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# The Effect of Oil Price on Exchange Rate in Ghana

**By**

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## DECLARATION

I hereby declare that this submission is my own work towards the degree of Master of Science (Economics) and that, to the best of my knowledge; it contains no material previously published by another person, nor material which has been accepted for the award of any other degree of the University, except where acknowledgement has been made in the text.

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## DEDICATION

I dedicate this project to the Almighty Allah for favoring me with wisdom and my parents for their understanding and support.

## ACKNOWLEDGEMENT

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## ABSTRACT

The aim of the research was to find out the relationship between exchange rate and oil prices. The study test for the presence unit root was found using the ADF test and the PP test procedure at levels but the variables became stationary after the first difference. Oil price showed a lot of volatility but the trend of the movement of exchange rate did not fluctuate as much since it was contant during some periods. However, both trends kept on increasing moderately with oil price change being lower than exchange rate. The study employed the Vector Error Correction Model (VECM). The secondary data employed consist of monthly time series data sampled over the period of January 2000- May 2015.

The cointegration results showed that the variables are cointegrated hence have a long run equilibruim relationship. The short run estimation, the results shows that, past period value of real exchange rate imposes a positive and significant impact on the current level of exchange rate. The short run coefficient of oil price is positive but insignificant. Inflation has a negative and significant effect on exchange rate. The long run results show that, oil price has a positive and significant effect on exchange rate in Ghana. Inflation on the other hand has a negative and significant long run effect on exchange rate. The study recommends the storage of oil when the price is relatively low and hedging to reduce the risk associated with increase in oil price.

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# CHAPTER ONE

# INTRODUCTION

## 1.0 Background to the Study

Ghana, like every other nation, needs oil as a vital ingredient in achieving a sustainable growth. It is a bulk commodity which is heavily associated with household and the nation's economic empowerment. Oil occupies about 40% of annual global consumption of energy. About 24% of energy consist of oil, while 69.5% and 6.4% are made up of biofuels and hydro respectively (IEA, 2012).The sector for production of the economy Ghana depends heavily on oil as their major energy source. The agricultural sector alone consists of 96.7% of energy being oil, the formal manufacturing occupies 52% and transport is 92% (Armah, 2003). The impact of oil on other macroeconomic variables could be negative or positive.

The demand for oil consumption in Ghana keeps on increasing and because of its important role in the economy, the country rely largely on importation to keep up with its demand and this makes it vulnerable to the changes in international prices of the commodity. The increase in oil internationally is borne in the economy through the movement of exchange rate. Dawson (2007) showed that for an oil importing country, the increases in oil prices results in the depreciation of its domestic currency since more of the invoicing currency would be needed to purchase the same amount of oil as before. The changes in real oil prices have been found to be the dominant source of the movement of real exchange rate (Chen and Chen 2007).

Frequent fluctuations of inflation and oil price affect a countries exchange rate as well as the growth rate of that economy. This is one of the core reasons why countries such as Ghana need to examine their relationships. For example, the economy was interrupted in 2000 when the price of oil per barrel increased to $27.39 with an inflation rate of 25.19%. That same period saw an increase in the exchange rate (depreciation of the cedi) at 49.8%. The prices of oil then decreased and fluctuated moderately during the following years till 2005 when it shot up again averaging $50.04 per barrel. Inflation on the other hand decreased to 15.12% in 2005 while exchange rate fell from 49.8% in 2000 to 17.7% in 2005. The prices of inflation kept fluctuating as oil price also kept on fluctuating within the years with a barrel of oil averaging $91.17 in 2013 and $85.60 by the end of 2014 **(**BoG, 2001, 2006, 2014**,** 2015 and Hamilton, 2011**)**. Exchange rate on the other hand is not left out since it turns to be affected by changes in inflation and exchange rate.

Oil is vital since it is a source of energy and revenue to the country which is widely used in the production of goods and service. Its contribution to the growth of the country's GDP is significant. For instance, without the inclusion of oil production, the growth of real GDP was 9.4% in 2011 which reduced to 3.9% in 2013(Appiah-Adu and Bawumia, 2015). Though the prices of oil declined in the global market in the year 2014, the domestic prices were not reduced but kept on increasing instead. During this same period, the exchange rate had been experiencing high levels of volatility. Therefore, it is interesting to study the relationship between inflation, oil price and exchange rate due to their significant contribution to the development of the Ghanaian economy.

## 1.1 Statement of the Problem

The Ghanaian economy's exchange rate system has witnessed many ups and downs. Available data shows that the movement of the exchange rate has been constant for most periods but fluctuates in other periods. In the year 2000, the cedi saw a depreciation of 49.8% against the US Dollar which reduced to 13.2% in 2002. Depreciation of the cedi increased in 2008 to 20.1%. During the third quarter of 2012, the cedi saw a depreciation of 18% and a cumulative of 14.6% by the end of 2013. By the end of the second quarter in 2014, there was a depreciation of the cedi of 26.1% and an average of 31.2% by the end of that year. Undoubtedly, the economy of any country is affected by the movement of exchange rate. Inflation in 2000 was 40.50% which declined moderately afterwards. In 2005, inflation was 14.80% and increased to 18.13% in 2008.The growth of GDP has been declining over the years from 15.0% in 2008 to 7.9%in 2012. The poor growth continued to 5.0% by the end of 2013 (BoG, 2001, 2002, 2006, 2009, 2013, 2014)

The problem arising from frequent depreciation and increasing oil price is that, it affect the overall growth rate in the economy. Thus, the Ghanaian economy has gone through poor growth rates during periods of oil price volatility. There was an average decline in GDP per capita of over 3% a year between 1973 and 1983 (Fosu and Aryeetey, 2008). This economic misfortune was partly due to the shocks to the prices of oil (Aryeetey and Harrigan, 2000). During this era, oil prices increased from $2.48 per barrel in 1972 to $11.58 per barrel in 1974 and to $36.83 per barrel in 1980 (Hamilton, 2011). To fully attribute the recession of the economy during this term to the nature of oil price movement would be improper since the instability of the

Ghanaian politics, and the mismanagement of the economic at its peak play a major role.

This term of misfortunes of the economy and shocks to the prices of oil was followed by reforms in the country's economy and relatively low prices of oil. There was then a stable growth due to this development and the growth of the country's GDP averaging about 5% annually since the commencement of democracy in1993 (Killick,2010). Not only does the fluctuation of oil price affected the economy of Ghana, available evidence shows that the rate at which inflation change have impact on exchange rate as well ( Kojima, 2009, and Mhango, 2010). The question is: how does oil price influence the behaviour of exchange rate in Ghana? An answer to this question is key for policy purposes and hence need to be empirically proven.

It should be noted that not only does oil price affect exchange rate, frequent depreciation of the country's currency has implication on growth, international trade and the rate of capital inflows into the economy. For example, frequent fall in the exchange rate would increase a country's export, all other things being equal. Again, frequent fluctuations in exchange rate due to unstable oil price and inflation can affect the capital inflows and also mitigate the rate of foreign direct investment since investors are likely to invest in countries with stable exchange rate.

It is therefore important to stress that, such a small open economy developing country, Ghana, which does not control the world price of oil, there is high probability for exchange rate to change when the prices of oil goes change. Again, when inflation changes relative to the rest of the world, it turns to influence the behaviour of the economies exchange rate. However, and most importantly, the true impact of oil price on exchange rate is not known for certainty hence this study is worth taken. This is

important since most existing literature focused on few macroeconomic variables when examining the behaviour of exchange rate leaving oil price out of their equation ( see for instance: Cote, 1994, and Insah and Chiaraah, 2013). Although in Ghanaian literature, exchange rate has been examined in terms of the factors that determines its behaviour **(**Bawumia, 2014**)** relatively scarce literature are available on the impact of oil price on exchange rate. while existing studies focused on the direction of flow between oil price and exchange rate, this study will not only focus on the causality between the two variables, the short and long run effect of oil price and inflation on exchange rate were analyzed.

### 1.2 Objectives of the study

The main aim of this study is to analyze the effect of oil price and inflation on exchange rate in Ghana.

Specifically, the study intends to accomplish the following objectives:

- To find out the correlation between oil price and exchange rate
- To find out the response and magnitude of oil price on exchange rate
- To find out the causality between oil price and exchange rate in Ghana
- To find out the effect of inflation on exchange rate in Ghana

### 1.3 Hypothesis of the study

The researcher seeks to test these hypotheses which are based on the research objectives

- $H_o$ : there is no significant relationship between oil price and exchange rate in Ghana

  $H_1$: there is a significant relationship between oil price and exchange rate in Ghana

- $H_o$ : there is no significant relationship between inflation and exchange rate in Ghana

  $H_1$: there is a significant relationship between inflation and exchange rate in Ghana

- $H_0$ : there is statistically significant effect of oil price and inflation on exchange rate

  $H_1$: there is no statistically significant effect of oil price and inflation on exchange rate

- $H_0$ : there is no causality between oil price, inflation and exchange rate in Ghana

  $H_1$: there is causality between oil price, inflation and exchange rate in Ghana

### 1.4 Justification of the Study

There have been studies on the exchange rate and the economy, oil prices and economic growth among others (Adu-Gyamfi 2012, Nnadike, 2007) but none has examined the relationship between the volatility of exchange rate and prices of oil in

Ghana. This work gives an in-depth knowledge on the movement of exchange rate and oil prices markets and their transmission mechanism into the markets of each other.

This research also intends to assist the authorities in designing an exchange rate policy framework that will help to reduce the uncertainties in the markets of exchange rate. This is also to help government to enhance the facilitation of the flow of the country's energy in order to increase the welfare of the economy since oil is a source of energy.

Again, investors and stakeholders of this economy will benefit from this study, especially those who invest in the exchange market and depend on oil for the production of goods and services. It will enlighten them and they would be able to adopt measures and strategies in order to excel in their area of trade.

Finally, this study will fill the gap in literature since none has studied these variables in the Ghanaian economy. It also gives the path for further research into the relationship between the volatility of exchange rate and oil prices or any other variable.

### 1.5 Scope of the Study

This study is based on the Ghanaian economy over 15 years' period starting from 2000 to May, 2015. This period is chosen since this is the time the economy recorded its highest level of depreciation. Though the economy has been fluctuating within the periods, it experienced highly volatile exchange rate in the year 2000 of over 20% depreciation against the US Dollar. This is also due to the availability of data for the

purpose of the study which seem difficult in collecting. Monthly data on inflation, oil price and exchange rate were employed to address the subject matter in this study.

### 1.6 Organization of the Study

The researcher divided this paper into five chapters. The first chapter consists of the background of this study, the problem and the aim of this research. It also talks about the scope and justifies the need for the study. The second chapter which is the literature review entails the reviewed theories of exchange rate and oil price movement. The determinants of the movement of exchange rate are also looked at. It finally gives the pass through of other studies based on this study and those similar to it. The chapter three is about the procedure and the method used for sampling and the analysis of the study. The fourth chapter depicts the analysis of the data and gives an in depth analysis of the results. The final chapter which is the fifth chapter contains the summary of the findings of the study, conclusions of the research and recommendations by the researcher.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 Introduction

This chapter contains the theories on prices and exchange rate which are relevant to the study. The factors that are responsible for the movement of exchange rate are looked at. It also looked at empirical evidence of the relationship between exchange rate and oil prices which have been put across by various researchers in different economies.

## 2.1 Theoretical Review

The aim of this section is to review the points that are critical in knowledge currently. The collection of concepts in relation to the subject will serve as a guide for the research in the determination of the measurement and relationship between the variables understudied.

### 2.1.1 Relationship between Exchange Rate and Oil Prices

Exchange rate can be defined as a price in one currency in terms of other currency. For instance, the price of the US Dollar in terms of Ghana Cedi, the price of the Pound Sterling in terms of the Ghana Cedi, the price of Dominican Pesos in terms of US Dollar, to mention but few. Exchange rate can either depreciate or appreciate. A depreciation of exchange rate implies that much more of the domestic currency is required in exchange for the foreign currency. On the other hand, exchange rate is said to appreciate if less of the domestic currency is required the foreign currency.

When exchange rate depreciates, oil prices increases and vice versa. The US Dollar happens to be the invoicing currency for oil prices. The depreciation of the dollar increases the demand for the oil since less of the currencies of the importing countries like the Ghana Cedis would be needed to purchase the oil. The depreciation of the dollar also reduces the revenue of the oil producers and their purchasing power of input for the production of the oil. This results in higher cost of production and eventually reduces the supply of oil in the oil market. The prices of oil then goes up since the demand for oil would be higher than supply. This is consistent with Grisse (2010) who studied the drivers of the correlation between exchange rate and oil prices.

The changes in price of oil affect the movement of exchange rate in both the exporting and importing countries. When the prices of oil increases, more of the domestic currencies, the Ghana Cedis for instance, would be needed to purchase the same quantity of oil as before. The increase in the supply of the cedi vis-à-vis constant supply of the Dollar will cause the price of the Dollar to increase as a result of the interaction of demand and supply in the foreign exchange market thereby leading to depreciation in the domestic currency. This is also consistent with the findings of the study by Novotný (2012) on the relationship between oil prices and exchange rate.

### 2.2 Determinants of Exchange Rate

The movement of exchange rate is primarily known to be determined by supply and demand and interest rate. However, the nature of each market of a nation also controls the movement of its exchange rate. There have been studies on the deterministic factors of this movement by different researchers from different countries.

Zwanzger (2009) studied the determinants of the Chilean peso to the US Dollar. He employed the method of simple regression with monetary policy interest rate, money supply, inflation, and the price of copper as the independent variables. He found that money supply and monetary policy interest rate are insignificant in explaining the movement of the exchange rate. The variations were well explained by inflation within the early periods of his study. However, when the price of copper increased internationally, it has been explaining the movement of the exchange rate as inflation too has been insignificant.

Kuijs (1998) prepared a paper on the Nigerian economy which analyses the determinants of output, exchange rate and inflation in the long run. The method of co-integration was employed to a data from the foreign exchange market, market of non-oil products, and that of broad money in disequilibrium in this paper. Inflation was found to be affected by the excesses of money supply over the demand for money and not by the markets of foreign exchange rate and non-oil products. The movement of exchange rate could be explained by the balance of payment disequilibrium with non-oil and monetary policy being insignificant. The foreign exchange market was found to have an effect on output in the short run but money market remained insignificant, however, in the long run, output responded to potential output.

Stancik (2006) analyzed the volatile nature of exchange rate in the EU members. The Tarch model was used in the analysis of the data from 1999 to 2010. The countries of that are more open have relative lower fluctuations in their exchange rate but the weakness of the currencies depended on the policies of each individual country. The major changes in exchange rate regimes have a significant effect on the movement of

exchange rate whereas the minor changes are insignificant in the determining the movement of exchange rate.

Awan, Ahmed, Sial and Sher (2012) showed that in Pakistan, there exist a relationship between exchange rate and monetary variables using co-integration and error correction model. The county's debt was found to be positively related to the movement of the PKR/USD as the government borrows to finance its budget and balance of payment deficit and development projects. The negative relationship among the real GDP and interest rate and the countries exchange rate was not significant.

Tiwari, Dar, and Bhanja (2013) showed that shocks to oil prices affect the fluctuations in exchange rate in India. This is because the country depends a lot on oil consumption so whenever there is a shock in the prices of oil, the Indian rupee depreciates against the US dollar since inflation would be high.

In Ghana, the cedi has been experiencing instability over the years and this has been attributed to a lot of factors which include inflation, public debt and speculation among other factors.

### 2.3 Empirical Review

Oil has a lot of importance in the economy because of the dependence on it in the production of energy. In the same way, exchange rate has an effect on the economy of every country because of trade internationally. However, their movement has been of a lot of concern due to their roles internationally and domestically. This section

therefore deals with the reviewing of studies of the correlation between the oil prices and exchange rate by different authors.

A study by Grisse (2010) on the drivers of the correlation between exchange rate and oil prices explains that oil is priced in dollars and the depreciation of it does not only increase the demand for oil but reduces the purchasing power of oil producers. This result in higher oil prices because though demand would be high, supply would be reduced. Likewise, when prices are set higher, the US Dollar appreciates since more would be demanded. The paper then concludes that though higher oil prices leads to depreciation of the dollar as depreciation also results in higher oil prices, interest rate explains most of the variations in the two variables in the US.

Bahattin (2011) did an assessment on the dynamic conditional correlation and of the one year rolling average correlation between the daily change in the oil prices and the nominal effective exchange rate. He concluded that there is a strong relationship with a declining negativity and casualty runs from oil prices to exchange rate.

Doğan, Ustaoğlu and Demez (2012) investigated the relationship between real oil prices and the real exchange rate in Turkey. The method of co-integration with structural breaks by Perron was used on a data collected on a monthly basis. According to them, the global financial crisis that hit the world in 2oo7/o8 did not have much impact since most of its exports are industrial products.

Novotný (2012**)** examined the link between the Brent crude oil price and the US dollar exchange rate. He studied the interdependence between the monthly logarithm returns of nominal exchange rate and prices of Brent oil, gold, industrial metals and agricultural commodity prices. They demonstrated that there is a negative correlation

coefficient between exchange rate and commodity prices especially oil, industrial metals and agricultural commodity prices. The large amount of money is probably due to excess liquidity and speculative demand as a result of low interest rate. A 1% depreciation in the nominal exchange rate results in 2.1% increase in Brent oil prices. The impact of the volatility of the US dollar is dampened in the euro area. The prices of the Brent crude oil are determined by the exchange rate and interest rate.

Zhang (2013) studied the link between price of oil and the value of US dollar using the method of co-integration on a monthly basis data. He found no significant co-integration between them except for a period of two structural breaks over time. The first break was in 1986 when the production in Saudi Arabia was not restricted and led to the collapse of oil by more than 70%. The second break was during the period of 2000 and 2005 when OPEC's excess capacity could not meet the increasing demand of the emerging economies. Hence, these two structural breaks are important evidence of a stable relationship between the prices of oil and the value of the US dollar.

Osigwe (2015) studied the exchange rate, oil prices and the economic performance of Nigeria simultaneously. He employed the ordinary least square and two stage least square estimation techniques. He concludes that real exchange rate has a negative relationship with oil prices and both real exchange rate and oil price have a positive relationship on the economic performance.

Patrick (2013) threw light on the effect of the fluctuations on the retail oil prices. He used the simple regression method in the analysis of the studies. It indicated that in Kenya, the volatility of exchange rate moves in the same direction as the prices of oil.

It however concludes that exchange rate fluctuation explains only a fraction of the variation in the changes in the prices of oil, and that total variations may be caused by taxes, and speculations among others.

Aziz and Bakar (2009) did a study on oil price and exchange rate of a net oil exporting and a net oil importing countries. This study also took into account the effect of interest rate on exchange rate. He employed three modelling exercise on monthly data from 1980 to 2008. The unit root test and the panel co-integration test showed that the variables are integrated of order one and there exist a co-integration among them. Finally, using the pooled mean estimator, there was no sign of long run relationship between oil prices and exchange rate in the net exporting countries. However, he concludes there is a positive impact of the oil price and exchange rate in the net oil importing countries.

In summary, a lot of papers have investigated the link between the exchange rate and the oil prices and its adverse effect. Some papers found no correlation between the two variables except for two structural break periods. Many of the studies used the method of cointegration. There were few others that employed the method of least and the simple regression method. None of the studies was from Ghana. However, it is not evident enough from the empirical review, the correlation between exchange rate and oil prices since the population and sample design and the countries under studies vary.

This paper however, hopes to give an in-depth knowledge on the relationship between the movement of real exchange rate and oil prices in Ghana using the VECM.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.0 Introduction

This chapter opens by specifying the model for the study in a functional and regression form. The study then proceeds to explain the source and data typed as well as the sample period covered. The variables definitions or measurement and the estimation techniques are discussed under this chapter.

## 3.1 Model Specification

Following the studies of Grisse (2010) and Novotný (2012**)**, the model for the study is specified as:

$$EXC_t = f(OilP, INFL) \quad (3.1)$$

where $EXC_t$ represents exchange rate, $OilP$ is oil price and $INFL$ is the inflation rate. Equation (3.1) shows that exchange rate is a function of oil price and inflation. The above equation can be represented in an estimable regression equation as follows

$$EXC_t = \delta_0 + \delta_1 OilP_t + \delta_2 INFL_t + \varepsilon_t \quad \ldots (3.2)$$

where the $\delta_0, \delta_1$ and $\delta_2$ are the constant term, the coefficient of oil price, and coefficient of inflation rate respectively. The error term is represented by $\varepsilon_t$. From equation (3.2), the study expects the coefficient of oil price to be positive a priori. This is because, when world oil price increases, the amount of cedi needed to buy one

barrel of oil (in US dollar) would rise (see: Grisse, 2010). Such indicates a depreciation of the Ghanaian currency hence a positive relationship between them especially as the economy relies heavily on oil importation. However, a study by Bahattin (2011) and Doğan, Ustaoğlu and Demez (2012) found contradictory results. This gives an indication that, though this study expects oil price to depreciate the Ghanaian cedi, there is a possibility for the economy to realize an inverse relationship between oil price and exchange rate as well.

With respect to inflation rate, the study expects an ambiguous expected sign of the coefficient. Thus, the coefficient can assume a negative or positive effect on exchange rate. The possible reason for this assertion is that, when inflation is moderate relative to the rest of the world, not only will domestic demand increase; export of the Ghanaian economy is likely to rise which would cause the cedi to appreciate. In this case, the relationship between inflation and exchange rate will be positive (see for instance: Novotný, 2012). However, when inflation exceeds some threshold level it would have negative effect on the exchange rate. According to Frimpong and Oteng-Abayie (2010), inflation tend to hurt the economy when it exceed 11% threshold, in such a way that it becomes higher relative to the rest of the world, the domestic economic agent would respond rationally by demanding from relatively cheaper goods and services from outside. In this situation, import is likely to rise which would then impose a negative impact on exchange rate. This situation implies depreciation of the Ghanaian currency against the dollar.

### 3.2 Data Source and Variables definition

#### 3.2.1 Type of Data and Source

The study employed a secondary data. The secondary data consist of monthly time series data sampled over the period of January 2000- May 2015. The sample size was selected due to unavailability of data for the period before 2000. The existing data were mainly monthly time series. The source of the data employed in this study is from the Bank of Ghana Statistics, 2015. The data for oil price was sourced from the Europe Brent Spot Price (2015).

#### 3.2.2 Variable definitions

##### 3.2.2.1 Inflation

Inflation refers to the persistent increase in the general price level of goods and services over a period of time. In other words, inflation represents the annual percentage change in the cost to the average for purchasing a basket of goods and services for a longer period of time. In an economy where there is higher inflation, most economic fundamentals become distorted as well as the exchange rate of an economy. In view of this, the study employs the consumer price index (CPI) as a proxy for inflation.

##### 3.2.2.2 Real Effective Exchange Rate (Rer)

Exchange rate is defined as the price of one currency in terms of the other. In finding out the effect of exchange rate on an economy, trade analyst and policy makers are interested in real exchange rate (see for instance Sharma, 2000; and Cline, 2009). The real exchange rate is thus chosen instead of nominal exchange rate. Real exchange

rate is important for this study because it takes away the inflationary component from nominal exchange rate and hence makes analysis and prediction parsimonious

#### 3.2.2.3 Oil Price

The crude oil price is in real terms. The Crude oil prices are monthly spot price.

### 3.3 Estimation Technique

This section discusses the estimation procedures used in estimating the model under section 3.1. To be able to effectively make decisions on the choice of model to employ, it is important for the study to examine the stationarity properties of the variables used. To be able to do this, two main test were used. The first is the traditional Augmented Dickey Fuller Test and the Philips-Perron unit root test procedure. The Error correction method employed to examine the short and long run relationship is done within the frame work of Johansen (1988) cointegration and vector error correction mechanism (VECM) method. Again, the study examined the vector granger causality between the variables in other to examine the direction of flow between the variables employed in the study

#### 3.3.1 Unit Root Tests

The study tests for the stationarity of inflation, oil price and exchange rate using the Augmented Dickey Fuller (ADF) test. This procedure is specified below,

$$\Delta y_t = \beta_1 + \beta_2 y_{t-1} + \alpha(t) + \sum \Upsilon i \Delta yt - i + u_t \qquad (3.3)$$

Where, the symbol Δ represents the first difference operator, *y* is the variable under consideration (with respect to this study, it can represent inflation, exchange rate or oil price). The constant term is shown by $\beta_1$. The coefficient under consideration is $\beta_2$. α is the trend coefficient, $\sum \Upsilon i \Delta yt - i$ shows the summation of all past values of the

variable under consideration which is being employed to eliminate the effect of autocorrelation with $\Upsilon_i$ being the coefficient and '$u_t$' is the error term.

### 3.3.2 Phillips-Perron (PP) test

Another test for the existence of unit root is provided by Phillips and Perron (1988). This testing method is a generalized process of the traditional ADF. The Philips and Perron (1988) test is superior to the ADF test since the test corrects for Hetereoscedasticity and serial correlation of the error term non-parametrically. This makes the PP test robust to fundamental forms of hetereoscedasticity in the residual term $\varepsilon_t$. The test regression follows the AR (1) process and it is specified as;

$$\Delta y_{t-1} = \alpha_0 + \gamma y_{t-1} + \varepsilon_t \qquad (3.4)$$

The coefficient under consideration is represented by $\gamma$.

From both the ADF in equation (3.3) and the Philip-Perron test in equation (3.4), the study tests the null hypothesis of existence of unit against the alternative hypothesis of non-existence of unit root. In the case where the null hypothesis is not rejected, then the implication is that the variable in question possesses unit root which also indicate that the variable is non-stationery.

### 3.4 Cointegration test

In studying the effect of oil price and inflation on exchange rate, the process of dynamic adjustment to shock in the long run is the key. This is because; macro-variables are also believed to have a uniform long-run relationship over time. In view of this, the Error Correction Model (ECM) is used to estimate the parameters in the model.

According to Jansen and Schulze (1996), the error correction model is important because it examines the dynamic relationships between macroeconomic variables. Another reason why the ECM is most preferred is that, inflation, exchange rate and oil price are expected to be non-stationary at the levels, and when it holds, it may be unlikely for the variables to have a long run or equilibrium relationship. Given the characteristics of the variables employed in this study makes the ECM the best method for this study.

#### 3.4.1 Johansen Cointegration Technique and VECM

In other for the study to examine the short run and the long run impact of oil price and inflation on exchange rate, the Johansen cointegration test and the vector error-correction model (VECM) is the most fundamental. This is because, whenever there are two or more variable in a regression equation, then the appropriate technique in determining the existence of cointegration is the Johansen method since there may be a possibility of two or more cointegrating vectors. When such a situation occur, the Engel-Grange method of examining cointegrating may not be efficient.

Johansen's cointegration technique employs the maximum likelihood in order to determine the number of cointegration vectors of the variables sequentially. One

significant of this test is that, all the components in the disturbance process are tested and the critical values are conditionally determined on a normal distribution of the residual process.

Using the Johansen's cointegration method, equation in (3.1) can be reduced to the matrix notion as; $A_t = [EXC_t, OilP_t, INFL_t]$. This gives the regression form as follow;

$$A_t = v + Z_1 A_{t-1} + Z_2 A_{t-2} + Z_3 A_{t-3} + \mu_t \qquad (3.5)$$

Where $A_t\,(n \times 1)$ shows a vector of variables (exchange rate, oil price and inflation rate), v$(n \times 1)$ is a vector of parameters, $Z_1\,(n \times n)$ represents matrices of parameters, and $\mu_t\,(n \times 1)$ describes a vector of error terms with zero mean and the covariance matrix which is *iid*.

To represent the equation (3.6) in a VECM form, the following equation is specified.

$$\Delta A_t = v + \Gamma_1 \Delta A_{t-1} + \Gamma_2 \Delta A_{t-2} + \Gamma_3 \Delta A_{t-3} + \Pi A_{t-1} + \mu_t \qquad (3.6)$$

Where $\Gamma_1 = I - A_1 - A_2 - A_3$, and $\Pi = -(I - A_1 - A_2 - A_3)$. The symbol $\Pi$ has a reduced rank of $0 < r < n$ and it shows a matrix that informs us about the long run equilibrium relationship between exchange rate, oil price and inflation rate. The matrix $\Pi$ can be expressed as $\Pi = \alpha\beta^I$. Where the symbols $\alpha$ and $\beta^I$ are both $n \times r$ matrices of rank *r*. $\alpha$ measures the speed at which the model restores to equilibrium whilst $\beta^I$ explains the long run matrix of coefficient of the variables. $A_t$ is integrated of order one [ I (1)]. $\Delta A_t$ is stationary, that is, I(0). Hence, all $i = 1, 2, 3$ are also stationary; the residual is also assumed to be stationary. This also implies that, $\Pi X_{t-1}$

is also integrated of order zero; I (0). Cointegration exist if components of $\mathbf{X}_t$'s are

zero, and when it holds, then all the rows of $\Pi$ must be cointegrated since the number of distinct cointegration vector relies on the row rank of the matrix (Harris, 1995).

The matrix $\Pi$ of order $3 \times 3$ has rank *3*, therefore a *3*-dimensional vector space is created. The implication is that, all the $3 \times 1$ vectors can generate a linear combination of its row. Any of such combination of the rows is expected to be stationary, meaning that, $A_{t-1}$ has stationary components if the rank of $\Pi$ is *r 3*.

### 3.4.1.1The Trace Test

The number of cointegration in the study under the Johansen test is done by the trace test. This tests the null hypothesis of the existence of *r* cointegrating vectors present in the model. The test statistic for the trace test is given as;

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1-\lambda_i) \qquad (3.7)$$

Where the null hypothesis is given as $H_0$: $\lambda_i = 0$ .According to Sjo (2008) the trace test has been found to be a better test for cointegration and works well with small samples.

### 3.4.1.2 The Maximum Eigenvalue

Another test employed by the Johansen cointegration testing procedure is the maximum eigenvalue tests. This test the null hypothesis of *r* cointegrating vectors that

are present as against the alternative hypothesis of (*r+1*) cointegrating vectors. Each eigenvalue represents a stationary relationship. The test statistic is given by;

$$\lambda_{\max}(r, r+1) = -T\ln(1-\lambda_{r+1}) \tag{3.8}$$

Where *T* is the sample size, $\lambda_i$ is the $i^{th}$ largest canonical correlation for *r* = 0, 1, 2…., *p*-2, *p*-1

# CHAPTER FOUR

# DATA ANALYSIS, RESULTS AND DISCUSSIONS

## 4.0 Introduction

This chapter entails the discussions of results and analysis of the data which was collected for the purpose of this study in both tables and charts. The immediate results discussed are about the test for unit roots which are presented in both tables and charts. The next discussion of result entails the main aim of the study which is to establish the relationship between the chosen variables. The chapter then goes ahead in the next discussion to trace out the reaction of the lead and lag values of each variable. It finally presents the percentage contribution of each variable for the variation in the other variable.

## 4.1 Unit Roots Tests Results

In investigating the relationship between exchange rate and oil price, the study tested for the existence of unit root in the series. To ensure that the evidence of presence of unit root in the individual series or otherwise is strong, we apply two competing tests; Augmented Dickey-Fuller test and the Philips-Perron test for unit root. In both cases, the null hypothesis is the presence of unit root in the individual series (non-stationarity). This is tested against the alternative of stationarity. Table 4.1 shows the unit root test results.

**Table 4.1 Stationarity Results**

| VARIABLES | ADF TEST TAU stat | | PHILLIPS – PERRON TEST | | ORDER OF INTGN |
|---|---|---|---|---|---|
| | CONST | CONST + T | CONST | CONST + T | |
| **,PANEL A: LEVELS** | | | | | |
| Lnreexc | -1.144 | -1.091 | -1.236 | -0.863 | ? |
| Lnoilp | -1.647 | -2.173 | -1.704 | -2.050 | ? |
| Lncpi | -2.095 | -3.916* | -2.047 | -1.960 | ? |
| **PANEL B: FIRST DIFFERENCE** | | | | | |
| DLnreexc | -7.836*** | -7.918*** | -7.821*** | -7.914*** | **I (1)** |
| DLnoilp | -10.991*** | -10.995*** | -11.00*** | -11.01*** | **I (1)** |
| DLncpi | -8.123*** | -8.319*** | -7.978*** | -8.029*** | **I (1)** |

Note: ***means rejection of the null hypothesis at the 1% significant level

From the Table 4.1 above, the null hypothesis of unit root could not be rejected for all the series at the level for both the ADF and the Philips-Perron tests. That is the test statistics for exchange rate, oil price and inflation are all insignificant when estimated with constant, and with constant and trend. Similarly, the test statistics under the Philips-Perron test shows that, the variables are insignificant hence the study did not have enough evidence to reject the null hypothesis of no unit root. However, when

estimated at their first differenced, the null hypothesis of existence of unit root is rejected at 1% level of statistical significance for both the ADF and the PP tests. We therefore conclude that all the underlying series in the present study are integrated of order one [I (1)]. The behaviour of the variables as they are all integrated after the first difference satisfies the criteria for using the VECM techniques.

### 4.2 Trend Behaviour of oil price, exchange rate and inflation

This section presents the trend analysis between inflation, exchange rate and oil price.

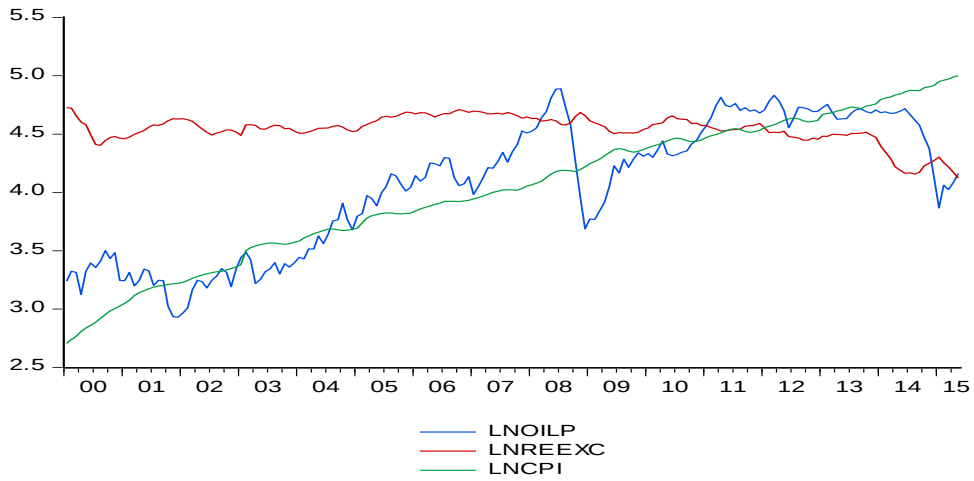



**Figure 4.1: Trends in Oil price, exchange rate and inflation**

The trend behaviour as seen in figure 4.1 shows that, exchange rate has been higher than oil price and inflation since between 2000 and 2008. However, whilst exchange rate remains fairly constant between this years, oil price fluctuates and trends upwards reaching its peak in 2008. However, oil price fell sharply in fourth quarter in 2008 and then rose again at the end of 2008. Inflation on the other hand has trend upwards since 2000 and is constantly showing a positively sloped trend. Comparatively, converged

between 2010 and 2013 after which oil price and exchange rate showed a downward slope.

### 4.3 Results and Analysis of the Cointegration

This section discusses the Johansen cointegration test results. The appropriate lags where automatically generated using the Schwarz Bayesian information criterion (SBIC) method. The Johansen method indicates that, if the trace statistics is not greater than the critical value, then the null hypothesis of no cointegration cannot be rejected. If on the other hand the test rejects the null hypothesis, then cointegration is said to be present. The cointegration result is presented in table 4.2

**Table 4.2 Johansen Cointegration Results**

| **Multivariate model : Exchange rate, Oil price and Inflation** | | | | | **Decision** |
|---|---|---|---|---|---|
| **Hypothesized No. of CE(s)** | **Trace Statistics** | **Max eigenvalue** | **0.05 critical value(trace)** | **0.05 critical value(Max)** | **COINTEGRATION PRESENT** |
| None * | 32.78554** | 25.12970** | 29.79707 | 21.13162 | |
| At most 1 | 7.655836 | 7.573924 | 15.49471 | 14.26460 | |
| At most 2 | 0.081913 | 0.081913 | 3.841466 | 3.841466 | |

Note: ** indicate rejection of the null hypothesis at 5% level.

To examine the existence of cointegration between the variables, the study compares the trace statistics and the maximum eigenvalue to their respective critical value. If these test statistics fall above their critical values, then the null hypothesis of no cointegration is rejected. From the estimated results, the trace statistic is 32.786 and is

higher than the critical value of the trace statistics. The study therefore rejects the null hypothesis and concludes that, there exist a long run equilibrium relationship between exchange rate, inflation and oil price. Again, the value for the maximum eigenvalue is 25.130 which is higher than its critical value. This also rejects the null hypothesis and concludes that, there exist one cointegration relationship between exchange rate, oil price and inflation. The existence of cointegration is a prerequisite of the estimation of the VECM hence the study proceeds to estimate the short and long run relationship between exchange rate, oil price and inflation.

### 4.4 Diagnostic Test

Before the study proceeds to analyze the short and long run results, it is important to first analyze the post estimation test results to ensure that they are not spurious. Therefore, having established empirically that there exist at least one cointegration between exchange rate, oil price and inflation, drawing conclusion from the adjustment parameters in the VECM model depends on the stationarity of the cointegration equation.

In view of this, it is required that the study check for the stationarity of the cointegrating equation. To check for the stationarity of the cointegration equation, the study predicts the cointegrating equation and graphs them overtime. The figure below shows the cointegration behaviour over time.

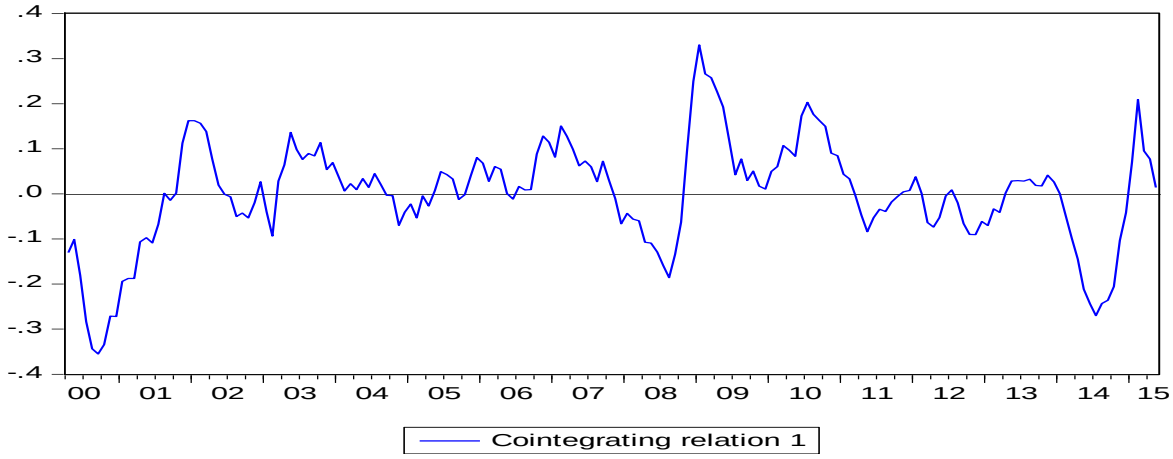



**Figure 4.2 trend in cointegration equation**

Although large shocks are likely to affect the cointegration graph, the graph shows that, the behaviour of the cointegration cause maintained fairly stable pattern and hovers around a value of zero. This is not to say that the graph is stable as we see spikes along the graph, the figure does depicts that the graph falls within the 95% confidence level indicating a stationary cointegration equation.

The study also checked whether the number of cointegrating equation is correctly specified since it may have implication on the specification of the model and the results thereof. As the study stated in chapter three, if the process VECM is stable, then the remaining *r* moduli are strictly assumed to be less than one. The stability of the model is analyzed using the inverse roots of AR characteristic polynomial shown in figure 4.3 below;

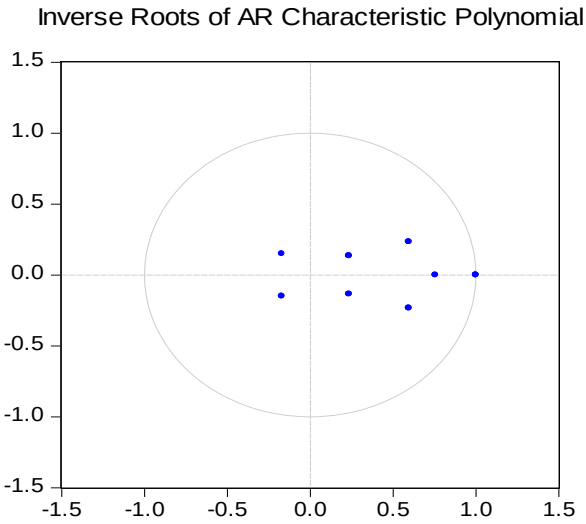



**Figure 4.3: Stability Test**

With reference to figure 4.3 the VECM specification imposes 2 unit moduli. Since there are no general criteria in the distribution theory to determine how far the remaining roots are far from 1, establishing whether or not they are too close to one may prove difficult. However, graphing the eigenvalues of the companion matrix as depicted in the above figure show that none of the dot falls outside the unit circle. This nature of the figure is an indication that the VECM model is correctly specified hence the estimated short and long run can be relied upon for prediction.

Again, the test whether there are issues of serial correlation, whether or not the errors are normally distributed and whether the residuals are homoscedastic. The results (see appendix) shows that; first, the errors are skewed and kurtotic. Secondly, the LM test shows that, there are no issues of hetereoscedasticity and also, the hypothesis of no serial autocorrelation is not rejected. Having examined the model, the study therefore proceeds to discuss the short run and long run results.

### 4.5 Estimated Short-run Results

#### 4.5.2 Short-run Results from the VECM model

Using the VECM, the estimate of the short-run and adjustment parameters are displayed in table 4.2

**Table 4.2 Estimated Short-Run Results for the Multivariate VECM mode**

| MULTIVARIATE VARIABLES ((LNREEXC, LNOILP and LNCPI) | | | |
|---|---|---|---|
| Dependent variable: Exchange Rate | | | lags: 2 |
| Variable | ***Equation 1*** D(LNREEXC) | ***Equation2*** D(LNCPI) | ***Equation 3*** D(LNOILP) |
| *ECM*(-1) | -0.048279*** | -0.015863* | 0.246909*** |
| | (0.01474) | (0.00886) | (0.06017) |
| | [-3.27482] | [-1.79069] | [ 4.10364] |
| D(LNREEXC(-1)) | 0.535621*** | -0.111439*** | -0.559701* |
| | (0.07605) | (0.04570) | (0.31040) |
| | [ 7.04272] | [-2.43855] | [-1.80318] |
| D(LNREEXC(-2)) | 0.023320 | 0.042472 | -0.714960*** |
| | (0.08132) | (0.04886) | (0.33190) |
| | [ 0.28677] | [ 0.86919] | [-2.15417] |
| D(LNCPI(-1)) | -0.316675** | 0.511097*** | 1.179314** |
| | (0.13088) | (0.07864) | (0.53416) |
| | [-2.41959] | [ 6.49896] | [ 2.20779] |
| D(LNCPI(-2)) | -0.016398 | -0.075753 | -0.520805 |
| | (0.13323) | (0.08005) | (0.54375) |
| | [-0.12308] | [-0.94627] | [-0.95780] |
| D(LNOILP(-1)) | 0.012898 | -0.000689 | 0.172217** |
| | (0.01770) | (0.01064) | (0.07224) |
| | [ 0.72865] | [-0.06475] | [ 2.38382] |
| D(LNOILP(-2)) | 0.014369 | -0.001651 | 0.036249 |
| | (0.01773) | (0.01066) | (0.07238) |

| | | | |
|---|---|---|---|
| | [ 0.81020] | [-0.15492] | [ 0.50081] |
| C | 0.002756 | 0.006688** | -0.008030 |
| | (0.00223) | (0.00134) | (0.00912) |
| | [ 1.23338] | [ 4.98162] | [-0.88059] |
| R-squared | 0.311752 | 0.264279 | 0.187684 |
| Adj. R-square | 0.284064 | 0.234681 | 0.155005 |
| F-statistics | 11.25940*** | 8.928964*** | 5.743208*** |

Note:*, **and *** denotes significant at 10%, 5% and 1% level respectively; t-statistics in parenthesis

From table 4.2 the study focuses on the results under equation 1 since exchange rate is the dependent variable and the variable of focus. An inspection of the error correction term (ECM) of the exchange rate model (equation 1) shows that, the value is negative as expected and significant at 1% level. The ECM from economic perspective measures the speed of adjustment to equilibrium after macroeconomic shocks. Theoretically, the sign must be negative and significant for adjustment process to occur. The estimated result of the ECM is -0.048279 and confirms to theoretical proposition, hence, the adjustment process of the Ghanaian cedi to restore to equilibrium is effective and the model on the other hand is stable. However, the coefficient is too small and implies that, it would take about approximately 5% of any disequilibrium to be corrected monthly whenever there is shock to oil price and inflation. This means that, the adjustment process of exchange rate to changes in oil price and inflation would be slow and that it would take the economy more than a year to clear any shock to ensure long run equilibrium.

With reference to the short run estimation, the results show that, past period value of real exchange rate imposes a positive impact on the current level of exchange rate. This is because; the estimated coefficient of exchange rate lagged by one period is

0.535621 and statistically significant at 1% level. This implies that, when exchange rate depreciates in the previous month, it causes current exchange rate to further depreciate. This is explained by persistence or inertia of exchange rate in Ghana. On the contrary, two months past behaviour of exchange rate does not have any significant effect on current month's exchange rate behaviour.

The short run coefficient of oil price is positive but the results shows that, the variable does not have any significant effect on exchange rate in Ghana. In other words, past values of oil price does not influence the behaviour of exchange rate in the short term. This result is not surprising since changes in oil price takes time for investors to respond to their demand pattern hence its short run effect may not be significant.

Turning to the short run estimate for inflation, the estimated coefficient shows that, the short run coefficient of inflation is negative. The result further shows that, it is the immediate past month's value of inflation that tends to affect current level of exchange rate. The negative (-0.316675) and significant coefficient of inflation implies that, in the short term, increases in inflation would appreciate the Ghanaian cedi as the exchange rate of the cedi to the US dollar falls.

### 4.6 Long-Run Results and Analysis

The long-run relationship between exchange rate, oil price and inflation is given by the Johansen's normalization result. The output is presented in table 4.3 below.

**Table 4.3 Estimated Long-Run Results**

| **Dep. Variable** | **Coefficient** | **Std. Error** | **t-statistics** |
|---|---|---|---|
| LNREEXC | | | |
| **LNOILP** | 0.356523 | 0.07849 | 4.54199*** |
| **LNCPI** | -0.408183 | 0.07594 | -5.37535*** |
| **C** | 4.735689 | | |

Note: *** imply significant at 1% level

The estimated long run results show that, oil price has a positive and significant effect on exchange rate in Ghana. Specifically, the elasticity value of a proportionate change in oil price on exchange rate is 0.3565 and significant at 1% level. This means that, as the world price of oil increases, the exchange rate between cedi and the dollar would rise indicating depreciation of the value of the Ghanaian currency in terms of the US dollar. This result is not surprising since the Ghanaian economy is small to control the price of oil and any increment in oil price would have an adverse effect on the exchange rate. Again, we see from the estimated result that, the value of the coefficient is inelastic which further gives proof that, as long as the Ghanaian economy depends on oil as it is seen as a necessity and essential to facilitate growth and development, the changes in oil price would affect the behaviour of exchange rate in Ghana.

Inflation on the other hand has a negative and significant long run effect on exchange rate. Thus, the coefficient of inflation is -0.408183 and statistically significant at 1% level. The implication of the result is that, inflation causes depreciation of the Ghanaian cedi. The possible reason is that, the rate of inflation is destructive to cause exchange rate depreciation.

### 4.7 Impulse Response Results

This section discusses the impulse response function. Specifically, the discussion is focused on how exchange rate responds to shocks in oil price and inflation in Ghana. This is presented in the figure 4.0 below:

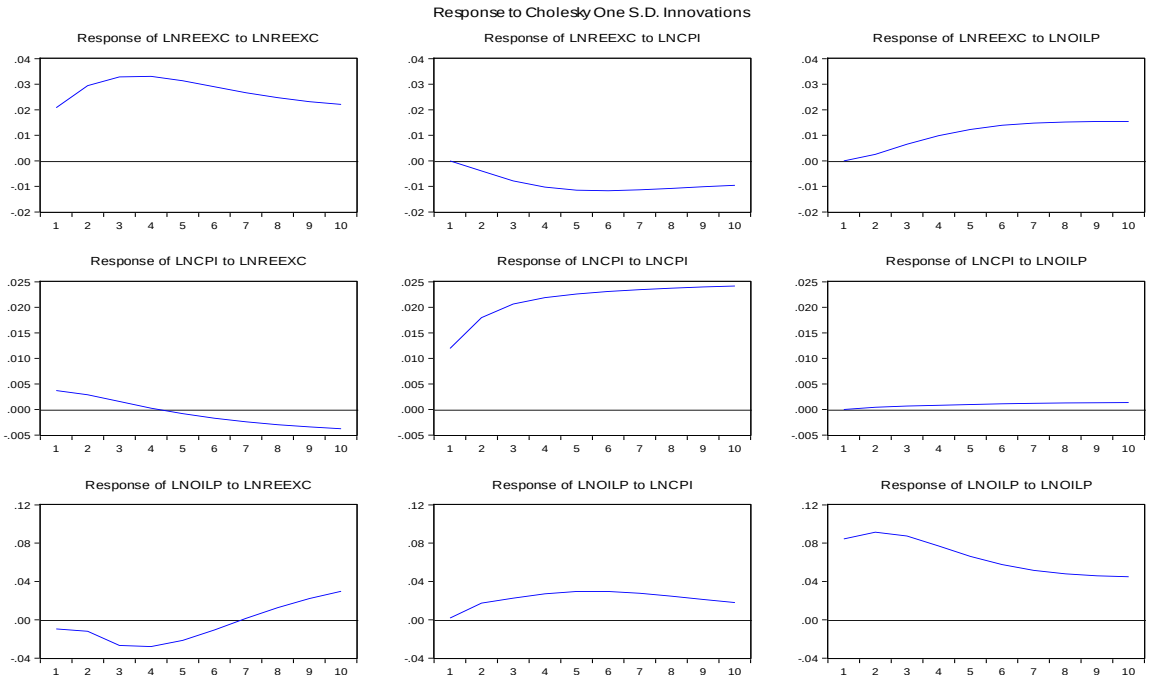



**Figure 4.4 Impulse Responds graph**

Figure 4.4 depicts how exchange rate responds to short run shocks of oil price and inflation. From the figure, it is seen that any external shock to oil price would have a permanent effect on exchange rate. From the graph it is seen that, the responds of exchange rate to oil shock increases fairly upwards from the 1st month to the 8th

month and remains constant. The implication of this is that, increase in oil price would tend to depreciate the Ghanaian currency. The responsiveness of exchange rate to inflationary shock shows that, the shock is temporal. Hence from the graph, any shock to inflation begins to die out indicating that, such shock would not lead to a permanent change in exchange rate but that, the shock would be eliminated after the 1st month.

### 4.8 Forecast Error Variance Decomposition Results

The variance of exchange rate was decomposed to find out how oil price proportionately contributes to its variations. The percentage contribution of inflation to the variation of exchange rate was also sought.

**Table 4.4 Variance Decomposition Results**

| Period | S.E. | LNREEXC | LNCPI | LNOILP |
|---|---|---|---|---|
| 1 | 0.020811 | 100.0000 | 0.000000 | 0.000000 |
| 2 | 0.036344 | 98.32328 | 1.187954 | 0.488763 |
| 3 | 0.050049 | 94.97312 | 3.073559 | 1.953322 |
| 4 | 0.061636 | 91.34979 | 4.811484 | 3.838730 |
| 5 | 0.071158 | 87.92016 | 6.206496 | 5.873343 |
| 6 | 0.078952 | 84.89737 | 7.232446 | 7.870187 |
| 7 | 0.085395 | 82.32405 | 7.946363 | 9.729587 |
| 8 | 0.090832 | 80.16514 | 8.424214 | 11.41065 |
| 9 | 0.095539 | 78.35749 | 8.735188 | 12.90732 |
| 10 | 0.099723 | 76.83440 | 8.933458 | 14.23214 |

The table 4.4 shows the contribution of the exchange rate to its own movement and the changes in oil prices and inflation rate. It can be observed in the first quarter that

the contribution of exchange rate was 91.34% whilst oil prices gave 3.84% and inflation contributes 4.81% to the variation in exchange rate. The second quarter showed 80.165% from exchange rate movement and 11.4% from oil price changes whilst inflationt accounts for 8.42% change in exchange rate. The implication of the results is that, exchange rate tend to be highly responsive to changes in its past value as past values of exchange rate accounted for 76.83% hence there seems to be exchange rate inertial. In such instances, current policies employed to control exchange rate are not likely to be effective since it is more backward looking. Oil price on the other hand explains less of the variation in exchange rate.

### 4.9 Results for VECM granger – causality test

As part of the specific objectives, the study wanted to find out the direction of flow between the variables examined. In view of this, the study employs the VECM granger causality test with an appropriate lag order of 2 based on the Schwartz Bayesian Criterion.

**Table 4.5 Results of VECM granger - causality test**

Included observations: 182

Dependent variable: D(LNREEXC)

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(LNCPI) | 8.554675 | 2 | 0.0139 |
| D(LNOILP) | 1.406865 | 2 | 0.4949 |
| All | 9.721386 | 4 | 0.0454 |

Dependent variable: D(LNCPI)

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(LNREEXC) | 6.096272 | 2 | 0.0474 |
| D(LNOILP) | 0.032124 | 2 | 0.9841 |
| All | 6.323946 | 4 | 0.1762 |

From table 4.5, the results indicate that, there is a uni-directional relationship between oil price and exchange rate. In the first panel, it is revealed that, oil price does not granger-cause exchange rate rather it is inflation that granger causes exchange rate. This is because, when examined individually, the study failed to reject the null hypothesis that oil price does not granger cause exchange rate.

# CHAPTER FIVE

# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.0 Introduction

This chapter provides summary of the entire research, gives the necessary recommendations based on analysis, and the conclusion.

## 5.1 Summary of Findings

The aim of the research was to find out the relationship between exchange rate and oil prices. The presence of unit root was found using the ADF test and the PP test procedure at levels but the variables became stationary after the first difference. Oil price was rapid and showed a lot of volatility but the trend of the movement of exchange rate did not fluctuate as much since it was contant during some periods. However, both trends kept on increasing moderately with oil price change being lower than exchange rate.

The cointegration results showed that the variables are cointegrated hence have a long run equilibruim relationship. In the short run estimation, the results shows that, past period values of real exchange rate generates a positive and significant impact on the current level of exchange rate. On the contrary, two months past behaviour of exchange rate does not have any significant effect on current month's exchange rate behaviour. The short run coefficient of oil price is positive but the result shows that, the variable does not have any significant effect on exchange rate in Ghana. In other words, past values of oil price does not influence the behaviour of exchange rate in the short term. Turning to the short run estimate for inflation, the study found that,

inflation has a negative and significant effect on exchange rate. The result further shows that, it is the immediate past month's value of inflation that tends to affect current level of exchange rate.

With respect to the long run results, it was found that oil price has a positive and significant effect on exchange rate in Ghana. The study noted that, as the world price of oil increases, the exchange rate between cedi and the dollar rises indicating depreciation of the value of the Ghanaian currency in terms of the US dollar. This is because the Ghanaian economy is small to control the price of oil and any increment in oil price would have an adverse effect on the exchange rate. Again, the study realized that, the value of the coefficient is inelastic which further gives proof that, as long as the Ghanaian economy depends on oil as it is seen as a necessity and essential to facilitate growth and development, the changes in oil price would affect the behaviour of exchange rate in Ghana. Inflation on the other hand, has a negative and significant long run effect on exchange rate.

Impulse response function shows that, any external shock to oil price would tend to have a permanent effect on exchange rate. Thus the responds of exchange rate to oil shock increases fairly upwards from the 1$^{st}$ month to the 8$^{th}$ month and stabilizes. The variance decomposition shows the contribution of the exchange rate to its own movement and the changes in oil prices and inflation rate. It can be observed in the first quarter that the contribution of exchange rate was 91.34% whilst oil prices gave 3.84% and inflation contributes 4.81% to the variation in exchange rate. The second quarter showed 80.165% from exchange rate movement and 11.4% from oil price changes. The VECM granger causality test shows that, oil price does not granger

cause exchang rate. however, controlling for infaltion, the study realized that, causality runs from oil price and inflation to exchange rate in ghana.

## 5.2 Recommendations

Ghana, like many countries, depends a lot on energy so when prices of oil increases, the usage of energy becomes costly. The country saves less as much would be needed to purchase the same amount of oil. The country suffers from budget deficit and the Ghanaian Cedi continues to depreciate against the US Dollar as a result of oil prices increase. The research recommends that the country should have enough reserves to store oil when the price is relatively low. Also, the country can hedge the price of oil that the country demands in order to reduce the risk associated with increase in oil price.

The study also found that inflation does cause exchange rate depreciation. In this case, the study recommends that the existing inflation targeting should be extensive in order to help control the negative effect it has on exchange rate.

## 5.3 Conclusion

The research intent was to test the effect of oil price on exchange rate in Ghana. This study concludes that, there exist a positive relationship between oil price and exchange rate in Ghana. Controlling for the effect of inflation, the study found that, inflation has an inverse relationship with exchange rate in Ghana.

## REFERENCES

Adu–Gyamfi, A. (2011). Assessing the impact of exchange rate volatility on economic growth in Ghana (Doctoral dissertation, Department of Economics, Kwame Nkrumah University of Science and Technology).

Ahmed, S., Awan, R. U., Sial, M. H., & Sher, F. (2012). An econometric analysis of determinants of exchange rate in Pakistan. International Journal of Business and Social Science, 3(6).

Appiah-Adu, K., & Bawumia, M. (Eds.). (2015). Key determinants of national development: Historical perspectives and implications for developing economies. Ashgate Publishing, Ltd.

Armah, B. (2003). Economic analysis of the energy sector. Energy Commission of Ghana publication. Accra, Ghana.

Aryeetey, E., & Harrigan, J. (2000). Macroeconomic and sectoral developments since 1970. Aryeetey et al., Economic Reforms in Ghana, 5-31.

Aziz, M. I. A., & Bakar, A. (2009, August). Oil price and exchange rate: A comparative study between net oil exporting and net oil importing countries. In ESDS International Annual Conference, London.

Bawumia, M. (2014). Restoring the value of the cedi. Distinguished Speaker Series Lecture-Central University College, Ghana. March 25, 2014

Bank of Ghana Annual Reports, Monetary Policy; Inflation Outlook

Bahattin, B., (2011). Commodities: Exchange rate and oil prices. Energy market financialization and equity-commodity co-movements.

Chen, S. S., & Chen, H. C. (2007). Oil prices and real exchange rates. Energy Economics, 29(3), 390-404.

Cline, W. R., & Williamson, J. (2009). Estimates of fundamental equilibrium exchange rates. Peter G. Peterson Institute for International Economics.

Côté, A. (1994). Exchange rate volatility and trade. Bank of Canada Work. Pap, 94-5.

Dawson, J. C. (2007). The effect of oil prices on exchange rates: a case study of the Dominican Republic. Undergraduate Economic Review, 3(1).

Doğan, S., Ustaoğlu, M., & Demez, S. (2012). Relationship between Real oil price and Real exchange rate: the case of Turkey. Procedia-Social and Behavioral Sciences, 58, 1293-1300.

Europe Brent Spot Price, (2016). Petroleum and other liquids. US Energy Information Administration.

Fosu, A. K., & Aryeetey, E. (2008). Ghana's Post-Independence Economic Growth: 1960-2000. The Economy of Ghana—Analytical Perspectives on Stability, Growth and Poverty, James Currey, Suffolk.

Frimpong and Oteng-Abayie (2010). When is inflation harmful? Estimating the threshold effect for Ghana. American Journal of Economics and Business Administration, 2(3), 232-239.

Grisse, C. (2010). What drives the oil-dollar correlation? Unpublished manuscript.

Hamilton, J. D. (2011). Historical oil shocks (No. w16790). National Bureau of Economic Research.

Harris, R. I. (1995). Using cointegration analysis in econometric modelling (Vol. 82). London: Prentice Hall.

Insah, B., & Chiaraah, A. (2013). Sources of real exchange rate volatility in the Ghanaian economy. Journal of Economics and International Finance, 5(6), 232.

International Energy Agency. (2012). 2011 Key World Energy Statistics. International Energy Agency. Retrieved November 2, 2012, from www.iea.org

Jansen, W. J., & Schulze, G. G. (1996). Theory-based measurement of the saving-investment correlation with an application to norway. Economic inquiry, 34(1), 116-132Johansen, S. (1988). Statistical analysis of cointegration vectors. Journal of economic dynamics and control, 12(2), 231-254.

Killick, T. (2010). Development economics in action second edition: a study of economic policies in Ghana. Routledge.

Kojima, M. (2009). Government response to oil price volatility: Experience of 49 developing countries.

Kuijs, L. (1998). Determinants of inflation, exchange rate, and output in Nigeria.

Mhango, Y. (2010). Ghana: Annual economic outlook and the eve of oil production. Standard Bank Group Economics.

Nnadikwe, K. (2007). High oil dependence in Ghana: To what extent is Ghana vulnerable to oil price shock? University of Dundee, Scotland.

Novotný, F. (2012). The link between the Brent crude oil price and the US dollar exchange rate. Prague Economic Papers, 2, 220-232.

Osigwe, A. C. (2015). Exchange rate fluctuations, oil Prices and economic performance: Empirical Evidence from Nigeria. International Journal of Energy Economics and Policy, 5(2).

Patrick, K. (2013). The effect of exchange rate fluctuations on Changes in retail oil prices in Kenya (Doctoral dissertation, Unversity of Nairobi).

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. Biometrika, 75(2), 335-346.

Sharma, K. (2000). Export growth in India: Has FDI played a role (No. 816). Center discussion paper.

Stancık, J. (2006). Determinants of exchange rate volatility: The case of the new EU members.

Sjö, B. (2008). Testing for unit roots and cointegration. Web address https://www.iei.liu.se/nek/ekonometrisk-teori-7-5-hp-730a07/labbar/1.233753/dfdistab7b.pdf

Tiwari, A. K., Dar, A. B., & Bhanja, N. (2013). Oil price and exchange rates: a wavelet based analysis for India. Economic Modelling, 31, 414-422.

Zhang, Y. (2013). The links between the price of oil and the value of US Dollar. International Journal of Energy Economics and Policy, 3(4), 341.

Zwanzger, S. (2009). Determinants of exchange rates: the case of the Chilean peso (Doctoral dissertation, University of North Carolina Wilmington).

## APPENDIX

VECTOR ERROR CORRECTION MECHANISM (VECM) RESULTS

COINTEGRATION TEST RESULTS

Date: 02/19/16 Time: 12:09

Sample (adjusted): 2000M04 2015M05

Included observations: 182 after adjustments

Trend assumption: Linear deterministic trend

Series: LNREEXC LNCPI LNOILP

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.128967 | 32.78554 | 29.79707 | 0.0220 |
| At most 1 | 0.040761 | 7.655836 | 15.49471 | 0.5029 |
| At most 2 | 0.000450 | 0.081913 | 3.841466 | 0.7747 |

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.128967 | 25.12970 | 21.13162 | 0.0129 |
| At most 1 | 0.040761 | 7.573924 | 14.26460 | 0.4237 |
| At most 2 | 0.000450 | 0.081913 | 3.841466 | 0.7747 |

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

| LNREEXC | LNCPI | LNOILP |
|---|---|---|
| -9.556618 | -3.900851 | 3.407154 |
| -0.859184 | -0.651965 | -1.275209 |
| -5.507381 | 1.969401 | -2.114602 |

Unrestricted Adjustment Coefficients (alpha):

| | | | |
|---|---|---|---|
| D(LNREEX) | 0.005052 | 0.001738 | -0.000275 |
| D(LNCPI) | 0.001660 | 0.002037 | 0.000114 |
| D(LNOILP) | -0.025836 | 0.008355 | -0.000552 |

| | | |
|---|---|---|
| 1Cointegrating Equation(s): | Log likelihood | 1198.064 |

Normalized cointegrating coefficients (standard error in parentheses)

| LNREEXC | LNCPI | LNOILP |
|---|---|---|
| 1.000000 | 0.408183 | -0.356523 |

(0.07594) (0.07849)

Adjustment coefficients (standard error in parentheses)

D(LNREEX) -0.048279

(0.01474)

D(LNCPI) -0.015863

(0.00886)

D(LNOILP) 0.246909

(0.06017)

---

2 CointegratingLog

Equation(s): likelihood 1201.851

---

Normalized cointegrating coefficients (standard error in parentheses)

| LNREEXC | LNCPI | LNOILP |
|---|---|---|
| 1.000000 | 0.000000 | -2.499363 |
| | | (0.92668) |
| 0.000000 | 1.000000 | 5.249703 |
| | | (2.26382) |

Adjustment coefficients (standard error in parentheses)

| | | |
|---|---|---|
| D(LNREEX) | -0.049771 | -0.020839 |
| | (0.01475) | (0.00608) |
| D(LNCPI) | -0.017613 | -0.007803 |
| | (0.00877) | (0.00361) |
| D(LNOILP) | 0.239730 | 0.095337 |
| | (0.06010) | (0.02477) |

Vector Error Correction Estimates

Date: 02/19/16 Time: 12:10

Sample (adjusted): 2000M04 2015M05

Included observations: 182 after adjustments

Standard errors in ( ) & t-statistics in [ ]

| Cointegrating Eq: | CointEq1 |
|---|---|
| LNREEXC(-1) | 1.000000 |
| LNCPI(-1) | 0.408183 |
| | (0.07594) |
| | [ 5.37535] |
| LNOILP(-1) | -0.356523 |

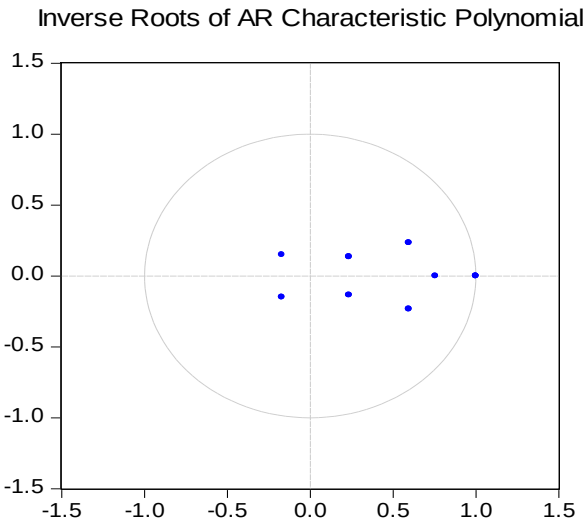
| | | | |
|---|---|---|---|
| | (0.07849) | | |
| | [-4.54199] | | |
| C | -4.735689 | | |

| Error Correction: | D(LNREEXC) | D(LNCPI) | D(LNOILP) |
|---|---|---|---|
| CointEq1 | -0.048279 | -0.015863 | 0.246909 |
| | (0.01474) | (0.00886) | (0.06017) |
| | [-3.27482] | [-1.79069] | [ 4.10364] |
| D(LNREEXC(-1)) | 0.535621 | -0.111439 | -0.559701 |
| | (0.07605) | (0.04570) | (0.31040) |
| | [ 7.04272] | [-2.43855] | [-1.80318] |
| D(LNREEXC(-2)) | 0.023320 | 0.042472 | -0.714960 |
| | (0.08132) | (0.04886) | (0.33190) |
| | [ 0.28677] | [ 0.86919] | [-2.15417] |
| D(LNCPI(-1)) | -0.316675 | 0.511097 | 1.179314 |
| | (0.13088) | (0.07864) | (0.53416) |
| | [-2.41959] | [ 6.49896] | [ 2.20779] |
| D(LNCPI(-2)) | -0.016398 | -0.075753 | -0.520805 |
| | (0.13323) | (0.08005) | (0.54375) |
| | [-0.12308] | [-0.94627] | [-0.95780] |
| D(LNOILP(-1)) | 0.012898 | -0.000689 | 0.172217 |
| | (0.01770) | (0.01064) | (0.07224) |
| | [ 0.72865] | [-0.06475] | [ 2.38382] |
| D(LNOILP(-2)) | 0.014369 | -0.001651 | 0.036249 |

| | | | |
|---|---|---|---|
| | (0.01773) | (0.01066) | (0.07238) |
| | [ 0.81020] | [-0.15492] | [ 0.50081] |
| C | 0.002756 | 0.006688 | -0.008030 |
| | (0.00223) | (0.00134) | (0.00912) |
| | [ 1.23338] | [ 4.98162] | [-0.88059] |
| R-squared | 0.311752 | 0.264279 | 0.187684 |
| Adj. R-squared | 0.284064 | 0.234681 | 0.155005 |
| Sum sq. resids | 0.075361 | 0.027210 | 1.255295 |
| S.E. equation | 0.020811 | 0.012505 | 0.084937 |
| F-statistic | 11.25940 | 8.928964 | 5.743208 |
| Log likelihood | 450.5952 | 543.2989 | 194.6271 |
| Akaike AIC | -4.863684 | -5.882406 | -2.050847 |
| Schwarz SC | -4.722848 | -5.741570 | -1.910011 |
| Mean dependent | -0.002943 | 0.012278 | 0.004650 |
| S.D. dependent | 0.024596 | 0.014294 | 0.092400 |

| | |
|---|---|
| Determinant resid covariance (dof adj.) | 4.40E-10 |
| Determinant resid covariance | 3.84E-10 |
| Log likelihood | 1198.064 |
| Akaike information criterion | -12.86884 |
| Schwarz criterion | -12.39352 |

**DIAGNOSTIC TEST RESULTS FOR VECM**




VEC Granger Causality/Block Exogeneity Wald Tests

Date: 02/19/16 Time: 12:11

Sample: 2000M01 2015M05

Included observations: 182

Dependent variable: D(LNREEXC)

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(LNCPI) | 8.554675 | 2 | 0.0139 |
| D(LNOILP) | 1.406865 | 2 | 0.4949 |
| All | 9.721386 | 4 | 0.0454 |

Dependent variable: D(LNCPI)

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(LNREEC) | 6.096272 | 2 | 0.0474 |
| D(LNOILP) | 0.032124 | 2 | 0.9841 |
| All | 6.323946 | 4 | 0.1762 |

VEC Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Date: 02/19/16 Time: 12:12

Sample: 2000M01 2015M05

Included observations: 182

| Lags | LM-Stat | Prob |
|---|---|---|
| 1 | 21.63452 | 0.0101 |
| 2 | 10.16848 | 0.3370 |

Probs from chi-square with 9 df.

VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: residuals are multivariate normal

Date: 02/19/16 Time: 12:12

Sample: 2000M01 2015M05

Included observations: 182

| Component | Skewness | Chi-sq | df | Prob. |
|---|---|---|---|---|
| 1 | 0.114630 | 0.398581 | 1 | 0.5278 |
| 2 | 2.160859 | 141.6358 | 1 | 0.0000 |
| 3 | -0.520079 | 8.204620 | 1 | 0.0042 |
| Joint | | 150.2390 | 3 | 0.0000 |

| Component | Kurtosis | Chi-sq | df | Prob. |
|---|---|---|---|---|
| 1 | 6.623105 | 99.54556 | 1 | 0.0000 |

| | | | | |
|---|---|---|---|---|
| 2 | 16.19636 | 1320.591 | 1 | 0.0000 |
| 3 | 3.365183 | 1.011303 | 1 | 0.3146 |
| Joint | | 1421.147 | 3 | 0.0000 |

| Component | Jarque-Bera | df | Prob. |
|---|---|---|---|
| 1 | 99.94414 | 2 | 0.0000 |
| 2 | 1462.226 | 2 | 0.0000 |
| 3 | 9.215923 | 2 | 0.0100 |
| Joint | 1571.386 | 6 | 0.0000 |

VEC Residual Heteroskedasticity Tests: Includes Cross Terms

Date: 02/19/16 Time: 12:13

Sample: 2000M01 2015M05

Included observations: 182

Joint test:

| Chi-sq | Df | Prob. |
|---|---|---|
| 337.0651 | 210 | 0.0000 |

Individual components:

| Dependent | R-squared | F(35,146) | Prob. | Chi-sq(35) | Prob. |
|---|---|---|---|---|---|
| res1*res1 | 0.253316 | 1.415178 | 0.0807 | 46.10354 | 0.0992 |
| res2*res2 | 0.130898 | 0.628272 | 0.9455 | 23.82348 | 0.9237 |
| res3*res3 | 0.457401 | 3.516432 | 0.0000 | 83.24690 | 0.0000 |
| res2*res1 | 0.132614 | 0.637769 | 0.9397 | 24.13581 | 0.9165 |
| res3*res1 | 0.258360 | 1.453174 | 0.0660 | 47.02157 | 0.0843 |
| res3*res2 | 0.453954 | 3.467913 | 0.0000 | 82.61971 | 0.0000 |

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 02/19/16 Time: 12:13

Sample: 2000M01 2015M05

Included observations: 182

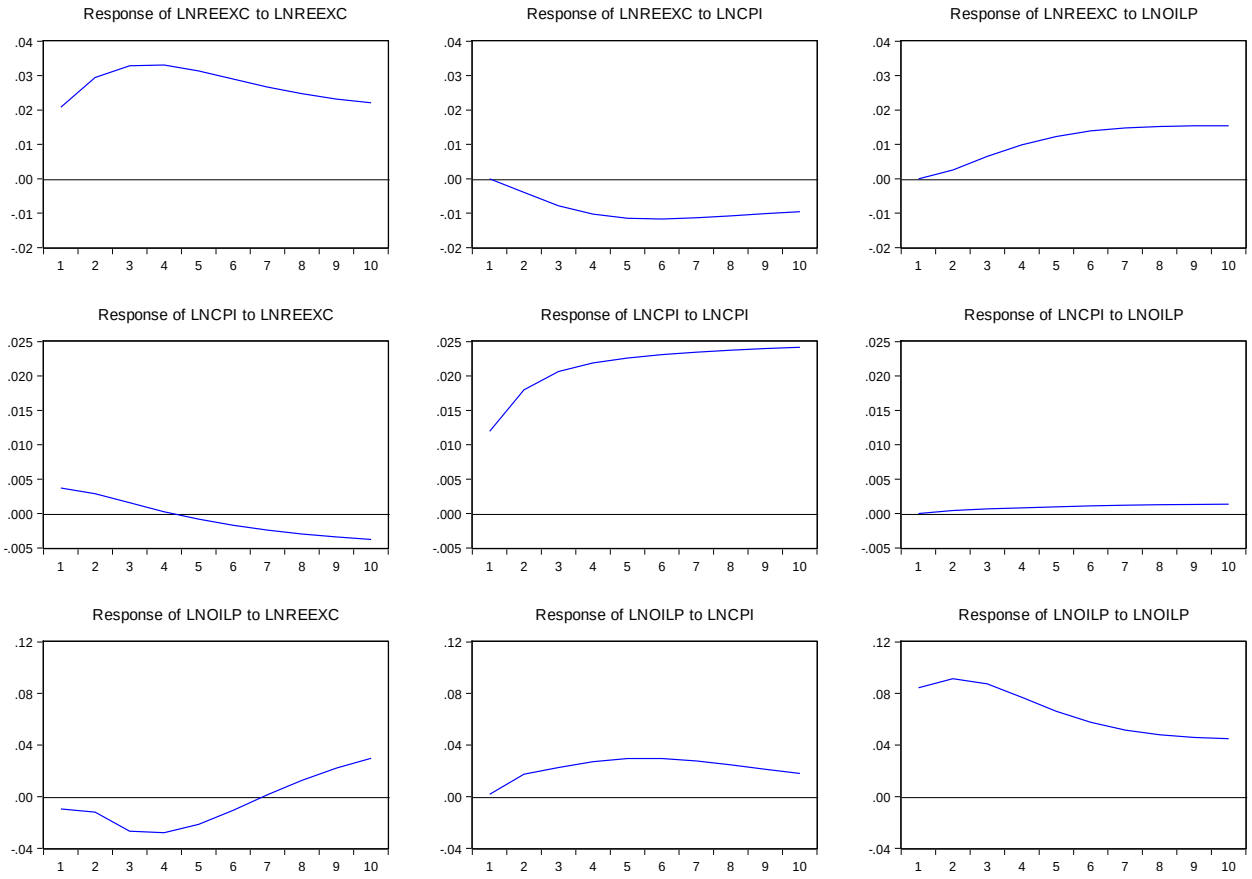
Joint test:

| Chi-sq | df | Prob. |
|---|---|---|
| 195.3684 | 84 | 0.0000 |

Individual components:

| Dependent | R-squared | F(14,167) | Prob. | Chi-sq(14) | Prob. |
|---|---|---|---|---|---|
| res1*res1 | 0.128784 | 1.763292 | 0.0480 | 23.43867 | 0.0535 |
| res2*res2 | 0.054162 | 0.683072 | 0.7888 | 9.857481 | 0.7725 |
| res3*res3 | 0.312247 | 5.415689 | 0.0000 | 56.82891 | 0.0000 |
| res2*res1 | 0.053855 | 0.678983 | 0.7927 | 9.801652 | 0.7765 |
| res3*res1 | 0.114125 | 1.536734 | 0.1029 | 20.77083 | 0.1077 |
| res3*res2 | 0.356188 | 6.599453 | 0.0000 | 64.82615 | 0.0000 |

Response to Cholesky One S.D. Innovations



Variance Decomposition of LNREEXC:

| Period | S.E. | LNREEXC | LNCPI | LNOILP |
|---|---|---|---|---|
| 1 | 0.020811 | 100.0000 | 0.000000 | 0.000000 |
| 2 | 0.036344 | 98.32328 | 1.187954 | 0.488763 |
| 3 | 0.050049 | 94.97312 | 3.073559 | 1.953322 |
| 4 | 0.061636 | 91.34979 | 4.811484 | 3.838730 |
| 5 | 0.071158 | 87.92016 | 6.206496 | 5.873343 |
| 6 | 0.078952 | 84.89737 | 7.232446 | 7.870187 |
| 7 | 0.085395 | 82.32405 | 7.946363 | 9.729587 |
| 8 | 0.090832 | 80.16514 | 8.424214 | 11.41065 |
| 9 | 0.095539 | 78.35749 | 8.735188 | 12.90732 |
| 10 | 0.099723 | 76.83440 | 8.933458 | 14.23214 |

Variance Decomposition of LNCPI:

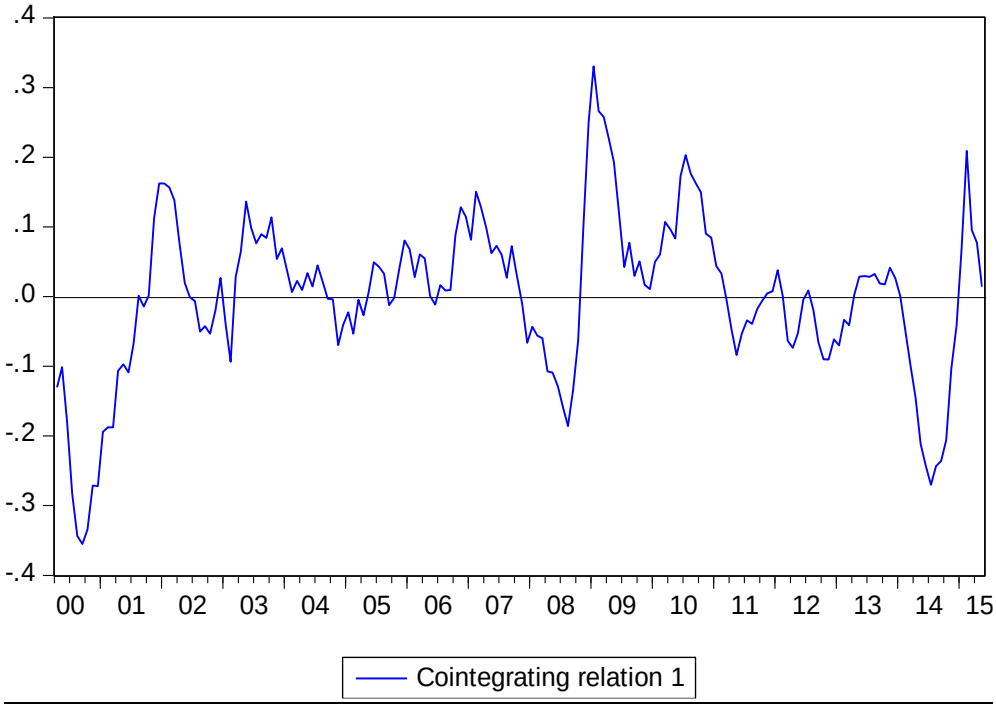
| Period | S.E. | LNREEXC | LNCPI | LNOILP |
|---|---|---|---|---|
| 1 | 0.012505 | 8.774144 | 91.22586 | 0.000000 |
| 2 | 0.022093 | 4.506571 | 95.45744 | 0.035986 |
| 3 | 0.030278 | 2.665636 | 97.26471 | 0.069654 |
| 4 | 0.037368 | 1.755113 | 98.15043 | 0.094452 |
| 5 | 0.043685 | 1.320206 | 98.56188 | 0.117914 |
| 6 | 0.049450 | 1.149741 | 98.70968 | 0.140574 |
| 7 | 0.054795 | 1.130464 | 98.70771 | 0.161831 |
| 8 | 0.059805 | 1.196499 | 98.62252 | 0.180978 |
| 9 | 0.064535 | 1.307910 | 98.49445 | 0.197639 |
| 10 | 0.069023 | 1.440195 | 98.34800 | 0.211801 |

Variance

Decomposition of LNOILP:

| Period | S.E. | LNREEXC | LNCPI | LNOILP |
|---|---|---|---|---|
| 1 | 0.084937 | 1.246391 | 0.048646 | 98.70496 |
| 2 | 0.126609 | 1.466590 | 1.893374 | 96.64004 |
| 3 | 0.157809 | 3.832962 | 3.246762 | 92.92028 |
| 4 | 0.179886 | 5.378033 | 4.763337 | 89.85863 |
| 5 | 0.195128 | 5.787496 | 6.343853 | 87.86865 |
| 6 | 0.205862 | 5.468961 | 7.768029 | 86.76301 |
| 7 | 0.214033 | 5.063723 | 8.862897 | 86.07338 |
| 8 | 0.221073 | 5.076400 | 9.551594 | 85.37201 |
| 9 | 0.227860 | 5.729732 | 9.856985 | 84.41328 |
| 10 | 0.234820 | 6.996955 | 9.861916 | 83.14113 |

Cholesky Ordering: LNREEXC LNCPI LNOILP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Cointegrating relation 1