Effect of oil price volatility on the Kenyan stock Market

Leiyagu Naishorwa Donna

083629

Submitted in partial fulfillment of the requirements for the Degree of
Bachelor of Business Science in Financial Economics
at Strathmore University

Strathmore Institute of Mathematical Sciences
Strathmore University
Nairobi, Kenya

[July 2017]

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.

LEIYAGU NAISHORWA DONNA ..... [*Name of Candidate*]

..... [*Signature*]

17/11/2017 ..... [*Date*]

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

MELEAH OLEDE ..... [*Name of Supervisor*]

..... [*Signature*]

17/11/2017 ..... [*Date*]

Strathmore Institute of Mathematical Sciences

Strathmore University

Abstract

This study seeks to examine the relationship between the international oil market performance and the performance of stocks in the Kenyan stock market. The study, therefore, employs a bivariate GARCH-BEKK(1,1) model to study this relationship and the choice of this model is driven by the fact that the model ensures positive definiteness, which makes it more effective in analysis of volatility and shock spillover. The findings of this study indicate that there exists unidirectional volatility spillover from the international oil market to the Kenyan stock market returns. The conditional variance of the Kenyan stock market returns is also seen to be affected by past volatility in the stock market.

Table of Contents

Chapter One **4**
Introduction 4
Background 4
Problem Statement 9
Research Objective 10
Research Question 10
Significance of the Research 10
Chapter Two **11**
Literature Review 11
Theoretical Literature Review 11
Empirical Literature Review 16
The case of Kenya 17
Chapter Three **18**
Methodology 18
Research design 18
Data collection 18
Population and sample 18
Data analysis 19
Chapter 4 ..... **22**
Results and discussions 22
Data analysis and descriptive statistics 22
Chapter 5 ..... **27**
Conclusions and recommendations 27
Conclusion 27
Limitations 28
Policy Recommendations 28
Areas for further research 28
References **29**

Chapter One

Introduction

Background

Volatility spillover can be defined as the effect of variations in one sector, which in this case is the oil market, on the returns or behavior of another, which in this case would be the stocks market. Volatility spillover between different sectors in an economy has been of great importance to most investors as well as portfolio managers over the years. This is because many investors and portfolio managers are concerned with getting optimal weights for the assets they hold in their portfolio which will maximize the portfolio's risk-adjusted return. The weight they decide to allocate, for example to stocks, will be dependent on how volatile stocks are, given the current stock market conditions. Volatility spillover of other sectors to the stock market will, therefore, be important to the investor as it is also used in determining the state and volatility of the stock market.

Over the years, oil has grown to be a key indicator of the level of economic activity in different economies all over the world. It has been important in shaping the social, political and economic states of many countries worldwide. This is because according to studies such as (Hamilton J. D., 1983) increases in the prices of oil accounted for a huge proportion of the declined macroeconomic performance of OPEC. (Apergis & Miller, 2008) also showed an evident relationship between oil price increases and stock market performance. This was the case in the oil crisis of 1973 that saw the US economy go into a recession with most of the sectors including the financial sector being affected. This was evident in the crush of its stock market as well.

A study by (Blanchard & Gali, 2007) shows that changes in oil prices, after the 1970s, has had a direct impact on macroeconomic variables such as inflation, unemployment and the growth in the U.K, Germany, Italy and Japan. The study also established that there are 3 factors that would affect the responsiveness of an economy to changes in the oil prices and these were: the reliability of the monetary policy, the percentage share oil takes in consumption and production and rigidities of real wage.

There are three macroeconomic variables that are directly affected by shifts in the prices of oil. These are inflation level, level of GDP and the GDP growth rate and employment. These are affected to the extent that higher oil prices affect the consumer spending of most people and the earnings of oil-dependent companies which forces them to cut production costs by laying off workers. This increases the prices of goods produced by these companies with also increases inflation in the economy.

In the case of inflation, an increase in the general level of prices for goods and services in an economy is most of the time a consequence of an increase in oil prices. According to a study by (Chen, 2009), a shock in the oil sector is significant in determining the inflation rate of a country but how the responsive it is to it, depends on if the shock is based on the supply rather than the global aggregate. A further study by (Hunt, 2006) suggested that significant hikes in the oil prices can cause inflation similar to that of the 1970s only if monetary policy fails to take into account the economy's supply capacity and the workers fail to accept the changes in their consumption wages which are attributable to increased oil prices. Both studies show that oil price shocks have a directly proportional relationship in most cases

GDP basically refers to the output levels of an economy. It then follows that GDP growth rate is the rate at which the output level in an economy grows annually. A study by (Hamilton J. D., 1983) asserts a nonlinear relationship between GDP and oil prices in that, supply side shocks of oil should lead to a speculation of lower levels of GDP. This could be attributed to the fact that it disrupts consumption and spending by individuals and firms in the economy. A study by (Ghosh, Varvares, & Morley, 2009) uses an Error Correcting Model (EMC) to establish that oil prices reduced GDP growth by a significant 0.4% in the first period and 1.7% in the second period as prices rose. This relationship is evident from periods even before 1977 (Jiménez-Rodríguez, 2009) and these studies shows just how significant oil price shocks are in determining the level GDP in an economy.

Unemployment is also-directly affected by a shift in oil prices. This is because high levels of oil prices tend to cause higher production costs for firms, which then leads firms to find a way to cut their costs and one way would be laying off workers to cut spending on employee wages. This can be seen in the study by (Ordóñez, Sala, & Silva, 2011) which uses a Smooth Transition Regression (STAR) model to investigate the level to which oil prices affect labor market fluctuations and the study concluded a

significant relationship between the two. This was because higher oil prices impacted the employment cycle and caused structural unemployment by reducing the probability of getting jobs in an economy.

Considering the huge impact oil prices has on the economy, an inference can be made that these shifts in the oil market, also have a significant direct impact on the financial markets or an indirect effect, through the impact it has on various macroeconomic variables (Anand, Sunil, & Ramachandran, 2014). This was seen also evident in the oil crisis of 1973, where the rising of oil prices eventually led to the crush of the stock market. A study by (Ahmadi, Manera, & Sadeghzadeh, 2015) also shows a significant relationship between the two exists and that the level to which stock returns respond to shocks in oil prices is generally affected by the driving force behind the shock, with consumption demand shock being the biggest contributor.

A recent study by (Bastianin, Conti, & Manera, 2015) also assessed the impact of oil price shocks in G7 countries and concluded that aggregate demand side shocks have a larger impact on the variability of the stock markets of the selected countries and in the long run it accounted for more than 10% of the total volatility. This clearly shows that oil shocks, especially those are based on the aggregate demand have a significant impact on the stock market performance due to its impact on different consumer behaviors such as cutting spending on certain sectors when oil prices are high.

However, most of the studies that were previously done focused on developed economies and the then prompted a study by (Devlin & Titman, 2004) which examined the impact of oil price shocks in developing countries. The study concluded that in as much as these countries try to mitigate these effects by setting up stabilization and savings funds, oil price increases still have a significant impact on the government revenues and expenditure. This study also takes this approach by focusing on the relationship between the oil prices and the returns of listed stocks in the Nairobi Stock Exchange index (NSE-20) in Kenya.

According to a study by (Chichilnisky, 1985), the growth rates of middle-income oil-importing countries exceeded the growth rates of oil exporting middle-income countries in the period between 1973-1982. Low income countries on the other hand

had average growth rates of 4.9% as seen in the table below over the same period. This is a clear indication that middle-income developing countries were not as adversely affected, in terms of growth, by the high oil prices in this period. This shows that most of the effects of these high oil prices were felt by low-income developing countries and this forms the basis of this study with its focus being on Kenya.

Growth of GDP per capita, 1960 – 95 (Average annual percentage change)

Country Group	1960 – 73	1973 – 79	1980 - 85
All development countries	3.7	2.0	0.7
Low Income	3.0	2.9	3.2
Asia	3.4	3.3	3.7
Africa	1.0	-1.0	-1.6
Middle Income			
Oil Importers	3.8	3.3	-0.6
Major exporters of manufactures	4.4	3.6	-0.3
Other	2.6	1.7	-0.9
Oil exporters	4.3	2.3	-0.4
Industrial Countries	3.9	2.1	1.5

Source: World Bank Development Report 1984

The Kenyan economy is making the big shift into automating most its processes and this is expected to make it more prone to the effects of higher oil prices. This is because higher oil prices will increase production costs, affect consumer spending and also impact government revenues.

As compared to countries like India however, whose oil sector is regulated, making it hard to correctly capture the fluctuations in this sector (Anand, Sunil, & Ramachandran, 2014) Kenya has bilateral trade agreements with various oil-producing countries, set out to promote trade and improve economic relations with these countries. This makes it easier to capture these fluctuations and to capture the impact oil shocks have on the Kenyan economy. A report by Oxford Business Group on Kenya indicates that due to increased construction projects in the country with an aim to

achieve to vision 2030, petroleum imports have been increasing over years with Asian countries holding 60% of all the Kenyan imports.

An unexpected oil price shock would, therefore, have a significant impact on the Kenyan economy and this calls for further study on whether these oil shocks have spillover effects to the Kenyan financial markets. This study will therefore assess the impact oil price volatility has on the returns on stocks listed on the Nairobi Stock Exchange (NSE) over the years by focusing on oil prices and the NSE-20 index returns. The NSE-20 index comprises of the following listed companies which are listed in their respective sectors;

NSE-20 Share Index composition

Agricultural Sector	**Sasini Ltd**
Commercial & Services Sector	Nation Media Group Scangroup Ltd
Banking Sector	Kenya Commercial Bank Ltd The Cooperative Bank of Kenya Ltd Diamond Trust Bank Ltd Barclays Bank Ltd Equity Bank Ltd CFC Stanbic Holdings Ltd
Manufacturing & Allied Sector	East African Breweries Ltd British American Tobacco Kenya Ltd Athi River Mining Bamburi Cement Ltd
Energy & Petroleum Sector	KenolKobil Ltd Kenya Power & Lighting Ltd Kengen Ltd
Insurance Sector	British-American Investments Company (Kenya) Ltd CIC Insurance Group

Telecommunications and Technology Sector	Safaricom Ltd
Investment Sector	Centum Investment Ltd

Table 1 NSE-20 Share Index composition

Problem Statement

The oil crisis of 1973 drove most economists into evaluating the impact of an oil shock on the economy. Initially, the studies done indicated a direct impact on various macroeconomic variables such as inflation (Chen, 2009), GDP (Hamilton J. D., 1983) and unemployment (Ordóñez, Sala, & Silva, 2011). There was, however, a speculation that these oil price shocks had an impact on other sectors such as the financial markets. A study by (Bastianin, Conti, & Manera, 2015) then assessed the impact of oil price shocks on the stock market volatility of the G7 countries and found a significant relationship between the two variables. This study together with others such as (Apergis & Miller, 2008), (Miller & Ratti, 2009) and (Gencer & Demiralay, 2014) have however only focused on the impact of oil shocks on the stock markets of developed economies and a question is then left on what the case would be for developing stock markets.

A study by (Chichilnisky, 1985) shows that low-income developing countries are the one that are seriously affected by the high oil prices in the period between 1973-1982. This was shown in their growth rates during this period which significantly low. Middle-income oil-importing countries had growth rates that exceeded those of middle-income oil-exporting countries during the same period. There is, therefore, a need to study the impact of high oil prices on the Kenyan stock market as an example of a low-income oil-importing country which is more susceptible to the adverse effects of higher oil prices.

Research Objective

To determine if the international oil prices are significant in explaining stock market returns in Kenya

To examine the linkage between fluctuations in oil prices and the performance of the NSE-20 index in Kenya

Research Question

Do international oil prices play a significant role in determining stock market returns in Kenya?

What is the relationship between oil price fluctuations and the performance of the NSE-20 index in Kenya?

Significance of the Research

This study will be of benefit to monetary policy makers and other economic advisory agents concerned with areas of monetary planning and inflation targeting in an economy. This is because the findings of the study will enable them to set policies that are inclusive of other factors in the economy such as inflation in an inflation targeting regime and ensure that these policies are also set to cater for the possibility such shocks occurring. This is because the two are seen to have a relationship in that the occurrence of one affects the other.

The study is also of importance to investors who invest in the stock market. This study will help in shaping their investment decisions to either maximize profits or cover them from expected losses. This is because it is evident that such shocks impact the stock market returns and it would, therefore, be wise to consider the probability of these shocks occurring before putting all of his or her investment in stocks. This would call for diversification into 'safer' forms investment in such cases.

The study will also benefit the society at large due to the direct impact of increased oil prices on the consumption patterns in the economy as people tend to spend less of investment goods. The study will offer an explanation to the impact high oil prices have their various investment and consumption decisions.

Chapter Two

Literature Review

This section of the paper reviews existing literature on the subject matter of the study. Assessing first the validity of the premise that the volatility spillover of oil prices in the economy needs to be managed well. This section analyzes the impact oil price shocks have on different macro-economic variables such as inflation, unemployment and GDP. It then goes ahead to review studies done before that have shown a negative relationship as well as those that showed a positive relationship between oil price shocks and stock prices. It finally analyzes the transmission of volatility as done by other studies and summarizes how this study fits into the literature.

Theoretical Literature Review

Oil price volatility and the macro-economy

After the oil embargo of 1973-1974, many economists and researchers rushed into assessing the impact the rise in oil prices had on different macro-economic variables. They had reason to believe that the volatility in oil prices drove most fluctuations in the economy due to an economic slump that followed the oil embargo in the US economy.

According to a study by (Hamilton J. D., 1983), seven out of the eight post-war economic recessions in the United States were preceded by a dramatic increase in the prices crude oil. Oil price increases are found to account for a large proportion of the post-OPEC macro-economic performance, however, decreases in oil prices are not seen to impact the economy positively. Oil price increases that revert previous oil decreases are not expected to have a significant impact on the economy and according to the study, a correlation between oil price shocks and economic performance is established even in periods before 1973.

Correlation between oil prices and the state of the economy is also driven by the impact the rise in world oil prices had on macroeconomic costs. One was in the view of oil as an important input in production. This made an increase in the prices of oil to consequently increase the cost of production as well for many oil-dependent companies. The second one was the fact that oil was regarded as a consumer good in many households. This was because many households used it as either petrol or heating

oil. This made them more susceptible to being at a loss if the prices of oil were to suddenly increase (Masih, Peters, & Mello, 2011).

Most studies had however focused on the impact of oil price volatility on the performance of the US economy which would not necessarily be a base to generalize the impact of these fluctuations of oil prices on other economies (Ahmadi, Manera, & Sadeghzadeh, 2015), (Apergis & Miller, 2008), (Bastianin, Conti, & Manera, 2015) and (KILIAN & PARK, 2009). This led a study of the same in Greece by (Papapetrou, 2009), which analyzed the impact of oil price shocks on economic activity in Greece. The study made use of a Regime Switching Model and Threshold Regression Modelling to study this relationship between 1982-2008 and found that it the negative correlation between the two variables was strongest when the oil prices changed rapidly.

Oil price shocks were therefore proven to be a significant driving force behind most fluctuations in the economy. This led to other studies that were done to investigate the causality between the oil price shocks and the different macro-economic variables such as GDP and GDP growth rate, exchange rate, unemployment and inflation.

Starting with the GDP and GDP growth rate, as a measure of economic performance in an economy, oil price increases have been seen to have a negative relationship with GDP and GDP growth rate. The rise in oil prices, however, only affects GDP to the extent to which it disrupts spending by consumers and firms on certain key sectors (Hamilton, 2000). The relationship between the two macro-economic variables has also been analyzed and a study by (Jiménez-Rodríguez, 2009) found the relationship to be non-linear over the years, even in periods before 1977 in the US economy.

Oil price shocks also have a negative impact on the real exchange rates, even in the event of markets being perfect in the long run. A study by (Nikbakht, 2010) analyzes the long-term relationship between the fluctuations in oil prices and the real exchange rates and finds that oil prices are indeed the dominant drivers of real exchange rate volatility. The two are seen to have a significant long-run relationship. A reversed causality between the two variables is also observed, where the nominal exchange rates also explain the nominal oil prices in some economies (Beckmann & Czudaj, 2012)

Increases in oil prices have over the years been seen to have a significant impact on job reallocation, job destruction and job creation. It was evident that the automobile

industry in the US was greatly affected by the oil crisis of 1973 as people shifted to buying smaller cars which were fuel conserving. This triggered a massive job reallocation as most of these automobile companies laid off their workers. (Davis & Haltiwanger, 2001) studied the effects of oil price shocks on job creation and destruction of US manufacturing jobs and found that oil shocks accounted for 20-25 percent of the variability in employment growth. The study also showed that job destruction showed greater short-term sensitivity to oil shocks as compared to job creation.

(Ordóñez, Sala, & Silva, 2011) made use of smooth transition regression (STAR) models to investigate the influence of oil prices on labor market fluctuations and found that the oil shocks were significant in driving job market flows, the job finding probability was the main transmission mechanism of such shocks and that they bring a new amplification mechanism for the volatility of labour market and should, therefore, be considered to complement labour productivity shocks.

Oil price volatility is also seen to have a significant impact on the inflation rate in an economy. Negative effects on the output levels in the US, according to a study by (BERNANKE, GERTLER, & WATSON, 1997) were due to both the effect of higher oil prices as well as the response of monetary policy which aimed at controlling the inflationary consequences. It was also evident that the reaction of monetary policy to ease inflation is a significant determinant of the impact of the oil price shocks on the inflation level. Other studies have however shown that the impact of these shocks after 1980 have not necessarily had a significant impact on the core inflation. An example is a study by (Hooker, 1999) that showed that since 1980, oil price changes only affect inflation only through their share in a price index, while before 1980 oil shocks contributed substantially to core inflation.

(Hunt, 2006) identifies two responses that are necessary for energy price shocks to generate similar stagflation as witnessed in the 1970s. These were: misperception of monetary authority about the supply capacity and the ability of workers to temporarily resist some erosion in their real consumption wages resulting from oil price increases. Otherwise, the oil price shocks would not trigger the stagflation witnessed in the 1970s.

Oil price volatility and the stock market

Considering the impact oil price shocks have on the macro-economy, it would not be wise to assume that this impact does not spillover to other sectors of the economy through a ripple effect. Many studies have been done with an aim to assess the impact oil price increases have on the financial sector, and most specifically the stock market.

The relationship between oil prices and stock prices is mostly seen to be negative due to the impact higher oil prices have on the expected future earnings of a company. The two can, however, be positively related when the higher oil prices are driven by global aggregate demand.

According to (Huang, Masulis, & Stoll, 1996), higher oil prices reduce the expected earnings of companies for which oil is either a direct or indirect cost of production. The stock price of the company would consequently reduce if the stock market is efficient. Higher oil prices also impact stock prices negatively through the interest rates, where higher oil prices would make policy makers to increase the interest rates so as to ease inflationary pressure, which would, in turn, increase the discount rate used in stock pricing and make alternative investments such as bonds, more attractive. Both ways account for the reduction of the stock prices driven by increases in the prices of oil.

(Sadorsky, 1999) also proves that the negative relationship holds by use of a vector autoregressive model to establish that after 1986, oil price movements explain a larger portion of the variance in real stock returns as compared to interest rates. This showed that increases in oil prices would be negatively correlated with the stock prices, which would reduce.

(Malik & Hammoudeh, 2007) expands the study to examine volatility and shock transmission mechanism among US equity, global crude oil markets and equity markets of Saudi Arabia, Kuwait and Bahrain. Results indicated that in all cases, Gulf equity markets receive volatility from the oil market but only in the case of Saudi Arabia, there was significant volatility spillover from the Saudi market to the oil market. A similar study was also carried out in Tunisia by (Hamma, Jarboui, & Ghorbel, 2014), using a bivariate GARCH model and the results showed that majority of relationships are unidirectional in that the volatility spillover was from oil markets to the Tunisian stock market.

Contrary results are however found in other studies with some indicating a positive relationship and others proving no relationship at all.

A study by (Apergis & Miller, 2008), uses a Vector Autoregressive model to study the impact of oil price changes on stock market returns in a sample of eight countries- Australia, Canada, France, Germany, Italy, Japan, the UK and the US. The findings of the study are that international stock market returns do not respond in a large way to oil market shocks and in this way no defined relationship could be derived between the two variables.

A study by (Miller & Ratti, 2009) used a cointegrated vector error correction model to analyze the long run relationship between world price of crude oil and international stock markets over 1971-2008. The findings of the study were that there was a significant negative relationship between world oil prices of crude oil and the international stock market returns until 1999, but the relationship deteriorated afterward. The relationship after 1999 was found not to be statistically significant.

(KILIAN & PARK, 2009) went further and identified the fundamental supply and demand shocks underlying the changes in oil prices and found that supply shocks were less important as compared to global aggregate demand shocks in influencing oil prices. This study showed that how the US real stock returns react to an oil price shock depends on the underlying cause of the oil price shock. The relationship between the two variables was seen to be positive if the oil price increases were driven by global aggregate demand.

There has been a clear trend of a negative correlation between oil prices and stock prices in many economies. This is because, in the case of developing countries, an oil price shock is expected to have a negative impact on the whole economy, including its financial market because these economies are still very dependent on oil in their production processes.

This makes developing economies, to be more susceptible the effects of such oil shocks driven by a reduction in the aggregate supply. This is because such countries have many on-going infrastructural development projects, which are oil dependent, to enable them to move up the development ranking. This makes them heavy importers of oil, which makes a fall in the aggregate supply of oil, to drag its economy into a slump and subsequently affect the earnings of most companies, which still have oil as

either a direct or indirect cost of production. This would consequently affect the stock prices.

Empirical Literature Review

Transmission of volatility

Different studies have employed different volatility models to assess the relationship between oil price shocks and stock market returns. These include models such as ARCH, GARCH, VAR, VECM or a combination of either. A study by (Cong, Wei, Jiao, & Fan, 2008) employed a VAR (Vector Auto-Regressive Model) to investigate the interactive relationship between oil price shocks and the Chinese stock market. Their findings were that some shocks negatively impacted the stocks of oil companies but had no significant impact on stock returns.

A study by (Masih, Peters, & Mello, 2011) employed a VEC (Vector Error Correcting) model to examine the impact of oil price fluctuations and oil price volatility on the performance of equity markets. Their findings were that oil price shocks have two negative effects of the profitability of firm. One was through a direct impact on a firm's production costs and second was through an indirect effect where investors act on a foreseen decline in firm's profit margins which affects the stock market indices. (Miller & Ratti, 2009) also employed the same VECM but with additional regressors to study the long-term relationship between world crude oil prices and international stocks and found stock market indices respond negatively to oil price shocks.

A study by (Malik & Hammoudeh, 2007) employed a multivariate GARCH (Generalized Auto-Regressive Conditional Heteroskedasticity) model to examine the volatility and shock transmission mechanism among US equity, Gulf equity and global crude oil markets. The findings of the study were that Gulf equity markets receive volatility from the oil markets but only in the case of Saudi Arabia is the volatility spillover from Saudi market to the oil market significant.

A study by (Gencer & Demiralay, 2014) employ a bivariate GARCH model to analyze the shock and volatility spillover between oil prices and Turkish sector returns using five sectors in the Turkish equity market. The finding of the study was that there was significant unidirectional volatility spillover from the oil sector to some of the sectors in the Turkish equity market. (Hamma, Jarboui, & Ghorbel, 2014) also used the bivariate GARCH model to study the effects of oil price volatility on the Tunisian

stock market and found majority of the relationships were unidirectional from the oil market to the Tunisian stock market.

According to (Hamma, Jarboui, & Ghorbel, 2014),VAR and VEC models which have been used by different studies before, do not capture the non-linearity of the relationship especially in periods of financial stresses and crises like 2007-2008 due to their standard linear framework. GARCH models are therefore more advantageous with its versions such as the BEKK model guaranteeing positive definiteness of the covariance matrix under very weak conditions. The BEKK version of the GARCH model is also parsimonious in that it significantly reduces the number of parameters to be estimated. This is therefore the reason this study employed the GARCH model with the BEKK(1,1) representation to model the relationship between oil prices and stock market returns.

The case of Kenya

In the case of Kenya, the vision 2030 was put in place to ensure Kenya transforms into a middle-income economy in the next 20 years. Several initiatives have ever since been put to achieve this vision. These included many infrastructural developmental projects which boosted the country's petroleum consumption with the petroleum importation level increasing over the years. The bilateral trading agreements in Kenya are also put in place to boost trade with Asia now holding approximately 60% of all Kenyan imports (Oxford Business Group, 2016)

A study by (Onuonga, 2012) investigates the relationship between energy consumption and economic growth in Kenya and establishes that energy consumption is determined by the economic growth in the country. The study also points out that as per 2007, the consumption of petroleum was at 3121.8 tones and it was expected to rise by 2% per annum.

This shows that a shock in the oil sector would have a significant impact on the economy of an oil importing country like Kenya and this would not leave the financial sector unscathed. This study will therefore employ a bivariate GARCH model for which the BEKK (1,1) representation will be used to estimate the mean and the conditional variance between the Kenyan NSE-20 stock index returns and the oil prices, thus establish the volatility spillover between the two variables.

Chapter Three

Methodology

Research design

The nature of this study is explanatory. This is because the study seeks to analyze the relationship between oil prices and the stock market return, proposing either variable as a cause of the other. The study employs the use of quantitative methods to analyze the causation between the two variables due to the numerical nature of the measures of both variables. The study will take up a cross-sectional design since there will be two variables of interest which will be assessed and a relationship between them established.

Data collection

The data used for this study will be in the form of secondary data and will include two types of data. For the equities segment of the data, historical weekly data on the NSE 20 index will be used for the period between 2006-2012 and the frequency of the stock return fata will be weekly. Data on crude oil prices will be from the Energy Information Administration (EIA) database which offers two representations for crude oil prices; WTI and Brent prices. The database offers weekly data for the period between April 2006 and June 2012 and is recorded at the end of every trading week. The data is also readily available on the internet for any interested parties.

Population and sample

The population of this study will be the low-income oil-importing developing countries in the world and the sample be Kenya. This is because Kenya's oil market is less regulated as compared to those of other low-income developing countries like India (Anand, Sunil, & Ramachandran, 2014). Regulated oil markets make international crude oil prices only have an impact if they are reflected in the domestic retail oil price. This should follow that the results of this study should almost be similar to the results that would be derived from the study, if it was carried out in other low-income oil importing developing country. Additionally, the study focuses on the period between 2006-2012. This is because data on the world crude oil prices is only available at a weekly frequency for that period and the weekly data is less noisy as compared to using daily data for the same period.

Data analysis

In order to establish the relationship between oil prices and NSE-20 returns, the study will make use of several descriptive statistics for the return series of the NSE-20 index which include; the mean of the return series, the standard deviation as a measure of deviation, the maximum value, the minimum value, the kurtosis and the skewness of the returns.

The study will also make use of an ARCH test, which is a statistical test for conditional heteroscedasticity, the Ljung-Box statistic which will be a test for autocorrelation of the data and the Jarque-Bera statistic which will be testing for normality of the return series.

The data collected will be used to measure the relationship between the index returns and the oil market. This will be done by employing a bivariate GARCH model for which a BEKK representation will be used. The conditional variance covariance matrix is normally expressed as follows;

$$H_t = C_0^{*\prime} C_0^* + \sum_{k=1}^{K} \sum_{i=1}^{q} A_{ik}^{*\prime} \varepsilon_{t-i} \varepsilon_{t-i}' A_{ik}^* + \sum_{k=1}^{K} \sum_{i=1}^{P} B_{ik}^{*\prime} H_{t-i} B_{ik}^*$$

This is where; C_0^*, A_{ik}^* and B_{ik}^* are (NxN) matrices and C_0^* being specified as a lower triangular matrix.

This study will focus of the standard BEKK parameterization for the bivariate GARCH (1,1) model which is written as;

$$H_t = C_0^{*\prime} C_0^* + A_{11}^{*\prime} \varepsilon_{t-1} \varepsilon_{t-1}' A_{11}^* + B_{11}^{*\prime} H_{t-i} B_{11}^*$$

$$H_t = C_0^{*\prime} C_0^* + \begin{bmatrix} a_{11}^* & a_{12}^* \\ a_{21}^* & a_{22}^* \end{bmatrix}' \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11}^* & a_{12}^* \\ a_{21}^* & a_{22}^* \end{bmatrix}$$
$$+ \begin{bmatrix} b_{11}^* & b_{12}^* \\ b_{21}^* & b_{22}^* \end{bmatrix}' H_{t-1} \begin{bmatrix} b_{11}^* & b_{12}^* \\ b_{21}^* & b_{22}^* \end{bmatrix}$$

Where; H_t is a (2x2) matrix of conditional variance autocovariance at time t, C_0^* is also a (2x2) triangular matrix made up of three parameters, A_{11}^* is a (2x2) matrix as well made up of parameters and B_{11}^* is also a (2x2) matrix of parameters. The difference between the two will however be that A_{11}^* will be measuring the correlation between

conditional variances and past errors squared while B_{11}^{*} will be measuring the correlation between conditional variances and past conditional variances.

This model is the model of choice for this study because it is parsimonious in that it reduces the number of parameters to be estimated and it also limits the covariance matrix to be positively definite under weak stationarity.

In our case, the mean and variance equation will be derived as follows, so as to have a better understanding of the role each parameter plays in the model

$$r_{1t} = \mu_1 + \Phi_{11} r_{1,t-1} + \varepsilon_{1t}$$

$$r_{2t} = \mu_2 + \Phi_{22} r_{2,t-1} + \varepsilon_{2t}$$

The conditional variance for the world crude oil market returns at time t will be given as;

$$h_{11,t} = C_{11}^2 + C_{21}^2 + a_{11}^2 \varepsilon_{1,t-1}^2 + 2a_{11}a_{21}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{21}^2 \varepsilon_{2,t-1}^2 + b_{11}^2 h_{1,t-1} + 2b_{21}b_{11}h_{12,t-1} + b_{21}^2 h_{2,t-1}$$

The conditional covariance between oil market returns and those of the corresponding sector returns on the NSE-20 index will be given by;

$$h_{12,t} = C_{11}C_{12} + a_{11}a_{22}\varepsilon_{1,t-1}^2 + (a_{12}a_{11} + a_{11}a_{22})\varepsilon_{1,t-1}\varepsilon_{2,t-1} + b_{11}b_{12}h_{1,t-1} + (b_{12}b_{21} + b_{11}b_{22})h_{12,t-1} + b_{21}b_{22}h_{2,t-1}$$

Finally, the conditional variance of the NSE-20 index returns for the different sectors will be given by;

$$h_{22,t} = C_{12}^2 + C_{22}^2 + a_{12}^2 \varepsilon_{1,t-1}^2 + 2a_{12}a_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{22}^2 \varepsilon_{2,t-1}^2 + b_{12}^2 h_{1,t-1} + 2b_{12}b_{22}h_{12,t-1} + b_{22}^2 h_{2,t-1}$$

From the model equations above, the parameters a_{12}, a_{21}, b_{12} and b_{21} will be used to reveal how shock and volatility are transmitted over the set time for the study, between the two variables (crude oil market returns and the returns of the NSE-20 index).

The off-diagonal elements of matrices A and B will be used to capture the cross-market effects. For instance, (a_{12} and a_{21}) will capture shock spillovers and (b_{12} and b_{21}) will capture volatility spillovers.

The parameters of the model will be estimated by employing the Maximum Likelihood Estimation (MLE) and the Ljung- Box statistic will be used to test for linear dependence in the standardized variables of this study.

This study will also be based on the assumption that the residuals are identically and independently distributed, and they follow a conditional multivariate normal distribution with a mean of zero and variance of 1.

Chapter 4

Results and discussions

The results highlighted in this section of the study will be divided into two. The first will entail the results of various descriptive statistics performed on the data and the second will entail an empirical analysis of the effect of oil price changes on the NSE-20 index returns by use of the Garch-bekk (1,1) model.

Data analysis and descriptive statistics

The return series of the three prices were calculated using the formula below;

$R_{i,t} = (P_{i,t+1} - P_{i,t})/P_{i,t}$ for t = 1,2,3,…,T; where $R_{i,t}$ denotes the continuously compounded rate of return and $P_{i,t}$ denoted the closing price of the indices at time t.

The return series of the indices were then plotted and the graphs were as follows, with the first being the NSE-20 returns, then the Brent returns adjacent to it, followed by the WTI returns.

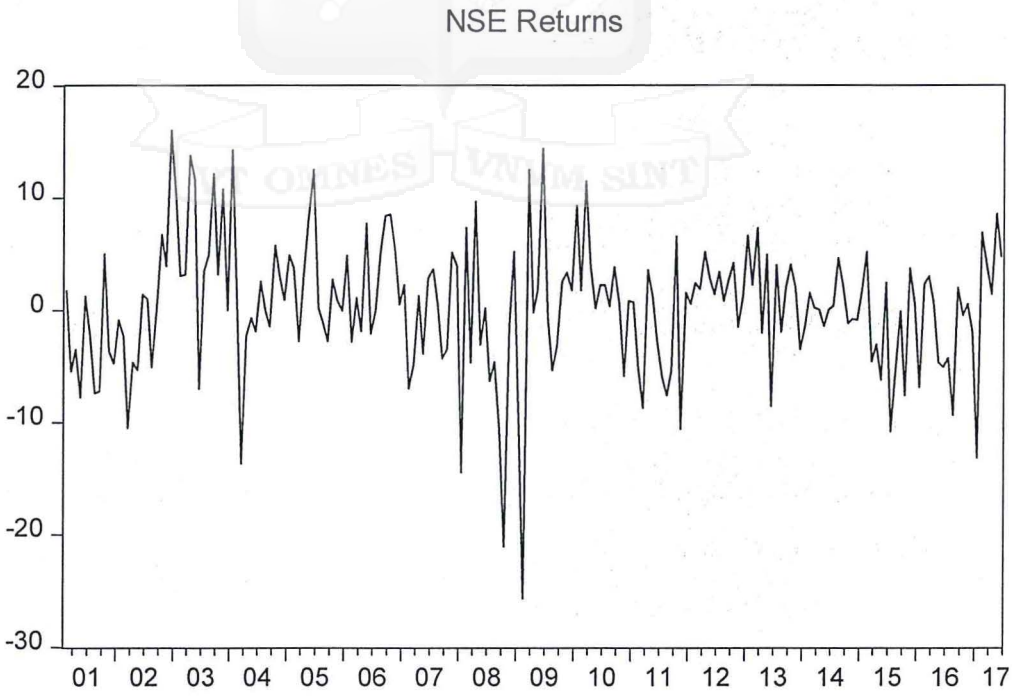

Figure 1 NSE Returns

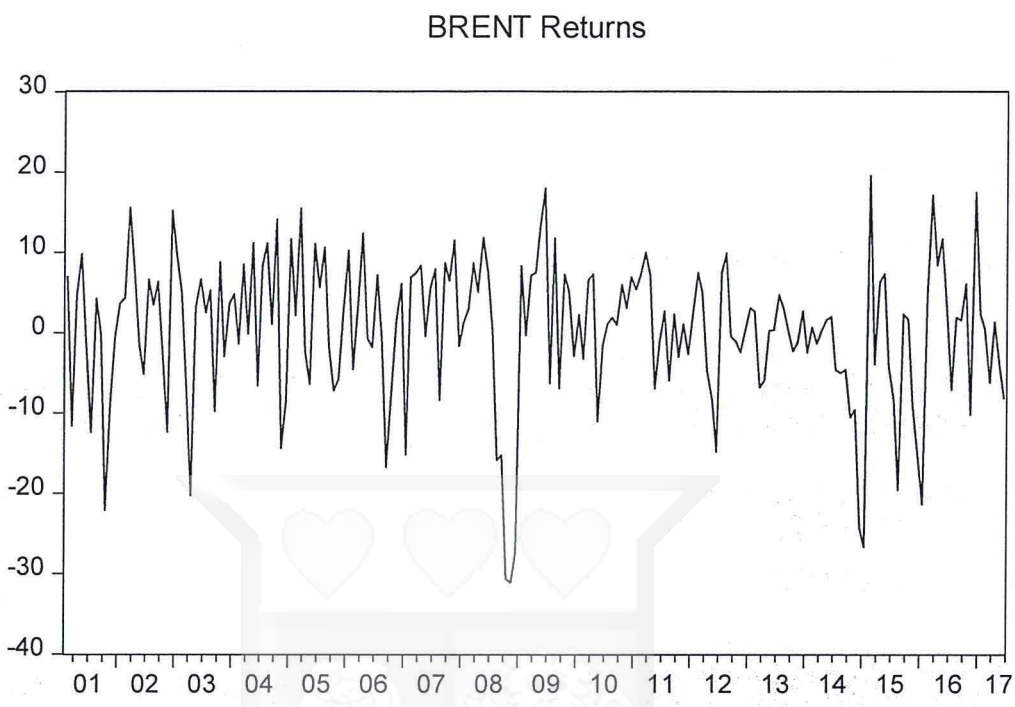

Figure 2 BRENT Returns

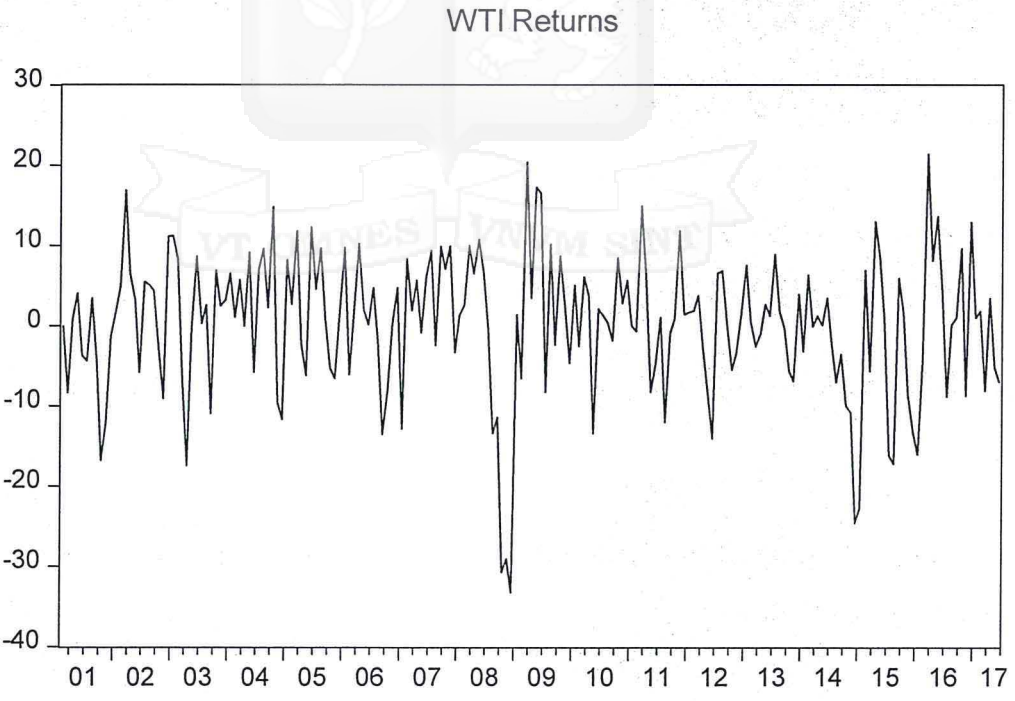

Figure 3 WTI Returns

A test for stationarity of the return series first was carried out using the Augmented Dickey-Fuller (ADF) test to establish if the they were time series. The results established the return series to be stationary which permitted for further analysis of the series.

ADF Test Statistic	t-statistic	Prob*
NSE Returns	-4.82472	0.0001
WTI Returns	-6.40703	0.0000
Brent Returns	-6.37125	0.0000

Table 2 ADF test for stationarity

The descriptive statistics calculated included for this study the mean, median, standard deviation, minimum value, maximum value, skewness and kurtosis of the indices' returns whose results are tabulated below.

Index	NSE-20 Returns	WTI Returns	Brent Returns
Observations	197	197	197
Mean	0.326091	0.214832	0.301157
Median	0.679988	1.292382	1.629958
Std. Dev.	5.975105	8.86222	9.126311
Min	-25.6668	-33.1981	-31.0955
Max	16.0193	21.38658	19.59772
Skewness	-0.51628	-0.78667	-0.88752
Kurtosis	5.09585	4.510249	4.231457
JB Statistic	44.8073*	39.04108*	38.31066*
B-P Chi2(1)	26.25*	60.96*	77.59*
LB Q-Statistic	37.6473	21.0018	17.9342

Table 3 Descriptive statistics

The statistical tests also performed on the return series included the skewness/kurtosis test for normality, the Breusch Pagan test for heteroskedasticity of the residuals and the Ljung-Box test for serial correlation. The JB statistics is the empirical results of the Jarque-Bera test for normality which is based on the skewness and kurtosis of the return series. This test confirms that the return series are not normally distributed. The LB Q-statistic on the other hand is the Ljung-Box empirical result for the Ljung-Box test for serial correlation. The (*) represents rejection of the null hypothesis in the associated statistical test at a 5% level of significance.

A test was also carried out to establish whether the international oil prices (WTI and BRENT) were significant in predicting the model and the results below showed that from a Generalized Linear Model (GLM), we can conclude that all the 3 factors are highly significant in predicting the model at a 5% significance level.

	Estimate	Std error	t-value	Pr(>l t l)
Intercept	-2.200e+03	5.042e+02	-4.364	2.07e-05 *
Date	2.860e-01	3.734e-02	7.660	8.63e-13 *
Crushing WTI	7.665e+01	1.089e+01	7.037	3.30e-11 *
Europe Brent	-4.761e+01	9.752e+00	-4.882	2.19e-06 *

Table 4 Test for significance of the variables

Maximum Likelihood Estimation (MLE) is used to estimate the coefficients of the bivariate GARCH model and this is optimized using the Berndt, Hall, Hall and Hausman (BHHH) algorithm. An assumption is also made on the residuals which is that they follow a conditional multivariate normal distribution with a mean of zero and a variance-covariance matrix.

Coefficients	Estimate	Std. Error	t value	Pr(>|t|)
μ_1	0.008732*	0.004103	2.12796	0.033341
μ_2	0.014799*	0.005237	2.82589	0.004715
$A0_{11}$	0.033192*	0.007852	4.22741	2.36E-05
$A0_{21}$	0.001273	0.027898	0.04562	0.963613
$A0_{22}$	0.040736	NA	NA	NA
A_{11}	0.10218	0.095999	1.06439	0.287153
A_{21}	0.191219	0.131065	1.45896	0.144575
A_{12}	0.177467*	0.08063	2.20099	0.027737
A_{22}	0.562344*	0.090531	6.21165	5.24E-10
B_{11}	0.718162*	0.139651	5.14256	2.71E-07
B_{21}	-0.5	NA	NA	NA
B_{12}	0.183082	0.099971	1.83134	0.06705
B_{22}	0.5648*	0.089144	6.33579	2.36E-10

Table 5 GARCH-BEKK(1,1) model results

The results from the estimation of the GARCH-BEKK(1,1) model are tabulated below including the statistical test applied to the standardized residuals. The results show that at a 5% level of significance (*), the NSE-20 index returns are significantly impacted by volatility in the oil prices in general. The significance of the A12 show that the NSE-20 index returns are also affected by the past volatility of the international oil market which proves that oil price volatility has a significant effect on the returns of the Kenyan stock market. The positive sign of the A12 coefficient also indicates that high past volatility in the oil market, would cause an increase in the variability of current NSE-20 stock returns by the same proportion.

In addition to this, the significance of the B11 shows that the NSE-20 index is also significantly and directly affected by its own past volatility in that, if it experienced any volatility in previous periods, its current returns would also be affected. The positive sign of the B11 coefficient also indicates that an higher past volatility in the NSE-20 stock returns, would increase the variability of the current NSE-20 returns.

Chapter 5

Conclusions and recommendations

Conclusion

The findings of this study show evidence of volatility and shock spillover between international oil prices and the Kenyan stock market returns. The study employed a GARCH-BEKK (1,1) representation to analyze the relationship and established that the volatility of the stock market returns is directly affected by past volatility in the oil market as well as current unexpected shocks in the oil market.

The results are also consistent in confirming the significance of oil prices as a factor that drives stock market returns in Kenya. This could be attributed to the fact that the country is still very dependent on imported oil and a significant number of firms, both listed and not listed, depend on oil as an important input to production. This then makes these firms to be more vulnerable to supply-side shocks in the oil market and a significant rise in the cost of oil would directly impact the firm's returns through increased costs of production.

In more developed economies, the volatility transmission between oil price fluctuations and stock market returns could be controlled, through their more developed financial markets, which allow for trade of different financial instruments. This enables investors to protect themselves from huge losses through more effective hedging strategies. However most developing economies such as Kenya, lack developed financial markets. This makes the portfolio of an investor trading in the Kenyan stock market to more vulnerable to shocks in the oil market, considering the fact that these firms are still very dependent on imported oil as an input to production.

Appropriate hedging strategies, permitted by the Kenyan stock market, therefore need to be put in place for investors who trade in the Nairobi Securities Exchange (NSE), so as to protect them from volatility in the international oil market.

Limitations

The main limitation of this study was that the relationship between international oil price volatility and the stock return volatility was only carried out for one country, Kenya. This study assumes that the study carried out in Kenya could be concluded for other low-income, oil-importing developing economies which might not be necessarily the case.

The study also focuses on only the impact of oil price volatility on the returns of the NSE-20 index in Kenya and fails to access the impact it has on the individual sectors of the Kenyan stock market. Although the NSE-20 is made up of companies from the different sectors, the study on the individual sectors would offer elaborate picture of which sectors are most affected by the oil price volatility.

Policy Recommendations

The findings of this study show that oil price volatility has a significant impact on the volatility of stock market returns in Kenya. This therefore implies that investors holding Kenyan stocks in their portfolio need to hedge themselves against sudden increases in the prices of oil to avoid making huge losses.

According to (Hamma, Jarboui, & Ghorbel, 2014), the investors and portfolio managers will be required to come up with optimal weights, and hedge ratios, so as to effectively hedge themselves against unexpected shifts in the oil prices. They will therefore aim at risk minimization without a reduction in their returns.

Areas for further research

The study may imply that oil price volatility has a significant effect on the stock market performance in Kenya, but this might not be the case in other low-income, oil-importing developing economies. There is therefore a need to expand the scope of this research and include other countries in this category to see if the same holds for them.

The study also concludes that hedging is required to protect the investor from making significant investment losses but there is need to establish the appropriate hedging strategy to be used by these investors. This is therefore an area that requires further research so as to enable investors to better hedge themselves against such fluctuations.

References

Ahmadi, M., Manera, M., & Sadeghzadeh, M. (2015). Global Oil Market and the U.S. Stock Returns. *Fondazione Eni Enrico Mattei (FEEM) (2015)*.

Anand, B., Sunil, P., & Ramachandran, M. (2014). Volatility Spillover between Oil and Stock Market Returns. *Indian Economic Review*, Vol. 49, pp. 37-56.

Apergis, N., & Miller, S. M. (2008). Do Structural Oil-Market Shocks Affect Stock Prices? *Economics Working Papers*.

Bastianin, A., Conti, F., & Manera, M. (2015). The Impacts of Oil Price Shocks on Stock Market Volatility: Evidence from the G7 Countries. *Fondazione Eni Enrico Mattei (FEEM)* .

Beckmann, J., & Czudaj, R. (2012). Oil price and U.S. dollar exchange rates dynamics. *University of Duisburg-Essen, Department of Economics*.

BERNANKE, B. S., GERTLER, M., & WATSON, M. (1997). Systematic Monetary Policy and the Effects of Oil Price Shocks. *Brookings Papers on Economic Activity*.

Blanchard, O. J., & Gali, J. (2007). THE MACROECONOMIC EFFECTS OF OIL SHOCKS: WHY ARE THE 2000S SO DIFFERENT FROM THE 1970S. *NATIONAL BUREAU OF ECONOMIC RESEARCH*.

Chen, S.-S. (2009). Revisiting the Inflationary Effects of Oil Prices. *The Energy Journal*, Vol. 30, pp. 141-154.

Chichilnisky, G. (1985). Oil Prices and the Developing Countries: The Evidence of the Last Decade. *INTERECONOMICS*.

Cong, R.-G., Wei, Y.-M., Jiao, J.-L., & Fan, Y. (2008). Relationships between oil price shocks and stock market: An empirical analysis from China. *Energy Policy* , 3544– 3555.

Davis, S. J., & Haltiwanger, J. (2001). Sectoral job creation and destruction. *Journal of Monetary Economics* , 465-512.

Devlin, J., & Titman, S. (2004). Managing Oil Price Risk in Developing Countries. *The World Bank Research Observer*, Vol. 19, pp. 119-139.

Funashima, Y. (2014). A Wavelet Analysis of Output Fluctuations in the Japanese Economy. *Grants-in-Aid for Scientific Research*.

Gencer, H. G., & Demiralay, S. (2014). Shock and Volatility Spillovers between Oil Prices and Turkish Sector Returns. *International Journal of Economics and Finance*.

Ghosh, N., Varvares, C., & Morley, J. (2009). The Effects of Oil Price Shocks on Output. *Palgrave Macmillan Journals*, Vol. 44, pp. 220-228.

GHOSH, N., VARVARES, C., & MORLEY, J. (2009). The Effects of Oil Price Shocks on Output. *Palgrave Macmillan Journals*, Vol. 44, pp. 220-228.

Hamilton. (2000). What is an Oil shock? *National Bureau of Economic Research.*

Hamilton, J. D. (1983). Oil and the Macroeconomy since World War II. *The University of Chicago Press*, Vol. 91, pp. 228-248.

Hamma, W., Jarboui, A., & Ghorbel, A. (2014). Effect of oil price volatility on Tunisian stock market at sector-level and effectiveness of hedging strategy. *Procedia Economics and Finance*, 109 – 127.

Hooker, M. A. (1999). Are Oil Shocks Inflationary? Asymmetric and Nonlinear Specifications versus Changes in Regime. *Federal Reserve Board.*

Huang, R. D., Masulis, R. W., & Stoll, H. R. (1996). Energy Shocks and Financial Markets. *Journal of Futures Markets.*

Hunt, B. (2006). Oil Price Shocks and the U.S. Stagflation of the 1970s: Some Insights from GEM. *International Association for Energy Economics*, Vol. 27, pp. 61-80.

Jiménez-Rodríguez, R. (2009). Oil Price Shocks and Real GDP Growth: Testing for Non-linearity. *The Energy Journal*, Vol. 30, pp. 1-23.

KILIAN, L., & PARK, C. (2009). THE IMPACT OF OIL PRICE SHOCKS ON THE U.S. STOCK MARKET. *INTERNATIONAL ECONOMIC REVIEW.*

Malik, F., & Hammoudeh, S. (2007). Shock and volatility transmission in the oil, US and Gulf equity markets. *International Review of Economics and Finance*, 357–368.

Masih, R., Peters, S., & Mello, L. D. (2011). Oil price volatility and stock price fluctuations in an emerging market: Evidence from South Korea. *Energy Economics.*

Miller, J. I., & Ratti, R. A. (2009). Crude Oil and Stock Markets: Stability, Instability, and Bubbles. *Department of Economics, University of Missouri.*

Nikbakht, L. (2010). OIL PRICES AND EXCHANGE RATES: THE CASE OF OPEC. *Business Intelligence Journal.*

Onuonga, S. M. (2012). THE RELATIONSHIP BETWEEN COMMERCIAL ENERGY CONSUMPTION AND GROSS DOMESTIC INCOME IN KENYA. *The Journal of Developing Areas*, pp. 305-314.

Ordóñez, J., Sala, H., & Silva, J. I. (2011). Oil Price Shocks and Labor Market Fluctuations. *The Energy Journal*, Vol. 32, pp. 89-118.

Oxford Business Group. (2016). *THE REPORT: Kenya 2016.*

Papapetrou, E. (2009). OIL PRICE ASYMMETRIC SHOCKS AND ECONOMIC ACTIVITY: THE CASE OF GREECE. *Economic Research Department, Bank of Greece.*

Sadorsky, P. (1999). Oil price shocks and stock market activity. *Energy Economics*, 449-469.