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IMPACT OF OIL PRICES ON THE EXCHANGE RATE IN KENYA

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DECLARATION

I, PAMELLA ACHIENG NYAMUNGA, declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. Wherever contributions of others have been used, every effort is made to indicate this clearly, with due reference to the literature.

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

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List of Abbreviations

ARDL- Autoregressive Distributive Lag

KNBS- Kenya National Bureau of Statistics

LPG- Liquefied Petroleum Gas

OPEC- Organization of the Petroleum Exporting Countries

USD- US Dollars

OECD- Organization of Economic Co-operation Development

GARCH- Generalized Autoregressive Conditional Heteroscedasticity

ARCH- Autoregressive Conditional Heteroscedasticity

OLS- Ordinary Least Squares

ADF- Augmented Dickey-Fuller

CBK- Central Bank of Kenya

ABSTRACT

The aim of this study is to estimate the impact of global oil prices on the exchange rate of Kenya for a monthly series from April 2000- April 2016. The modelling exercise follows 3 steps. In first step, the paper investigates the unit root test to check for stationarity in the individual variables. The second step is to run a diagnostic test to check for autocorrelation, normality and heteroscedasticity. In the third step, we estimate the equation for our model using OLS to determine its significance and the relationship between oil prices and exchange rate. The results are that oil price and exchange rate have an inverse relationship with the coefficient of oil having a negative sign. The paper goes ahead and runs GARCH test to get the conditional volatilities of exchange rate and oil price and after which a linear regression model was used estimate the relationship between the conditional volatilities of the two variables. The study then concludes that the conditional volatility between the two variables is significantly related. This implies that oil prices are a very vital variable in determining the strength of the currency and its volatility. The Kenyan Government should consider the impacts of oil prices when formulating and implementing economic policies, especially the exchange rate policies.

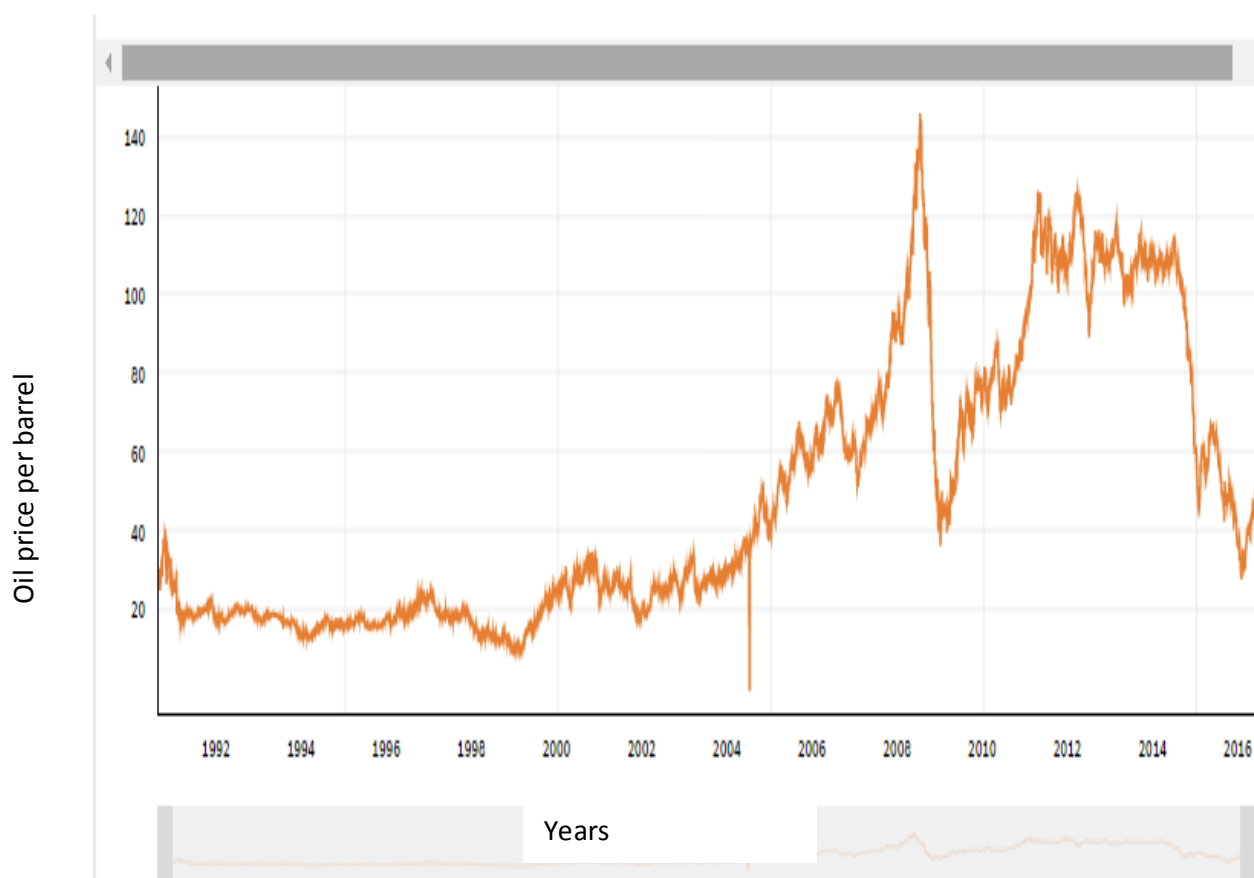
CHAPTER 1: INTRODUCTION

1.1 BACKGROUND INFORMATION

1.1.1 TREND OF OIL PRICES

Oil prices on the world market for crude oil, using the Brent benchmark, had been around 115 US Dollars per barrel for several years prior to mid-June 2014, but have, since then, rapidly fallen and oil is now trading at levels just under 60 Dollars per barrel¹. The graph below illustrates the trend of oil prices:

Figure 1.0 Trend of oil prices from 1992-2016



Source:

The oil prices have fallen by approximately 50 per cent. Expressed as the number of dollars per barrel, this is the second largest fall over a 12-month period in the last 50 years². The largest fall

¹ www.riksbank.se/.../PPR/.../rap_ppr_ruta2_150212_eng.pdf

² www.riksbank.se/.../PPR/.../rap_ppr_ruta2_150212_eng.pdf

occurred in conjunction with the financial crisis of 2008-2009, when demand in the global economy fell rapidly. This time however, oil price decrease is largely viewed as an effect of the increased global supply of oil.

The production of North America shale oil has increased sharply in recent years³. This lies behind the heavy increase of total oil production in Canada and in the United States. Russia, Iraq and Libya have also increased production since mid-June 2014. Unlike in previous price falls, when the oil cartel OPEC would decrease production to maintain prices, OPEC increased production.

Also another factor that has been attributed to the fall of oil prices is an expected decrease in demand for oil due to lowered expectations for global GDP growth. Nevertheless, the increase on supply is deemed to explain the greater part of the price fall, and this conclusion is shared by most studies. According to Arezki and Blanchard (2014), 65-80 per cent of the fall in oil prices until December 2014 can be explained by increased supply.

In Kenya, the Energy sector witnessed a steady rise in global inventories of crude oil and other fuels in 2015. This was due to: Sustained excess supply of crude oil, slowed global demand driven by slowed growth in the Chinese economy, increased production of shale oil in the US, and over-supply by the OPEC.

Consequently, Murban crude prices decreased to an average of USD 52.53 per barrel in 2015, down from an average of USD 99.45 per barrel in 2014. Locally, average retail prices of diesel and petrol declined by 13.4 per cent and 11.6 per cent, respectively, in 2015. Retail prices for illuminating kerosene recorded the largest decline of 25.0 per cent while that of LPG for a 13Kg cylinder dropped by 21.5 per cent over the same period⁴

Also, the balance of trade improved from a deficit of KSh 1,081 billion recorded in 2014 to a deficit of KSh 997 billion in 2015. Improvement in the balance of trade was due to: A rise in exports by 8.2 per cent to KSh 581 billion in 2015 and a decline in imports by 2.5 per cent to KSh 1,578 billion over the same period⁵. The decline in imports was mainly due to a remarkable fall in import prices of mineral fuels.

The KNBS data shows that petroleum accounted for 15.3 per cent of the country's import bill in the review period (2015)⁶, coming in third behind industrial imports and machinery, whose imports increased in the period. Petroleum products are Kenya's second largest import

³ www.riksbank.se/.../PPR/.../rap_ppr_ruta2_150212_eng.pdf

⁴ http://knbs.or.ke/index.php?option=com_phocadownload&view=category&id=16&Itemid=563 Economic Survey Highlights

⁵ http://knbs.or.ke/index.php?option=com_phocadownload&view=category&id=16&Itemid=563 Economic Survey Highlights

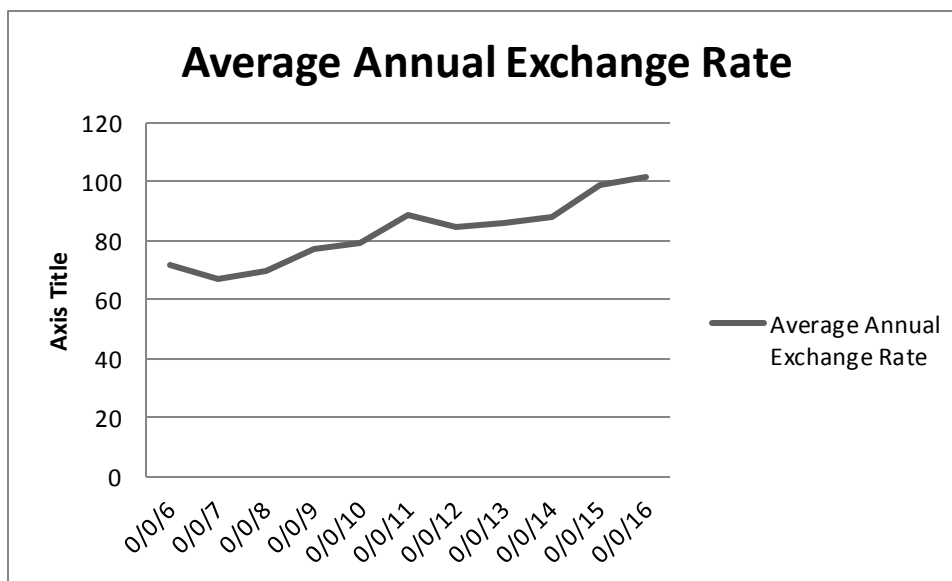
⁶ <http://www.businessdailyafrica.com/Lower-oil-prices-set-to-ease-Kenya-s-import-bill-in-2016/-/539546/3021446/-/sjembm/-/index.html>

commodity, accounting for 25 percent of the country's total imports. Kenya oil consumption stands at 4.5 million tonnes annually.⁷

1.1.2 TREND OF EXCHANGE RATE: KSH VS USD

The graph below illustrates the trend of the Kenya shilling exchange rate with the US Dollar:

Figure 2. Trend of the Kenya Shilling/US Dollar Exchange Rate from 2006-2007



Source: Central Bank of Kenya

The Kenya Shilling has recorded significant volatility against major currencies, including the US Dollar. In 2015, the Kenyan shilling appreciated slightly in the second half of September and at the beginning of October, after weakening to the lowest value in nearly four years and trading at 106.2 KES per USD on 7 September. In recent weeks, the shilling reversed the general downward trend that had been in place since the beginning of 2014. On 12 October 2015, the shilling traded at 103.1 KES per USD, which was 2.3% stronger than on the same day in September. Nevertheless, this was still 15.7% weaker than on the same day last year. Since the beginning of 2016, the shilling has lost 39 per cent of its value.

The recent appreciation of the shilling resulted from increased dollar inflows from investors who were attracted by rising yields on government securities. In addition, a shortage of shilling liquidity led to higher overnight lending rates. Nevertheless, the underlying factors that put the shilling under pressure over the course of the last year still remain in place: increasing strength of

⁷ <http://www.globaltimes.cn/content/947622.shtml>

the U.S. dollar, Kenya's large current account deficit and weakness in the tourism sector, which was adversely affected by security concerns over terrorist attacks.

1.1.3 EFFECT OF EXCHANGE RATE ON THE ECONOMY

A currency's level has a direct impact on the following aspects of the economy:

Merchandise trade:

This refers to a nation's international trade, or its exports and imports. In general terms, a weaker currency will stimulate exports and make imports more expensive, thereby decreasing a nation's trade deficit (or increasing surplus) over time.

A simple example will illustrate this concept. Assume you are a U.S. exporter who sold a million widgets at \$10 each to a buyer in Europe two years ago, when the exchange rate was EUR 1=1.25 USD. The cost to your European buyer was therefore EUR 8 per widget. Your buyer is now negotiating a better price for a large order, and because the dollar has declined to 1.35 per euro, you can afford to give the buyer a price break while still clearing at least \$10 per widget. Even if your new price is EUR 7.50, which amounts to a 6.25% discount from the previous price, your price in USD would be \$10.13 at the current exchange rate. The depreciation in your domestic currency is the primary reason why your export business has remained competitive in international markets.

Conversely, a significantly stronger currency can reduce export competitiveness and make imports cheaper, which can cause the trade deficit to widen further, eventually weakening the currency in a self-adjusting mechanism. But before this happens, industry sectors that are highly export-oriented can be decimated by an unduly strong currency.

Economic growth:

The basic formula for an economy's GDP is $C + I + G + (X - M)$ where:

C = Consumption or consumer spending, the biggest component of an economy

I = Capital investment by businesses and households

G = Government spending

$(X - M)$ = Exports minus imports, or net exports.

From this equation, it is clear that the higher the value of net exports, the higher a nation's GDP. As discussed earlier, net exports have an inverse correlation with the strength of the domestic currency.

Capital flows:

Foreign capital will tend to flow into countries that have strong governments, dynamic economies and stable currencies. A nation needs to have a relatively stable currency to attract investment capital from foreign investors. Otherwise, the prospect of exchange losses inflicted by currency depreciation may deter overseas investors.

Capital flows can be classified into two main types – foreign direct investment (FDI), in which foreign investors take stakes in existing companies or build new facilities overseas; and foreign portfolio investment, where foreign investors invest in overseas securities. FDI is a critical source of funding for growing economies such as China and India, whose growth would be constrained if capital was unavailable. Governments greatly prefer FDI to foreign portfolio investments, since the latter are often akin to “hot money” that can leave the country when the going gets tough. This phenomenon, referred to as “capital flight”, can be sparked by any negative event, including an expected or anticipated devaluation of the currency.

Inflation:

A devalued currency can result in “imported” inflation for countries that are substantial importers. A sudden decline of 20% in the domestic currency may result in imported products costing 25% more since a 20% decline means a 25% increase to get back to the original starting point.

Interest rates:

As mentioned earlier, the exchange rate level is a key consideration for most central banks when setting monetary policy. For example, former Bank of Canada Governor Mark Carney said in a September 2012 speech that the bank takes the exchange rate of the Canadian dollar into account in setting monetary policy. Carney said that the persistent strength of the Canadian dollar was one of the reasons why Canada’s monetary policy had been “exceptionally accommodative” for so long. A strong domestic currency exerts a drag on the economy, achieving the same end result as tighter monetary policy (i.e. higher interest rates). In addition, further tightening of monetary policy at a time when the domestic currency is already unduly strong may exacerbate the problem by attracting more hot money from foreign investors, who are seeking higher yielding investments (which would further push up the domestic currency).

1.2 PROBLEM STATEMENT

Oil imports represent a significant fraction of the trade balance for energy-dependent economies. Variability in oil prices is expected to have a large impact on the relative value of the currency in the case of small open economies. Since oil contracts are denominated in US dollars, changes in the price of oil have significant implications for the demand and supply of foreign exchange. In the past there has been fluctuating international oil prices, high demand for oil, and the exchange rate between the Kenyan currency against the major international currencies such as the U.S dollar fluctuating have worsened the oil import bill for Kenya. This in turn has led to adverse balance of payments.

However, with recent developments showing the falling price of oil between the periods 2014-2016, there has been an improvement in the trade balance due to increased exports and a decline in imports. If we are importing oil at a cheaper price then the Kenyan Shilling is expected to strengthen against the dollar considering the fact that importation of petroleum products account for 15.3 per cent of the country's import bill in the period 2015 according to KNBS. However, the Kenyan currency has been reported to be weakening against major currencies including the US dollar.

Is there a rational fundamental explanation for the behavior of the foreign exchange market, or is it a matter of traders responding to what other traders arbitrarily think? It is difficult to resolve this question, but some insight can be provided through an analytical examination of the relationship between oil price increases and exchange rates. This paper uses the case of Kenya, an energy-dependent emerging economy with a floating exchange rate, to illustrate this connection.

1.3 RESEARCH OBJECTIVE

This research intends to determine the following:

- i. What is the relationship between the price of oil and the exchange rate?
- ii. Is the conditional volatility of global oil prices and the exchange rate significantly related?

1.4 JUSTIFICATION

This study provides useful information concerning the volatility of oil prices both internationally and locally, the factors that affect it and how this affects the exchange rate. Petroleum products take up a large section of Kenya's imports. Since the price of oil affects the exchange rate it is important that we understand the type of relationship that exists, that way we are able ensure the Kenya shilling strengthens against other currencies which should make imports cheaper and hopefully forecast the exchange rate, either in the long-term or short-term period. Also, The findings of this study is expected to help financial institutions understand what the fall(rise) of oil prices means and how that information can be of use to them in the money market.

The study also adds to the existing literature and acts as a basis for scholars who will conduct related research in the future.

The government is expected to benefit from the results of the study by using them to formulate and effectively enforce the fiscal and monetary policies that will help stabilize the currency. These expositions therefore justified the importance of this study.

CHAPTER 2: LITERATURE REVIEW

Literature exploring the relationship between the international price of oil and the exchange rate can be grouped into two: the first is concerned with the impact oil prices have on exchange rates of energy-dependent large industrial economies, the second looks at the relationship between oil prices and exchange rates in oil-producing countries and lastly the possibility of forecasting exchange rates using oil prices.

RELATIONSHIP BETWEEN OIL PRICES AND EXCHANGE RATES

2.2 Impact oil prices have on exchange rates of energy-dependent large industrial economies

A comprehensive study of how oil prices impact exchange rates in Western economies is provided by Amano and van Norden (1998). These authors examine whether changes in the price of oil have permanent impacts on the real exchange rates for the United States, Germany, and Japan. They argue that supply-side shocks, which cause huge swings in the price of oil, are likely to translate into permanent shifts in the long-term real exchange rate equilibrium. Their research design consists of a two-step process that first analyzes the potential cointegration of oil prices and exchange rates and then explores the direction of causality. They find the monthly time series of oil prices and exchange rates between 1973 and 1993 for the aforementioned countries to be cointegrated and conclude that the direction of causality moves from oil prices to the real exchange rate. Amano and van Norden also consider the case of inverse causality; in other words, whether it is the real exchange rate which is responsible for variation in the price of oil. They find no evidence to support this conclusion. With an expanded data set comprising 16 OECD member countries and encompassing the 1973 to 1996 period, Chaudhuri and Daniel (1998) reach similar conclusions. These authors, employing cointegration techniques, concluded that the non-stationarity of the US dollar real exchange rate can be attributed to the non-stationarity in the real price of oil and interpret the cointegrating vector as the long-run equilibrium real exchange rate.

2.2 Impact of Oil prices on Oil Exporting Countries

The literature on the relationship between oil prices and exchange rates in oil producing countries covers a variety of economics. Theoretically it is established that an oil-exporting country may experience exchange rate appreciation when the price of oil rises, and depreciation when the oil prices fall (Golub)

(Oyundipe, 2013) Examined the effects of oil price, external reserves and interest rate on exchange rate volatility in Nigeria using annual data covering the period 1970 to 2011. The theoretical framework of this study is based on Generalized Autoregressive Conditional Heteroscedastic modeled by Tim Bollerslev (1986) and Exponential General Autoregressive Conditional heteroskedastic modeled by Daniel Nelson (1991). These models were used to estimate the relationship between oil price changes and exchange rate. Relevant descriptive and econometric analyses were employed. The econometric tests adopted include the unit root tests,

Johansen co-integration technique and the Vector Error Correction Model (VECM); the time series property examined shows that all the variables were stationary at first difference. The long run relationship among the variables was determined using the Johansen Cointegration technique while the vector correction mechanism was used to examine the speed of adjustment of the variables from the short run dynamics to the long run. It was observed that a proportionate change in oil price leads to a more than proportionate change in exchange rate volatility in Nigeria; which implies that exchange rate is susceptible to changes in oil price.

(J, 2004) Examined the influence of international price of oil and the real exchange rate in Russia's economy for the period 1995-2002. (J, 2004) chooses a different methodological approach from what has been done before that employs cointegration analysis, vector autoregression and vector error correction model. (J, 2004) makes quarterly observations of Russia's GDP, federal government revenues, real exchange rate of the Ruble and North Sea Brent crude oil prices are used as well. He then concludes that both international prices of oil and real exchange rate significantly affect Russia's output and fiscal revenues. However, (J, 2004) does not fully pursue the question of causality between the relationship of oil prices and exchange rates. This issue is explored in more details by (Akram) 2004.

The studies made of the Norwegian exchange rate find a numerically weak relationship between oil prices and the value of the Krone (see, Akram and Holter 1996, Bjørvik *et al* 1998). Norway is a major-oil exporting country. According to (Akram) the paper investigates whether oil prices have non-linear effects on the Norwegian exchange rate and whether allowance for non-linear effects enables us to explain major fluctuations in the Norwegian exchange rate. These fluctuations occurred in the context of exchange rate stabilization policy in most of the post Bretton Woods period. Tests reveal a non-linear negative relationship between the value of the Norwegian Krone and crude oil prices for the 1990-2000 period, especially when oil prices are below 14 USD. In other words: when the world price of oil rises the exchange rate between the Norwegian krone and the US dollar decreases, indicating an appreciation of the krone. Akram (2004) designs a linear equilibrium correction model that controls for trade and financial factors impacting the Norwegian exchange rate and concludes that the short-run oil price effects are much more significant than the long-run oil price effects

(Jahan-Parvar) Examines the validity of the 'Dutch disease' hypothesis by examining the relationship between real prices and real exchange rates in a sample of 14 exporting countries. They took interest in the 'Dutch disease' hypothesis due to the sharp increase in oil prices in the period 2001-2011. According to the hypothesis the inflow of oil windfalls into an oil exporting country may cause appreciation of the real exchange rate, reduce its competitiveness in the non-oil exporting sector, and limit its ability to build a diversified export. Earlier literature showing evidence of Dutch disease has not been conclusive. Taylor *et al.* (1986) finds a negative relation between Nigerian agricultural exports and its oil export revenues. (P.G, 1986) concludes that higher oil revenues enabled the Indonesian government to defer the much-needed currency

devaluation in the 1970s, and were the primary source of subsequent financial problems. (J.M, 1997) find significant demand and cost-of-living effects following the intensive build up period of the Norwegian petroleum sector, suggesting that Norwegian petroleum sector has been the culprit for the country's weak manufacturing performance. In contrast, (H.C, 1998) finds evidence of weak response in UK's manufacturing but positive and significant response in Norwegian manufacturing in response to oil and gas sector shocks.

(Jahan-Parvar) concludes that the application of the ARDL testing methodology to monthly data from fourteen oil exporting countries reveals the existence of stable long-run relations between real exchange rates and real oil prices in all countries consistent with Dutch disease hypothesis. Additionally, they uncover evidence of unidirectional short-run causality from oil prices to exchange rates in four countries, from exchange rates to oil prices in two countries, and bidirectional causality in four countries. There is no evidence of short-run causality in the remaining four countries. The implication of their findings is that the probability of Dutch Disease problem has not diminished over time, especially in developing countries.

In the case of the Scandinavian countries between 1975 and 2001, (Bergvall) considers both supply and demand factors determining the real exchange rate. Using an inter-temporal optimizing model and variance decomposition he shows that terms-of-trade shocks are most influential for the real exchange rates of Denmark and Norway in the long-run, and demand shocks are most influential for the real exchange rates of Sweden and Finland in the long-run. In that light, he finds that a decrease in the real price of oil lowers the real exchange rate of the Danish, Finish and Swedish currencies against a basket of currencies. The Scandinavian currencies appreciate when oil prices fall because the aforementioned countries are energy dependent – net oil importers. It follows that an increase in oil prices, signaling a deterioration of the terms of trade, will raise the Scandinavian exchange rates –depreciating the Northern European currencies. Simultaneously, he concludes that a decrease in the real price of oil raises the real exchange rate of the Norwegian krone against a basket of currencies. The Norwegian currency depreciates when oil prices fall because Norway is an oil exporter. It follows that an increase in oil prices, signaling in this case an improvement of the terms of trade, will lower the Norwegian exchange rate, thus appreciating the krone. This finding match (Akram)–see above.

Focusing on Latin American countries, (Joyce J. P., 2003) look at real and nominal factors that determine the real exchange rates in Argentina from 1976 to 1995; Colombia from 1971 to 1995 period; and Mexico from 1976 to 1994. Their research uses cointegration analysis in order to build a vector error correction model. They conclude that nominal factors significantly affect the real exchange rate, but that this only occurs in the short-term: long-term exchange rates are determined by real factors. The authors find that, especially in Colombia and Mexico, shocks to the terms of trade and to the growth rate of productivity significantly affect the real exchange rate. Since these two countries are highly dependent on their commodity exports (coffee and oil,

respectively) we can draw a link between international oil prices and the exchange rate of the Mexican peso. The Mexican case will be similar to Norwegian experience, where a deterioration of the terms of trade (i.e. a fall in the price of oil) depreciates the domestic currency (i.e. raises the exchange rate). In the case of Argentina the impact on exchange rates shocks to the terms of trade and productivity is smaller than in the other two economies.

2.3 Impact of oil price on Exchange rate for Oil Importing Countries

(Courage, 2014) investigate the impact of oil prices on the nominal exchange rate. The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) test was performed to determine the impact of oil prices on nominal exchange rate using monthly time series data covering the period between 1994 and 2012. The results show that oil prices have a significant impact on nominal exchange rates. In addition, the findings reveal that an increase in oil prices leads to a depreciation of the rand exchange rate. This implies that oil prices are a very important variable in determining the strength of the currency and its volatility.

2.1.4 Impact of Exchange Rate on Oil prices

Finally, some literature finds a causal relationship between changes in the value of the U.S. dollar and the international price of oil. In other words, these papers find that under specific circumstances it is the exchange rate that drives oil prices, instead of the other way around. Both Brown and Phillips (1986) and Cooper (1994) study the 1980-1984 periods, during which the US dollar appreciated and the US-dollar denominated international price of oil decreased. Brown and Phillips (1986) perform a simulation exercise showing that had the value of the US dollar remained relatively constant, the international price of oil would have fluctuated less than it actually did. Although this direction of causality does not hold in the long-run, Cooper (2004) confirms it during the 1980-1984 period when the US dollar appreciated (lowering oil prices) and the 1985-1987 when the US dollar depreciated (and oil prices rose).

2.1.5 Conclusion

Overall, the literature is mostly focused on large economies and oil-exporting countries. Articles devoted to small, open-economy, oil-importing countries are much scarcer. This paper contributes to the literature by surveying the effects of international oil prices on floating real exchange rates in the case of a developing small open economy experiencing growing energy dependence.

CHAPTER 3: METHODOLOGY

3.0 INTRODUCTION

This Chapter analyses the methodology used in examining the relationship between oil prices and Exchange rate in Kenya. The chapter begins with the research design of the study, then the study area, data source, data diagnostic and finally the model specification.

3.1 RESEARCH DESIGN

This research is aimed at establishing the relationship between oil prices and exchange rates for an oil-dependent developing country such as Kenya. The study uses a time-series research design in examining the relationship between changes in oil prices and exchange rate. The exchange rate is dependent on Inflation, and Interest rate among other factors that include the price of oil. We mainly want to determine how significant the impact of oil price on the exchange rate is.

3.2 POPULATION AND SAMPLING

Population

The research focuses on oil-importing countries in Africa. In this case, Kenya is the subject of the study and is considered representative of the energy-dependent market in Africa.

Sampling

Historical data relating to international oil prices, foreign exchange rates between the Kenya Shilling and the dollar, Inflation and Interest rate were sampled from April 2000 until April 2016. This was considered sufficient for analysis as this period is long enough to make conclusive observations.

3.3 DATA SOURCE

Data was obtained from a Secondary Source: Central Bank of Kenya (Interest Rate, Kenya Shilling against the US Dollar), Kenya National Bureau of Statistics (Inflation), and World Bank (Commodity Markets Data). The study used monthly data for each of the variables mentioned above for sixteen years.

3.4 DIAGNOSTIC CHECKING

3.4.1 Testing for Stationarity

To examine the existence of stationarity in the series, a unit root test is carried out for each of the variables through the Augmented Dickey-Fuller test. The test is as follows:

- i. Open the work file in E-views, then open one of the data series and view the unit root test.
- ii. The hypothesis is: H_0 : Has a unit root
 H_A : Has no unit root
- iii. If p-value > 0.05, accept H_0 , i.e. unit root test exists, therefore the data is non-stationary.
If p-value < 0.05, reject H_0 , i.e. unit root does not exist and therefore data is stationary.

3.4.2 Testing for Autocorrelation

To test for autocorrelation we do a diagnostic test on the regression equation using Ljung-Box Statistic, or the correlogram. We look at the Q-statistic and the probability value to determine if there is autocorrelation in the residuals. The hypothesis test is as follows:

H_0 = no autocorrelation

H_A = There is autocorrelation

If the Q-statistic is significant with small p-values then we reject the null hypothesis, H_0 because there is autocorrelation. However if the Q-statistic is insignificant with large p-values then we accept the null hypothesis.

3.4.3 Testing for Heteroscedasticity

To test for heteroscedasticity we run a diagnostic test on the regression equation. For this study we used Correlogram of squared residuals. H_0 : There is homoscedasticity.

If p-value < 0.05 fail to reject H_0 , i.e. there is homoscedasticity.

If p-value > 0.05 reject H_0 , i.e. there is heteroscedasticity.

3.4.4 Normality Test

We use the Jarque-Bera test of skewness and kurtosis to test for Normality. The H_0 : there is a normal distribution. If p-value is < 0.05, reject the null hypothesis and vice versa.

3.5 MODEL SPECIFICATION

First, the unit root test was carried out for each of the variables to check for their stationarity. Other diagnostic tests (as described above) are carried out to observe any violations of OLS assumptions. And lastly, the relationship between the variables was determined using OLS. We also introduce a GARCH framework into the analysis to estimate the conditional volatilities of Oil Prices and Exchange Rates and thereafter, carry out a linear regression model to estimate the relationship between the conditional volatilities of the two variables.

The model that is used to determine the relationship between oil price and exchange rate is:

$$EXC_t = \beta_0 + \beta_1 OP_t + \beta_2 INT_t + \beta_3 INF_t + \beta_4 GDP_t + \varepsilon_t$$

Where,

$EXC_t =$ Nominal Exchange Rate

$OP_t =$ Oil Price

$INT_t =$ 91 day T – Bill rate

$INF =$ Inflation Rate

$\varepsilon_t =$ error term

This model will determine how the selected variables (interest rate, oil prices, and inflation) impact on the exchange rate using monthly data.

For the GARCH model we will have the following equations:

Mean Equations

We specify the mean equations for the two variables (oil prices and exchange rates) as Autoregressive Models of order 1, as seen below:

$$EXC_t = \alpha_0 + \alpha_1 EXC_{t-1} + \varepsilon_t$$

$$OP_t = \alpha_0 + \alpha_t OP_{t-1} + \varepsilon_t$$

Variance Equation

Bollerslev (1986) generalised the ARCH (q) model to the GARCH (p, q) in which the conditional variance depends upon both the squared residuals and its own lagged value, which can be written as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2$$

Where,

σ_t^2 = Conditional Variance

ε_{t-1}^2 = lagged squared residuals

σ_{t-1}^2 = Previous period conditional variance

The equation above is used to estimate the heteroscedasticity effect on Oil Price and Exchange Rate market volatility. Given the parameters from the model, we will be able to extract time series data on conditional volatilities of both variables.

Given this data, we will estimate the relationship between the conditional volatilities of the two variables using the linear model specified below:

$$\sigma_{t(NEXC)}^2 = \beta_0 + \beta_1 \sigma_{t(OIL)}^2$$

Here, the study tests the null hypothesis that conditional volatility of two variables is not significantly related, i.e. $H_0: \beta_0 = 0$. This was tested against the alternative hypothesis, $H_a: \beta_0 \neq 0$, that conditional volatility of two variables is significantly related.

CHAPTER 4: RESULTS AND FINDINGS

This chapter gives us the results obtained from running tests on the Model specification and the interpretation of the results with regards to the study in order to make conclusive answers to the research questions in Chapter 1.

4.1 STATIONARITY TEST

To test for the existence of non-stationarity in the data series, the study establishes the order of integration of individual time series through the ADF Test.

The results are presented in Table 1:

Table 1: Results from the Augmented Dickey-Fuller Test

<p>• OIL PRICE</p> <p>Null Hypothesis: BRENT_CRUDE_OIL_PRICES__ has a unit root Exogenous: Constant Lag Length: 1 (Automatic - based on SIC, maxlag=14)</p>		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.980643	0.2953
<p>Null Hypothesis: D(BRENT_CRUDE_OIL_PRICES__) has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=14)</p>		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-9.131352	0.0000
<p>• INFLATION</p> <p>Null Hypothesis: INFLATION has a unit root Exogenous: Constant Lag Length: 13 (Automatic - based on SIC, maxlag=14)</p>		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.030762	0.0340
<p>• INTEREST RATE</p> <p>Null Hypothesis: INTEREST_RATE has a unit root Exogenous: Constant Lag Length: 1 (Automatic - based on SIC, maxlag=14)</p>		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.146054	0.0249

• **EXCHANGE RATE**

Null Hypothesis: KSH_USD has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic - based on SIC, maxlag=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-0.950561	0.7702

Null Hypothesis: D(KSH_USD) has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=14)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-11.38690	0.0000

Table 1 shows that oil prices and the exchange rate become stationary after the first difference therefore they have a unit root and are integrated of order one. Interest rate and Inflation do not have a unit root, therefore they are stationary.

4.2 DIAGNOSTIC TEST

Three diagnostic tests were carried out: the Correlogram of squared residuals, Normality test and the ARCH test.

- TESTING FOR AUTOCORRELATION

The presence or absence of autocorrelation in the residuals was tested using the Q-statistic. The results from the test are shown in Table 2. The Q-statistic is significant with small probability values, hence we reject the null hypothesis, i.e. $H_0 = no\ autocorrelation$. Thus, there is autocorrelation. **Table 2: Correlogram of standardized residuals-Q-statistic**⁸.

Although with autocorrelation the OLS remains unbiased, the standard formula for standard errors of OLS estimates are wrong. For this reason it is important to correct this when specifying the regression in Eviews by clicking the OPTIONS tab, check the “Coefficient Covariance Matrix” box and select “HAC (Newey-West)” which gets consistent estimates of the standard errors.

- NORMALITY TEST

The test statistic that is used to test the normality of residuals is Jarque-Bera test of skewness and kurtosis. The results from the normality test are presented in Table 3.

Table 3: Normality Test

Skewness	1.614462
Kurtosis	10.21661
Jarque-Bera	502.6479
Probability	0.000000

The probability value is insignificant. If the probability value is less than the critical values then reject the null hypothesis, $H_0 = normal\ distribution$. Also for a normal distribution Skewness=0 and Kurtosis=3. In order to correct this we introduce Logs in our equation.

- HETEROSCEDASTICITY

To check for presence of heteroscedasticity in the residuals, and ARCH test was conducted. Results are shown in Table 4.

⁸ Check Appendix A

Table 4: Heteroscedasticity Test: ARCH

Heteroscedasticity Test: ARCH

F-statistic	2.319459	Prob. F(1,189)	0.1294
Obs*R-squared	2.315586	Prob. Chi-Square(1)	0.1281

There is presence of heteroscedasticity therefore we reject the null hypothesis of homoscedasticity. Consequences of heteroscedasticity are that the variance of the OLS estimators is inflated and the standard errors become larger than usual but, the OLS remains unbiased. This can be corrected by getting consistent estimates of the standard errors using the HAC (Newey-West) option just like for autocorrelation.

4.3 REGRESSION ESTIMATION

The method used to estimate the relationship between the variables is the Least Squared method (LS). The results of this estimation are presented in Table 5 below.

Table 5: Estimation of Equation

Dependent Variable: DLOGEXC

Method: Least Squares

Date: 01/24/17 Time: 12:50

Sample (adjusted): 2000M05 2016M04

Included observations: 192 after adjustments

HAC standard errors & covariance (Prewhitening with lags = 0 from SIC
maxlags = 5, Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.615304	0.489934	1.255892	0.2107
DLOGBRENT	-0.057239	0.021617	-2.647830	0.0088
INFLATION	0.009341	0.038853	0.240410	0.8103
INTEREST_RATE	-0.067797	0.045098	-1.503333	0.1344
R-squared	0.049886	Mean dependent var		0.136901
Adjusted R-squared	0.034724	S.D. dependent var		1.807457
S.E. of regression	1.775799	Akaike info criterion		4.006991
Sum squared resid	592.8509	Schwarz criterion		4.074856
Log likelihood	-380.6712	Hannan-Quinn criter.		4.034477
F-statistic	3.290297	Durbin-Watson stat		1.722152
Prob(F-statistic)	0.021829	Wald F-statistic		2.495859
Prob(Wald F-statistic)	0.061219			

From the results in Table 5, DLOGBRENT which is the differenced log of oil prices, is the only variable that is significant at 5%. From the estimation of the coefficients we see that oil price and interest rate coefficients have a negative sign which means that they have an inverse relationship with the exchange rate. If oil prices are high, the exchange rate is low. This means that when the Brent crude oil prices are high in the US the US dollar depreciates causing the exchange rate here in Kenya to depreciate thus strengthening the currency and making the Kenya Shilling stronger relative to other currencies.

For the case of interest rates, when they are high it encourages foreign investors to come and invest due to high returns. Due to the large demand of the Kenya Shilling, the exchange rate is depreciated which in turn strengthens the currency.

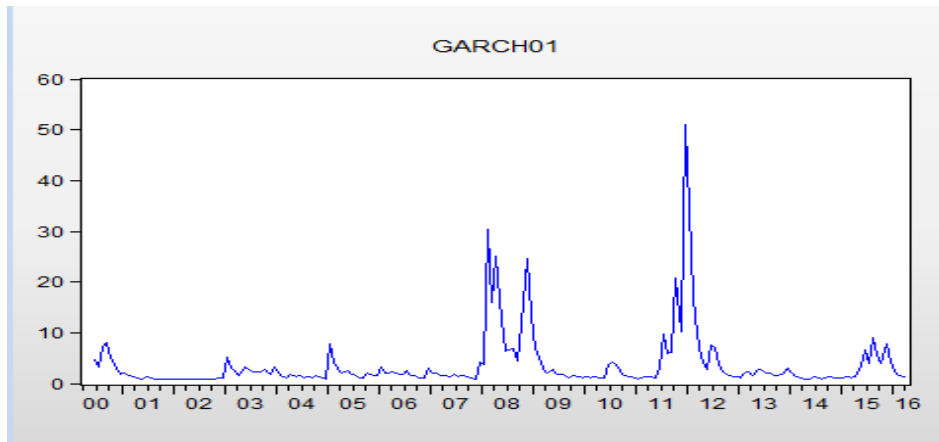
The inflation coefficient has a positive sign, which means that when inflation is high, exchange rate increases as well due to the fall in purchasing value of money which discourages foreign investors from investing in the country.

Since we used logarithm we must look at the elasticity of each coefficient. If Brent oil prices increase by 1% then the Exchange rate will increase by -0.057239%. If Inflation increases by 1%, Exchange rate will increase by 0.9341%. If Interest rate increases by 1% then Exchange rate will increase by -6.7797%.

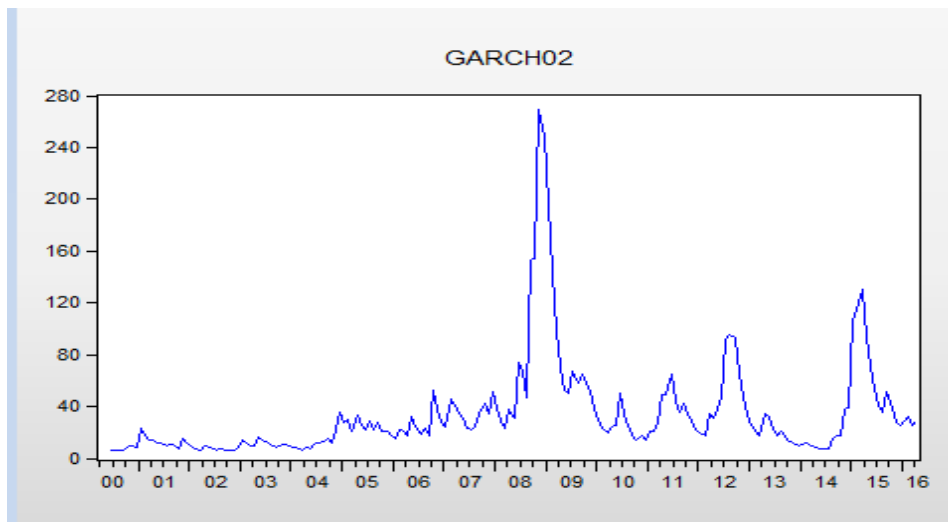
4.4 GARCH TEST

For the GARCH we used the variance equations in order to determine the conditional volatilities. The graphs below represent the GARCH variance series of the conditional volatilities:

Graph 1: Conditional volatility of Exchange Rate



Graph 2: Conditional volatility of Brent Oil Price



From visual observation we can see that in 2008 volatility in brent oil prices as well as the exchange rate spiked upwards gives evidence of a relationship between the two variables.

Using a linear regression model, we were able to estimate the relationship between the conditional volatilities of the two variables. The results are seen in Table 6 below:

Table 6: Regression of the Conditional Variance

Dependent Variable: DEXC_CONDVAR
 Method: Least Squares
 Date: 01/23/17 Time: 17:48
 Sample (adjusted): 2000M06 2016M04
 Included observations: 191 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.373234	0.570005	4.163536	0.0000
BRENT_CONDVAR	0.038995	0.011232	3.471640	0.0006

From the table above we accept the null hypothesis, $H_0: \beta_0=0$, because the p-value of the constant term is significant, therefore the conditional volatilities of exchange rate and oil prices are significantly related. This implies that oil prices can be used in determining the volatility of the exchange rate in Kenya.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

The paper investigates whether there is a relationship between global oil prices and the nominal exchange rate in Kenya. The study has applied unit root test, diagnostic tests, OLS and GARCH test to prove evidence of a relationship between nominal exchange rate, interest rate, inflation and the Brent crude oil price for the period April 2000- April 2016. The inclusion of interest rate, inflation and oil price as determinants of exchange rate seem to provide a reasonable model to explain the behavior of the exchange rate in Kenya. GDP would also be a good fit but unfortunately there was no monthly data available.

First, the tests found non-stationarity for exchange rate and oil prices because the series contain unit root and fail to reject the null hypothesis of unit root test at 5% significance level. Both inflation and interest rate are stationary.

Second, the diagnostic tests for autocorrelation, normality and heteroscedasticity were conducted. There was autocorrelation among the residuals, the model did not have a normal distribution because the $p\text{-value} < 0.05$ and there was heteroscedasticity.

Thirdly, we estimate the coefficients of the model in order to determine the relationship between oil price and exchange rate using OLS. Logarithm was introduced to correct for non-normality and “HAC (Newey-West)” in the OPTIONS Box to get consistent estimates of the standard errors thus correcting for autocorrelation and heteroscedasticity.

Lastly the GARCH test was conducted to determine the conditional volatilities for the variance equation and also determine the relationship between the two conditional volatilities using linear regression.

In conclusion we find that there is a relationship between global oil prices and the Kenyan Shilling, although its impact is very small (-0.057239%). From the results and findings we see that the model for estimating the relationship between Global oil prices and the Kenyan Exchange Rate against the dollar is significant and we see that they have an inverse relationship with each other. If the Brent crude oil price increases, the exchange rate against the dollar depreciates which means that the Kenyan currency is stronger and when the oil prices are low the currency weakens because the exchange rate appreciates.

Also we found that the conditional volatilities of exchange rate and oil prices are significantly related which means that there is a likelihood that the relationship between the two variables is likely to be attributable to a specific cause and not by chance or randomly.

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APPENDIX

APPENDIX A: Table 2: Correlogram of standardized residuals-Q-statistic

	AC	PAC	Q-Stat	Prob
1	0.135	0.135	3.5459	0.060
2	-0.150	-0.171	7.9289	0.019
3	0.021	0.071	8.0140	0.046
4	0.024	-0.017	8.1273	0.087
5	-0.121	-0.114	11.030	0.051
6	-0.065	-0.027	11.873	0.065
7	-0.035	-0.063	12.114	0.097
8	0.043	0.056	12.496	0.130
9	-0.003	-0.030	12.498	0.187
10	-0.065	-0.059	13.360	0.204
11	-0.047	-0.046	13.806	0.244
12	0.108	0.095	16.215	0.182
13	0.021	-0.016	16.303	0.233
14	-0.003	0.034	16.305	0.295
15	0.069	0.053	17.320	0.300
16	0.131	0.102	20.931	0.181
17	-0.037	-0.041	21.219	0.217
18	-0.081	-0.031	22.624	0.205
19	-0.028	-0.017	22.798	0.246
20	0.046	0.044	23.256	0.276
21	-0.031	-0.020	23.461	0.320
22	-0.009	0.027	23.478	0.375
23	0.045	0.036	23.930	0.408
24	0.003	-0.037	23.932	0.466
25	-0.049	-0.017	24.461	0.493
26	0.031	0.049	24.675	0.537
27	-0.029	-0.055	24.861	0.582
28	0.037	0.044	25.176	0.618
29	0.079	0.057	26.601	0.593
30	-0.051	-0.069	27.187	0.613
31	0.024	0.071	27.326	0.656
32	0.101	0.042	29.683	0.584
33	0.032	0.067	29.926	0.621
34	-0.048	-0.023	30.476	0.641
35	0.088	0.106	32.301	0.599
36	0.155	0.128	38.016	0.378