, financial analysts and portfolio managers on the ability of fluctuation in oil price in predicting stock returns. Similarly, understanding the relationship between oil price and stock market price is fundamental for an appropriate assessment of the impact of oil shocks on the performance of the stock market.

Furthermore, through comprehending the linkage between oil prices and the stock exchange, the government can be able to take proactive measures against policies that are detrimental to the stock market and overall the real sector. Therefore, the government can determine proper strategies and timings of policy actions to ensure macroeconomic stability.

## Chapter 2 Literature Review

Since the late 1980s, there has been a greater focus and a broader perspective on the impact of oil prices on the financial markets especially on asset prices such as stock prices. Given that oil price changes is crucial for understanding the volatility in stock market prices, the literature suggests that there is no consensus among scholars and economists on its impact. To be precise, the studies have found oil-stock price relationship to be controversial and the evidence is mixed, with the focus mainly on developed and emerging markets economies.

This chapter discusses the theoretical and empirical studies of the oil-stock price nexus that provides guidance to the rest of the study. The chapter is organised as follows. First, the theoretical underpinnings and macroeconomic view of the oil-stock price interaction. Second, a discussion of the empirical literature describing the short-run and long-run effects of oil prices on stock prices. Finally, the chapter concludes highlighting the knowledge gap that the study anticipates to fill.

### 2.1 Theoretical Framework

Theoretically, an asset price in a financial market is determined by its expected discounted cash flows (Huang, 1996). For stock prices, it equals the discounted values of expected future cash flows whose realized stock returns is given as:

$$p_i = \sum_{t=1}^T \frac{E(c_t)}{(1+r)^t} \quad (1)$$

where  $c$  is the cash flow stream;  $r$  is the discount rate;  $E(\cdot)$  is the expectation operator; and  $p$  is the stock market price. From equation 1, stock market prices (or returns) are influenced systematically by two factors, namely, the expected cash flows and discount rates.

According to Huang (1996), expected oil prices affect stock returns via the discount rate, which consists of both the expected inflation rate and the expected real interest rate. Since, both the expected inflation and interest rates are influenced by oil price, for a net importer of oil, an oil price increase will put downward pressure on the foreign exchange rate and upward pressure on the expected domestic inflation rate. A higher expected inflation rate raises the discount rate, which has a negative impact on stock returns. Furthermore, oil price influences the real interest rate as a higher oil price relative to the general price level leads to an increase in the real interest rate (Huang, 1996). This reduces stock prices following increased hurdle rate on

corporate investments (Effiong, 2014). Additionally, oil is considered an input in the production process. A rise in the oil prices raises the cost of production, which depresses aggregate stock price.

Furthermore, as countries urbanize and modernize their demand for oil increases significantly. Future oil demand is difficult to predict but is generally highly correlated with the growth in industrial production. Energy, financial markets and the economy are all explicitly linked together on a country's path of economic growth (Basher & Sadorsky, 2006). Hence, according to Basher & Sadorsky (2006), the net importers of fossil fuels such as crude oil face a high risk from oil price changes and the impact on profits of companies in these countries is likely to play a large role in the development of these economies and their financial markets.

## **2.2 Macroeconomic View**

The macroeconomic view is one of the five schools of thought that have a bearing on the stock price behaviour and focuses on indicators such as Gross Domestic Product (GDP), inflation and interest rates in understanding how the economy functions and also on the use of factor analysis technique to determine the factors affecting asset returns. The arbitrage capital asset pricing model (Ross, 1976) has been a primary motivation for earlier studies (see for instance Hamilton, 1983; Mork, Olsen, & Mysen, 1994). Among macroeconomic factors considered in models is crude oil price (see for instance Narayan & Narayan, 2010; Filis, 2010). This approach is based on the economic logic which suggests that everything does depend on everything else. Other approaches are: the fundamentalist approach, the technical approach, the efficient market approach and the random walk approach.

However, from a macroeconomic view, an oil price hike acts like an inflation tax on consumers and with two consequences (Basher & Sadorsky, 2006). Firstly, consumers have less disposable income to spend on goods and services and have to find alternative energy sources. Secondly, non-oil producing countries have to bear the rising costs and are faced with increasing risk and uncertainty caused by oil price volatility which negatively affects stock prices and reduces wealth and investment. On the contrary, an increase in oil price is expected to have a positive impact on stock markets in oil exporting countries, through income and wealth effects. This is due to a rise in government revenues and public expenditure on infrastructure and other mega projects (Al-Fayoumi, 2009).

Oil price movement is an important barometer for investors to make necessary investment decisions and for policy makers to adopt appropriate policies in managing stock markets

(Adebiyi, 2009) . Stock markets are often seen as leading economic indicators. Stock market are an important means of channelling funds to the real sector , it is therefore pertinent to know the relationship between oil prices and stock markets in order for the government to take proactive measures against policies that are injurious to the stock market in particular and real sector in general (Nwosa, 2014).

## **2.2 Empirical Evidence**

### **2.2.1 Short-run Effects**

The paper by Sadorsky (1999) investigates using an unrestricted VAR with GARCH effects with monthly data from 1947:1 – 1996:4, the relationship between oil changes and real stock returns in the United States. The results confirm that oil prices and oil volatility have a significant impact on aggregate stock returns and through variance decomposition analysis, it is revealed that stock returns fall in the short term in response to a rise in oil prices. In addition, the study also revealed that oil prices have asymmetric effects with positive oil shocks having a greater impact on stock returns and economic activity than negative oil price shocks. Similarly, Papapetrou (2001) using a multivariate VAR approach examines the impact of oil prices on stock returns in Greece for the monthly period 1989:1 – 1996:6. Her variance decomposition analysis reveals that an oil price shock has a negative effect on stock returns especially for the first four months.

In a slightly different study, Basher, Haug, & Sadorsky (2012) assess the importance of the relationship between stock prices and oil prices and the relationship between oil prices and exchange rates together into one empirical structural vector autoregression model with monthly data that covers from 1988:01 – 2008:12. The standard impulse response functions (IRFs) report that in the short-run, stock prices respond negatively to a positive oil price shock. Moreover, the results also indicate that increases in oil prices depress stock prices. Also, oil prices respond negatively to an unexpected increase in oil supply and oil prices respond positively to an unexpected increase in demand.

In an examination on the short-run reaction of stock markets to oil price shocks in the Asia-Pacific region, Nandha & Hammoudeh (2007) observed that stock markets in Phillipines and South Korea were oil sensitive when oil price is expressed in local currency only. In addition, the study observed that none of the countries studied was sensitive to oil prices expressed in US dollars, irrespective of conditions in the oil market.

Recently, Vinh (2014) investigated factors affecting Vietnam's stock prices including US stock price, foreign exchange rates, gold prices and crude oil prices. Using the daily data from 2005 to 2012, the results indicate that Vietnam's stock prices are influenced by crude oil prices. Particularly, the study found that in the short-run, Vietnam's stock prices have a low correlation with crude oil prices however Vietnam's stock prices indicated a high correlation with US dollar-VN Dong exchange rates and gold prices.

In Kenya, Gatuhi & Macharia (2013) examined the relationship between oil prices, exchange rates, interest rates and other macroeconomic variables and the stock market. Using monthly data from January 2009 to December 2012 and applying the Pearson's bivariate correlation coefficient, the findings showed that diesel oil prices positively and significantly influences the performance of the Nairobi Securities Exchanges and similarly indicated that interest rates have a negative and significant influence on the performance of the Nairobi Securities Exchange.

In Nigeria, Adaramola (2012) examined the short-run and long-run dynamic effects of oil price on stock returns spanning over 1985:1 – 2009:4 using the Johansen cointegration tests. A bivariate model was specified and empirical results showed a significant positive stock return to oil price shock in the short-run. Contrastly, in the long-run, results showed a significant negative stock return to oil price shock.

### **2.2.2 Long-run Effects**

In a study using daily data from 1979-1990 on stock prices and futures prices, the contemporaneous and lead-lag correlations between daily returns of oil futures contracts and stock return in the United States, Huang (1996) applied a multivariate vector autoregressive (VAR) approach to investigate possible lead, lag and feedback effects in the oil and stock markets. The results found no evidence of a relationship between oil prices and market indices such as the S&P 500. Based on the results, the study concludes that the much-touted influence of oil price shocks on the aggregate economy is more a myth than reality.

Using quarterly data from 1947-1991 to determine whether the reaction of international stock markets (Canada, Japan, United Kingdom and United States) to oil shocks can be justified by current and future changes in real cash flows and/ or changes in expected returns and using the Producer Price Index for fuels as a measure of oil prices, Jones & Kaul (1996) found that oil prices do have an effect on aggregate stock returns.

In an analysis on the long-run relationship between the world price of crude oil and international stock markets using a cointegrated vector error correction model with additional

regressors and allowing for endogeneously identified breaks in the cointegration and error correction matrices, Miller & Ratti (2009) revealed evidence of breaks after 1980:5, 1988:1 and 1999:1. The study also found a clear long-run relationship for the six Organisation for Economic Cooperation and Development (OECD) countries for the periods 1971:1 – 1980:5 and 1988:2 – 1999:9, suggesting that stock market indices respond negatively to increases in the oil price in the long-run. Nevertheless, the expected negative long-run relationship appeared to have disintegrated after 1999:9.

By employing an international multi-factor model that allows for unconditional and conditional risk factors to investigate the relationship between oil price risk and 21 emerging economies covering the period 1992:12 – 2005:10, Basher & Sadorsky (2006) found that for daily and monthly data, oil price increases have a positive impact on excess stock market returns in emerging markets. However, for weekly and monthly data, oil price decreases have a positive and significant impact on stock market returns.

Using a multivariate VAR analysis with linear and non-linear specifications of oil price shocks over the period 1986:1 – 2005:12, Park & Ratti (2008) observed a negative relationship between oil prices and stock returns in the United States and 12 European countries while for Norway, an oil exporting country, the study observed that the stock market responded positively to oil price rise.

In relation to non-linear specifications of oil price, Ciner (2001) examines the causality between oil prices and stock return in the United States using daily data from 1979-1990 on stock prices and futures prices, and relying on nonlinear causality tests, he finds that oil shocks affect stock index returns and also proves that a significant nonlinear correlation exists between oil prices and stock returns.

By applying a multivariate VAR model to examine the the impact of oil prices on real stock returns for Brazil, China, India and Russia from 1999:1 – 2009:9, Ono (2011) found that real stock returns respond positively to some of the oil price indicators (US Produce Price Index and net oil price increase) with statistical significance for China, India and Russia however Brazil does not show any significance responses. Also, analysis of variance decomposition showed that the contribution of oil price shocks to volatility in real stock returns was relatively large and statistically significant for China and Russia.

Using a bivariate GARCH model, Hamma (2014) investigated the transmission of volatility and shocks between oil prices and seven sector Tunisian stock indices spanning 2 April 2006

to 12 July 2012. Empirical results indicated the existence of significant shock and volatility spillovers across oil and Tunisian sector stock markets, but the intensity of volatility interactions varied from sector to sector. In addition, the results showed that the spillover is unidirectional from oil markets to stock markets. Correspondingly, oil price shocks whether temporary or permanent can be difficult to distinguish and uncertainties related to large changes in oil prices can have significant effects on consumer confidence and therefore on growth (Masih, 2011). The impact of these oil price shocks is likely to be significantly greater in oil-importing countries, especially where policy frameworks are weak, foreign exchange reserves are low and access to international capital markets is limited (Masih, 2011). Thus, a deeper re-examination of the standard view concerning 'transient shocks', particularly for net importing countries is pertinent (Misati, 2013).

In their investigation on the interactive relationships between oil price shocks and the Chinese stock market indices spanning from 1996-2007, Cong (2008) using multivariate VAR observed that oil price shocks have no statistically significant impact on stock returns on Chinese stock market indices. Also in another study, Maghyreh (2004) examined the relationships between oil price and stock market returns in 22 emerging economies for the period covering January 1, 1998 to April 31, 2004. The study utilizing VAR analysis and found that oil price did not impact stock returns in those emerging economies.

In his study, Nwosa (2014) examined the relationship between oil prices and stock market price in Nigeria for the period spanning 1985:1 to 2010:4. The study utilized the Johansen's multivariate cointegration test and the vector error correction model (VECM). The Johansen's test showed that the variables are cointegrated and the cointegration equation revealed that oil prices have a significant relationship with stock market price in the long run.

Correspondingly, Kapusuzoglu (2011) investigated the long term relationships between National 100, National 50 and National 30 Index of Istanbul Stock Exchange and international Brent oil price by applying the Johansen Cointegration test. The study determined that there was a long term relationship (cointegration) between each index and oil prices. Similarly, Narayan & Narayan (2010) using the Johansen Cointegration test and evidence on oil prices, stock prices and exchange rates assessed the relationship between oil prices and Vietnam's stock prices with daily series from 2000 to 2008. The study found both oil prices and exchange rates, have a positive and statistically significant impact on Vietnam's stock prices in the long run and not in the short run.

In investigating the time-varying correlation between stock market prices and oil prices for oil-importing and oil-exporting countries, Filis (2011) employed a DCC-GARCH-GJR approach with a monthly stock and oil prices from 1987-2009. Empirical findings showed that oil prices had a negative effect on all stock markets with an exception during the global financial crisis of 2008. An earlier study by Filis (2010) examined the relationship among macroeconomic factors (consumer price index and industrial production), stock exchange and oil prices in Greece spanning from 1996:1 – 2008:6. He employed a multivariate VAR model and found that in the long-run, oil prices and the stock market exercised a positive effect on the Greek consumer price index. Additionally, oil prices were found to have a significant effect on the stock market and oil prices did not have any effects on industrial production.

A different study was performed by Le & Chang (2011) who examined the response of stock markets to oil price volatility in Japan, Singapore, South Korea and Malaysia by applying the generalized impulse response and variance decomposition analysis to monthly data spanning 1986:01 – 2011:02. The results indicated that oil price shocks have non-linear impacts on stock market returns. Furthermore, the results suggested that the reaction of stock markets to oil price shocks varies across markets. Specifically, the stock market responded positively in Japan while negatively in Malaysia; the response in Singapore and South Korea was unclear.

### **2.3 Knowledge Gap**

There is extensive literature that has investigated the impact of oil prices on stock prices (returns) albeit with mixed results. Conventional wisdom in literature is that oil price shocks lead to stock market decline. However, such impact may differ between oil-importing countries and oil-exporting countries depending on the relative importance of oil to their macro economy (Park & Ratti, 2008). Empirical studies have found different results regarding the oil-stock price relationship including, a lack of statistical significance in the positive relationship (see for instance Sadorsky, 1999; Filis, 2010) or no relationship (see for instance Huang, 1996; Maghyereh, 2004).

This oil-stock price relationship has been explored in stock markets of developed countries (see for instance Anoruo & Mustafa, 2007; Ciner, 2001). Emerging markets in Latin America and Asia have been covered (see for instance Ono, 2011; Basher & Sadorsky, 2006). Furthermore, various African states have also been covered (see for instance Adaramola, 2012; Hamma, 2014). In the Kenyan context, the impact of oil price on various macroeconomic variables especially on inflation was covered by Misati (2013) within the periods 2008-2009 and 2011

and the study found that oil prices have a significant role on the overall inflation. However, there lacks a study that focuses on determining the long-run effect of oil prices on stock prices in Kenya.

Taking an overview of these studies, it is obvious that the literature is inconclusive regarding the relationship between oil prices and stock prices, although the studies reviewed have tried to generate a clearer understanding of the oil-stock price relationship. There is therefore hardly any doubt that a possible relationship between oil price movement and stock prices could exist. A fundamental reason why it is difficult to reach a definitive conclusion regarding the link could be the interrelationships involved in establishing the relationship between oil prices and stock prices. Oil price movement can have a significant impact on the stock prices, but so can other factors such as economic growth and interest rates, that are related to the stock market which the study addresses by including those factors in the study's model and hence highlighting the knowledge gap. Thus, whether these relationships exist in Kenya is the focus of this study.

## **Chapter 3 Research Methodology**

### **3.1 Research Design**

According to Parahoo (2006), the design selected should be the one most suited to achieve a solution to the proposed research questions. Following this study's research questions, the researcher employs an explanatory research design in applying standard methods discussed in the literature review.

This study utilizes quantitative methods. The data analyzed is monthly from January 2003 to October 2015. That time period was chosen for the study since it covers the scope which exhibited strong volatility in international oil prices especially during the global financial crisis in 2008-2009 and the recent sharp decline in the world oil prices in the mid-2014, early 2015. The study employs the Johansen's multivariate cointegration test and the vector error correction model (VECM) in its analysis.

### **3.2 Population and Sampling**

The population of interest in this study is from the Nairobi Securities Exchange (NSE) particularly, the daily values of the NSE 20 Share Index (NSE-20) and the OPEC Reference Basket (ORB) monthly spot oil prices from January 2003 to October 2015. Given that the study uses monthly prices, the sample that represents these daily values in the analysis is calculated for every last trading day in each month for the NSE- 20. Based on Fama's (1981) hypothesis that measures of economic activity have played a role in the analysis of stock market activity, the study also considers short term interest rate measured by the deposit interest rate and economic growth measured by the gross domestic product deflated by the GDP deflator, which may influence the relationships between oil prices and stock prices.

The study analyzes monthly data since this was the most popular frequency in the literature (Sadorsky, 1999; Papapetrou, 2001; Park & Ratti, 2008; Le & Chang, 2011; Ono, 2014). Using data of a lower frequency such as quarterly is likely to introduce smoothing effects, thus, wiping out out any meaningful results (French, 1987). Daily data would pose problems especially because of the complexities of dealing with weekends and public holidays.

The NSE-20 is selected since it is a good proxy for the whole stock market given that those 20 proxy companies represent the largest market capitalization with a 75% market capitalization of the entire market. On the other hand, other indices such as the NASI that includes stocks which are not actively traded especially due to lack of liquidity and given that it was only

introduced in 2008 would therefore be inappropriate as the proxy. Moreover, using FTSE indices would be problematic given that the data concerning the index components are kept confidential for commercial purposes.

ORB is chosen as a representative of the world oil prices since it is a weighted average of prices for petroleum blends produced by OPEC countries and ORB particularly incorporates Murban which is the crude oil imported by Kenya from United Arab Emirates. Nevertheless, there are prices of other types of oil, namely, West Texas Intermediate, Brent and Dubai that can serve as a benchmark for other types of crude oil, however the choice of crude oil prices would not significantly affect the study since crude oil prices have been observed to fluctuate in the same direction empirically (Chang & Wong, 2003). Furthermore, the study does not use domestic oil prices since they are influenced by several factors such as price controls, high and varying taxes on petroleum products, exchange rate fluctuation and domestic price index variations. Taking into account such considerations, the use of world oil price in US dollars and converting into domestic currency through the market exchange rate is justified (Le & Chang, 2011).

### **3.3 Data Collection**

All data used in this study is from secondary sources. The data series comprises of oil prices, stock prices, short term interest rates and economic growth. Oil prices are acquired from the OPEC database. Stock prices are obtained from the NSE database. Short term interest rates and economic growth indicators are sourced from the International Financial Statistics of the World Bank.

Considering the inflation factor, oil price and stock price are transformed into real terms. Oil prices are converted from US dollars into the domestic currency and then deflated by the domestic price index for inflation-adjusted real values. Stock prices are deflated for real values by the domestic Consumer Price Index (CPI).

For modeling purposes, all the data series are transformed to logarithmic form to stabilize the variability in the data (Narayan & Narayan, 2010; Kapusuzoglu, 2011; Le & Chang, 2011; Nwosa, 2014) with exception to interest rate (Nwosa, 2014).

### **3.4 Data Analysis**

#### **3.4.1 Model Specification**

The model is summarized as follows:

$$SP = f(OILP_t, itr_t, RGDP_t) \quad (2)$$

where SP is stock price, OILP is oil price, itr is short term interest rate and RGDP is economic growth.

Equation 2 can be written in the form of a multivariate VAR model as:

$$X_t = \alpha_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \dots + \beta_q X_{t-k} + \mu_t \quad (3)$$

Equation 3 can be written more compactly as:

$$X_t = \alpha_0 + \beta_1 \sum_{j=1}^k X_{t=j} + \varepsilon_t \quad (4)$$

where  $X_t$  is a 4x1-dimensional vector of endogenous variables of the model,  $\alpha_0$  is a 4x1-dimensional vector of constant and  $\beta_1$  is a 4x4 dimensional autoregressive coefficient matrices of established parameter and  $\varepsilon_t$  is k-dimensional vector of the stochastic error term normally distributed with white noise properties  $N(0, \sigma^2)$ .

### 3.4.2 Unit root tests and Lag Length Criteria

Various parametric and non-parametric tests have been developed for finding whether a series is stationary or non-stationary (i.e., includes a unit root). To ascertain the order of integration of the variables, the researcher is testing for unit root using, namely, Augmented Dickey-Fuller (ADF) and Phillips & Perron (PP) (1988).

Null hypothesis for both tests shows that a unit root exists in the autoregressive representation of the time series while alternative hypothesis shows that the series is stationary, If the calculated value is greater than the absolute critical value, then null hypothesis is rejected and series is said to be stationary.

Optimal lag lengths are selected by using the Schwarz's Bayesian information criterion (SBIC) rather than using the Akaike information criterion (AIC) since SBIC embodies a much stiffer penalty than AIC. However, the excess sensitivity of the results obtained from ADF and PP tests to the lag length determined has been criticized time to time. Therefore, Kwiatkowski (1992) developed KPSS test, which is not sensitive to lag length. Null hypothesis of KPSS stationary test is the reverse of the null hypothesis of ADF and PP unit root tests. This means that for the KPSS test, the null hypothesis is that the unit root does not exist (stationary) and alternative hypothesis signifies that time series is non-stationary (unit root exists).

### 3.4.3 Johansen Cointegration Technique

Cointegration is an important technique to examine whether the economic and financial time series are cointegrated (Vinh, 2014). According to Granger & Weiss (1983), cointegration is the statistical equivalence of the economic theoretical notion of stable long-run relationship. It is based on the properties of the residuals from the regression analysis when the individual analysis are non-stationary.

To test for a long-run relationship among the variables, they must have the same order of integration (Engle & Granger, 1987). The multivariate cointegration technique of Johansen & Juselius (1990) is employed to test the relationship. The Johansen approach to cointegration is based on a VAR model. Johansen (1988) suggests two tests, namely the trace and maximum eigenvalue test statistic.

The cointegration tests are based on the following equation:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \dots + \Gamma_{k-1} \Delta X_{t-k+1} + \pi X_{t-1} + \mu + \varepsilon_t \quad (5)$$

where  $\Delta$  is the first-difference operator,  $k$  denotes lag length,  $X_t$  is a vector of  $m$  non-stationary endogenous (stock price) variables,  $\Gamma_t$  and  $\Pi$  are a matrix of coefficients,  $\mu$  is a vector of constants, and  $\varepsilon_t$  is a vector for errors. The lag length,  $k$ , is chosen to ensure that the errors are independent and identically distributed.

The trace test examines the null hypothesis that the number of cointegrating vectors in the system,  $r$ , is less than or equal to  $r_0$  where  $r_0 < p$  and  $p$  is the number of variables in the system, whereas the alternative hypothesis is that the impact matrix is of full rank.

The maximum eigenvalue test examines the null hypothesis that there are  $r_0$  cointegrating vectors versus the alternative of  $r_0 + 1$  cointegrating vectors. The results imply the existence of a cointegrating relationship between oil prices and stock prices.

### 3.4.4 Vector Error Correction Model (VECM)

If the variables are integrated of the same order and are cointegrated, then the VAR model must include an error correction term (ECT) (Engle & Granger, 1987). Hence the VAR model incorporating the error correction model (ECM) is specified in a VECM as:

$$\Delta X_{t-1} = \alpha_0 + \pi X_{t-1} + \sum_{j=1}^k \Gamma_j \Delta X_{t-j} + \varepsilon_j \quad (6)$$

where  $\Delta$  is the difference operator,  $X_{t-1}$  is a 4x1-dimensional vector of non-stationary I(1) endogenous variables of the model,  $\alpha_0$  is a 4x1-dimensional vector of constant and  $\varepsilon_t$  is k-dimensional vector of the stochastic error term normally distributed with white noise properties  $N(0, \sigma^2)$ .  $\pi$  is the long-run matrix that determines the number of cointegrating vectors that consist of  $\alpha$  and  $\beta$  representing speed of adjustment towards long-run equilibrium and long-run parameter.  $\Gamma$  is the vector of parameters that represents the short-term relationship. VECM model of equation 6 enables the determination of the direction of causation between observed variables while providing estimate on both the long-run and short-run (Nwosa, 2014).

The VECM model differentiates between the short and long-run dynamic relationships and tests for the hypothesis that the coefficients of lagged variables and the error correction terms calculated from the cointegrating regression are zero. If the coefficients in the system are jointly significant, then the lagged variables in the system are important in predicting current movements of the dependent variables (i.e., the short run dynamics) and the dependent variables in equation 6 adjust to the previous period's equilibrium error (Anoruo & Mustafa, 2007). Because the cointegrating vectors bind the long-run behaviour of the variables, the VECM is expected to produce results in the impulse response analysis and variance decomposition that accurately reflects the relationship among the variables.

### **3.4.5 Impulse Response Functions**

The direction, timing and duration of stock market prices response to each oil price shocks is analysed using impulse response functions (IRFs). IRFs are often used to explain the dynamic effects of the shocks on the endogenous variables. An IRF traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables and analyses the interactive responses between oil price and stock price and obtains the contribution of oil price shocks to the variability in stock returns.

### **3.4.6 Variance Decomposition**

Since estimated coefficients from VAR models often appear to be lacking in statistical significance due to the inaccuracy of the technique in estimating standard errors, IRFs and forecasting variance decomposition are often used to explain the dynamic effects of the shocks on the endogenous variables.

While IRFs trace the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR. Pesaran & Shin (1998) propose a more general alternative to the Choleski decomposition which is unaffected by the ordering of the variables and which does not require the orthogonalisation of the reduced form innovations. The resulting responses are unique and fully take account of the historical patterns of correlations observed amongst the different shocks.

### **3.5 Limitations of the Study**

This study makes assumptions especially regarding the NSE-20 index. The NSE-20 index's constituents have been regularly revised within the scope of the study. For example, Uchumi Supermarket Limited and Mumias Sugar Limited were replaced by Centum Investments Limited and CFC Stanbic Holdings Limited in 2014 while CMC Holdings Limited was suspended from trading in 2011. This poses a problem since the data is not as consistent as the study might have required. However, the study assumes away such change as insignificant to the findings.

In addition, the study does not capture the historical dynamics of regime changes and also does not take into consideration structural breaks occurring within the scope of the study given the volatility of the stock market and oil prices. Rather the study relies on Johansen cointegration test whose findings have been found under some circumstances to be consistent with structural break cointegration tests.

Furthermore, the study examines a bivariate model involving oil prices and stock prices as the main variables rather than augmenting the bivariate model to a multivariate model by including other main variables such as exchange rate. This can limit the study since it is argued in economics literature, that bivariate models give rise to omitted variable bias (Narayan & Narayan, 2010).

## Chapter 4 Findings

This study examines the short-run and long-run effects of oil prices on stock prices in Kenya. The study adopts the VECM model to differentiate between the short and long-run dynamic oil-stock price relationship. Similarly, the study adopts to use the impulse response function and variance decomposition to explain the effects of oil shocks on stock prices.

### 4.1 Descriptive Statistics

**Table 1: Summary statistics: January 2003 to October 2015**

	LSP	LOILP
Mean	8.2722	8.8403
Median	8.1773	8.9030
Maximum	8.8875	9.6096
Minimum	7.7775	7.9162
Standard Deviation	0.2910	0.3229
Skewness	0.4107	-0.6894
Kurtosis	2.1201	3.5102
Jarque-Bera Probability	9.2957 0.0096	13.8681 0.0010
Observations	154	154

Note: LSP (logarithm of NSE-20 index); and LOILP (logarithm of oil prices).

Table 1 displays the results of the preliminary data analysis for the model's variables: monthly oil prices and NSE-20 index considered in the scope of the study. The mean return for both variables are positive, with maximum and minimum returns almost equal in magnitude. Regarding whether the series are distributed normally or not; skewness, kurtosis and Jarque-Bera statistics were considered. Both variables are not normally distributed; rather the oil price variable is negatively skewed and has a kurtosis in excess of 3 indicating it has a leptokurtic distribution while NSE-20 index is positively skewed and has a kurtosis of less than 3. The Jarque-Bera statistic and corresponding p-value confirm the rejection of the null hypothesis of normality at the 1% significance level.

## 4.2 Unit Root Test

**Table 2: Unit root test results of the model variables. The variables are shown to be stationary at the first difference by the ADF test.**

Augmented Dickey-Fuller test				Phillip-Perron test			KPSS test		
Variables	Level	1st Diff	Status	Level	1st Diff	Status	Level	1st Diff	Status
loilp	-1.5967	-9.6415	I(1)	-1.3873	-9.7212	I(1)	0.2332	0.0527	I(1)
lsp	-2.7360	-11.1555	I(1)	-2.8703	-11.3693	I(1)	0.1612	0.0980	I(1)
lrgdp	-1.0031	-5.7015	I(1)	-1.4923	-2.6543	I(1)	4.1002	0.0907	I(1)
itr	-3.5328	-4.3548	I(1)	-3.2293	-13.0793	I(1)	0.0661	0.0450	I(1)
<i>Asymptotic critical values</i>									
1%	-4.0192	-4.0469		-4.0192	-4.0196		0.2160	0.2160	
5%	-3.4395	-3.4528		-3.4395	-3.4397		0.1460	0.1460	

Note: loilp (log of oil prices); lsp (log of stock prices); lrgdp (log of real gross domestic product) and itr (short-term interest rate). The optimal lag length was determined through SBIC.

Table 2 shows that all variables are non-stationary according to ADF and PP tests at the 1% and 5% level of significance in their level form except for short-term interest rate which is stationary at level according to the KPSS test. All variables are stationary at the first difference, that is, integrated of order one I(1) by the ADF unit root test. Findings obtained from PP test are consistent with results of ADF test except for the conflicting evidence by the logarithm of real GDP which is not integrated from the first degree I(1) using the PP test. From these results, it will be possible to look into the matter to whether there is a long-term relationship (cointegration) between oil prices and stock prices.

## 4.3 Johansen Cointegration Test

Having confirmed the stationary status of the variables, the study proceeded to examine the long-run relationship (cointegration) among the model variables. The results are presented in Table 3.

**Table 3: Summary of Johansen Cointegration for the model variables. The table shows the existence of at most one cointegrating vector for the model variables.**

H <sub>0</sub>	H <sub>A</sub>	Eigenvalue	$\lambda_{Trace}$	95%	$\lambda_{max}$	95%
r=0	r=1	0.2066	54.9848*	47.8561	32.4127*	27.5843
r≤1	r=2	0.0827	22.5720	29.7970	12.0865	21.1316
r≤2	r=3	0.0439	10.4855	15.4947	6.2942	14.2646
r≤3	r=4	0.0294	4.1913	3.8414	4.1913	3.8414

Note: r indicates the number of cointegrating vector. Critical values are from MacKinnon (1999) P-values. \* indicates significance of the test statistic at 5% level.

The trace statistics and the maximum eigenvalue statistics reveal that the null hypothesis of no cointegration, for r=0 was rejected. The stated values of these tests were greater than their critical values. On the other hand, the null hypothesis of no cointegration, for r≤1 could not be rejected by both the trace and maximum eigenvalue statistics. The statistical values of these tests at r≤1 were less than their critical values which show evidence of a long-run relationship with at most one cointegrating vector that suggest that the variables are jointly determined.

#### 4.4 Effect of Oil Price on Stock Price

The resulting long-run relationship between the measures of oil prices and stock prices are estimated using VECM model of equation (6), presented in a long-run cointegration in table 4 below:

**Table 4: Long-run cointegration results among model variables. Table shows a negative change in stock prices due to change in oil prices and real gross domestic product.**

	Cointegrating Coefficient	LOILP	ITR	LRGDP
LSP	18.2263	-0.8967	0.0679	-0.2944
Standard Error	-	0.3027	0.0457	0.1445
t-statistic	-	-2.9628	1.4877	-2.0367

Note: LOILP (Log of oil prices); LSP (Log of stock prices); ITR (Short-term interest rate) and LRGDP (log of real gross domestic product).

Table 4 reveals that oil prices (loilp), real gross domestic product (lrgdp) and short term interest rates (itr) are significant determinants of stock prices in Kenya. In the long run, the result implies that there is 0.897 percent and 0.294 percent negative change in stock market price due to a 1 percent change in oil price and real gross domestic product, respectively. However, if there is a 1% increase in the short-term interest rate, it would increase the stock market price by 0.068 percent in the long run. Based on the Johansen cointegration test and result of the

cointegrating equation, the study surmises that the long-run effect between oil prices and stock prices is negative. This result is similar to that observed by Miller & Ratti (2009) on the negative long-run effect of oil prices on stock prices.

#### 4.5 Vector Error Correction Model

Based on the cointegration test, VECM captures the short-run and long-run interaction between oil prices and stock prices, presented in Table 5 below.

**Table 5: VECM Estimate. From the table the error correction term (ECT) for cointegration with stock price is statistically significant at 5%.**

	$\Delta LSP$	$\Delta LOILP$	$\Delta ITR$	$\Delta LR GDP$
$\Delta LSP$	-	0.1486 [1.0910]	-0.2197 [-0.3848]	0.0003 [-0.8062]
$\Delta LOILP$	-0.0197 [-0.3195]	-	-0.0269 [-0.0680]	0.0003 [-1.0863]
$\Delta ITR$	-0.0121 [-0.8724]	-0.0078 [-0.3680]	-	-2.99E-05 [-0.5466]
$\Delta LR GDP$	30.0907 [1.3721]	4.3302 [0.1296]	32.8301 [0.2342]	-
ECT	-0.0821 [-3.6577]*	-0.0663 [-1.9390]*	0.0659 [0.45992]	0.0002 [2.5847]

Note: Number above the parentheses are coefficient values while numbers in the parentheses are t-statistic values. \* indicates significance at 5%.

The table shows that the error correction term (ECT) for cointegration equation with stock price as dependent variable is statistically significant at 5%, meaning that oil prices have a long-run influence on stock prices. The ECT has a negative sign indicating a move back towards equilibrium and the coefficient estimate of the ECT of -0.082 shows that the relationship between stock prices and oil prices converges towards its long-run equilibrium at a slow speed. However, the short-run effect in the error correction model is tested using the Wald's test. The test works by testing the null hypothesis that a set of parameters is equal to the same value. In this model, the null hypothesis is that the short-run coefficients of oil price are simultaneously equal to zero.

**Table 6: Wald Test result on short-run effects of oil prices on stock prices. From the table, the null hypothesis is rejected illustrating that oil prices have a significant impact on stock prices.**

Test Statistic	Value	Df	Probability
F-statistic	3.2425	(4, 122)	0.0145
Chi-square	12.9699	4	0.0114

Null Hypothesis:  $C(6)=C(7)=C(8)=C(9)=0$

Note: C (6), C (7), C (8) and C (9) are the short-run coefficients of oil prices.

It was observed that the p-value was less than the general criterion of 0.05, so the null hypothesis is rejected indicating that in the short-run, oil prices have a significant influence on stock prices and this implies that there is a short-run causality running from oil prices to stock prices.

#### **4.6 Impulse Response of Stock Prices due to Oil Price Shocks**

This section assesses the effects of oil price shocks on stock prices in terms of impulse response functions. IRFs illustrate the impact of a unit shock to the error of each equation of the VAR (Le & Chang, 2011), which is essentially mapping out the dynamic response path of a variable due to a one-period standard deviation to another variable. Information from application of IRFs should provide some further evidence on the patterns of linkages amongst stock prices and oil price shocks as well as contribute to enhancing our insights upon how other macroeconomic variables react to system wide shocks and how these responses propagate over time (Masih, 2011). Impulse response of stock prices is demonstrated by Table 7 while IRFs of the other variables in VAR system are provided for in Figure 2.

**Table 7: Impulse Response of Stock Prices in Kenya due to oil price shocks over twelve month horizon. Table shows that stock prices are unresponsive to oil price shocks in the first month and begin responding from the second month and the response to oil price shocks gradually increases from the fourth month.**

Period	LSP	LOILP	ITR	LRGDP
1	0.0577	0.0000	0.0000	0.0000
2	0.0557	-0.0088	-0.0023	0.0065
3	0.0514	-0.0021	0.0006	0.0124
4	0.0554	-0.0012	0.0006	0.01566
5	0.0600	-0.0016	0.0065	0.0176
6	0.0565	-0.0041	0.0056	0.0193
7	0.0506	-0.0087	0.0080	0.0201
8	0.0465	-0.0142	0.0092	0.0200
9	0.0423	-0.0189	0.0124	0.0194
10	0.0390	-0.0245	0.0130	0.0186
11	0.0358	-0.0295	0.0144	0.0178
12	0.0333	-0.0335	0.0154	0.0171

Note: LSP (Log of stock prices); LOILP (log of oil prices); ITR (short-term interest rate); and LRGDP (log of Real GDP).

The results suggest that stock prices are not immediately responsive to innovations in oil prices in Kenya. The responses of stock prices to one standard deviation of oil price shock after one month is 0.0%. Six months after the oil price shocks, the responses of stock prices is -0.41% and after 12 months, the response of stock prices to oil price shocks is -3.35%.

The impact of oil price shocks on stock prices increases over time and indicates a negative short-run effect of oil prices on stock prices. Additionally, the study shows that in the first month, short-term interest rates and real GDP do not affect stock prices. However after the second month, it can be seen that short-term interest rates and real GDP affect stock prices. The impact of real GDP on stock prices is continually positive in the first 12 months while the influence of short-term interest rates is sometimes negative and sometimes positive.

#### **4.7 Variance Decomposition of Stock Prices**

Due to its dynamic nature, variance decomposition accounts for the share of variations in the endogenous variables resulting from the endogenous variables and the transmission to all other variables in the system (Brooks, 2014). In this study, the variance decomposition analysis specifically provides a tool for determining the relative importance of changes in oil prices, short-term interest rates and real GDP in explaining the volatility in stock prices.

**Table 8: Variance decomposition of stock prices in Kenya over twelve month horizon. From the table it is seen that most of the variation in stock prices is due to its own shocks.**

Period	LSP	LOILP	ITR	LRGDP
1	100.0000	0.0000	0.0000	0.0000
2	98.0768	1.1922	0.0831	0.6479
3	96.9652	0.8817	0.0627	2.0905
4	95.8091	0.6631	0.0494	3.4784
5	94.6588	0.5213	0.2956	4.5242
6	93.5186	0.5114	0.3982	5.5718
7	92.0445	0.7699	0.6195	6.5660
8	90.2933	1.4544	0.8775	7.3749
9	88.1322	2.5537	1.3252	7.9889
10	85.5854	4.2461	1.7506	8.4184
11	82.6320	6.4568	2.2224	8.6888
12	79.4565	9.0193	2.6961	8.8282

Note: LSP (Log of stock prices); LOILP (log of oil prices); ITR (short-term interest rate); and LRGDP (log of Real GDP).

Table 8 reveals that most of the variations in stock prices is due to the contribution of its own shocks. Immediately after the shock, oil prices contribute 1.19% to the variation in stock prices in Kenya. However, the effect decreases until the sixth month from where it begins to increase. After 12 months, the contribution of oil price shocks to the variation in stock prices is 9.02%. Moreover, the results show that real GDP explains stock price variation better than oil prices in the first 11 months while short-term interest rates have the least effect on stock price variation. After 6 months, real GDP and short-term interest rates contribute 5.57% and 0.39% of the variation in the stock prices, respectively.

## **Chapter 5 Discussion**

### **5.1 Short-Run Effects of Oil Prices on Stock Prices**

The investigation on the short-run effects of oil prices on stock prices is led by the estimation of a VECM which captures the short-run and long-run dynamic relationships of the variables. The study finds that in the short-run, oil prices have a significant influence on stock prices. Similarly, there is a short-run causality running from oil prices to stock prices. The result from IRF analysis indicates that oil price shocks causes an immediate decline in stock prices consistent with the finding of Papapetrou (2001) whose analysis revealed that an oil price shock has a negative effect on stock returns especially for the first four months. In addition, the variance decomposition of stock prices reveals that oil price shocks contribute 1.19% to the variation in stock prices in the short-run. On the other hand, in the short-run, the study finds that real GDP contributes 64.78% to the variation in stock prices, which is higher than the contribution by oil price shocks to the variation in stock prices.

Similarly, Basher, Haug, & Sadorsky (2012) found that in the short-run, stock prices respond negatively to a positive oil price shock. This implies that in the short-run, oil price increases depresses stock prices, as was also observed by Filis, (2010).

### **5.2 Long-Run Effects of Oil Prices on Stock Prices**

The study seeks to find out the long-run effects of oil prices on stock prices in Kenya. Given the result of the unit root tests, the Johansen's cointegration test then reveals that the variables are cointegrated. The cointegration estimate shows that oil prices are a significant determinant of stock prices in the long-run, as was also observed by Miller & Ratti (2009); Narayan & Narayan (2010); Kapusuzoglu (2011); and Nwosa (2014). The VECM model reveals the existence of negative long-run effects of oil prices on stock prices in Kenya. From the variance decomposition analysis, the cumulative effects of the oil price shocks account for 9.02% of the variation in stock prices in the long-run. Similarly, Adaramola (2012) observed a negative long-run relationship between oil prices and stock prices in Nigeria under his study. These results are consistent to theoretical expectations given the nature of Kenya as a net importer of oil.

### **5.3 Conclusion and Recommendations**

The study examines the short-run and long-run effects of oil prices on stock prices in Kenya for the period spanning January 2003 to October 2015. Empirical evidence reveals that the short-run and long-run effects of oil prices on stock prices are statistically significant. Oil prices

have a negative influence on stock prices in Kenya in the short-run as indicated by the impulse response functions of stock prices. In addition, the reaction of stock prices to oil price shocks takes effect almost immediately. On the other hand, the results from the VECM show that there is a significant negative long-run relationship between oil prices and stock prices in Kenya.

Given that the study finds the impact of oil price on stock prices to be significant, and Kenya being a net importer of oil, the results of the paper are important in assessing the risk from oil price changes and the impact oil price changes have on profits of firms in Kenya, which is therefore likely to play a significant role in the development of the country and its financial market.

By the same token, the results in this paper are useful for individual and institutional investors, financial analysts, managers and policy makers who are concerned with oil price shocks in Kenya and thus should take into consideration changes in oil prices in their financial decisions since oil prices have significant effects on stock prices in Kenya. Furthermore, there is need for firms to adopt policies that utilize alternative sources of energy such as solar, wind and geothermal energy in order to reduce their dependency on oil for productive activities and limit the adverse effect of future oil price shocks.

Further research efforts could be channeled towards investigating on a sectoral perspective, the long-term effects of oil prices on stock prices from one industry to another and also provide opportunities for future research on the impact of oil price shocks and oil price risks on stock returns across various industries and in different countries especially Sub-Saharan Africa. Additionally, since oil prices have been found to have a significant impact on stock prices, it would be interesting from a practical perspective to consider the ability of oil price changes to forecast or predict stock price movements. Given that this study assumes linear linkages between the main variables, non-linear linkages should also be considered whose results may provide additional insight on the influence of oil prices on stock index returns.

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# Appendices

Figure 2: Impulse Response Functions over twelve month horizon

