MACROECONOMIC VARIABLES AND OIL PRICE SHOCKS IN SUB-SAHARAN AFRICA OIL EXPORTING COUNTRIES

by

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DEDICATION

I dedicate this thesis to my late parents Alhaji Muhammad Aminu Sanusi the Chiroma of Kano and Hajia Mairo Dauda.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
ARCH	Autoregressive Conditional Heteroscedasticity
ARCH-LM	Autoregressive Conditional Heteroscedasticity Lagrange Multiplier
ARDL	Auto Regressive Distributed Lag
ARMA	Auto Regressive Moving Average
BEKK	Baba Engle Kraft and Kroner
BNA	Bank Nationale Angola
c.i.f	Cost Insurance and Freight
CBN	Central Bank of Nigeria
CEMAC	Central African Economic and Monetary Community
CFA	Communaute Financiere Africaine
CGARCH	Component Generalized Autoregressive Conditional Heteroscedasticity
CPI	Consumer Price Index
CUSUM	Cumulative Sum
CUSUMSQ	CUSUM of Squares
DAS	Dutch Auction System
DCC	Dynamic Conditional Correlations
DLOG	First Difference of Logarithm of a Variable
EGARCH	Exponential Generalized Autoregressive Conditional Heteroscedasticity
ERPT	Exchange Rate Pass Through
Exr	Exchange Rate

FCFA Franc Communaute Financiere Africaine

FGLS Feasible Generalized Least Squares

FIGARCH Fractionally Integrated Generalized Autoregressive Conditional Heteroskedasticity

FSU Former Soviet Union

GARCH Generalized Autoregressive Conditional Heteroscedasticity

GDP Gross Domestic Product

GMM Generalized Method of Moments

GNP Gross National Product

HQ Hannan- Quinn Criterion

IFS International Financial Statistics

IGARCH Integrated Generalized Autoregressive Conditional Heteroscedasticity

IMF International Monetary Fund

Inf Inflation

IRF Impulse Response Function

KPSS Kwiatkowski, Phillips, Schmidt, and Shin

Kz Kwanza

LDCs Less Developed Countries

LM Lagrange Multiplier

MGARCH Multivariate Generalized Autoregressive Conditional Heteroscedasticity

Ms Money Supply

MS-VECM Markov Switching Vector Error Correction Model

M-TAR Momentum Threshold Auto Regression

N/America North America

NGN Nigerian Naira

OECD Organization for Economic Cooperation and Development

OLS Ordinary Least Squares

Op Oil Price

OPEC Organization of Petroleum Exporting Countries

PP Phillips Perron

PPP Purchasing Power Parity

PVAR Panel Vector Auto Regression

RBC Real Business Cycle

RER Real Exchange Rate

ROP Real Oil Price

SAP Structural Adjustment Program

SC Schwarz Criterion

SSA Sub Saharan Africa

SVAR Structural Vector Auto Regression

TAR Threshold Auto Regression

UECM Unrestricted Error Correction Model

U.K United Kingdom

U.S United States

USD United States Dollar

VAR Vector Auto Regression

VEC Vector Error Correction

VECM Vector Error Correction Model

WDI World Development Indicators

WEO World Economic Outlook

WLS Weighted Least Squares

WDAS Wholesale Dutch Auction System

WTI West Texas Intermediate

YTL Yeni Turk Lirasi

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Appendix D: Mathematical Derivations of the ARDL Short run Dynamic effects Model for Angola

PEMBOLEHUBAH MAKROEKONOMI DAN KEJUTAN HARGA MINYAK DI NEGARA-NEGARA PENGEKSPORT MINYAK AFRIKA SUB-SAHARAN

ABSTRAK

Kajian ini telah memeriksa pembolehubah-pembolehubah makroekonomi dan kejutan harga minyak di tiga buah negara pengeksport minyak Afrika Sub-Saharan, iaitu Nigeria, Angola dan Gabon. Kajian ini telah menemui bukti limpahan yang tinggi kemudahruapan dari harga minyak benar ke kadar pertukaran benar di Nigeria dan Gabon dan limpahan yang rendah kemudahruapan dari harga minyak benar ke kadar pertukaran benar di Angola. Dalam erti kata lain, korelasi kemudahruapan antara kadar pertukaran benar Nigeria dan Gabon dan harga minyak benar didapati adalah lebih tinggi daripada korelasi kemudahruapan yang didapati antara dua pembolehubah itu untuk Angola. Implikasi dasar ekonomi keputusan-keputusan ini adalah bahawa kadar pertukaran benar Nigeria dan Gabon adalah lebih dipacu oleh kemudahruapan harga minyak daripada kadar pertukaran benar Angola, yang menjadi petanda risiko makroekonomi, mengurangkan perdagangan dan pertumbuhan adalah lebih dalam kedua-dua negara itu daripada Angola. Oleh itu, Nigeria dan Gabon lebih mudah terdedah kepada kesan makroekonomi daripada Dutch disease daripada Angola sebagaimana keputusan GARCH multivariat menunjukkan. Keputusan daripada ujian kointegrasi Johansen mendedahkan tiada bukti hubungan jangka panjang antara kadar pertukaran benar dan harga minyak benar bagi Nigeria dan Gabon, yang menyarankan bahawa dalam jangka masa panjang, tiada bukti penyakit Belanda untuk dua buah negara itu. Dalam kes Angola, ujian ARDL Bounds mendedahkan bukti hubungan jangka panjang yang stabil antara

kadar pertukaran benar dan harga minyak benar, yang mengesyorkan bahawa kesan-kesan makroekonomi penyakit Belanda adalah lebih kukuh dan berpanjangan di Angola daripada di Nigeria dan Gabon. Merujuk kepada dinamik jangka pendek antara kadar pertukaran benar dan harga minyak benar tiga buah negara itu, keputusan ujian sebab akibat Granger mendedahkan bukti sebab akibat dua hala antara kadar pertukaran benar dan harga minyak benar untuk Nigeria, yang menyarankan bahawa harga minyak benar dapat membantu dalam ramalan kadar pertukaran benar dan juga kadar pertukaran benar dapat membantu dalam ramalan harga minyak benar. Dalam kes Gabon, sebab akibat satu hala telah didapati dari kadar pertukaran benar ke harga minyak benar, yang mengesyorkan bahawa kadar pertukaran benar Gabon menyediakan maklumat mengenai pergerakan masa depan harga minyak benar dan harga minyak benar tidak boleh digunakan untuk meramalkan pergerakan masa depan dalam kadar pertukaran benar. Dalam kes Angola, tiada bukti sebab akibat jangka pendek antara dua pembolehubah tersebut. Keputusan kesan dinamik jangka pendek model ARDL menunjukkan bukti hubungan jangka pendek antara kadar pertukaran benar dan harga minyak benar, yang menyarankan bahawa sebab akibat jangka pendek di antara dua pembolehubah itu wujud. Kajian ini telah menemui bukti transmisi kejutan antara pembolehubah-pembolehubah makroekonomi ketiga-tiga negara itu, iaitu harga minyak, kadar pertukaran, bekalan wang, inflasi dan KDNK, dan kadar pertukaran Nigeria telah didapati lebih bertindak balas kepada kejutan harga minyak daripada kadar pertukaran Angola dan Gabon. Kejutan pembolehubah-pembolehubah itu sendiri telah didapati menjadi sumber dominan kejutan-kejutan. Ini menyarankan bahawa kejutan-kejutan adalah dalaman atau domestik. Transmisi kejutan makroekonomi dari tiga buah negara itu ke negara-negara rakan perdagangan jiran telah

diperhatikan, yang menyarankan bahawa rakan dagangan jiran tiga buah negara itu terdedah kepada kejutan makroekonomi luaran yang berasal dari tiga negara itu. Akhir sekali, kajian ini telah mendapati bahawa kejutan krisis ekonomi dan kewangan global 2008 telah memberi kesan kepada pembolehubah –pembolehubah makroekonomi ketiga-tiga negara itu dan juga rakan dagangan mereka. Ini menunjukkan ketiga-tiga negara itu dan rakan perdagangan jiran mereka mudah terdedah kepada ragam kejutan makroekonomi luar.

MACROECONOMIC VARIABLES AND OIL PRICE SHOCKS IN SUB - SAHARAN AFRICA OIL-EXPORTING COUNTRIES

ABSTRACT

The study has examined macroeconomic variables and oil price shocks in three Sub-Saharan African oil-exporting countries, namely Nigeria, Angola and Gabon. The study has found evidence of high volatility spillover from the real oil price to the real exchange rate in Nigeria and Gabon and low spillover of volatility from the real oil price to the real exchange rate in Angola. In other words, the volatility correlations between the real exchange rates of Nigeria and Gabon and the real oil price have been found to be higher than the volatility correlations between the two variables for Angola. The economic policy implication of these results is that the real exchange rates of Nigeria and Gabon are more driven by the volatility of oil price than the real exchange of Angola, which portends the macroeconomic risk of lowering trade and growth more in the two countries than Angola. Hence, Nigeria and Gabon are more susceptible to the macroeconomic effects of the Dutch disease than Angola as the multivariate GARCH results indicate. The results from the Johansen cointegration tests revealed no evidence of long run relationship between the real exchange rate and the real oil price for Nigeria and Gabon, which suggests that in the long run, there is no evidence of the Dutch disease for the two countries. In the case of Angola, the ARDL Bounds test revealed evidence of a stable long run relationship between the real exchange rate and the real oil price, which suggests that the macroeconomic effects of the Dutch disease are more sustained and long lasting in Angola than Nigeria and Gabon. With regards to the short run dynamics between the real exchange rates and real oil prices of the three countries, the results of the

Granger causality tests revealed evidence of bi-directional causality between the real exchange rate and the real oil price for Nigeria, which suggests that the real oil price can help in the prediction of the real exchange rate and also the real exchange rate can help in the prediction of the real oil price. In the case of Gabon, unidirectional causality has been found running from the real exchange rate to the real oil price, which suggests that the real exchange rate of Gabon provides information about the future movements in the real oil price and real oil price cannot be used to predict future movements in the real exchange rate. In the case of Angola, no evidence of short run causality between the two variables has been observed. The results of the short run dynamic effects of the ARDL model indicated evidence of a short run relationship between the real exchange rate and the real oil price, which suggests short run causality between the two variables exists. The study has found evidence of shocks transmission among the macroeconomic variables of the three countries, namely oil price, exchange rate, money supply, inflation and the GDP, and Nigeria's exchange rate has been found to respond more to oil price shock than the exchange rates of Angola and Gabon. The variables' own shocks have been found to be the dominant source of the shocks. This suggests that the shocks are internal or domestic. Transmission of macroeconomic shocks from the three countries onto their neighboring trading partner countries has been observed, which suggests that the neighboring trading partners of the three countries are vulnerable to external macroeconomic shocks that stem from the three countries. Finally, the study has found that the shock of the global economic and financial crisis of 2008 had affected the macroeconomic variables of the three countries as well as those of their trading partners. This indicates the vulnerability of the three countries and their neighboring trading partners to vagaries of external macroeconomic shocks.

CHAPTER 1: INTRODUCTION

1.1 Background to the study

Oil is an indispensable input for production, economic growth and social development. Two-thirds of the global energy requirements are met with oil and gas supplies (African Development Bank and African Union, 2009). Crude oil is among the main sources of energy, and one of the most important and widely traded commodities that affects the global economy and international trade (Milonas and Henker, 2001).[1] It is arguably the most influential physical commodity in the world, because of the significant role it plays in the world economy (Kuncoro, 2011).

Africa is among the major oil exporting regions of the world. It consumes less than 30% of its oil and gas, the remaining proportion is exported. It was estimated that 9.5% of global crude oil reserves and 8% of gas reserves are located in the Sub-Saharan Africa (Sahu, 2008). It was also estimated that 12% of global oil production comes from the Sub-Saharan oil-producing countries. Oil accounts for over 70% of the total exports of Angola, Chad, Congo, Equatorial Guinea, Gabon and Nigeria, and 30 to 40% for Cameroon and Côte d'Ivoire respectively (Qureshi, 2008). Tables 1.1 and 1.2 show the proved oil reserves and production levels in some major oil producing Sub-Saharan African countries, and Table 1.3 shows the exports of oil products in the selected countries of this study.[2]

[1] The effects of oil price volatility or shocks on international trade are discussed in Chapter Three.
[2] Proven reserves mean a definite quantity of energy sources estimated with reasonable certainty by geologists.

Table 1.1 Proved Oil Reserves in the Major Oil-producing Sub-Saharan African Countries (Thousand million barrels) (1992 – 2012)

Country	1992	2002	2011	2012
Nigeria	21.0	34.3	37.2	37.2
Angola	1.3	8.9	10.5	12.7
Sudan	0.3	0.6	5.0	1.5
Gabon	0.8	2.4	2.0	2.0
Congo	0.7	1.5	1.6	1.6
Chad	-	0.9	1.5	1.5
Equit.Guinea	0.3	1.1	1.7	1.7

Source: BP Statistical Review of World Energy (2013).

As can be seen from Table 1.1 above, Nigeria is the largest oil-producing country in Sub-Saharan Africa and also has the largest oil reserves among the countries presented in the table. Angola is the second largest oil producer after Nigeria in Sub-Saharan Africa and has the second largest oil reserves, and Gabon is the fourth largest oil producer in the region but emerges third in terms of oil reserves capacity. However, as can be observed from Table 1.2 below, in terms of oil production, Nigeria still emerges as the largest oil producer, while Angola, Sudan, Equatorial Guinea and Gabon are the second, third, fourth and fifth largest oil producer in Sub-Saharan Africa respectively.[3]

Table1.2 Oil Production in the Major Oil-producing Sub-Saharan African Countries (thousand barrels per day) 2002 -2012

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Nigeria	2087	2233	2430	2502	2392	2265	2113	2211	2523	2460	2417
Angola	905	870	1103	1404	1421	1684	1901	1804	1863	1726	1784
Sudan	241	265	301	305	331	468	480	475	465	453	82
Gabon	256	274	273	270	242	246	240	241	255	254	245
Congo	227	208	217	239	271	221	235	269	294	293	296
Chad	-	24	168	173	153	144	127	118	122	114	101
Equat..Guinea	230	266	351	358	342	350	347	307	274	252	283

Source: BP Statistical Review of World Energy (2013).

Oil resources in Africa are concentrated in a relatively small number of countries and sub-regions, mostly Northern and Western Africa. The eight major oil-exporting countries in Sub-Saharan Africa are Angola, Cameroon, Chad, the Republic of Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, and Nigeria (Qureshi, 2008). Nigeria, Angola and Gabon in particular, have been exporting oil since the

[3] It is noteworthy that Sudan is the third largest oil producer in Sub-Saharan Africa, and Equatorial Guinea the fourth after Nigeria and Angola. But, Gabon as the fifth largest oil producer is selected in this study because it started producing and exporting oil earlier than Sudan and Equatorial Guinea.

1960s (Qureshi, 2008). Others like Chad, Côte d'Ivoire, and Equatorial Guinea, started exporting oil in recent years (Qureshi, 2008). The major oil producers in Africa include Nigeria, Algeria, Libya, and Angola (Sahu, 2008). These countries are the largest oil producers in the region. Other producers are Egypt, Sudan, Equatorial Guinea, Congo Republic, Chad, Gabon, Tunisia and Cameroon (Sahu, 2008). Oil in the region covers almost one fifth of the United States oil imports, and one third of China's imports (African Development Bank and African Union, 2009). The oil sector accounts for the majority of exports and economic activity in most of the oil-producing countries of Sub-Saharan Africa such as Nigeria, Angola and Gabon. The huge proportion of exports in these countries is oil products. Table 1.3 below shows the exports of oil products in the three selected countries.

Table 1.3 Oil Products Exports of Nigeria, Angola and Gabon (kilo barrels per day), 1985-2011

Country	**Angola**	**Gabon**	**Nigeria**
Year			
1975	2	9	5
1980	4	12	32
1985	10	2	14
1990	9	3	62
1995	14	6	24
2000	11	5	21
2005	20	3	48
2006	31	3	38
2007	31	4	26
2008	29	5	18
2009	23	5	13
2010	20	5	18
2011	25	5	26

Source: International Energy Agency, *Oil Information* (2013).
Note: 1 kilo barrel is equivalent to 1,000 barrels.

Globally, oil price shocks have been considered as the major source of economic fluctuations. Hamilton (1983) indicates that all except one of the US macroeconomic downturns since World War II were preceded by higher oil prices. However, since the 1970s, the impact of oil price shocks on macroeconomic variables has been under academic investigation (Gisser and Goodwin, 1976; Mckillop, 2004; Blanchard and Gali, 2007; Aliyu, 2009; Iwayemi and Fowowe,

2011). Over the decades, oil prices have had significant effects on a wide range of macroeconomic indicators and these effects were considered as both real and inflationary (Gisser and Goodwin, 1976). Therefore, since the 1970s, the causes and consequences of oil price shocks and their macroeconomic effects on the oil-exporting as well as oil-importing nations of the world have received a great deal of academic attention (Kilian, 2009). For example, the oil price shock of the 1970s has been adjudged as responsible for the US recessions, for higher inflation, slowdown in the US productivity and for its stagflation respectively (Kilian, 2009). The effects of oil price shocks have been analyzed from their demand and supply channels of transmission to the macro economy (Gisser and Goodwin, 1976; Kilian, 2009).

Historically, oil shocks have been adjudged as the major cause of oil price volatility and as mentioned earlier, the dominant source of macroeconomic fluctuations (Kilian, 2009).

The first oil price shock of the early 1970s occurred from 1973 to 1974 following the OPEC embargo. During that time, Syria and Egypt launched a military attack on Israel and consequently, the Arab members of the Organization of Petroleum Exporting Countries imposed an embargo on oil exports to some countries that were allies of the Israel and consequently, oil production declined thereby putting an upward pressure on the prices (Hamilton, 2011).

The second oil shock occurred as a result of the Iranian revolution of 1978 to 1979, this also was a positive oil shock that occurred consequent to the cut in oil production by Iran. The third oil shock was the outcome of Iran-Iraq War from 1980-1981. At that time (1978 and 1981) the real price of oil had doubled (Kilian 2009, Hamilton, 2011). The fourth oil shock can still be attributed to the Iran Iraq War which led to a precipitous decline in oil prices from 1981 to 1986 following a sharp

fall in oil prices. Because, in 1986, Saudi Arabia had ramped oil production thereby causing a collapse of oil prices from USD 27 per barrel to USD 12 per barrel (Hamilton, 2011). The fifth oil price shock occurred due to the Gulf War in 1990 / 91 which engendered temporary spikes in oil prices internationally which vanished thereafter. From 1997 to 2000 oil prices had fallen due to the Asian crisis following a problem in the financial system of the East Asian countries. The crisis had caused the price of oil to fall below USD 12 in real terms which was the lowest price since 1972. Another episode of oil shock occurred between the second half of 2002 and first half of 2003. It was as result of the Venezuelan unrest and the second Persian Gulf War. This oil shock was characterized by an ephemeral spike in oil prices internationally which vanished in the second half of 2003 (Hamilton, 2011).

Nonetheless, increased demand and stagnant supply was the factor responsible for the positive oil shock witnessed from 2007 to 2008. In 2008, the world had been hard hit by sudden liquidity drain in the global financial system following the global economic and financial crisis which caused a dramatic fall in oil prices internationally (Kilian, 2009; Hamilton, 2010; 2011).[4] The recent oil shock between June 2014 and March 2015 was the outcome of rapid increase in oil supply especially in the US and a corresponding sharp fall in the demand for oil in the emerging markets, namely China and Brazil (Hou et al., 2015).[5]

Oil price fluctuations often tend to have effects on macroeconomic variables such as exchange rates, inflation, and gross domestic product (Gronwald, 2012). However, the macroeconomic effects of oil price shocks differ across countries on the globe, depending on whether a country is an oil importer or exporter (Krugman,

[4] It is noteworthy that whilst political factors such as war were said to be responsible for most of the oil shocks, other oil shocks such as the ones of 1973/74; 1979/80 and 2003-2008 were historically said to be caused by fluctuations in the global business cycle (Kilian, 2009).
[5] The trend of fluctuations in the international oil price is depicted in Figure 1.6

1983). For example, a positive oil price shock causes transfer of wealth from the oil-importing to the oil-exporting countries. It also causes real appreciation of the exchange rates of oil exporters (Krugman, 1983). Moreover, oil price shocks pose serious challenges for policy makers in oil-exporting countries (Kilian, 2009).

Generally, higher oil prices and huge fluctuations of the exchange rates are regarded as the major factors that impede economic growth (Jin, 2008). Appreciation of the real exchange rates of oil-exporting countries following a positive oil shock is termed as the Dutch disease in the literature. The Dutch disease was first investigated by Corden and Neary (1982).[6] In most oil-exporting countries of the world such as the African oil exporters, real oil prices and real exchange rates tend to co-move (Coleman et al., 2011). Higher oil prices in these countries often render their real exchange rates overly appreciated, and if the real exchange rate of an economy is overvalued, exports of other sectors such as manufacturing and agriculture become expensive internationally, and this has implications for growth. Therefore, the major economic problem in most Sub-Saharan African oil-exporting countries is the highly unstable macroeconomic environment often due to fluctuations in oil prices and their exchange rates (Coleman et al., 2011). Figure 1.1 depicts the international average crude oil price and the exchange rates of the three selected countries of the study, namely Nigeria, Angola and Gabon[7].

[6]The Dutch disease is the apparent causal relationship between the increase in the economic development of a specific sector for example oil (in the case of the selected countries of the study that export oil products) and a decline in other sectors such as manufacturing and agriculture. This macroeconomic problem is often due to inflow of revenues from the progressing non-tradable sector, thereby making the real exchange rate of the country that produces and exports the natural resource overly appreciated. This in turn has the potential of making the country's exports more expensive and her imports cheaper, which undermines the international competitiveness of the country's export sector and hampers growth respectively.

[7] It is worth noting that Figure 1.1 above is just a graphical depiction of the oil price and exchange rates of the three selected countries from 1970 to 2012. The exchange rates are period average rates for each country's national currency per US dollar and the oil price is the world average price (US dollars per barrel). The figure shows only a plot of each series, and does not provide any information about their volatilities. Information about volatilities of the series is provided in Figures 1.2, 1.3 and 1.4 respectively.

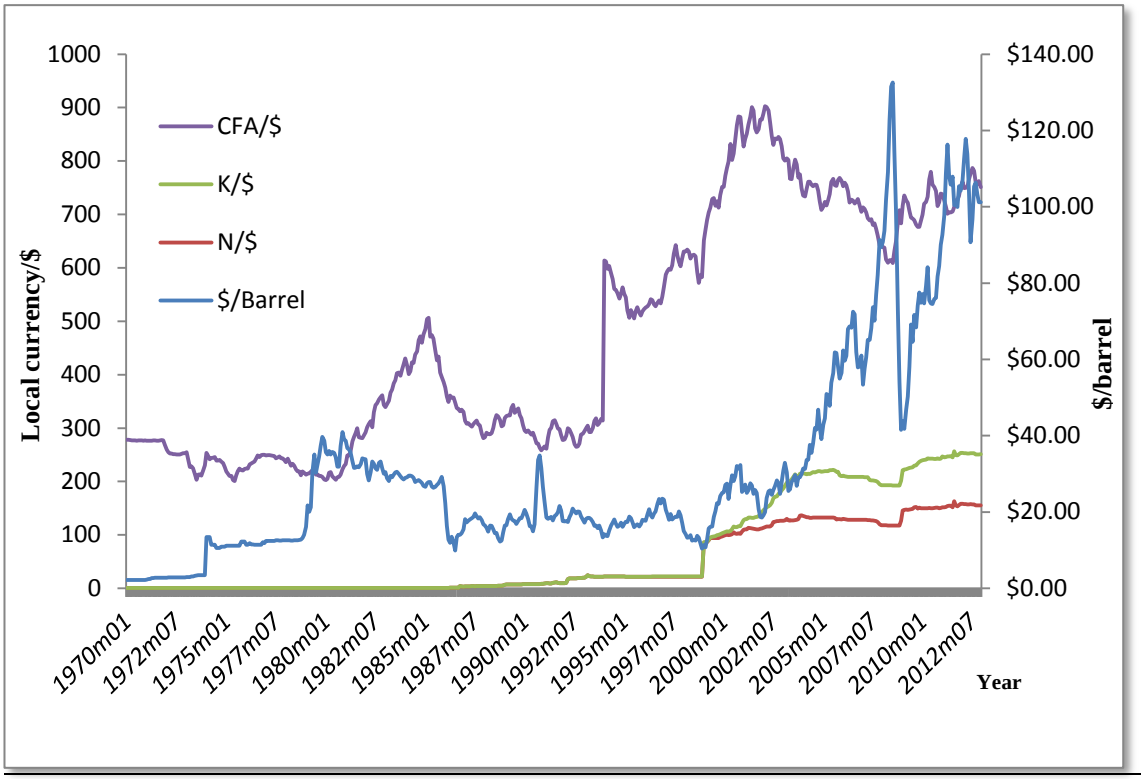

Figure 1.1 Average World Crude Oil Prices and Exchange Rates of the Selected Countries (1970-2012)
Source: International Monetary Fund, *International Financial Statistics* (2013).

Historically, the price of oil is characterized by a high degree of volatility often resulting from oil shocks following developments on the international oil markets.[8] Most economic variables are volatile, some are much more so than others. Oil prices and exchange rates are among the economic variables that are highly volatile.[9] The volatility of oil prices and exchange rates takes two forms, namely rising and falling. In the case of exchange rates, these changes or movements are referred to as appreciation and depreciation. Appreciation of the domestic currency implies a fall in the domestic price of the foreign currency and has the tendency of increasing the import intensity of a country and reducing its export performance, thereby affecting growth. The opposite holds in the case of a depreciation of the

[8] These developments include both political such as wars and financial such as speculation as Kilian (2009) indicates.
[9] According to Black (2002) volatility generally implies a liability to fluctuate over time.

domestic currency vis-a-vis the foreign currency. The volatility of both the oil price and exchange rate portend greater risks for trade, growth and economic management.

First, oil price volatility can hamper savings, investment and the gross domestic product (Serven and Solimano, 1993; Hamilton, 1983; 2010, De Pratto et al., 2009). It can also affect the money supply, inflation, consumption, employment and output (Hsieh, 2008; Lescaroux and Mignon, 2008; De Pratto et al., 2009; Hamilton, 2005; Zhou and Wang, 2014). Second, exchange rate volatility can affect trade and economic growth (Wang and Barrett, 2002; Broda, 2004).[10] However, it is widely accepted that financial volatilities move together over time across assets and markets (Laurent, 2009). In other words, there could be volatility spillover from one economic variable to another. If there are correlations in volatilities of two or more economic variables, it implies that there could be volatility spillover effects from one of the variables to another. Usually, the real exchange rates of oil-exporters as earlier highlighted tend to appreciate during periods of booms (rising oil prices), and depreciate during periods of busts (falling oil prices). This implies that there could be volatility spillover effects from the oil price to the exchange rates of oil exporters such as Nigeria, Angola and Gabon. Figures 1.2, 1.3, and 1.4 show the percentage changes (log first difference) of the real oil prices and the real exchange rates of the selected countries. The percentage changes are used as a proxy of volatility in the two variables. As can be observed from Figure 1.2 below, the percentage changes in real oil prices and real exchange rates of Nigeria are almost identical. It can therefore be anticipated that volatilities of the two variables might be correlated over time. Figure 1.2 below indicates that for Nigeria, from 1970 to 2012, there could be

[10] Detailed discussions on the macro economic effects of volatile oil prices and exchange rates are provided in Chapter Three.

correlations between the volatilities of real oil prices and real exchange rates, as the percentage changes of the two variables seem almost identical

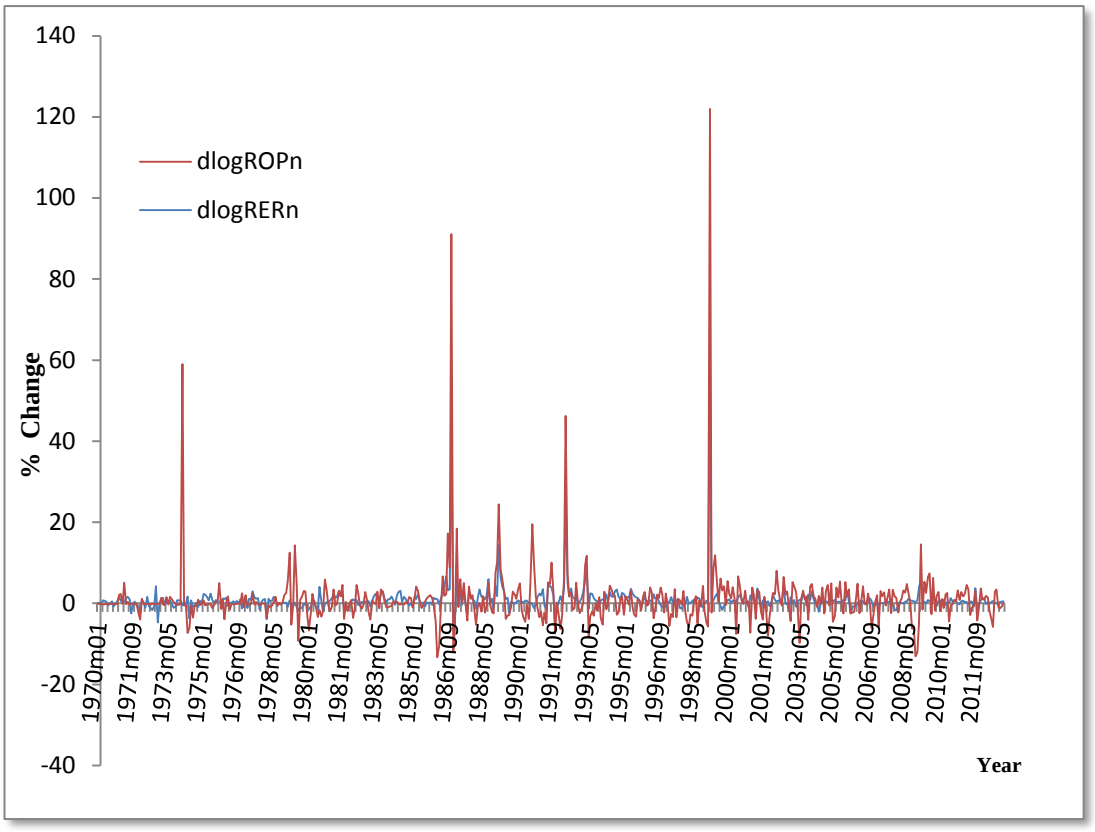

Figure 1.2 Monthly Percentage Changes (dlog) in the Real Oil Price and Real Exchange Rate of Nigeria (1970-2012)
Source: International Monetary Fund, *International Financial Statistics* (2013).

Generally, the intuition behind the notion of volatility in economic variables such as oil prices and exchange rates is that periods of low volatility can be expected to be accompanied by another period of low volatility and periods of high volatility can be expected to be accompanied by another period of high volatility which is termed as volatility clustering in the literature.[11]

[11] It is noteworthy that real oil prices were converted into logarithms and computed by dividing the world average crude oil price by the consumer price indices (CPIs) and multiplied by the period average exchange rates of the selected countries, i.e. domestic currency vis-à-vis the US dollar (see Fakhri, 2011). Nonetheless, the real exchange rates were computed by multiplying period average exchange rates as a proxy of the nominal exchange rates by the ratio of the US consumer price index to the consumer price indices of the selected countries. It is noteworthy, however, that the percentage changes / log first difference of the series reflects volatility of the series and were constructed by

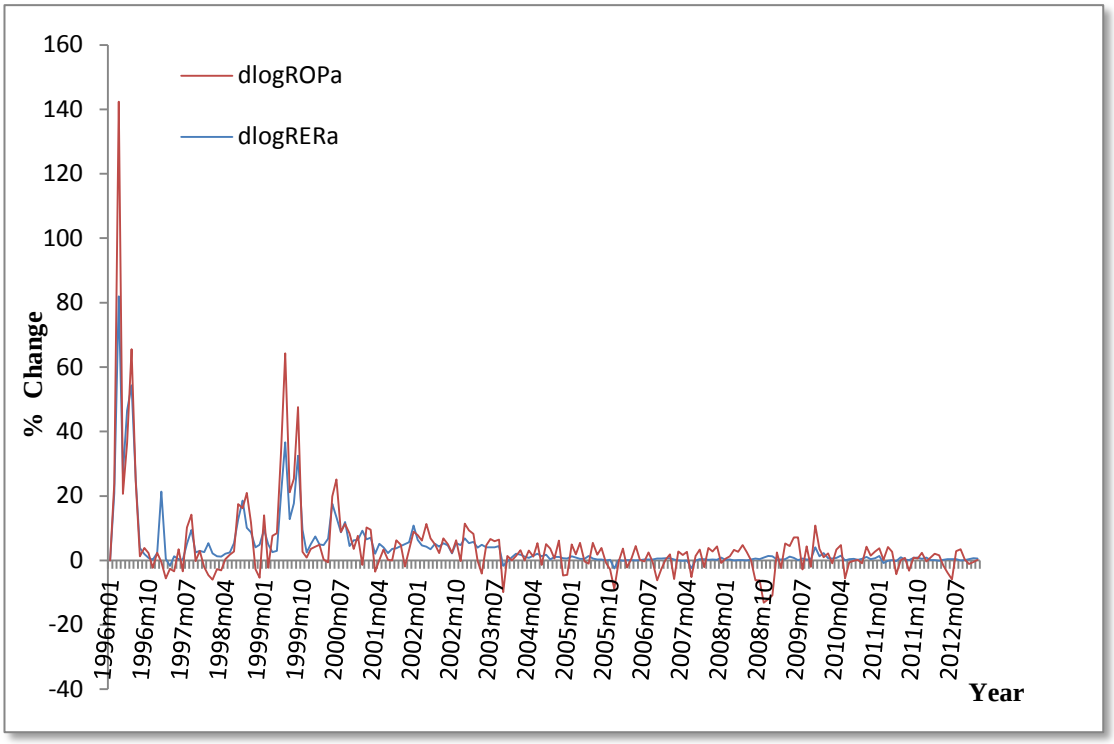

Figure 1.3 Percentage Changes in the Real Oil Price (dlogROP) and Real Exchange Rate (dlogRER) of Angola (1996-2012).
Source: International Monetary Fund, *International Financial Statistics* (2013).

As can be observed from Figure 1.3 above, for Angola also, volatility correlations can be expected between the real oil price and real exchange rate as clustering of volatilities of the two variables seems almost identical.

taking first differences of the data and multiplying by 100 [see Koop (2000); Horvath and Johnston (2005)].

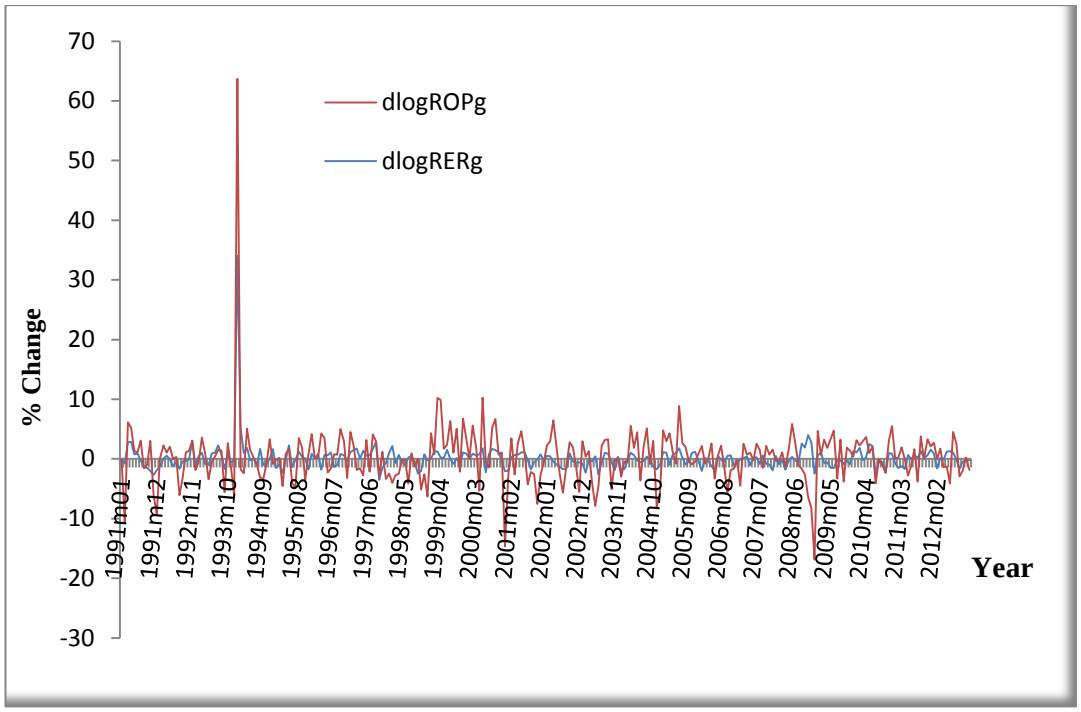

Figure 1.4 Monthly Percentage Changes in the Real Oil Price (dlogROP) and Real Exchange Rate (dlogRER) of Gabon (1991-2012).
Source: International Monetary Fund, *International Financial Statistics* (2013).

Like Nigeria and Angola, for Gabon also, there seems to be a sign of volatility correlations between the real oil price and real exchange rate from 1991 to 2012 as Figure 1.4 above indicates. Volatilities of the two variables seem to be correlated, i.e., co-moving in the same direction as the figure indicates. Krugman (1983) has established theoretically the tendency for the real exchange rates of oil-exporters to appreciate when oil prices rise and to depreciate when oil prices fall. The study shows that the opposite holds for oil importers. In the case of oil exporters, Akram (2002) indicates that theoretically, an oil-exporting country may experience exchange rate appreciation when oil prices rise and depreciation when they fall. Therefore, the volatility of oil price as mentioned earlier could have implications for exchange rates and other macro economic variables such as inflation, money supply, and the gross domestic product whereas the volatility of exchange rates could have implications for trade, balance of payments and economic growth respectively. Figure 1.5 shows how increase in oil prices (booms) may lead to appreciation of the

real exchange rates of oil exporters, and how decrease in oil prices (busts) may cause their exchange rates to depreciate. It is noteworthy that the opposite may hold for oil-importing countries as mentioned earlier.

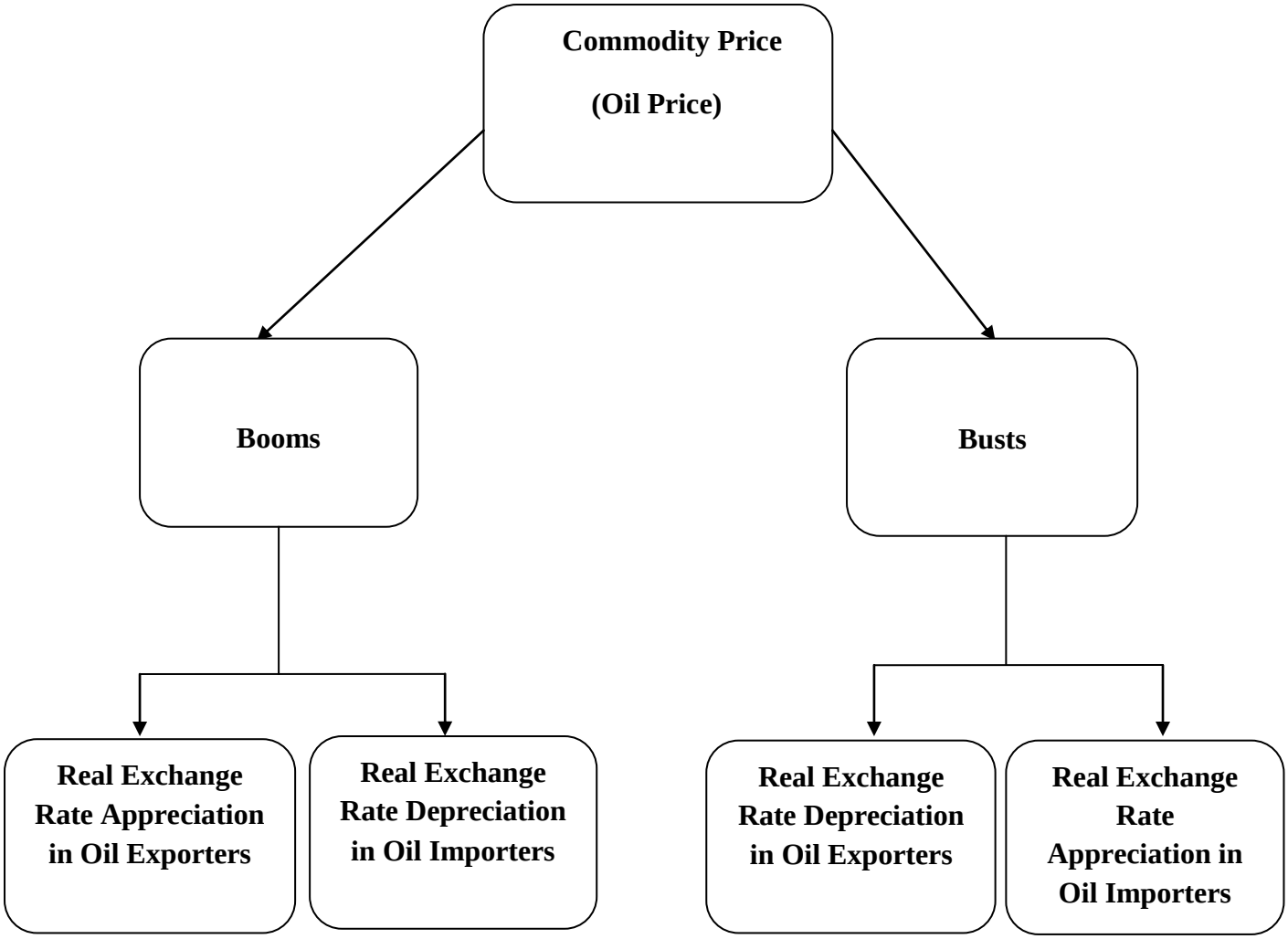

Figure 1.5 A Diagrammatic Depiction of the Effects of Changes in Oil Prices on the Real Exchange Rates of Oil Exporters and Oil Importers
Source: Prepared by the researcher

Internationally, oil prices have been volatile since the first oil price shock of the early 1970s. The 1970s and 1980s, historically, marked the first periods of high volatility in oil prices and exchange rates in Sub-Saharan African oil-exporting countries. The Arab-Israel conflict that occurred at the end of 1973 had led to a very high increase in the price of oil by the Organization of Petroleum Exporting Countries (OPEC) (Pilbeam, 1998). However, since the adoption of structural

adjustment reforms in the 1980s and 1990s, exchange rates in most of the Sub-Saharan African countries became highly volatile (Olayungbo et al., 2010). Most of the countries had in the 1980s and 1990s embarked on economic liberalization reforms that involved the liberalization of exchange rates through the implementation of structural adjustment programs. Historically, the first oil shock of the 1970s had coincided with the shift internationally from the system of fixed exchange rates to that where exchange rates were allowed to float. The high increase in the price of oil during the 1970s had a huge impact on the world economy and brought to a halt any hopes of restoring the fixed exchange rate system (Pilbeam, 1998). Since the 1970s, both oil prices and exchange rates have become highly volatile internationally and since then, the relationship between the two variables has received much attention in the literature (Ozturk et al., 2008). As earlier highlighted, fluctuations of the oil price and exchange rate often tend to have implications for other macroeconomic variables, namely inflation, money supply and the gross domestic product (GDP).

Moreover, macroeconomic shocks generated by fluctuations of the oil price and exchange rates can transmit from the oil-exporting countries to their trading partners through trade links. Therefore, apart from the link between oil prices and exchange rates, their volatilities as well as macroeconomic effects, another thing to which much attention has not been paid, is the issue of trade links between the Sub-Saharan African oil-exporters and their neighbors, and the tendency of transmission of macroeconomic shocks from the oil-exporters of the region onto the neighboring countries. For example, Buiter and Purvis (1980) indicate that the nature of an oil shock is such that a country does not face it in isolation; it is a disturbance which influences its major trading partners simultaneously. Moreover, the IMF (2012) has provided evidence of the existence of a strong informal sector trade relation between

the major oil-exporting countries of Sub-Saharan Africa such as Nigeria and her neighbors. However, a substantial proportion of the trade among the Sub-Saharan African countries takes place in agricultural goods, such as cereals and grains, oil or petroleum products. Therefore, given evidence of trade existence between the selected countries of the study and their neighbors as shown in Tables 1.4, 1.5 and 1.6, it can be anticipated that there could be transmission of macroeconomic shocks from these selected countries, namely Nigeria, Angola and Gabon to their neighboring trading partners. Furthermore, the International Monetary Fund (2012) shows that the increase in Nigeria's fuel prices in January 2012 had a substantial impact on inflation of the Benin Republic (Regional Economic Outlook, 2012).[12] The Tables 1.4, 1.5 and 1.6 below show evidence of intra-regional trade flows between the selected countries of the study and countries that share geographical borders with them.[13]

Table1.4 Nigeria's Intra-regional Trade with Neighboring Countries (Billions USD) (1985-2012)

Partner Country	**Benin**		**Cameroon**		**Chad**		**Niger**	
Year	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
1985	1654030	201918	2794950	3187910	0	1462650	2434940	5456740
1990	969035	473588	73989000	583596	24894000	512581	3689040	8486400
1995	120023	5035800	90472300	9251360	11564200	2421020	31714000	21925100
2000	6310620	36007400	246000000	875127	1840470	602347	387916	599300
2005	32623000	15080000	563000000	1338520	12157900	737907	56557000	698905500
2010	59337500	59337500	1020000000	2914180	22113900	1606550	103000000	152000000
2011	75358600	75358600	1300000000	3351310	28084600	1847540	131000000	175000000
2012	82429600	82429600	1420000000	3737660	30719800	2060520	143000000	195000000

Source: International Monetary Fund, *Direction of Trade Statistics* (2013).
Note: Imports are valued c.i.f.

Table 1.4 above shows the trade links between Nigeria and the neighboring countries. These countries are Benin, Cameroon, Chad and the Niger Republic. Adding the exports and imports together for the years 2010 to 2012, it implies that

[12] The Benin Republic is one of the countries that shares geographical borders with Nigeria.
[13] Angola, shares borders with Namibia to the south, Zambia to the east, and the Democratic Republic of the Congo to the north-east, and the South Atlantic Ocean to the west. It is noteworthy, however, that the trade statistics between Angola and Namibia are not available; therefore they are not reported in Table 1.5 below.

there has been an increase in trade between Nigeria and its neighbors with a higher trade volume between Nigeria and Cameroon respectively.

Table 1.5 Angolan Intra-regional Trade with Neighboring Countries (Billions USD) (1985-2012

Partner Country	**Republic of Congo**		**Zambia**	
	Exports	Imports	Exports	Imports
Year				
1985	103807	13084600	17662.7	1144620
1990	848105	4246240	4562.1	919357
1995	3301990	7124740	6774.5	358695
2000	3595630	18030100	23158.8	391978
2005	319793	11392900	8732.81	659777
2010	526617	18761200	26888.2	3340800
2011	679337	24201900	47827.7	3678840
2012	721837	25716100	49863.3	3835420

Source: International Monetary Fund, *Direction of Trade Statistics* (2013).
Note: Imports are valued c.i.f.

From Table 1.5 above, adding exports and imports for each country together, it can be seen that trade flows have been increasing between Angola and the Republic of Congo from 2010 to 2012. Although trade between Angola and Zambia has been increasing over the same period, yet, it is lower in terms of volume compared to the volume of trade between Angola and the Republic of Congo.

Table 1.6 Gabon Intra-regional Trade with Neighboring Countries (Billions USD) (1985-2012)

Partner Country	**Cameroon**		**Republic of Congo**		**Equatorial Guinea**	
Year	Exports	Imports	Exports	Imports	Exports	Imports
1985	5738710	32109200	0	0	0	0
1990	1923270	34923500	0	0	0	0
1995	1915990	27397100	0	0	0	0
2000	1971470	16400100	7381500	1419850	1604190	146176
2005	3090560	70621300	1148970	25041100	2495490	227394
2010	6012890	137000000	1892060	41236400	4109440	374460
2011	6734440	154000000	2440760	53195000	5301180	483053
2012	7021070	160000000	2593460	56522900	5632830	513273

Source: International Monetary Fund, *Direction of Trade Statistics* (2013).
Note: Imports are c.i.f.

Table 1.6 above shows trade flows between Gabon and her neighbors. Adding exports and imports for the three neighboring countries, namely Cameroon, the Republic of Congo and Equatorial Guinea together, it can be seen that from 2010

to 2012 trade among these countries has been increasing with higher trade figures between Gabon and Cameroon.[14]

1.2 Oil Prices

The price of oil is determined on the international oil markets and is denominated in U.S dollars (Kilian, 2006). Oil prices have been volatile since the large oil price increase of the 1970s and 1980s (Bacon and Kojima, 2008). Historically, fluctuations in oil prices started from the early 1970s (Oriavwote and Eriemo, 2012). Oil price volatility or shock is often the outcome of three major factors, namely shortage in the supply of oil, increase in the demand for oil, and other factors. Therefore, oil price fluctuations are explained by changes in the supply, demand and other factors. Other factors include political events such as wars and geological incidents. However, it is worth noting that changes in the supply and demand for oil are mostly caused by these other factors, namely political events such as wars (Kilian, 2009). Tables 1.7 and 1.8 below present the world supply and demand for oil from 1990 to 2012.

Table 1.7 World Oil Supply, 1990-2000 (million barrels per day)

OECD	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**
N/America	11.0	10.8	14.0	14.9	14.1	14.6	15.7
Europe	4.3	6.3	7.1	6.0	4.0	3.8	3.5
Pacific	0.7	0.8	0.8	0.5	0.8	0.6	0.6
Non-OECD							
FSU	11.5	6.8	7.5	11.8	13.5	13.6	13.7
Europe	0.3	0.3	0.2	0.2	0.1	0.1	0.1
China	2.8	3.0	3.1	3.5	4.0	4.1	4.2
Other Asia		2.1	2.3	2.7	3.7	3.6	3.6
L/America	5.4	6.3	3.9	4.4	1.6	4.2	4.2
M/East	1.3	1.9	1.9	1.9	1.6	2.6	2.3
Africa	1.9	2.2	2.9	3.8	2.5	2.1	2.1
OPEC							
Crude	22.7	25.1	27.9	29.8	29.2	29.9	31.5
NGLs[15]	2.0	2.4	2.9	4.8	5.4	5.8	6.2
Total Supply	63.9	68	74.5	84.3	80.5	85	87.7

Source: International Energy Agency (2012), *Oil Market Reports.*

[14] All figures in Tables 1.4, 1.5, and 1.6 are in billion U.S dollars, and the volume of trade among the countries is computed by adding exports and imports together. Moreover, only the recent years are considered, namely 2010, 2011 and 2012.

[15] NGLs denote Natural Gas Liquids.

As can be seen from Table 1.7 above, the supply of oil by all the three regions, namely the OECD, non-OECD, and OPEC, has increased from 2010 to 2012 with the highest total supply recorded in 2012. Nevertheless, looking at the Table 1.8 below, the demand for oil by the three regions from 2010 to 2012 has also increased, with a higher level of demand in 2012.

Table 1.8 World Demand for Oil (1990-2012)

OECD	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**
N/America	18.9	19.8	24.0	25.5	23.8	23.5	23.7
Europe	12.7	13.9	15.1	15.6	14.6	14.4	13.8
Pacific	6.0	6.7	8.6	8.6	7.8	7.9	8.5
FSU	-	4.8	3.6	3.9	4.5	4.7	4.5
Europe	-	1.4	0.7	0.7	0.7	0.7	0.7
China	2.3	3.3	4.8	6.7	9.1	9.5	9.5
Other Asia	-	8.0	7.3	8.8	10.4	10.7	11.3
L/America	5.1	6.0	4.9	5.1	6.3	6.5	6.5
M/East	3.3	4.1	4.7	6.0	7.8	7.9	7.6
Africa	2.1	2.1	2.4	2.9	3.4	3.4	3.4
Total Demand	50.4	70.1	76.1	83.8	88.4	89.2	89.5

Source: International Energy Agency Oil Market Report.

In the 1970s, particularly from the early, mid and late 1970s, the price of oil had risen. In 1979 in particular, there was a significant rise in oil prices following the Iranian revolution. Nevertheless, after the Iranian revolution in 1979 as can be seen from Figure 1.6, oil prices had fallen and continued to fall until the mid 1980s. But in 1990 the prices had risen due to the Gulf war. Then, from the late 1990s to 2008, the prices had risen again significantly. However, in the second half of 2008, the prices declined precipitously owing to the global economic and financial crisis.[16] The changes in the prices over these periods are depicted in Figure 1.6 below.

[16] The historical chronology of the oil shocks has been discussed previously under section 1.1 of this chapter.

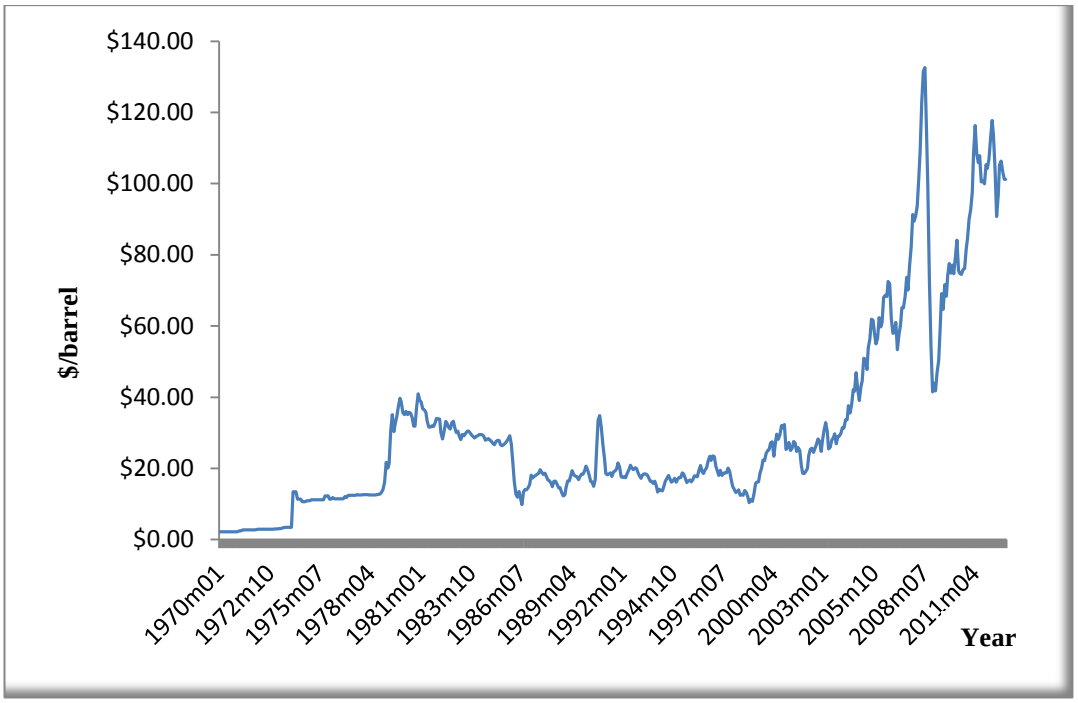

Figure 1.6 World Monthly Petroleum Average Crude Price (1970-2012)
Source: International Monetary Fund, *International Financial Statistics* (2013).

1.3 Exchange Rates

In the history of exchange rates, the 1970s had witnessed a dramatic adjustment in the international monetary system from a regime of pegged exchange rates which had prevailed for about a quarter of a century since the Bretton Woods conference, into a regime of flexible, though managed rates (Dornbusch,1980). Since that shift from a pegged exchange rate system to a flexible exchange rate system, exchange rates of various countries in the world have been fluctuating widely, and hence, the high volatility in exchange rates across countries which prevails until today. In most of the Sub-Saharan African countries, exchange rates have historically been highly volatile since the introduction of the economic liberalization reforms and structural adjustment programs in the 1980s and 1990s. The reforms had involved liberalizing their international trade and foreign exchange rate regimes, which occurred in the 1980s and 1990s (Maehle et al., 2013). Prior to the liberalization, the exchange rate regimes of many of them were hitherto

characterized by stringent administrative control policies. The changes in the exchange rates of the selected countries are presented in Figure 1.1 of this chapter.

1.4 The Global Economic and Financial Crisis

The global economic and financial crisis which had rocked the world in the second half of 2008 had adversely affected the macroeconomic performance of most African countries, especially the oil-producing and exporting nations of Sub-Saharan Africa (Kasekende et al., 2009). The crisis had worsened the already existent macroeconomic instability in the countries as reflected by its adverse effects on their macroeconomic indicators such as inflation, money supply, gross domestic product (GDP), commodity prices such as oil prices and the exchange rates of the countries. For example, Kasekende et al. (2009) have established that oil prices had plummeted by 65% from USD 125.73 per barrel at the inception of the financial crisis to USD 43.98 in January 2009. This had caused a fall in oil revenues in most oil-producing and exporting nations of Sub-Saharan Africa. However, with regards to the effects of the crisis on the exchange rates of the countries, Kasekende et al. (2009) further indicate that in most countries of the continent the impact of the crisis had manifested itself through currency fluctuations, especially against the U.S dollar and the euro.

1.5 Problem Statement

Oil price and exchange rates are important macroeconomic variables and their fluctuations have implications for other macroeconomic variables such as the price level or inflation, money supply and the gross domestic product (GDP) or the overall growth of an economy. The oil price and exchange rate fluctuations can cause macroeconomic instability that can affect economic growth, particularly in the countries that are highly dependent on oil. The oil price and exchange rate

movements can have both the long run and short run effects on an economy. Macroeconomic shocks generated by fluctuations in the price of oil can affect macroeconomic variables of oil-exporting countries of Sub-Saharan Africa and those of their trading partners through the trade transmission effects. Moreover, fluctuations in the oil price and exchange rates can undermine the effectiveness of economic policies designed to achieve growth. Given this problem the study sets out to achieve the following objectives.

1.6 Objectives of the Study

The main objective of this study is to investigate the macroeconomic effects of fluctuations in the oil price and exchange rate in three selected oil-exporting countries of Sub-Saharan Africa, namely Nigeria, Angola and Gabon. Based on this objective, the study seeks to achieve the following sub-objectives:

1. To investigate empirically the volatility spillover from the real oil price to the exchange rate of the selected countries.
2. To examine the long run relationship and the short run dynamics between the real oil price and real exchange rate of the selected countries.[17]
3. To examine the transmission of shocks from the oil price and exchange rate to other macroeconomic variables of the selected countries.

[17]A long run relationship between the real oil price and the real exchange rate of the selected countries means the existence of a common stochastic trend in the two variables for the selected countries (Enders, 2010). In other words, the objective aims at testing whether or not the variables co-trend together and whether or not they rise and fall at the same time. This is analogous to testing the existence of cointegrating vectors between the variables and how many cointegrating vectors exist if there is any. Examining the short run dynamics between the variables is analogous to testing which of the two variables provides information about the future movements of the other. In other words, the short run causality test between the variables aims at providing information on the direction of causality and whether or not one variable provides information for the prediction of the other variable (Asteriou and Hall, 2011). However, it is noteworthy that the terms long run and short run do not refer to any specific time period. Moreover, it is noteworthy, that for both the first as well as the second objective real rather than nominal variables will be used because Hamilton (2005) establishes that it is real rather than nominal variables that matter for economic decisions. But, due to the paucity of data, nominal variables will be used for the third as well as fourth objectives of the study.

4. To investigate the transmission of macroeconomic shocks from the selected countries onto their neighboring countries.
5. To examine the macroeconomic effects of the 2008 global economic and financial crisis on the selected countries and the transmission of the shock onto their neighboring trading partners.

1.7 Research Questions

1. Are there any volatility correlations between real oil prices and real exchange rates of the selected countries?
2. Is there any long run relationship and short run dynamics between the real exchange rates and the real oil prices of the selected countries?
3. What are the macroeconomic effects of oil price and exchange rate shocks on other macroeconomic variables such as the money supply, inflation and gross domestic product (GDP) in the selected countries?
4. What are the channels of transmission of macroeconomic shocks from the selected countries to the neighboring countries that trade with them?
5. What are the macroeconomic effects of the 2008 global economic and financial crisis on the selected countries and the transmission of the shock onto their neighboring trading partners?

1.8 Significance of the Study

The prices of crude oil and exchange rates can be considered as key research subjects (Huang and Tseng, 2010). Oil price and exchange rate dynamics form an integral aspect of international macroeconomics nowadays. The impact of oil price changes is crucial in studying the effects of exchange rate movements on the macro economy. Yet, empirical studies on the relationship between oil prices and exchange

rates are very limited and scanty on the economies of Sub-Saharan Africa. Therefore, this study is significant for at least three reasons. First, from the literature perspective, although a number of studies have examined the relationship between oil price and exchange rate, yet, there seems to be insufficient empirical evidence on the issue of spillover of volatility from the real oil price to the real exchange rate in Sub-Saharan Africa oil-exporting countries. As such, this study seeks to investigate the three major oil-exporting countries of Sub-Saharan Africa, namely Nigeria, Angola and Gabon simultaneously with regards to the issue of volatility correlations or spillovers between oil prices and their exchange rates, as well as the issue of the macroeconomic effects of volatility of the two variables.

Second, although a plethora of studies have looked at the notion of macroeconomic shocks transmission associated with fluctuations of oil prices, yet, there seems to be a gap in addressing the issue of transmission of macroeconomic shocks from the Sub-Saharan Africa oil-exporting countries onto their neighboring trading partners.

From the econometric methodology perspective, although various studies have approached the relationship between oil prices and exchange rates using different statistical and econometric techniques, yet, there seems to be less attention on the use and application of the multivariate GARCH techniques in examining volatility correlations between the oil price and exchange rate. This study attempts to fill the observed methodological gap.

Moreover, the study will use the panel vector autoregressive (PVAR) techniques in addressing the issue of transmission of macroeconomic shocks from the selected countries onto their neighboring trading partners. To the best of the

researcher's knowledge, this study is the first to apply this econometric technique in addressing this issue in the oil-exporting countries of Sub-Saharan Africa.

1.9 Scope of the Study

The study focuses on the three oil-producing countries of Sub-Saharan Africa, namely Nigeria, Angola and Gabon. The period covered by the study is 1970 to 2012 for Nigeria, 1991 to 2012 for Gabon, and 1996 to 2012 for Angola for the purpose of volatility spillover analysis. It is noteworthy that the period covered for Gabon and Angola is shorter due to unavailability of data from 1970 on the consumer price index (CPI) variable for the two countries, which served as an obstacle for computing the real oil prices and the real exchange rates from 1970 for the two countries. However, for the analysis of macroeconomic effects of oil prices and exchange rates on the selected countries as well as their neighboring trading partners, the period 1970 to 2012 will be used for Nigeria and Gabon as well as their trading partners, while for Angola, only the period 1980 to 2012 can be covered due to unavailability of data from 1970 on the inflation variable for the country and its trading partners.

1.10 Organization of Study

The study comprises of six chapters. The first chapter contains the introduction. The second chapter presents background information about the countries covered by the study. Chapter Three is the literature review, which is dichotomized into the theoretical and empirical literature on the volatility of oil prices, volatility of exchange rates, the relationship between oil prices and exchange rates, oil price shocks and the macro economy, and oil price shocks and their international trade repercussions. Chapter Four contains the methodology to be used

in carrying out the research. Chapter Five discusses the major empirical findings of the study (econometric results) and finally, Chapter Six is the conclusion.