THE NEXUS OF OIL CONSUMPTION, OIL PRICE VOLATILITY AND ECONOMIC GROWTH IN GHANA

BY

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DECLARATION

I hereby declare that this thesis is my own work towards the MSc 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 in the University, except where due acknowledgement has been made in the text.

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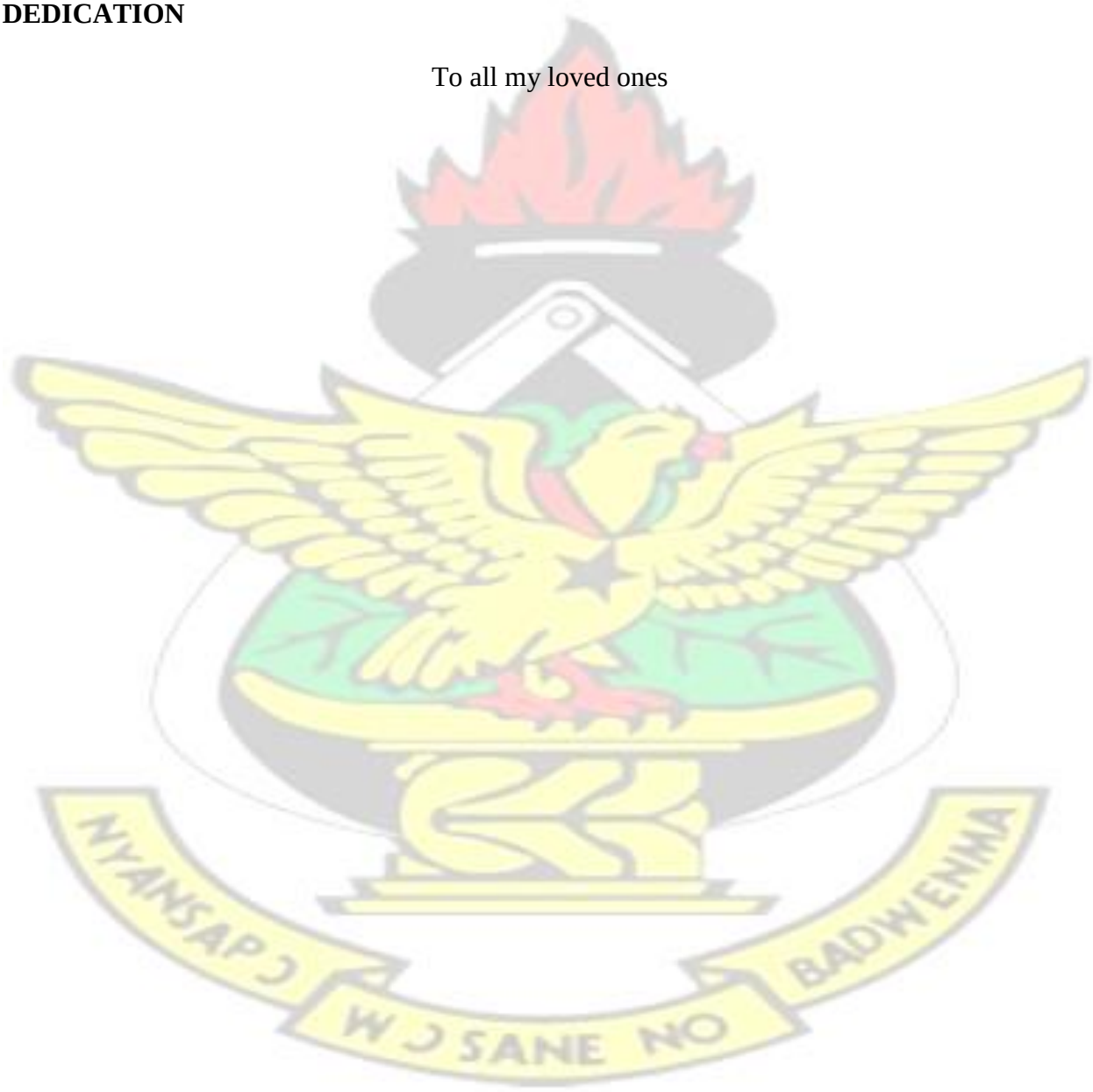
DEDICATION

To all my loved ones



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ABSTRACT

The study investigated the nexus of oil consumption, oil price volatility and economic growth in Ghana. Annual time series data sourced from the World Bank‟s Development Indicator (WDI) were used in this study, and the series spanned from 1980 to 2013. The ADF test proved all the variables to be stationary after first differencing. The Johansen cointegration test indicated two cointegration equations among the series. The study found a statistically significant positive relationship between crude oil consumption and Ghana‟s economic growth, both in the long and in the short run. Crude oil price was found to have a negative relationship with Ghana‟s economic growth in the short run, but a positive relationship with Ghana‟s economic growth in the long run. The study further found a negative significant relationship between oil price volatility and Ghana‟s economic growth in the long run.

The study recommends an efficient consumption of crude oil especially in the productive sectors (Manufacturing, Agricultural and Transport sectors) of the economy, in order to stimulate Ghana‟s economic growth. And also, to reduce Ghana‟s vulnerability to oil price volatility, policy makers must adopt risk management instruments such as physical reserves and hedging against oil prices.

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ABBREVIATIONS

ADF Augmented Dickey Fuller Test

DF Dickey Fuller

GDP Gross Domestic Product

VAR Vector Autoregression

VECM Vector Error Correction Model

IRF Impulse Response Function

VDF Variance Decomposition Function

ECT Error Correction Term

WDI World Development Indicator

CEPA Centre For Energy Policy Analysis

GSS Ghana Statistical Service

IFS Institute of Fiscal Studies

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The economic development of every country depends on energy. Energy is utilized in diverse ways (i.e. lighting, cooking, power for automobiles and other industrial machinery). In order to accelerate the growth of an economy, access to energy at affordable rates of diverse forms is imperative. This points to the fact that a sufficient and cheap supply source of energy is required in meeting the needs of firms and domestic users.

Crude oil is one form of energy that drives economies across the globe. As such any substantial change in its price will significantly impact on the economic growth and general wellbeing of the populace across the globe. The demand for crude oil for some time has been on the ascendency basically due to rapid modernization and urbanization of economies across the globe.

Scanty information usually among the industry players is a key cause of oil price shocks (Millennium development goals report 2005). Factors like weather, problems along the production-consumption chain, and sometimes comments by OPEC members among others were also cited as motivating factors of oil price shocks.

Crude oil discovery, its production and fluctuations in its price have both caused great prospects and severe economic, social, and political problems to a number of low income countries. Most low-income countries face a significant amount of import bill for crude oil, basically because they are net importers of crude oil. Also for some of these low-income countries, crude oil commands virtually half of their total imports. This means, rampant changes in the price of crude oil on the global scene affects the growth and macroeconomic performance of these countries. Shocks in crude oil prices can lead to high inflation and high social pressure in low income countries. This is

because, in those countries food prices contributes virtually to half of the consumption which in turn is positively correlated with fuel prices.

Energy sources in Ghana consist of biofuel and waste which accounts for 69.5% (principally used for cooking by the rural people), crude oil which accounts for 24.1% and hydro accounting for 6.4% (IEA, 2012). The productive sectors of the Ghanaian economy depends on crude oil as their core energy source. Armah (2003), revealed that, these sectors include the Agricultural sector, Transport sector and manufacturing sector and they account for 96.7%, 92% and 52% of energy consumption respectively. This is an indication that, shocks in the prices of crude oil on the global scene will certainly have an impact on Ghana"s economic growth.

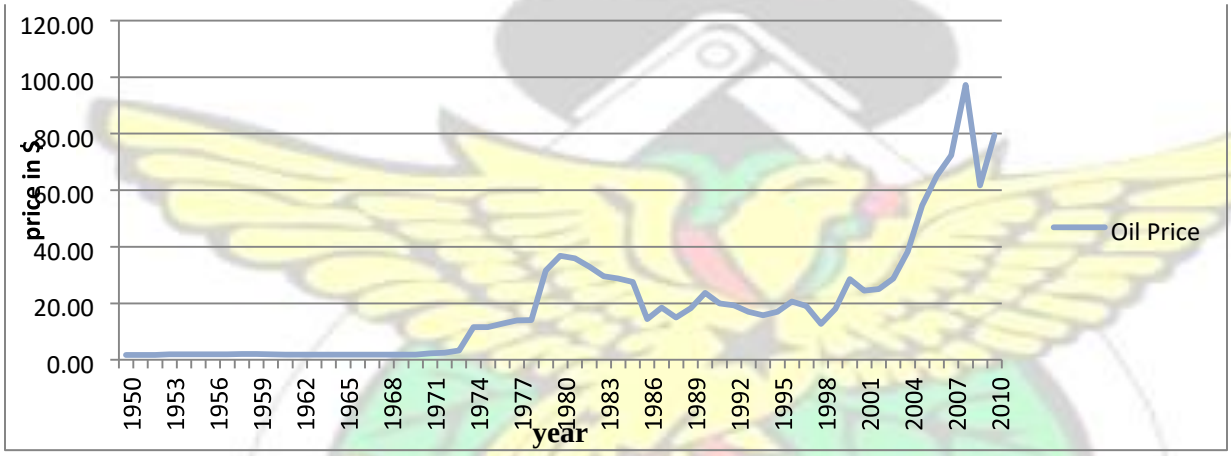

Figure 1.1: History of Oil Price

Source: British Petroleum Statistical Review

Notwithstanding the cardinal role of crude oil in the economy of Ghana, in addition to increasing demand of crude oil products, Ghana largely depends on imported crude to meet its demand for petroleum products. This puts Ghana in a much vulnerable position due to fluctuations in the price of crude oil on the global market. Fluctuations in the prices of crude oil has an impact on every country, and this impact is transmitted in the demand and supply channels (JimenezRodrigue &Sanchez, 2005). In Ghana, when there are hikes in the prices of global crude oil, it is often reflected in the local economy through corresponding price hikes in domestic products of crude oil

nationwide. Because crude oil products are very instrumental input source for the various productive sectors of the economy, such price hikes have a tendency to have grave consequences on the growth of the economy.

Periods of oil price shocks have been marked with declining rate of growth in Ghana. An instance is the periods of 1973 and 1983, where the country saw an average fall in GDP per capita in excess of 3% each year (Fosu & Aryeetey, 2008). In 1974 and 1979-81, the shocks in the crude oil prices were attributed in part as the reason for this economic misfortune (Aryeetey & Harrigan, 2008). During this period, global prices of crude oil increased to about four folds from $ 2.48 in 1972 to $11.58 per barrel by 1974. It is difficult however, to fully ascribe the fall in economic activities during this period to fluctuations in global prices of crude oil only. This is because, during this same periods, the country was bedeviled with political instability, high corruption rates as well as gross mismanagement. This period of economic downturn in the country and global shocks in crude oil price was followed by reforms in the economy and also comparatively low prices of crude oil. This progress made it viable for the country to enjoy sustained growth with a 5% average GDP growth since 1993 (Killick, 2010).

Ghana continued to enjoy this stability in the economy until in the year 2000 and 2008 where there was a disruption, caused by a shock in oil price. With an average of $28.3 per barrel of crude oil in 2000, this triggered domestic price of products of crude oil to rise by more than 20%, causing an increase in budget deficit by 87.7% and growth in the economy fell from 4.4% in 1999 to about 3.7% in 2000 with a 40.8% rise in inflation. The Ghanaian exchange rate at the time in nominal terms depreciated from GH¢0.35 to a dollar at the start of the year, 2000 to GH¢0.63 to a dollar by close of the year in 2000 (World Bank, 2012). Likewise, the stable growth of the Ghanaian economy was again disrupted in 2008 as a result of shocks in global crude oil prices and food.

Crude oil prices shot up to about $ 147 per barrel in July 2008. In an attempt by government to mitigate the effect on the domestic consumer, to an extent occasioned fiscal deficit. Inflation kept rising from 10.9% in 2006 to 12.8% in 2007, 18.45% in 2008 and 20.75% in 2009 (Ghana Statistical Service).

Ghana discovered crude oil in 2007 in commercial quantities, nonetheless the commercial production of this crude oil was on-stream in December 2010.To meet domestic needs, Ghana imports crude oil as well as crude oil products purposely because, it is unable to refine its own crude oil as a result of some technical challenges. Crude oil which was once a major import commodity has become one of Ghana‟s major exports commodities. Hence, crude oil has become a major source of tax revenue for Ghana in recent times and also an integral input in producing goods and services. According to the World Bank, Ghana‟s economy grew by 15% in GDP in 2011 as a result of increased oil exports (WDI, 2014) Crude oil therefore plays a key role or influences the growth of Ghana as a major source of energy.

This work intends to fill a vital research gap by bringing clarity on the nexus of oil consumption, fluctuations in its price and the growth of the Ghanaian economy, with regards to the quantum of the impact, the transitory nature of the shock and also the symmetry of the shock.

1.2 Statement of the research problem

Despite Ghana‟s discovery of oil in commercial quantities in 2007, and consequent lifting of oil in 2010, Ghana‟s importation of oil is substantially high. Ghana‟s importation of crude oil and refined products in 2013 amounted to US$ 3.4 billion (IFS, 2015). Ghana‟s chief source of crude oil import is Nigeria, this is so on the basis of Nigeria‟s proximity to Ghana, and also because

Nigeria‟s crude is highly preferred by our refinery because of its higher refinery margins. A study conducted by World Bank in 2005, revealed that Ghana‟s dependence ratio of oil has risen to 53.6%. Fascinatingly, it appears that aside Ghana being an oil dependent country whose consumption keeps increasing year by year in order to meet it socio-economic growth, Ghana is also vulnerable to shocks in crude oil prices on the international market. A similar report by the Centre for Policy Analysis [CEPA], (2007) showed that, the increased public expenditure, coupled with the currency crises that occurred in 2000 and continued in 2001 and 2002 was due to the incessant surge in the price of crude oil on the international market and also government‟s failure to pass on the increments to the consumer. This implies that, government‟s decision to absorb increments in crude oil products through subsidies instead of allowing for automatic price adjustment meant government expenditure exceeded its target in those years.

The recent falls in the prices of crude oil has presented a very serious fiscal challenge to the government of Ghana. According to the Institute for Fiscal Studies [IFS],(2015) Though the average production from Ghana‟s fields is expected to still hover around 103,000 barrels per day through 2016, the government had no option than to reduce substantially it oil revenue in the 2015 and 2016 budgets due to slumps in oil prices below the anticipated target. For the 2015 fiscal year, total oil revenue reduced from GH¢ 4.2 billion to GH¢1.8 which represents a 58% drop in oil revenue (IFS, 2015).

With coming on stream of oil production in Ghana, the anticipation was that, the extra revenue to be accrued would assist in reducing government borrowing from the open market; thereby ensuring the availability of more funds for the private sector. This anticipation has been challenged as a result of oil price shocks, and has rather caused government to borrow more. In essence, Ghana‟s

public debt has been on the ascendency in recent years, in spite of coming on stream of revenue from oil.

Shocks in oil prices affects Ghana‟s foreign reserves, causes a decline in the government‟s revenue, causes a crisis in its currency and most importantly an impediment to the country‟s ability to meet its financial commitments. The consequential outcome has been contributions from the academic fraternity and also churning out of policies among policy makers.

1.3 Objectives of the study

The research will seek to study the linkage between Ghana‟s oil consumption, oil price volatility, and the growth of the Ghanaian economy, which is a developing economy particularly for the period spanning 1980 - 2013. Specifically the research will seek;

1. To examine the effects of crude oil price and consumption on Ghana‟s economic growth.
2. To investigate the effects of crude oil price volatility on Ghana‟s economic growth.
3. To investigate how Ghana‟s economic growth and crude oil consumption responds to shocks in oil price volatility.

1.4 Research Questions

The research will look for answers to the following questions, in order to meet the set objectives

1. Does global crude oil prices and crude oil consumption in Ghana have any significant impact on Ghana‟s economic growth?
2. Does crude oil price volatilities have any significant impact on Ghana‟s economic growth?

3. How does Ghana‟s economic growth and crude oil consumption responds to shocks in oil price volatility?

1.5 Justification of the study

Shocks in oil prices has drawn keen attention among academics and policy makers across the globe over the years. This as a result of its effects on output, inflation and the stability of the economy. It is important to study the oil consumption, oil price and economic growth nexus in Ghana because crude oil has become Ghana‟s second export earner after cocoa and hence shocks in it price will impact the growth of the Ghanaian economy.

A number of researches done in this regard have mainly focused on the relationship between crude oil price and economic growth, particularly in the developed and also net oil importing countries in the sub-Saharan Africa. This work intends to fill a major research gap by incorporating a third vital variable which is oil consumption, and to ascertain how the relationship plays in Ghana.

1.6 Scope and delimitations of the study

The study focuses on investigating the nexus of oil price volatility, oil consumption and Ghana‟s economic growth. It includes theoretical and empirical works on price volatility, oil consumption and it linkage to economic growth. Annual data spanning from 1980 to 2013 is used in this study. This period is chosen as a result of availability of data of the choice variables.

1.7 Organization of the Study

The study is undertaken in five chapters. Chapter one features the background to the study, the problem statement, objectives, justification and the scope of the study. Chapter two reviews both theoretical and empirical literature on the topic under study. The third chapter covers the methodology used in the study. Chapter four of this work is dedicated to the analysis and

discussions of results obtained from the data used in this work. The final chapter, which is chapter five concludes the work with a summary of major findings, recommendations and suggestions for future works.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews relevant literature on oil price volatility, oil consumption and economic growth. This chapter has two sections. The first section reviews theoretical literature on oil price volatility, oil consumption and economic growth, whiles the second section reviews empirical works related to this study.

2.2 Theoretical Review

This section reviews theoretical works related to the topic.

2.2.1 Oil Price Volatility And Economic Growth

Typical theories of growth have mainly concentrated on capital, labour and land as the main input, while failing to identify the cardinal importance primary energy like crude oil. Nonetheless, there have been efforts to evolve theories that incorporate the role oil price volatility on the growth of economies, hence bridging the gap between oil price volatility and economic growth.

Proponents of the symmetric relationship of economic growth and price of oil such as Goodwin (1985), Hooker (1986) and Laser (1987) hypothesized that, volatility in the growth of Gross national product (GNP) is caused by volatility in oil prices. They based their theory on how the economies of oil exporting and oil importing countries reacted to occurrences in the oil market in 1948 and 1972. After thorough studies of empirical works, Hooker (2008) showed that between 1948 and 1972 oil price levels impacted significantly on GDP growth.

Laser (1987) later, confirmed the symmetric relationship between economic growth and volatility in oil price. Laser(1987) contends that increases in prices of oil leads to a fall in GDP while a

reduction of oil prices leads to an unambiguous result on GDP depending on the type of country(whether oil exporting or oil importing country).

Another school of thought, the asymmetry-in-effect theory of economic growth, explains the asymmetric link between economic growth and oil price volatility by concentrating on three potential ways: sectorial shock, counter-inflationary monetary policy and uncertainty. Proponents of this theory reveal that oil price increases and counter-inflationary response are significantly related. Balke (1996) agrees with this submission and portends that effects of oil price volatility on GDP is not sufficiently explained by monetary policy alone.

The renaissance growth theory was carved from the symmetric and asymmetric School of thoughts. Lee (1998), a proponent of the renaissance growth theory centered her theoretical work on differentiating between changes in oil prices and volatility in oil price. Lee (1998) contends that, oil price volatility and oil price change, impact economic growth negatively and in diverse ways: the impact of Oil price volatility on economic growth is immediate meanwhile the effects of oil price change on economic growth is felt after one year. Lee (1998) end by stating that, "it is volatility in crude oil prices that has a significant effect on economic growth and not oil price levels".

2.2.2 Oil Consumption and Economic Growth

Theories on crude oil consumption and the growth of an economy are generally grouped into three categories. The first theory suggest that, consumption of energy is a necessity for economic growth, such that energy is a direct input in the process of production and also complements labour and capital (Ebohon, 1996). This theory simply mean increasing consumption of crude oil triggers

the growth in an economy. This implies that energy conservation policies have damaging repercussions on the growth of the economy.

The second theory assumes a feedback relationship between the consumption of crude oil and growth of an economy. This theory suggests existence of a bidirectional linkage between the consumption of oil and the growth of an economy. This means an increase in the amount of crude oil consumed induces growth in the economy, likewise growth in the economy will also lead to an increase in oil consumption.

The third theory suggests, a neutral relationship between growth in the economy and the amount of oil consumed. As such this theory suggests that, policies initiated to conserve the use of energy will have no significant effect on the economy.

2.3 Empirical Literature

The portion of the literature review related empirical works relevant to this study.

2.3.1 Causality from oil Price to Economic growth

Several studies have analyzed the relationship between oil price and the growth of an economy. Hamilton (1983) showed a negative relationship between the growth of the United States economy and the price of crude oil. Hamilton‟s results was confirmed by Hooker (1994) and further demonstrated that, a 10% increase in the price of shrunk GDP by approximately 0.6% in the United States. Later Lee et al (1995) and Hamilton (1996) made known a non- linear transformation model and a granger causality test. Their result showed a negative relationship between price of oil and economic growth in New Zealand.

In a comparative research, Jin (2008) revealed that, hikes in the price of oil causes a decline in the economic growth of Japan and China, nonetheless increase in oil price leads to an expansion of the Russian economy. Specifically, he concludes that a 10% increase in price of crude oil triggers a 5.16% growth in the GDP of Japan.

In a related work Glasure and Lee (1997), examined the causality between GDP and the consumption of energy for South Korea and Singapore by using the granger causality test, together with cointegration and error correction modelling. Their work revealed a causality in both directions between income and energy for both countries. On the contrary, their work revealed no causality between consumption of energy and GDP for South Korea. It also revealed a one directional causality in the case of Singapore from the consumption of energy to GDP.

Chang and Wong (2003) focused on Singapore and investigated how the shocks in oil prices impacts on the economy of Singapore. They found an insignificant negative correlation between oil price fluctuations, inflation, gross domestic output and the rate of unemployment. In contrast, a similar work by Farzanegan and Markwardt (2009) with focus on Iran indicated a positive strong correlation between shocks in oil price and output from industry.

One recent work conducted in Thailand by Rafiq et al (2009) found out that, volatility in oil prices impacts negatively on investment in the short run, nonetheless it has a long run negative effect on unemployment.

In a related work, Sadorsky (1999) strongly held that, changes in oil prices have great influence on economic activities. This was corroborated by Papapetrou (2001) and Park and Ratti (2008), when they looked at it from the point of view of Greece and some other European countries.

With regards to works on Ghana, Jumah and Pastuszyn (2007) for the time spanning 1965 to 2004 assessed the linkage that exists between shocks in oil prices and monetary policy in Ghana.

The study aimed to examine the relationship that exists between prices crude oil on the global market and aggregate demand in Ghana by the use of cointegration analysis, through interest rate channel. Their work concluded that, crude oil prices on the global scene has a direct effect on general price levels which also has an effect on output. The results further showed that, initial response in monetary policy is static when oil prices go up but with high rates of inflation. The resultant increased inflation causes additional contraction of monetary policy. In essence the output does not return that fast to where it was initially after a shock in oil price, but rather drops over a period of time.

In a similar work, Tweneboah and Adam (2008) estimated both the long and short run linkages between global oil price and monetary policy for the period 1970 to 2006 in Ghana, their result showed the existence of long run linkages between global oil prices, price levels(domestic), exchange rate, interest rate and GDP. They further showed that, oil price shocks manifest in Ghana, through an increase in rate of inflation and fall in output.

2.3.2 Neutral hypothesis

This hypothesis contends that, no causality exist between growth of an economy and consumption of energy. This hypothesis implies that, conservation of energy will not cause growth in an economy and also growth in an economy on the other hand will not stimulate energy consumption. In a related work, Asafu-Adjaye (2000) examined the causality between income and the consumption of energy for Indonesia, India, Thailand and Philippines by the use of cointegration techniques and error correction model. The study discovered a short run causality running from energy to income in Indonesia and India. Also a two way granger causality was found in

Philippines and Thailand. The study however found neutrality with regards to income and energy consumption in the case of Thailand and Philippines.

Rafiq and Salim (2011) in examining the short run and long run causality between GDP and consumption of energy of six emerging economies found neutrality between income and energy consumption in Malaysia, Philippines and Indonesia.

Belaid and Abderrahmani (2013), for the period of 1971-2010 investigated the relation between oil prices, electricity consumption and economic growth in Algeria. The study employed multivariate cointegration technique and found no evidence of neutrality hypothesis.

In a related work, Akide (2007), examined the effects of oil price volatility on economic growth in Nigeria using quarterly data spanning from 1970 to 2000, and found out that for the period understudy, shocks in oil prices did not affect output in Nigeria.

In supporting the neutrality hypothesis, Mulegeta et al (2010) applied panel cointegration method on forty (40) Sub-Saharan African countries. The results from the study supported the neutrality hypothesis in the short run, except for the middle income countries.

Furthermore, Aqeel and Butt (2001) for the period of 1955 to 1956 applied the cointegration technique and granger causality test and found that, economic growth causes consumption of petroleum in Pakistan, but gas consumption in Pakistan justifies the neutrality hypothesis.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter provides a description of the methodology used to achieve the objectives of the study. Precisely, it addresses issues on model specification, Estimation strategies and source of data and description.

3.2 Model Specification

From the literature review and an assessment of the theoretical framework, the model for this work is specified. The model uses oil prices, oil consumption and gross domestic product (GDP) figures as the main variables in the model. Two models will be specified in consonance with the research objectives. The first model will seek to investigate the effects of oil price and oil consumption on Ghana"s economic growth and the second will also seek to examine the effects of oil price volatility on the economic growth of Ghana.

The unrestricted VAR model of order p is presented in equation (3.1) y

$$Ay_t \square_{i\,t} \square \square \ldots Ay_{p\,t\,\square\,p} \square B_i Z_t \square\square_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

Where; y_t is the vector of endogenous variables, Z_t is the vector of endogenous variables,

A_i and B_i are coefficient matrices, p is the maximum lag length

$\square_t$ is an uncorrelated zero mean white noise process

$\square_t$ has the properties below.

$E(\square_t) \square 0$ for all t

$E(\square\square_{s\ t}) \square\square$ if $s \square t$

$E(\square\square_{s\ t}) \square 0$ if $s \square t$

Ω is a variance- covariance matrix with non-zero off diagonal elements.

In order to achieve the first objective of this study, the model is specified as;

LGDP (*LOP LCON Z*, ,).....(3.2)

Where $LGDP$, LOP, $LCON$ represents Ghana"s economic growth, oil price, oil consumption respectively. Whiles Z is a vector consisting of control variables that may contribute to Ghana"s economic growth, and comprises, exchange rate (LEX), government investment ($LINV$) and interest rate ($LINT$). Hence equation (3.2) becomes:

LGDP (*LOP LCON LEX LINV LINT*, , , ,).....(3.3)

The econometric model in equation (3.3) is then estimated as:

LGDP *O* *1LOP* *2LCON* *3LEX* *4LINV* *5LINT* *t*.....(3.4)

Where $_i$ represents the parameters to be estimated, t refers to the time span considered in this study and $_t$ refers to the white noise and L represents natural logarithm.

In order to be able to define oil price shocks with reference to studies like Chen and Hsu (2012) and Elyasani et al (2011), a univariate GARCH (1, 1) model is estimated to generate oil price volatilities.

$oil_t = oil_{t-1} + \varepsilon_t \quad \varepsilon_t / oil_{1,\ldots} oil_{t-1} \sim N(0, h_t)$

$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$

Such that oil_t is the oil price at time t , ε_t represents change in price of oil at each time, and follows a normal distribution of zero mean and variance that depends on time. ω is the average variance rate of the price of oil price in the long run, α_1 is a measure of the sensitivity of oil price volatility

to the last change in the oil price and β_2 is a measures the sensitivity to all previous values of oil price variance.

To ensure that the GARCH model is covariance stationary $\omega_o > 0, \alpha_1 \geq 0, \beta_2 \geq 0$ and $\alpha_1 + \beta_2 < 1$. Hence to achieve objective two of this study, equation (3.3) is re estimated as:

$LGDP = (OPV\ LCON\ LEX\ LINV\ LINT, \ldots)$.....(3.5)

The explicit estimable econometric model can be expressed as:

$LGDP = \alpha_o + \alpha_1 OPV + \alpha_2 LCON + \alpha_3 LEX + \alpha_4 LINV + \alpha_5 LINT + \varepsilon_t$.....(3.6) where OPV represents oil price volatility. All other variable are as defined previously. The variables are logged due to the fact that, logging

(i) Enables variables to be converted into same unit of measurement

(ii) Minimizes heteroskedasticity in the model (Gujarati, 2005).

3.3 Estimation Strategies

The estimation strategy of this study follows three steps: (i) the test of stationarity of all the variables in the study (ii) the test of the existence of long-run equilibrium relationship among the variables and (iii) the estimation of the parameters of the model in equation 3.4 and 3.6

3.3.1 Unit Root Test

One of the most important steps to undertake in statistical analysis especially when working with time series data is to examine the stationarity of all the variables to be used. This is done to help ascertain the order of integration of the variables and also to give an idea of the choice of estimator. Running of regression on non-stationary time series data might lead to what is known as „spurious regression" thereby leading to a t-statistics that can"t be relied upon. Results from such regressions

might also lead one into arriving at wrong economic conclusions. The Augmented Dickey-Fuller (ADF) test was used to examine the stationarity of all the series used in this study. The unit root test in the ADF framework is of the form:

$$\Delta y_t = \alpha_o y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t \quad \text{.....(3.7)}$$

Where Δ is the first difference operator, y_t represent the variables under consideration in this study, t is the time trend, p is the optimal lag length and ε_t represents the error term.

The test of stationary in a time series simply imply the test of the null hypothesis that states that, the time series is non-stationary, against the alternative hypothesis ; the time series is stationary. Rejection of the null hypothesis means the series is stationary likewise failing to reject the null hypothesis signifies that the series has a unit root therefore non-stationary.

3.3.2 Cointegration Test

Variables in a time series analysis are said to be cointegrated, if they show a long run equilibrium relationship. For the purpose of this study The Johasen cointegration procedure is used. This cointegration technique starts by defining a vector autoregression (VAR) of a set of variables of y of order p as:

$$y_t = \mu + \sum_{i=1}^{p-1} \Gamma_i y_{t-1} + \varepsilon_t \quad \text{.....(3.8)}$$

Where $\Gamma_i = -\left(I - \sum_{j=1}^{i} A_j\right)$ $i = 1, \ldots, p-1$ and $\Pi = -\left(I - \sum_{i=1}^{p} A_i\right)$

If the coefficient matrix □ has a reduced rank, $r < n$, it means there exist an $n\ r$□ matrices □ and □ which have rank r such that, □□□□' and □' y_t is stationary. Where r represents the number of cointegrating relationship, the entries of matrix □ are the adjustment parameters in the vector error correction model(VECM), also the columns of matrix □ is a cointegrating vector.

The trace test and the maximum eigen value test are used to determine the number of cointegrating equations in the model.

The trace test is of the form:

$$J_{trace}\,\square\square^{T}\sum_{i\,r\square\,\square 1}^{n} In(1\square\square_i).....(3.9)$$

The trace test statistics, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors.

The maximum eigen value test is also expressed as:

$$J_{\max}\,\square\square TIn(1\square\square_{r\,\square 1}).....(4.0)$$

And it tests the null hypothesis of r cointegrating vectors as against the alternative of $(r+1)$ cointegrating vectors. T represents the sample size, and □$_i$ is the ith largest canonical correlation.

3.3.3 Vector Error Correction Model (VECM)

After the test of cointegration, the long-run relationship among the variables is established using the vector error correction model. The VECM within the VAR framework is estimated, to obtain the long run relationships among the variables understudy. The lag length selection criterion is based on the Akaike Information Criterion (AIC). A generalized form of the VECM within the

VAR frame work is represented below:

$$\Delta Y_t = \alpha_o + \beta_1 X_{t-1} + \beta_2 Y_{t-1} + \beta_3 ECT_{t-1} + \varepsilon_t \quad \text{.....(4.1)}$$

$$\Delta X_t = \alpha_o + \beta_1 X_{t-1} + \beta_2 Y_{t-1} + \beta_3 ECT_{t-1} + \varepsilon_t \quad \text{.....(4.2)}$$

Where ECT_{t-1} represents the error correction term, and Δ signifies the first differenced form of the variables in the model.

The VECM with oil price, in this study is estimated as:

$$\Delta LGDP = \alpha_o + \sum_{i=1}^{p} \beta_1 \Delta GDP_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta LOP_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta LCON_{t-i} + \sum_{i=1}^{p} \beta_4 \Delta LEX_{t-i} + \sum_{i=1}^{p} \beta_5 \Delta LINV_{t-i} + \sum_{i=1}^{p} \beta_6 \Delta LINT_{t-1} + \beta_7 ECT_{t-1} + \varepsilon_{t1} \quad \text{.....(4.3)}$$

And the VECM with oil price volatility is also estimated as:

$$\Delta LGDP = \alpha_o + \sum_{i=1}^{p} \beta_1 \Delta GDP_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta OPV_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta LCON_{t-i} + \sum_{i=1}^{p} \beta_4 \Delta LEX_{t-i} + \sum_{i=1}^{p} \beta_5 \Delta LINV_{t-i} + \sum_{i=1}^{p} \beta_6 \Delta LINT_{t-1} + \beta_7 ECT_{t-1} + \varepsilon_{t2} \quad \text{.....(4.4)}$$

3.3.4 Variance Decomposition Functions (VDF) and Impulse response functions (IRF) In order to test for the response of the dependent variable to the shocks of other variables included in the model the study employs the use of the variance decomposition function (VDF) and also the impulse response function (IRF) within the vector autoregressive framework. Unlike any causality test the VDF and IRF provides the response of the variables of interest to a shock in other variable in a time frame. The VDF and IRF in the context of the Vector Autoregressive (VAR) estimation are conducted to elaborate the dynamic relations that exist among variables. The VDF is conducted to determine whether a proportion of forecast variance of one variable is attributed to the effects of the other variables whereas the IRF analyses how one variable responds to a sudden temporary adjustment in another variable.

In order to evaluate the VDCs and IRFs, the study first estimates a VAR model in order to compute the VDCs and IRFs as expressed below;

$$Y\ c_t \square\ \square\square_1 Y_{t\square 1} \square\square_2 Y_{t\square 2} \square\ \square ... \ \square_q Y_{t\ q\square} \square\square_t \quad (4.5)$$

Where Y_t represents the dependent variable, c is the vector, $\square_j$ are parameters, t represents the time trend, q represents the optimal lag length and $\square$ represents the white noise.

In stimulating a standard VDF the orthogonalized responses are normally used where the underlying shocks of the VAR model are orthogonalized using the Cholesky decomposition. However, Lutkepohl, (1991) and Laurens and Cordoso (1998) state that, this approach is variant to how the variables are arranged in the VAR model, especially when the correlation between the variables is large. In line with this, the study adopts an alternative method; the generalized forecast error variance which is invariant to variable arrangement in the VAR model as proposed by Pesaran and Shin (1998) and Koop et al (1996). Again, the generalized forecast error variance method simultaneously estimates shock effects amongst the variables. This study therefore uses the generalized approach in estimating the variance decomposition.

3.3.5 Data Description and Sources

This study uses annual time series data that spans from1980-2013 for all variables. The variables used in this study include real GDP per capita (GDP), crude oil consumption (CON), real effective exchange rate (EX), interest rate (INT), and government investment. All data used in this study were obtained from the World Bank"s World Development Indicator database. The study uses GDP per capita to proxy economic growth in Ghana. GDP per capita is the value of GDP divided by the population of the country. This study uses GDP per capita measured in constant US$.

Crude oil consumption (CON) measures the total quantity of crude oil consumed in a year within the country for various economic activities. It is measured in kilotonnes.

Brent spot prices (OP) were used as crude oil price in this study, measured in dollar per barrel.

The choice of Brent crude oil over other crude oil types is justified by the fact that, Ghana‟s import of crude oil from Europe and Nigeria uses Brent spot prices. And also because Brent is a major benchmark in the trade of crude oil across the world.

Interest rate (INT) refers to the interest charged by financial institutions on loans given to the private sector. And it is measured as a percentage of the credit given.

Government fixed capital formation is measured in constant US$. It refers to the net increase in physical asset of a country. It is used as a proxy for government investment in this study

CHAPTER FOUR

DATA ANALYSIS

4.1 Introduction

This chapter presents and discusses the results of the study. The results on the stationarity properties of the variables included in the model are first presented. This is followed by the cointegration results, after which results on the estimated coefficients for both the long and shortrun are presented. Finally results of the variance decomposition function (VDF) and impulse response functions (IRF) are presented.

4.2 Result of Stationarity Test

In order to avoid the occurrence of spurious results and for the reason that all variables in this study are time series data, a stationarity test was conducted on all the variables. Series data that are stationary at levels are said to be integrated of order zero, I (0). While those that become stationary upon differencing them once are said to have order of integration of one, I (1). The Augumented Dickey Fuller (ADF) test was used to examine the stationarity of all the variables in this study.

The ADF test, tests the null hypothesis of the existence of non stationarity against the alternate hypothesis of the existence of stationarity in the series.

Table 4.1 reports the ADF test with constant only and no trend.

Table 4.1 THE ADF Unit root test

ADF UNIT ROOT TEST AT LEVELS					
VARIABLE	**1%**	**5%**	**10%**	**t-stats**	**Prob**
LCONS	-3.679322	-2.967767	-2.622988	1.070079	0.9962
LEX	-3.646342	-2.954021	-2.615817	-1.575220	0.4837
LGDP	-3.646342	-2.954021	-2.615817	0.747737	0.9914
LINT	-3.646342	-2.954021	-2.615817	-1.829099	0.3604
LINV	-3.653730	-2.957110	-2.617434	-0.287555	0.9161
LOP	-3.646342	-2.954021	-2.615817	-0.240240	0.9233

Source: Author‟s own construction

ADF UNIT ROOT TEST AT FIRST DIFFERENCE					
VARIABLES	**1%**	**5%**	**10%**	**t-test**	**Prob**
LCONS	-3.679322	-2.967767	-2.622989	-4.211207	0.0027
LEX	-3.653730	-2.957110	-2.617434	-5.895520	0.0000
LGDP	-3.653730	-2.957110	-2.617434	-4.451350	0.0013
LINT	-3.653730	-2.957110	-2.617434	-7.341072	0.0000
LINV	-3.653730	-2.957110	-2.617434	-8.685649	0.0000
LOP	-3.661661	-2.960411	-2.619160	-4.449841	0.0013

Source: Author‟s own construction

The results from table 4.1 indicates that, all the variables used in this work i.e Oil consumption (LCON), exchange rate(LEX),economic growth (LGDP), interest rate(LINT), government investment (LINV) and crude oil price (LOP) were not stable at levels, but were stationary upon first differencing. This means that all the variables in this study are I (1).

4.3 Lag length Selection

Five different information criterion were used in this work, namely the likelihood ratio (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan- Quinn information criterion (HC). The desired lag length selected by all five in the VAR specification is 2. This is shown in table 4.2. Hence the cointegration test for this work is set to lag 2.

Table 4.2 Lag length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	29.42651	NA	8.89 e-09	-1.511388	-1.233842	-1.420915
1	64.76549	54.71842*	9.73e-09	-1.468741	0.474080	-0.835430*
2	97.10814	37.55921	1.63e-08*	-1.232783*	2.375314*	-0.056633

* indicates lag order selected by the criterion at 5% significance level

4.4 Cointegration test

The cointegration test conducted in this study centered on the two test statistics which were proposed by Johansen (1991).These are the trace statistics and the maximum eigen value statistics. Both test suggested two cointegrating equations among our variables, which is indicative of the existence of a long run relationship among the variables. In essence, we rejected the null hypothesis of no cointegration at 5 % significance level. Table 4.3 shows the results

Table 4.3 Johansen Cointegration Two-Test Trace test

No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**

None *	0.962053	169.4381	95.75366	0.0000
At most 1 *	0.699504	71.29139	69.81889	0.0380
At most 2	0.449993	35.22176	47.85613	0.4363
At most 3	0.240014	17.28702	29.79707	0.6188
At most 4	0.157136	9.053371	15.49471	0.3605
At most 5	0.122632	3.924874	3.841466	0.0476

Trace test indicates 2 cointegrating eqns) at the 0.05 level
(

Maximum Eigenvalue test

No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.962053	98.14675	40.07757	0.0000
At most 1 *	0.699504	36.06963	33.87687	0.0269
At most 2	0.449993	17.93474	27.58434	0.5006
At most 3	0.240014	8.233649	21.13162	0.8888
At most 4	0.157136	5.128497	14.26460	0.7255
At most 5	0.122632	3.924874	3.841466	0.0476

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

4.5 Result Of Oil Price And Consumption On Economic Growth

Based on the results obtained from the Johansen cointegration test which indicated the existence of long run relationship and together with the I (1) order of integration of the variables, The study went on further to use The VECM estimation with a lag structure of two to examine the long and short run relationship among the variables.

Table 4.4 shows the long run dynamics of the VECM model with oil price oil consumption.

Table 4.4 VECM Long run relationship with Oil Price and Oil consumption

Cointegrating Eq:	CointEq1
LGDP(-1)	1.000000
LCON(-1)	2.884200* (0.35659) [8.08830]
LEX(-1)	-0.613522* (0.08707) [- 7.04600]
LINV(-1)	1.004934* (0.14040) [7.15768]
LINT(-1)	1.273678* (0.20481) [6.21897]
LOP(-1)	2.154223* (0.18444) [11.6800]
C	0.351909

Standard errors in ( ) & t-statistics in [ ],*, **, ***, indicate Coefficients are significant at 1%, 5%, and 10% significance level

In table 4.4 economic growth (LGDP) is set as the dependent variable, while oil consumption(LCON), exchange rate(LEX), government investment(LINV), interest rate(LINT) and oil price(LOP) are set as the independent variables. A cursory look at table 4.4 indicates that, the coefficients of all the independent variables are statistically significant at 1% significance level.

The result shows that LEX which represents exchange rate has coefficient of -0.61. This means that a 1% increase in exchange rate will trigger a decline in economic growth (LGDP) by 0.61% at 1% significance level. On this basis we argue that increase in exchange rate is detrimental to Ghana‟s economic growth in the long run holding all the variables constant.

The study finds a positive significant positive significant relationship between government investment (LINV) and economic growth (LGDP). Specifically, it indicates that a 1% increase in investment triggers 1% increase in economic growth, when all other variables are held constant in the long run. This result is expected and it is consistent with a similar work by Naser Tawiri (2010) in Libya.

Concentrating on oil consumption (LCON) and oil price (LOP) which are the main variables of interest, the study found that the coefficient of oil consumption is 2.884 and statistically significant at 1%. The economic interpretation of this is that a 1% increase in crude oil consumption in Ghana triggers 2.884% increase in Ghana‟s economic growth holding all other variables constant in the long run. This is an indication that oil consumption is a major driver of economic growth in Ghana. Cengiz Aktas and Veysel Yilmaz (2008) confirm a similar result in Turkey.

Interestingly, the long run result indicates that the coefficient of crude oil price (LOP) is positive and significant at 1%.The result shows that Ghana benefits from crude oil price increases. Specifically, a 1% increase in crude oil price causes 2.154% increase in Ghana‟s economic growth (LGDP) in the long run, when other variables are held constant. This result could possibly be due to the high revenue Ghana is currently enjoying as a result of the exportation of its crude oil. Ebele E (2015) also confirms a similar result in Nigeria.

Table 4.5 VECM Short Run Relationship With Oil Price and Oil Consumption

Dependent Variable: $\Delta LGDP$			
Regressor	**Coefficient**	**Standard Error**	**T-Stats**

C	0.018961	0.02816	0.67323
$\Delta LGDP_{t-1}$	-0.270357	0.19424	-1.39189
$\Delta LGDP_{t-2}$	0.107026	0.19252	0.55591
$\Delta LCON_{t-1}$	0.919921*	0.40268	2.28448
$\Delta LCON_{t-2}$	0.820190***	0.45522	1.80174
ΔLEX_{t-1}	-0.200784*	0.09730	-2.06352
ΔLEX_{t-2}	-0.029029	0.08540	-0.33992
$\Delta LINV_{t-1}$	-0.408863*	0.08986	-4.54985
$\Delta LINV_{t-2}$	-0.229905*	0.08678	-2.64920
$\Delta LINT_{t-1}$	-0.664190*	0.17734	-3.74528
$\Delta LINT_{t-2}$	-0.452137*	0.15697	-2.88034
ΔLOP_{t-1}	-0.762355*	0.22824	-3.34010
ΔLOP_{t-2}	-0.236864**	0.13259	-1.78640
ECT	-0.287210	0.10055	-2.85636
R_2	0.743132*		

*, **, ***, indicate Coefficients are significant at 1%, 5%, and 10% significance level.

The results indicates that the error correction term which represents the speed of adjustment to the long run equilibrium is -0.287 and it is statistically significant at 1% significance level. This means that, any short run shock in the cointegrating variables which causes economic growth ($\Delta LGDP$) to divert from it long run equilibrium is corrected by 28.7% within current period. Considering the short run elasticity, the result shows that crude oil consumption (LCON) has a positive significant relationship with economic growth (LGDP) at 1% significance level. Specifically it means that an increase in crude oil consumption by 1% will cause an increase in economic growth by 0.92% in the short run. This result is consistent with the result of the long run, which also has a positive relationship with economic growth at 1% significance level.

Exchange rate has a negative relationship at 1% significance level with economic growth. It specifically means from the coefficients that, a 1% increase in exchange rate causes a decline in

economic growth by 0.2% in the short run. This is in consonance with the long run result because they all have negative signs.

The study found that government investment (LINV), in the short run has a negative relationship with economic growth. Specifically it means in the short run, an increase of 1% in government investment causes 0.41% decline in the economic growth (LGDP) at 1% significance level, holding all other variables constant. Also, this result is not consistent with that of the long run. The result of the long run had a positive relationship with economic growth at 1% significance level.

The study further found the short run coefficient of oil price to be -0.762 and statistically significant at 1%. This implies that, a 1% increase in prices of oil causes a 0.762% short run decline in economic growth, when all other variables are held constant at 1% significance level.

4.6 Test for oil price volatility

Since the focus of this study is not only oil price, but also oil price volatility the series of oil prices is tested for GARCH effects. This will help in estimating the interaction between oil price volatility and Ghana‟s economic growth. Table 4.6 presents the results.

Table 4.6 The Estimation Result of GARCH (1,1) Model for Oil Price Series

Variable	Coefficient	Std. Error	z-Statistic	Prob.

C	0.466229	0.047171	9.883719*	0.0000
LOP	0.855006	0.002056	415.9358*	0.0000
	Variance Equation			
C	0.009436	0.008658	1.089834	0.2758
RESID(-1)^2	-0.415680	0.228371	-1.820197	0.0687
GARCH(-1)	1.225440	0.001943	630.6511*	0.0000
R-squared	0.859406			
Adjusted R-squared	0.854871			

Indicates 1% significance level

The GARCH (1, 1) estimation for oil price indicates the presence of a strong GARCH effect in the time series. As seen in table 4.6, the GARCH coefficient is significant at 1% significance level.

4.7 Result Of Oil Price Volatility And Consumption On Economic Growth

Having determined that, oil prices is characterized by a significant level of volatility over the period under consideration, the model is re-estimated by incorporating oil price volatility variable to examine it impact on Ghana‟s economic growth. Table 4.7 presents the results of the long run relationship with oil price volatility

Table 4.7 VECM Long Run Relationship with Oil Price Volatility

Cointegrating Eq:	CointEq1
LGDP(-1)	1.000000
LCON(-1)	3.214344* (0.85726) [3.74958]
LINV(-1)	2.797805* (0.42957) [6.51310]
LINT(-1)	-1.294960* (0.28928) [- 4.47643]
OPV(-1)	-24.65212* (3.34146) [- 7.37765]
LEX(-1)	2.360552* (0.19070) [12.3784]
C	47.85862

Standard errors in ( ) & t-statistics in [ ],*, **, ***, indicate Coefficients are significant at 1%, 5%, and 10% significance level

Table 4.7 indicates that all the independent variables ($LCON$, $LINV$, $LINT$, OPV, and LEX) are significant at 1% significant level.

The study found that, oil consumption had a coefficient 3.21 which implies that a 1% increase in the consumption of oil will generate a 3.21% increase in the growth of Ghana‟s economy ($LGDP$) in the long run, at 1% significance level when other variables are held constant. The result also shows that, the coefficient of government investment ($LINV$) is positive (2.80) and significant at

1%. Meaning that, for every 1% increase in government investment, economic growth in the long run, will also increase by approximately 2.80%.

Interest rate had a coefficient of -1.29 which was significant at 1% level. This indicates that a 1% increase in interest rate will shrink Ghana"s economic growth by 1.29% in the long run holding all other variables constant.

Considering oil price volatility, which is our main variable of interest, from table 4.7, it has a coefficient of -24.65, significant at 1% significance level. The coefficients imply that a unit increase in oil price volatility will cause a decline of Ghana"s economic growth by 24.65%, holding other variables constant. Oriakhi and Iyoha (2015) also confirm a similar result in Nigeria.

Table 4.8 VECM Short Run Relationship With Oil Price Volatility

Dependent Variable: $\Delta LGDP$			
Regressor	**Coefficient**	**Standard Error**	**T-Stats**
C	-0.00268	0.05947	0.04522
$\Delta LGDP_{-1}$	0.299710	0.23682	1.26557
$\Delta LGDP_{-2}$	0.123587	0.22806	0.54191
$\Delta LCON_{-1}$	0.003833	0.52715	0.00727
$\Delta LCON_{-2}$	1.013040***	0.57872	1.75048
ΔLEX_{-1}	-0.049766	0.12859	-0.38703
ΔLEX_{-2}	-0.020903	0.10636	-0.19653
$\Delta LINV_{-1}$	-0.259807***	0.13870	-1.87323
$\Delta LINV_{-2}$	0.053842	0.13502	0.39877
$\Delta LINT_{-1}$	-0.317464	0.22226	-1.42832
$\Delta LINT_{-2}$	0.099994	0.20923	0.47790
ΔOPV_{-1}	0.876300	1.55274	0.56436
ΔOPV_{-2}	1.011077	1.21911	0.82935
ECT	-0.018650	0.03018	-0.61823

*, **, ***, indicate Coefficients are significant at 1%, 5%, and 10% significance level

After incorporating oil price volatility ( ) variable in the model the short run results as displayed in table 4.8 shows that, oil consumption($\Delta LCON_{-2}$) has a positive significant relation with OPV

economic growth ($\Delta LGDP$). Specifically, the results show that, a 1% increase in oil consumption leads to 1.013% increase in economic growth in the short run, when all other variables are held constant at 10% significance level. This result is consistent with the result of the long run relationship, which also showed a positive relationship with economic growth at 1% significant level.

Government investment ($\Delta LINV_{-1}$) on the other hand shows a coefficient of -0.26 at 10% significance level. The economic interpretation of the result is that, a 1% increase in government investment ($\Delta LINV_{-1}$) will lead to 0.26% decline in economic growth ($\Delta LGDP$) in the short run, at 10% significance level. This relationship is not consistent with the result of the long run as they have opposite signs.

Focusing on our main variable of interest; oil price volatility (OPV), from the short run result, oil price volatility has a positive relationship with economic growth ($\Delta LGDP$), but the relationship is statistically insignificant. However it was statistically significant in the long run at 1% significant level with a positive coefficient.

4.8 Result of impulse Response Function Of Economic growth to Oil Price Volatility The impulse response function makes it possible to ascertain the responsiveness of the economic growth variables in a vector autoregressive model to a shock in the oil price volatility variable. The impulse response in this study is within a ten year horizon. The horizontal axis in the graph indicates the number of years after the impulse has been initialized while the vertical axis shows the responses of the economic growth variable. The impulse response of Ghana"s economic growth to oil price volatility was estimated as seen in figure 4.1

Figure 4.1 Response of Ghana's Economic growth to Oil Price Volatility

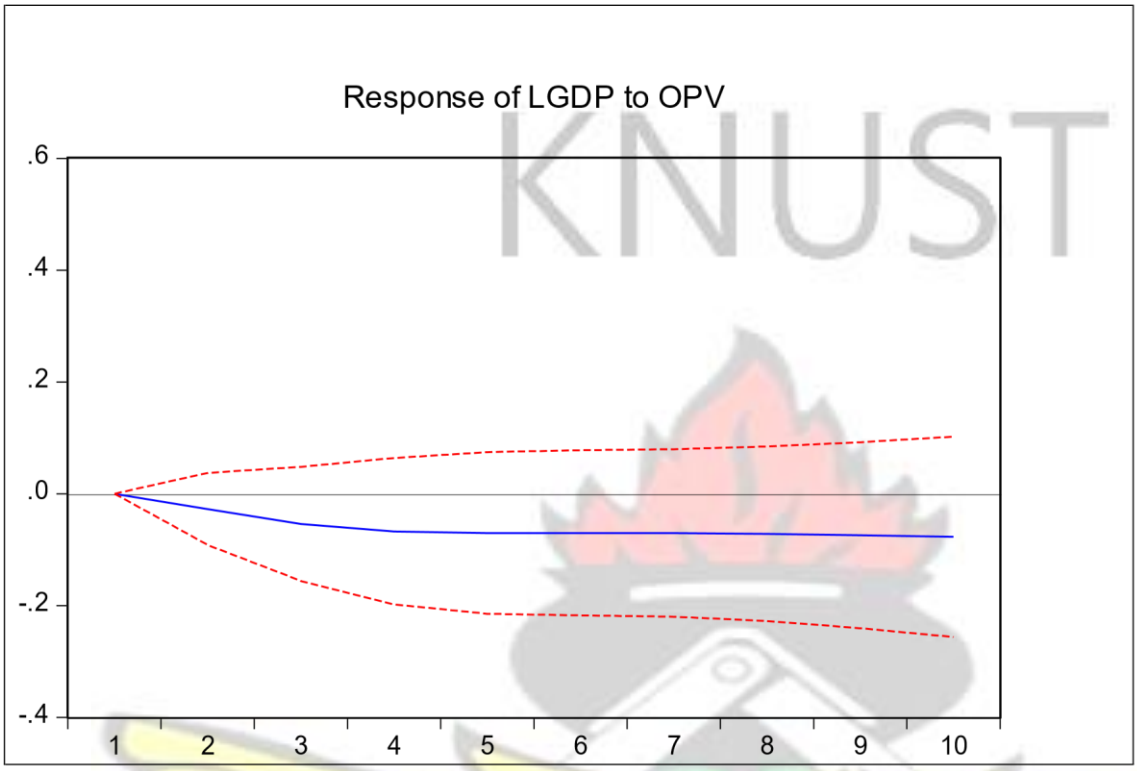

Figure 4.1 indicates that Ghana's economic growth ($LGDP$) reacts in the negative as a result of shocks in oil price volatility. Ghana"s economic growth shows a sustained decline in response to a shock in oil price volatility until after the fourth year, after which the decline virtually becomes constant. This is as a result of the uncertainty that oil price volatility comes with; firms consume less oil, postpone investment and in effect affects output, leading to a fall in the growth of the country. Iwayemi and Fawowe (2011) found a similar result in Nigeria.

Figure 4.2 Response of Ghana's Oil Consumption to Oil Price Volatility

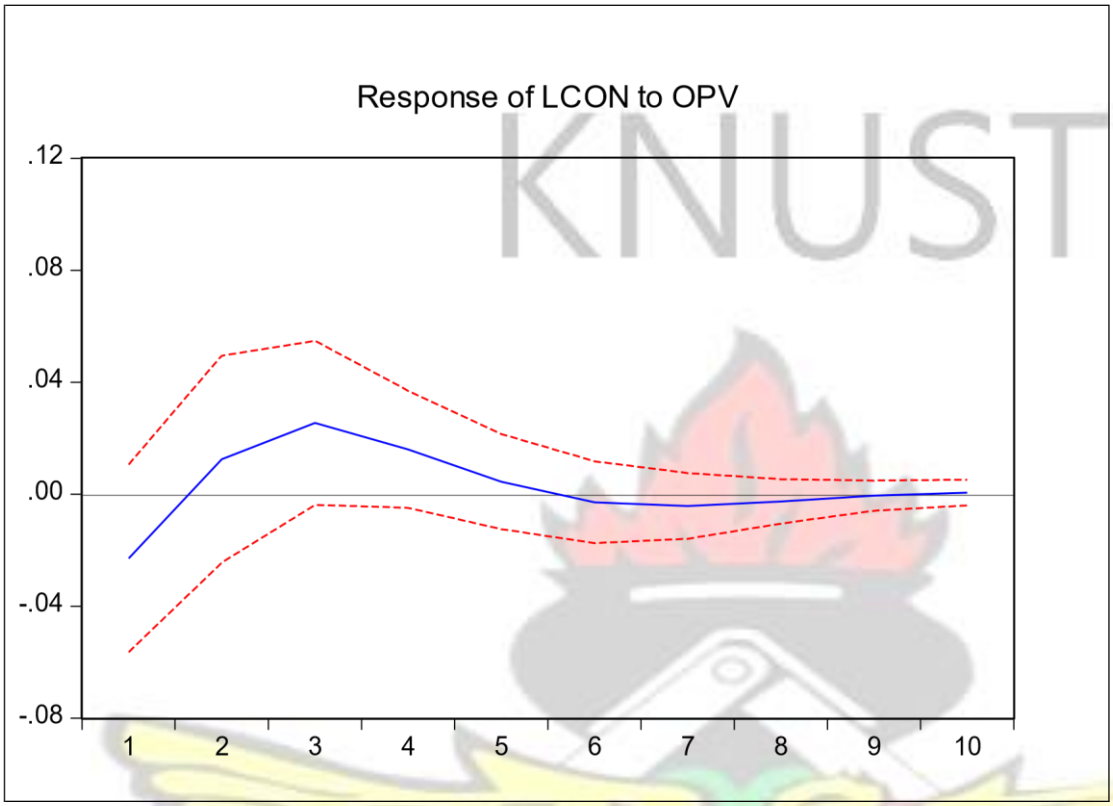

Figure 4.2 shows the response of oil consumption ($LCON$) as a result of shock in oil price volatility. The figure shows an initial negative response to oil price volatility(OPV) till about the 1.5 period, after which it rises till the third period, from which it shows a sustained decline over the periods till it reaches equilibrium in the final period.

4.9 Variance Decomposition

For the variance decomposition, we examine the forecast error variance in economic growth ($LGDP$) explained by its own innovations (shocks) or innovations (shocks) in other variables. The generalized variance decomposition function within an unrestricted VAR model was conducted in this study.

Table 4.9 presents the variance decomposition function of the variables in a ten year horizon.

Table 4.9 Variance Decomposition of Economic Growth (LGDP)

Variance Decomposition of LGDP						
% Forecast Variances Explained By Innovations in						
Horizon	**LGDP**	**LINV**	**LINT**	**OPV**	**LCON**	**LEX**
1	89.036	7.9748	1.1211	0.43495	15.780	9.4386
2	84.167	10.639	3.4765	0.45299	14.185	8.6746
3	75.227	15.041	6.9525	0.37839	11.855	7.6701
4	64.334	18.283	11.100	0.86291	10.146	6.5462
5	53.995	19.554	14.532	2.8212	8.9292	5.4719
6	44.938	19.341	16.634	6.1442	8.1122	4.5743
7	37.642	18.326	17.679	9.8558	7.7156	3.9467
8	32.138	16.997	18.057	13.144	7.7823	3.5879
9	28.239	15.586	18.012	15.777	8.2517	3.4493
10	25.613	14.185	17.681	17.854	9.0072	3.4779

Source: Author‟s own construction

Table 4.9 shows that, own shock explains the greatest fraction of the forecast error variance of economic growth (LGDP) as expected from theory. Aside that, a cursory look at table 4.9 indicates that, innovations in government investment(LINV) contributed more to the forecast error variance in economic growth as compared to the other variables over the time horizon. Similarly, interest rate, crude oil consumption, exchange rate and oil price volatility all contributed sequentially to the forecast error variance of economic growth over the specified time horizon. The explanatory power of investment nonetheless decreased over increasing time horizon. This is evident specifically from the seventh through to the tenth horizon; it fell from 18.326%, 16.997%, 15.586%, and 14.185% respectively.

Crude oil consumption‟s contribution to explaining the forecast error variance in economic growth was 15.780% in the first horizon. This fell over the increasing time horizon, till 9.0072% in the tenth horizon.

Crude oil price volatility on the other hand contributed 0.43% of the forecast error variance in economic growth in the first horizon, but also saw an increase over the time horizon, till it recorded 15.78% and17.85% in the 9^{th} and 10^{th} horizon respectively.

With regards to the contribution of the shocks in exchange rate to the forecast error variance of economic growth, the first and second horizon recorded 9.4% and 8.67% respectively to the forecast error of economic growth. However, it effect saw a gradual decline over the periods till the tenth period were it contributed 3.48%.

The variance decomposition function (VDF) in table 4.9 substantiates the role of government investment, interest rate, oil price volatility, consumption of crude oil, and exchange rate in accounting for the fluctuations in Ghana‟s economic growth, over the time horizon. In terms of explanatory power, government investment and interest rate explained the majority of the forecast error variance of economic growth compared to the other variables.

CHAPTER FIVE

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter outlines the major findings, conclusions, and policy recommendations.

5.2 Summary of Major findings

The study after conducting the stationarity test by the use of the ADF test, found all the variables used in this study to be stationary after differencing them once i.e. I (1). The cointegration test was conducted by employing the Johansen cointegration test. The study found a long run relationship among the variables.

Considering the model with oil price, government investment was found to have a statistically significant positive relationship with economic growth in the long run but had a negative significant relationship with economic growth in the short run.

With regards to crude oil consumption, the study found a positive significant relationship between the consumption of crude oil in Ghana, and economic growth, in the long and in the short run.

Interest rate had a negative significant relationship with growth of Ghana‟s economy in the short run, nonetheless a positive significant relationship in the long run.

Interestingly, crude oil price was found to have a positive significant relationship with Ghana‟s economic growth in the long run but in the short run, had negative significant relationship with Ghana‟s economic growth.

Considering the model with oil price volatility, the study found crude oil consumption to have a positive significant relationship with Ghana‟s economic growth, both in the long and in the short run. Government investment on the other hand was found to have a positive significant long run

relationship with economic growth nonetheless, a negative significant relationship with economic growth in the short run.

A negative significant relationship was found to exist between interest rate and economic growth both in the long and in the short run. The study subsequently found a negative statistically significant relationship between volatility in oil price and economic growth in the long run and a positive relationship with Ghana‟s economic growth in the short run, but it is statistically insignificant.

Through the variance decomposition function, the study found that shocks in government investment is the highest contributor to the forecast error variance of Ghana‟s economic growth as compared to the other variables used in this study.

5.3 Conclusions

The study sought to empirically examine the linkage that exist between, the consumption of crude oil, oil price volatility and growth of Ghana‟s economy, by the use of annual data from the World Development Indictor database for the period spanning from 1980 to 2013. The Johansen cointegration test and the vector error correction model was employed to investigate the long run and the short run association among the variables.

All the variables used in this study were found to be I(1), using of the ADF test. The Johansen cointegration test showed the existence of two cointegrating equations among the variables under consideration. As a result, the study further on estimated the VECM.

The study found a positive relationship to exist between crude oil consumption and economic growth in Ghana, in the long and in the short run. The result shows the significant impact crude

oil plays in the socio economic development in Ghana, such as transportation, electricity generation and in the service and manufacturing sectors.

The study also found the existence of a positive significant relationship between oil price and growth of Ghana‟s economy in the long run. However a negative relationship in the short run. Ebele E (2015) found a similar result in Nigeria. This result could possibly be due to the recent high revenue Ghana is receiving from it oil exportation in recent years. Making oil revenue the second highest earner after cocoa.

Furthermore, oil price volatility was found to have a negative and significant association in the long run, with Ghana‟s economic growth. The result implies a decrease in national consumption, as a result of uncertainty generated by volatility in oil price. Also, the negative relationship means a decrease in production and investment as a result of the uncertainty that oil price volatility brings about, hence manifesting in a decline in national output.

5.4 Recommendations

Based on the findings, the study recommends that government and policy makers must adopt policies that encourage an efficient consumption of crude oil, particularly in the productive sectors of Ghana‟s economy in order to stimulate growth.

With regards to the results that showed a negative relationship with oil price volatility and economic growth, this research recommends that conscious efforts must be made as a country to diversify the country‟s energy mix, together with energy mix of various sectors of the economy in order to insulate Ghana off the negative effects of shocks in oil price on the global market. Also special incentives could be given to investors in order to attract private investment in the energy sector especially in hydro, wind and solar.

Furthermore, to reduce the country‟s vulnerability to oil price volatility, policy makers must adopt risk management instruments such as physical reserves and hedging against oil prices.

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APPENDIX

UNIT ROOT TEST

Null Hypothesis: LCON has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		1.070079	0.9962
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one -sided p -values.

Null Hypothesis: D(LCON) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		-4.211207	0.0027
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one -sided p -values.

EXCHANGE RATE

Null Hypothesis: LEXChas a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		-1.575220	0.4837
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one -sided p -values.

GDP

Null Hypothesis: LGDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statis tic		0.747737	0.9914
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one -sided p -values.

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		-4.451350	0.0013
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

*MacKinnon (1996) one-sided p -values.

INTEREST RATE

Null Hypothesis: LINT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		-1.829099	0.3604
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one -sided p -values.

Null Hypothesis: D(LINT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		-7.341072	0.0000
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	

	10% level	-2.617434

*MacKinnon (1996) one -side d p-values.

lNVESTMENT

Null Hypothesis: LINV has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		- 0.287555	- 0.9161
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

*MacKinnon (1996) one -sided p -values.

Null Hypothesis: D(LINV) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		-8.685649	0.0000
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

*MacKinnon (1996) one -sided p -values.

OIL PRICE

Null Hypothesis: LOP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		-0.240240	0.9233
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one -sided p -values.

Null Hypothesis: D(LOP) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey -Fuller test statistic		-4.449841	0.0013
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

*MacKinnon (1996) one -sided p -values.

LM TEST

VEC Residual Serial Correlation LM
Tests

Null Hypothesis: no serial correlation at lag order h Included observations: 30

Lags	LM- Stat	Prob
1	37.48997	0.4007
2	24.21913	0.9327

Probs from chi -square with 36 df.

NORMALITY TEST

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Included observations: 30

Component	Skewness	Chi-sq	df	Prob.
1	0.273154	0.373066	1	0.5413
2	-0.336611	0.566536	1	0.4516
3	-0.206224	0.212642	1	0.6447
4	0.082890	0.034354	1	0.8530
5	-0.174210	0.151746	1	0.6969
6	-0.150186	0.112779	1	0.7370
		1.451123		
Joint			6	0.9627

Component	Kurtosis	Chi-sq	df	Prob.
1	3.040012	0.002001	1	0.9643
2	2.385073	0.472669	1	0.4918

3	3.815535	0.831371	1	0.3619
4	2.101882	1.008270	1	0.3153
5	2.516231	0.292541	1	0.5886
6	3.634002	0.502448	1	0.4784
		3.109299		
Joint			6	0.7950

Component	Jarque-Bera	df	Prob.
1	0.375067	2	0.8290
2	1.039205	2	0.5948
3	1.044013	2	0.5933
4	1.042624	2	0.5937
5	0.444286	2	0.8008
6	0.615226	2	0.7352
Joint	4.560422	12	0.9711

WALD TEST

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.831708	28	0.4126
F-statistic	0.691739	(1, 28)	0.4126
Chi-square	0.691739	1	0.4056

Null Hypothesis:
C(4)+C(5)=1 Null Hypothesis
Summary:

Normalized Restriction (= 0)	Value	Std. Err.
-1 + C(4) + C (5)	-0.190240	0.228734

Restrictions are linear in coefficients.

Dependent Variable: OP(-1)
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Included observations: 33 after adjustments
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.466229	0.047171	9.883719	0.0000
OP	0.855006	0.002056	415.9358	0.0000
Variance E quation				
C	0.009436	0.008658	1.089834	0.2758
RESID(-1)^2	-0.415680	0.228371	-1.820197	0.0687
GARCH(-1)	1.225440	0.001943	630.6511	0.0000

R-squared	0.859406	Mean dependent var	3.412916
Adjusted R-squared	0.854871	S.D. dependent var	0.626943
S.E. of regression	0.238839	Akaike info criterion	-0.061215
Sum squared resid	1.768368	Schwarz criterion	0.165529
Log likelihood	6.010043	Hannan-Quinn criter.	0.015078
Durbin-Watson stat	2.090793		