

OIL PRICE AND EXCHANGE RATE VOLATILITY IN NIGERIA

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ABSTRACT

Nigeria is a mono-product economy, where the main export commodity is crude oil, changes in oil prices has implications for the Nigerian economy and, in particular, exchange rate movements. The latter is mostly important due to the double dilemma of being an oil exporting and oil-importing country, a situation that emerged in the last decade. The study examined the effects of oil price, external reserves and interest rate on exchange rate volatility in Nigeria using yearly data from the year 1970 to 2011. The theoretical framework of this study is based on Generalized Autoregressive Conditional Heteroskedasity modeled by Tim Bolderslev (1986) and Exponential General Autoregressive Conditional heteroskedastic modeled by Daniel Nelson (1991). The models are used to estimate the relationship between oil price changes and exchange rate. Relevant descriptive and econometric analyses were employed. The econometric tests used include the unit root tests, Johansen co-integration technique and the Vector Error Correction Model (VECM) when the unit root tests were carried out; all the variables were stationary at first difference. The long run relationship among the variables was determined using the Johansen Co-integration technique while the vector correction mechanism was used to examine the speed of adjustment of the variables from the short run dynamics to the long run. It was observed that a proportionate change in oil price leads to a more than proportionate change in exchange rate volatility in Nigeria by 2.8%. I therefore recommend that the Nigeria government should diversify from the Oil sector to other sectors of the economy so that Crude oil will no longer be the mainstay of the economy and frequent changes in crude oil price will not influence exchange rate volatility significantly in Nigeria.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

“There are various evidences, particularly over the post-Breton woods era, pointing to the vital role of oil price fluctuations in the determination of the path of the exchange rate” (Adeniyi et al, 2004). According to Krugman (1983), exchange rate appreciates in response to rising oil prices and depreciates with response to falling oil prices in oil exporting countries, while the opposite is expected to be the case in oil importing countries.

Volatility is the fluctuation in the value of a variable, especially price (Routledge, 2002). According to Englama et al (2010), a volatile exchange rate makes international trade and investments more difficult because it increases exchange rate risk. Exchange rate volatility tends to increase the risk and the uncertainty of external transactions and predisposes a country to exchange rate related risks (Jin, 2008).

According to Adedipe (2004), when Nigeria gained politically independence in October 1960, agricultural production was the main stay of the economy, contributing about 70% of the Gross domestic product (GDP), also employing about seventy percent of the working population and responsible for about ninety percent of foreign government revenue. The initial period of post-independence till mid – 1970s witness a fast advancement of industrialized capacity and output, as the contributions made by the manufacturing sector to GDP rose from 4.8% to 8.2%. This pattern changed when crude oil became very important to the world economy.

According to Englama et al (2010), crude oil became an export commodity in Nigeria in 1958, following the discovery of the first producible well in 1956. The contribution of oil to the federal government revenue in 1970 rose to 82.1% in 1974 from 26.3% and in 2008 constituted 83% of

the federal government revenue, largely on account of increase in oil prices in the international market. The gigantic rise in oil revenue was caused by the Middle East war of 1973. It created extraordinary, surprising and unforeseen wealth for Nigeria and the naira appreciated as foreign exchange influxes offset outflows and Nigeria foreign reserves assets increased (Adedipe, 2004). The economy of Nigeria gradually became dependent on crude oil as productivity declined in other sectors (Englama et al, 2010).

Nigeria is a mono – product economy, according to OPEC statistical bulletin (2010/2011) the value of Nigeria’s total export revenue in 2010 was US\$70,579 million and the revenue of petroleum exports from the total export revenue was US\$61,804 million which is 87.6% of total export revenue this means that Nigeria’s economy will be vulnerable to the movements of oil prices.

During periods of favorable oil price shocks triggered by conflict in oil – producing areas of the world, the rise in the demand for the commodity by the consuming nations, seasonality factors, trading positions etc. Nigeria experiences favorable terms of trade evidenced by a large current account surplus and exchange rate appreciation. On the converse, when crude oil prices are low, occasioned by factors such as low demand, seasonality factors, excess supply, the Nigeria experiences unfavorable terms of trade evidenced by budget deficit and slow economic growth (Englama, 2010). An example was a drop in the revenue from oil exports during the global financial crisis in 2009. According to, OPEC statistical bulletin (2010/2011), oil export revenue dropped from US\$74,033 million in 2008 to US\$43,623 million in 2009 and the naira depreciated to N148.902 in 2009 from N118.546 in 2008.

This study attempts to discover the extent to which oil price influences exchange rate volatility in Nigeria. Oil price changes directly affects the inflow of foreign exchange into the country, therefore there is a need to investigate its impact on the naira exchange rate volatility (Englama et al, 2010).

1.2 STATEMENT OF PROBLEM

Crude Oil is a key source of energy in Nigeria and the in the world. Oil being an important part of the economy of Nigeria plays a strong role in influencing the economic and political fate of the country. Crude oil has generated great wealth for Nigeria, but its effect on the growth of the Nigerian economy as regards returns and productivity is still questionable (Odularu 2007).

From the period of the oil boom of the 1970s till now, Nigeria has neglected her strong agriculture and light manufacturing bases in favor of unhealthy dependence on crude oil. New oil wealth has led to a concurrent decline of other sectors in the economy and has fueled massive migration to cities and led to increasingly wide spread poverty especially in rural areas. Nigeria's job market has witnessed very high degree of unemployment, small wage and pitiable working environments (Adedipe, 2004 and Odularu 2007). Between 1970 to 2000, Nigeria's poverty rate increased from 36 percent to just fewer than 70 percent and it is believed that oil revenue did not seem to add to the standard of living at this time but actually caused it to decline (Martin and Subramanian, 2003).

Oil price fluctuations have received important considerations for their presumed role on macroeconomic variables. Higher oil prices may reduce economic growth, generate stock exchange panics and produce inflation which eventually leads to monetary and financial instability. It will also lead to high interest rates and even a plunge into recession (Mckillop,

2004). Sharp increases in the international oil prices and the violent fluctuations of the exchange rate are generally regarded as the factors of discouraging economic growth (Jin, 2008).

A very good example is the period of the global financial crisis, the price of oil fell by about two thirds from its crest of \$147.0 per barrel in July 2008 to \$41.4 at end of December 2008. Before the crises, oil price was high, exchange rate was stable but with the dawn of the global financial crisis (GFC) oil price crashed and the exchange rate caved-in, depreciating by more than 20 per cent. Since oil price volatility directly affects the inflow of foreign exchange into the country, there is a need to investigate if it has direct impact on the Naira exchange rate volatility (Englama et al, 2010)

The oil market has been and will continue to be an ever changing arena. This is because oil is so vital to the world economy, it is present in everyone's daily lives and its market is truly global (El – badri, 2011).

Thus, it is on this note that this research seeks to find out the effect of oil price on exchange rate volatility and its effects on the Nigerian economy, as well as suggest methods of minimizing the adverse effects it can produce on the economy as a whole.

1.3 SCOPE OF STUDY

The purpose of the study is to determine the relationship between oil price and exchange rate in the Nigerian economy. It covers the period between 1970 and 2011.

1.4 RESEARCH QUESTIONS

The study attempts to give answers to the following questions

1. Do oil price have a significant relationship with exchange rate volatility in Nigeria?
2. What is the long run impact of oil price on exchange rate volatility in Nigeria?

1.5 OBJECTIVES OF THE STUDY

The major objective for this research is to determine if a long run relationship exists between oil price and exchange rate in Nigeria. The specific objectives include:

1. To examine if there exists a significant relationship between oil price and exchange rate volatility in Nigeria.
2. To assess the long run impact of oil price on exchange rate volatility in Nigeria.

1.6 RESEARCH HYPOTHESIS

In effort to realize the objectives of the study, the following hypothesis will be tested:

H0: Oil price has no statistical significant effect on exchange rate volatility in Nigeria

H1: Oil price has a statistical significant effect on exchange rate volatility in Nigeria

H0: There is no long run relationship between oil price and exchange rate volatility in Nigeria

H1: There is a long run relationship between oil price and exchange rate volatility in Nigeria

1.7 DEFINITION OF TERMS AND CONCEPTS

VOLATILITY: Fluctuations in the value of a variable, especially price.

OIL - PRICE: The price in dollars at which a barrel of crude oil is sold for in the international market.

EXCHANGE RATE: The price of one currency in terms of another. It can be expressed in one of two ways, as units of domestic currency per unit of foreign currency or units of foreign currency per unit of domestic currency

ECONOMIC GROWTH: This is the growth of the real output of an economy overtime.

EXCHANGE RATE VOLATILITY: It refers to the swings of fluctuations in the exchange rates over a period of time or the deviations from a benchmark or equilibrium exchange rate.

OPEC: Organization of Petroleum Exporting Countries. It consists of twelve members which includes Nigeria.

1.8 SIGNIFICANCE OF STUDY

Researches conducted in this field of study have found out that oil price influence exchange rate to a great extent, especially oil producing countries. Nikbakbt (2009) showed that real oil prices have been a dominant source of real exchange rate movement and there exist a long run and positive linkage between real oil price and real exchange rates for OPEC countries. Oil exportation has contributed positively to Nigeria GDP, local expenditure, government revenue and foreign exchange reserves (Odularu 2007). Also in the words of Adedipe (2004) the oil price influences government policy and exchange rate in Nigeria.

Although a wealth of literature exist relating oil price and exchange rate to economic growth in Nigeria, little focus on the effect of the oil price on exchange rate in Nigeria. This project seeks to fill this gap in literature as it focuses on the effect of oil price on exchange rate volatility in Nigeria and whether or not it has a significant influence on exchange rate volatility in Nigeria. Thus, this study is of great benefit to the government and policy makers. It reemphasizes the need to diversify and promote the growth of other sectors of the economy, in other to increase economic growth and improve the standard of living for Nigerians.

1.9 RESEARCH METHODOLOGY

Econometric technique will be used to analyze the effect of Oil price on exchange rate in Nigeria. The GARCH (1, 1) model is used to measure exchange rate volatility and the conditional variance series generates the volatility data from 1970 – 2011. The method adopted in determining a long run relationship between oil price and exchange rate volatility is the Johansen co-integration technique and the Vector Error Correction Model (VECM) specifies the convergence or divergence among the variables in the model.

1.10 DATA SOURCES

The study will make use of secondary data and it will be sourced from the central bank of Nigeria statistical bulletin 2011, BP statistical review on energy 2012 and exchange rate volatility is represented by conditional variances which will be generated using E-Views 5.0

1,11 OUTLINE OF CHAPTERS

This study is divided into five chapters. Chapter one which is the present chapter, gives a general overview of the study. Chapter two reviews papers related to this topic. It includes theoretical issues, empirical issues and the results of research relating to this topic.

The third chapter focuses on the research methodology it includes, technique of estimation, model specification and it also employs statistical technique in finding statistical relationship between the variables. Chapter four involves the presentation of data, analysis and discussion of results in chapter three. Lastly, chapter five, summarizes the major findings in this research study, concludes and gives policy implications of findings.

CHAPTER TWO

LITERATURE REVIEW

2.1 REVIEW OF DEFINATIONAL ISSUES

The crude oil price and exchange rates are key research subjects, and both variables generate considerable impacts on macroeconomic conditions such as economic growth, international trade, inflation, and energy management. The relationships between the two have been studied, mainly for guidelines of interaction and causality. In past decades, changes in the price of crude oil have been shown to be a key factor in explaining movements of foreign exchange rates, particularly those measured against the U.S. dollar (Huang and Tseng, 2010).

While a considerable amounts of studies have dealt with some aspect of the relationship between international oil price and exchange rate, a number of questions still spring to mind namely: Is there a role of oil prices in exchange rate determination in Nigeria, Do positive and negative shocks to oil prices volatility have symmetric effect on exchange rate volatility? Among other questions (Adeniyi, Omisakin, Yaqub and Oyinlola, 2012).

This section brings together relevant literature regarding oil price and exchange rate. Brief reviews are given with respect to the history of oil prices, history of crude oil in Nigeria, Exchange rate volatility, various exchange rate management system practiced Nigeria, importance of exchange rate stability, measuring of exchange rate volatility and the relationship between oil price and exchange rate in Nigeria. Theoretical and methodological issues on the topic are also looked at.

2.1.1 HISTORY OF OIL PRICES

Since the ending of the 1940s to the beginning 1970s the international oil price was very steady having only small changes. Then from the early 1970 to the early 1980s the price of oil increased beyond expectation with respect to the rise of OPEC and the disruption in the supply of crude oil.

OPEC first experienced the power it had over oil during Yom Kippor War which started in 1973. OPEC imposed an oil restriction on western countries as a result of US and the Europe support for Israel. Production of Oil was reduced by five million barrels a day. The cut back amounted to about seven percent of the world production and the price of oil increased 400 percent in six months.

From 1974 to 1978 crude oil prices were relatively stable ranging from \$12 to \$14 per barrel. Then between 1979 and 1980 during the Iranian revolution and Iraq war world oil production fell by 10% and caused the rise of crude oil from \$14 to \$35 per barrel. Oil prices were leading consumers and firms to adopt a more conserve energy. People purchased cars that could manage fuel and organizations purchased machine that were more fuel efficient (Sharma 1998).

Increased oil price also enlarged search and production by nations that were not members of OPEC. Beginning from 1982 to 1985 OPEC wanted to steady the price of oil through production of quotas, but safeguarding efforts, global economic meltdown and wrongful quotas produced by OPEC participant countries contributed to the plunging of oil prices beneath \$10 per barrel.

From the Mid – 1980s the fluctuations in the price of oil has occurred more frequent than the past. OPEC has continually been trying to influence oil price to ensure its stability through allocation of production quotas to its member countries but has been unable to stabilize it. OPEC share of the world oil production has fallen from 55 percent in 1976 to 42% today.

Oil prices matter in the economy in various ways. Changes in oil price directly affect transportation costs, heating bills and the prices of goods made with petroleum products. Oil price spikes induce greater uncertainty about the future, which affects households and firms spending and investments decisions. Also changes in oil prices leads to reallocations of labor and capital between energy intensive sectors of the economy and those that are non-energy intensive sector. (Sill, 2009).

2.1.2 BRIEF HISTORY OF OIL IN NIGERIA

The search for oil began in 1908 by a German company named Nigeria Bitumen Corporation, but there was no success until 1955 when oil was discovered in Oloibiri in Niger delta by shell-BP. Nigeria started exporting crude oil in 1958 but in major quantity started to flow in 1965, after the establishment of the bonny island on the coast of Atlantic and the pipeline to link the terminal.

In 1970, as the Biafra war was ending there was a rise in world oil price and Nigeria benefited immensely from this rise. Nigeria became a member of Organization of petroleum exporting countries (OPEC) in 1971 and the Nigerian National Petroleum company (NNPC) which is a government owned and controlled company was founded in 1977. By the late sixties and early seventies, Nigeria had attained a production level of over 2 million barrels of crude oil a day. Although there was a drop in production of crude oil in the eighties due to economic down turn, by 2004 Nigeria bounced back producing 2.5 million barrels per day, but the Niger delta crisis and the global economy financial crises reduced Nigeria oil production and the world oil price.

The discovery of oil brought in the eastern and mid – eastern regions of Nigeria brought hope of a brighter future for Nigeria in terms of economic development as Nigeria became independent,

but there were also grave consequences of the oil industry, it fuelled already existing ethnic and political tension. The tension reached its peak with the civil war and reflected the impact and fate of the oil industry.

Nigeria survived the war and was able to recover mainly from the huge revenue gained from oil in the 1970s. Nigeria gained a lot from the three year oil boom. There was a lot of money to meet all our development need. The oil revenue which was supposed to be a blessing became a cause because of the corruption and the mismanagement of revenue from oil. The enormous impact of the oil shock on Nigeria grabbed the attention of scholars and they tried to analyze the effect of oil price on economic growth in Nigeria. A set of radical oriented writers were interested in the nationalization that took place during the oil shock as well as the linkages between oil and an activist foreign policy. Regarding the latter, the emphasis was on OPEC, Nigeria's strategic alliance formation within Africa, the vigorous efforts to establish the Economic Community of West African States (ECOWAS), and the country's attempts to use oil as a political weapon, especially in the liberation of South Africa from apartheid.

Many people had hoped that Nigeria will become an industrial nation and a prosperous nation from the benefits of oil but they were greatly disappointed when we Nigeria hit a major financial crisis that led to the restructuring of the economy (Odularu, 2007; Ogundipe and Ogundipe 2013)

2.1.3 EXCHANGE RATE VOLATILITY

It is well-known in literature that getting the exchange rate right or maintaining relative stability is important for both internal and external balance and consequently growth in the economy. Exchange rate is the most important price variable in an economy and performs the twin role of

maintaining international competitiveness and serving as nominal anchor to domestic price (Mordi 2006).

Swings or fluctuations in the exchange rates over a period of time or deviations from a equilibrium exchange rate is referred to exchange rate volatility. Where there is multiplicity of markets parallel with the official market there could be deviations from the equilibrium exchange rate. Volatility over any time period interval tends to increase when supply, demand or both are likely to respond to large random shocks and when the elasticity of both supply and demand is low price volatility tends to be low (Obadan 2006)

The exchange rate is subjected to variations when it is not fixed, thus floating exchange rate tends to be more volatile. Economic essentials affect the level of volatility and the extent to which exchange rate stability is maintained. Favorable economic circumstances and outcome which in turn would appreciate the currency and maintain stability is caused by strong fundamentals. (Mordi 2006)

2.1.4 VARIOUS EXCHANGE RATE MANAGEMENT PRACTISED IN NIGERIA

Nigeria exchange rate moved from a fixed regime in the 1960s to a pegged arrangement between the 1970s and the mid-1980s, and to end with various types of the floating regime since 1986, following the adoption of the Structural Adjustment Programme (SAP). A regime of managed float has been the most important feature of the floating regime in Nigeria since 1986 without any strong compulsion to protecting any particular parity.

Fixed exchange rate regime practiced in Nigeria led to an over appreciation of the Nigerian currency and it was encouraged by the exchange regulator guidelines that produced noteworthy

alterations in the Nigerian economy. This led to a rise in importation of finished goods beyond expectation and it had terrible effect on internal production, Nigeria's balance of payment situation and Nigeria's foreign reserve level. This situation and many other issues encouraged the adoption of a more flexible exchange rate regime which is the SAP regime in 1986.

A continued distortion of the value of exchange rate in the market for foreign exchange rate will cause a hostile effect on Nigeria's economic performance in the medium term. Therefore, the Nigerian authorities should react to changes in the equilibrium exchange rate on time. Given the structure of the Nigerian economy, maintenance of a realistic exchange rate for the naira is very vital, and the need to reduce fluctuations in production and consumption, increase the inflow of non-oil export receipts and attract foreign investments.

Fixed exchange rate regime requires the fixing of the local currency exchange rate to a piece of gold, a locus currency like the dollar or a bag of monies or the SDR, with the main goal of maintaining a small rate of inflation. The rewards and shortcomings of the fixed regime have been acknowledged very well in a number of literature. It includes but is not limited a reduction in the cost of trading, increase in macroeconomic stability, dependability increase due to stability in the exchange rate and improved response to local nominal shocks. A main drawback of the fixed exchange rate regime, however, is that it infers the damage of monetary policy independence.

The activities of demand and supply will control the exchange rate in a floating exchange regime. This system believes that there is no hand controlling the foreign exchange market even the government and that the exchange rate corrects to any shortfall or excess in the foreign exchange market without the intervention of the public. This means that any change in the demand and supply of foreign exchange can change the exchange rates but cannot change the

reserve position of the country. In this arrangement, the exchange rate assists as a “jumbo” for outside shocks, therefore permitting the monetary authorities complete discretion in the demeanor of monetary policy. The drawbacks of the freely floating exchange rate system have been known. It include insistent exchange rate variations, increased inflation and increased transaction cost. The best advantage of the floating exchange rate system, is monetary policy freedom, explained by a country’s capacity to influence its monetary totals and control its national interest rate and inflation.

An adjustment to the freely floating system is managed floating system which exists when the local government interferes in the market for foreign exchange in order to regulate movements in the exchange rate. It does not obligate itself to maintain a fixed exchange rate or some thin limits round it.

From the Inception of the CBN, Nigeria’s exchange rate policy goal has aimed at conserving the outside value of the local currency and upholding a solid position of the balance of payments, which, certainly, is a foremost provision of the aiding law. The disappointment of the Autonomous Foreign Exchange Market (AFEM), which was presented in 1995, led to an Inter-Bank Foreign Exchange Market (IFEM) was presented on October 25, 1999. The initial plan of the IFEM was to be mutual quote system. It intended to vary the foreign exchange supply in the economy by boosting the financing of the inter-bank jobs from foreign exchange earned privately. IFEM goal was also aimed at encouraging the naira to attain an applied exchange rate. IFEM operations also experienced comparable glitches and delays as the AFEM. This was caused by inflexibilities on the supply side, the repeated expansionary fiscal activities by the Nigerian government and the resultant difficulty of consistent surplus liquidness in the system. Central Bank of Nigeria introduced the Dutch Auction System (DAS) again to remove the IFEM.

This system was created to accomplish a stable exchange rate of the naira that will lessen the undue demand for foreign exchange, safeguard the reducing level of external reserves and accomplish a genuine exchange rate for the Nigerian currency. The DAS was perceived as a give-and-take auction system in which CBN and legal dealers together will partake in the market of foreign exchange rate to buy and sell foreign exchange. CBN is required to decide on the quantity of foreign exchange it wants to sell and at the price that buyers will be willing to buy. The marginal rate is the “presiding” rate at the auction, which means it is the rate that clears the market.

The foreign exchange earnings of Nigeria are over ninety percent dependent on the revenue from crude oil exports. The consequence of this action means that unpredictability of the world’s oil prices has an immediate impact on the supply of foreign exchange in Nigeria. Also, Nigeria’s oil sector generates over eighty percent of the government revenue in Nigeria. Therefore, an increase in the world oil prices leads to a higher revenue shared between the federal, state and local government of Nigeria and this has been the trend since the early 1970s, expenses also increases in the same manner and it is difficult to bring down when oil prices falls down and revenues falls together with it. There is no doubt that such unpredictable expenditure level has been the main cause of Nigeria government deficit spending. It is for this very reason that foreign reserves are maintained by the government so that the expenditure needs of the country can be met when the price of oil decreases in the international oil market. A key concern is the economic situation in Nigeria, position in the outside economic setting and the consequence of several hit and misses jolts on the local economy. Hence, nations like Nigeria are most likely to take up a system which guarantees more flexibility because they are easily affected by unstable inner financial circumstances and outside shocks, which needs real exchange rate to depreciate,.

On the whole, there is an overall agreement that a fixed exchange rate system should be taken up if what causes macroeconomic volatility is mostly internal. While a flexible exchange rate system is favored if volatility is mainly external in nature. Therefore it is becoming increasingly accepted that irrespective of what exchange rate system a country adopts, the overall achievement rests on its obligation to maintain sound economic fundamentals and a good banking system (Sanusi 2004).

Schnabl (2007) argued that theoretically flexible exchange rate makes it easier for a country to adjust to asymmetric specific real shocks. Whereas, the micro economic effects of low exchange rate fluctuations under fixed exchange rate system are linked to reduced transaction costs for international trade and capital flows thereby increasing economic growth. If exchange rate volatility is eliminated, international arbitrage enhances efficiency, productivity and welfare.

2.1.5 IMPORTANCE OF EXCHANGE RATE STABILITY

1. When exchange rate is stable it increases the standard of living of the people by helping to decrease the uncertainty about general price developments and in so doing improve the transparency of general prices.
2. It leads to reduction in inflation risk premia in interest rates: if creditors are certain that prices will remain stable in the future, they will not demand for an extra return (risk premium) to compensate them for the inflation risks associated with holding nominal assets over the longer term. It increases the incentive to invest because the capital market allocates resources more efficiently. This again fosters job creation and, more generally, economic welfare.

3. It also helps to circumvent unnecessary hedging risk: The maintenance of exchange rate stability will make it less likely for individuals and firms to redirect resources from productive uses in order to hedge themselves against inflation or deflation, for example by indexing nominal contracts to price developments. Since full indexation is not feasible or is too costly, in a high-inflation environment there is an reason to stockpile real goods given that in such circumstances they retain their value better than money or certain financial assets. An excessive stockpiling of goods hinders economic and real income growth because it is not an efficient investment decision.
4. It increases the benefits of holding cash: Inflation can be interpreted as a unknown tax on holding cash. This means that, people who hold cash (or deposits which are not rewarded at market rates) experience a decline in their real money balances and thus in their real financial wealth when the price level rises, just as if part of their money had been taxed away. Therefore, the higher the anticipated rate of inflation, leads to a fall in demand by households for cash holdings. This happens when inflation is fully expected, that is inflation is uncertain. Consequently, if people do not hold a lot of cash, they must make more regular visits to the bank to withdraw money. In general, reduced cash holdings can be said to generate higher transaction costs.
5. It contributes to financial stability: Unexpected revaluations of assets owing to unforeseen changes in inflation can undermine the reliability of a bank's balance sheet. For example, let us assume that a bank provides long-term fixed interest loans which are financed by short-term time deposits. If there is a sudden shift to high inflation, this will mean a fall in the real value of assets. Following this, the bank may face solvency problems. If monetary policy maintains price stability, inflationary order inflationary

shocks to the real value of nominal assets are avoided and financial stability is therefore also enhanced.

6. Maintenance of a constant exchange rate contributes to broader economic goals: In summary all of these arguments suggest that a central bank that maintains exchange rate stability contributes substantially to the achievement of broader economic goals, such as higher standards of living, high and more stable levels of economic activity and employment (European central bank, 2007)

2.1.6 MEASURING OF EXCHANGE RATE VOLATILITY

In the vast wide-ranging literatures on exchange rate volatility, there has been no agreement on the appropriate approach for evaluating volatility by economic researchers. The lack of an agreement on this topic echoes a number of factors as different theories cannot provide a definite guidance as to which measure is the most suitable. Moreover, the type of measure to be adopted will depend on the scope of study. The time period over which fluctuations is to be measured, as well as whether it is unrestricted volatility or the sudden movement in the exchange rate parallel to its predicted value needs to be taken into consideration. Finally, in shaping the applicable measure of exchange rate to be used, the level of collective trade flows should be taken into consideration.

The degree to which exchange rates, due to its habitually high volatile state are a source of risk and ambiguity depends on the degree to which movements in the exchange rate are predictable. With hedging, the predictable part can be hedged away so that the cost on trade is minimal. A realistic measure would be to use the forward rate as an sign of the future spot rate, and indicating the exchange rate risk with the discrepancies between the current spot rate and the

earlier period forward rate even though using the forward rate as an indicator as a problem with predicting the future exchange rates adding to the fact that quotations are only existing for major currencies.

McKenzie (1999) believes that there are a number of measures that should be taken into consideration ranging from the structural models to the time series equation making use of the ARCH/GARCH approaches. The standard deviation of the first variation of logarithms of the exchange rate is the most widely used in measuring exchange rate volatility. If the exchange rate is on a steady trend, which could easily be forecasted the result will therefore not be a source of uncertainty. The standard deviation is calculated over a period of one year to point out a short-run volatility and in acquiring long-term variability, a period of five years is used.

Finally, in measuring exchange rate volatility, the importance of currency invoicing is to be taken into consideration. Mostly, trade between two developing countries is not invoiced in the currency of either country. A standard currency is been used mostly the U.S. dollars is often used as the invoicing currency. It may look like the volatility of the exchange rate between the two trading partners' currencies is not the important volatility to consider however this is wrong. For example, if trade exports from China to Nigeria are invoiced in U.S. dollars, it might look like the Chinese exporters would only care about the changes between the U.S. dollar and the Chinese Yuan, but not between the Nigeria naira and the Chinese Yuan. Nevertheless, any change between the Chinese Yuan and the Nigeria naira holding constant the Chinese Yuan/U.S. dollar rate must mirror fluctuations in the Nigeria naira/U.S. dollar rate. As the latter could affect the Nigerian demand for Chinese exports, changes in the Chinese Yuan/Nigeria naira exchange rate would also affect the Chinese exports to Nigeria even if the trade is invoiced in the U.S. dollar (Ojebiyi and Wilson 2011)

2.1.7 OIL PRICE AND EXCHANGE RATE

According to Adedipe (2004) the different exchange rate regimes in Nigeria can be classified into different periods relating to vagaries in the international oil market.

1. The Post-Independence Era (1960 – 1971)

The Nigerian currency was pegged at par to the British pound sterling (GBP) using administrative measures, to sustain the parity. The devaluation of GBP in 1967 made Nigeria adopt the US dollar, which was deemed better to support the import substitution industries which depend heavily on net imported inputs. Throughout this period the Nigerian pound sterling was overvalued, inhibiting optimal growth in agriculture and in goods produced for exports.

2. The Oil Boom Era (1972 – 1986)

During this period the exchange rate moved in the same pattern as the oil prices and the naira remained overvalued as a result of the huge increase in foreign exchange earnings. This currency was anchored to the GBP until, 1972 when the GBP was floated and then pegged to the US dollar. However in 1978, the naira was anchored on a basket of currencies of Nigeria 12 major trading partners. This was changed in 1985 and the Naira reverted to quotation against the US dollars.

3. The Post – Sap Era (From 1986)

The Naira was subject to a managed float system in a continuing effort to restructure the economy away from oil dependency. The policy of deregulation of the foreign exchange market in 1986 was to show the true value of the naira, this was in the view of boosting oil-non exports.

Thus, from N0.89388/US\$ at the end of 1985, the exchange rate weakened to N2.0206/\$ at the end of 1986. This was done in expectation of promotion of non-oil exports and the naira was further devalued in March 1992 by 44% to N17.2984/\$. Devaluation of the naira in order to encourage non-oil export has not produced the desired return.

The Exchange rate value of Nigeria is very crucial to the Annual budget, the Gross domestic product (GDP), the level of development, among other things. Therefore, a study on the effect of Oil price on Exchange rate volatility is very important.

2.2 REVIEW OF THEORETICAL ISSUES

Diverse theoretical relationship between oil price and exchange rates have been established in literature (Beckmann and Czudaj 2012). Oil price fluctuations have received significant considerations for their believed role in macroeconomic variables. The consequences of large increases in the oil price on macroeconomic variables have been of great concern among economist and policy makers as well as the general public, since two major oil price shocks hit the global economy in the 1970s (Sill 2009)

The thought that exchange rate is the most difficult macroeconomic variable to model empirically is debatable. Many papers have suggested that oil price might have a significant influence on exchange rate. The proposition that oil price might be adequate enough to explain all the long run movements in real exchange rate appears to be new (Al-Ezzee, 2011)

Nigeria like among other low income countries has adopted two main exchange rate regimes for the purpose of gaining balance both internally and externally. The purpose for this different

practice is to maintain a stable exchange rate (Umar and Soliu 2009). A fluctuating real exchange rate as a result of adverse fluctuation stemming from volatile oil prices are damaging to non – oil sector, capital formation and per capita income (Serven and Solimano 1993 and Bagella 2006).

The consequences of substantial misalignments of exchange rate can lead to shortage in output and extensive economic hardship. There is reasonably strong evidence that the alignment of exchange rate has a substantial influence on the rate of growth of per capita output in low income countries (Isard 2007).

According to Trung and Vinh (2011) there are two reasons why macroeconomic variables should be affected by oil shocks. First, oil increase leads to lower aggregate demand given that income is redistributed between net oil import and export countries. Oil price spikes could alter economic activity because household income is spent more on energy consumption and firms reduce the amount of crude oil it purchases which then leads to underutilization of the factors of production like labor and capital. Second, the supply side effects are related to the fact that crude oil is considered as the basic input to production process. A rise in oil price will lead to a decline in supply of oil because of the rise in cost of crude oil production which will lead to a decline in potential output.

For various reasons known and unknown, oil price increases may lead to significant slowdown in economic growth. Five of the last seven United States of America recessions were preceded by significant increases in the price of oil (Sill, 2009). A factor discouraging economic growth is sharp increases in the international price of oil (Jin, 2008).

Analysis of the impact of asymmetric shocks caused by exchange rate and oil price variability on economic growth has been a major concern of both academics and policy makers for a long time now (Aliyu 2009). According to Amano and Norden (1998) many researchers suggest that oil fluctuations has a significant consequence on economic activity and the effect differ for both oil exporting countries and oil importing countries. It benefits the oil exporting countries when the international oil price is high but it poses a problem for oil importing countries.

According to Plante (2008) theoretically immediate effect of positive oil price shocks is the increase in the cost of cost of product for oil importing countries , this is likely to reduce output and the magnitude of the depends on the demand curve for oil. Higher oil prices lower disposable income which then leads to a decrease in consumption. Once the increase in oil price is believed to be permanent, private investments will decrease. But if the shocks are perceived as persistent oil is used less in production, the productivity of labor and capital will decline and potential output will fall.

Some researchers have carried out research the issue of oil price and exchange rate further. According Rickne (2009) political and legal institutions affect the extent to which the real exchange rate of oil exporting countries is affected by international oil price shocks. In a theoretical model strong institutions protect real exchange rate from oil price volatility by generating a smooth pattern of fiscal spending over the price cycle. Empirical analysis carried out on 33 oil exporting countries show that countries with high bureaucratic quality and strong and impartial legal system have real exchange rate that are affected less by oil price. Also

according to Mordi and Adebisi (2010) the asymmetric effect of oil price changes on economic activity is different for both oil price increase and oil price decrease. Patti and Ratti (2007) shows that oil price increases have a greater influence on the economy than a decrease in oil price.

2.3 REVIEW OF METHODOLOGICAL AND EMPIRICAL ISSUES

Empirical research on the part of oil price plays as a determinant of real exchange rate has yielded somewhat puzzling results for oil exporting countries. (Rickne, 2009)

According to empirical works carried out, there has been what appears to be a rather strong relationship between real oil prices and real exchange rates of a number of countries (Plante 2008).

Korhonen and juurikkala (2007) showed that increasing crude oil prices cause a real exchange rate appreciation in oil exporting countries and this is not shocking, since they earn a significant amount from oil exportation. There is also a significant relationship between real oil prices and real exchange rates for oil importing countries; evidence has been seen for Spain (Camarero and Tamant 2002).

A study carried out on the Russian economy by Spatafora and Stavrev (2003) confirm the sensitivity of Russia's equilibrium real exchange rate to long run oil prices. Likewise, Suseeva (2010) verified a long run positive relationship between the real oil price and the real bilateral exchange rate against Euro in Russia. Lizardo and Mollick (2010) provided proof that between the year 1970s to 2008, movements in the value of the U.S dollar against major currencies was significantly explained by oil prices. They found that when oil prices group currencies of oil

importers such as china suffer depreciation. On the other hand, in net oil exporters such as Canada, Mexico and Russia increase in oil prices leads to a noteworthy depreciation of the US dollar. But, Akram (2004) finds strong evidence of no linear relationship between oil prices and the Norwegian exchange rates.

Using Blanchard – Quah identification strategy Clarida and Gali (1999) estimate the share of exchange rate fluctuations that is due to the different shocks in oil. Using quarterly data from 1974 to 1992 comparing the United States of America to four different countries (Germany, United Kingdom, Japan and Canada) they found that more than 50% of the variance of real exchange rate changes over all the horizons was caused by real oil shocks. Amano and Norden (1998) using data on real effective exchange rates for Germany, Japan and United States of America discovered that real oil price is the most important factor in determining real exchange rates in the long run.

An advance in the productivity of tradable relative to non-tradable if larger in other countries could lead to the appreciation of the real exchange rate. This is the Balassa-Samuelson hypothesis formulated by Balassa (1964) and Samuelson (1964). According to Coudert (2004), the Balassa-Samuelson effect is the mechanism by which an appreciation of the real exchange rate occurs owing to changes in relative productivity. We use the real oil price as a representation of the terms of trade and examine the influence of oil price fluctuations and productivity differentials on the real exchange rate given that oil price is the main export good driving the terms of trade in oil exporting countries. In practice, the price of the main exported good is often used as an indicator of the terms of trade (Sossounov and Ushakov, 2009).

Using a panel of 16 developing countries Choudhri and Khan (2004) provided strong evidence of the workings of the Balassa Samuelson effects. Coudert (2004) survey provided evidence that the trend appreciation in the real exchange rate observed in countries of central and Eastern Europe during the early 2000 stemmed in fact from a Balassa effect. The writer noted that even though other factors were just as responsible, the estimated Balassa effect goes some way in explaining the real appreciation.

Kutan and Wyzan (2005) using an extended version of the Balassa-Samuelson model finds evidence that changes in oil prices had a significant effect on the real exchange rate during 1996 to 2003 and that the Balassa- Samuelson working through productivity changes may be present though its economic significance may not be large.

Cashin et al (2004) carried out a study on over 50 commodities exporting developing countries and he finds along-run relationship between exchange rate and the exported commodity's price in one third of their sample. In a recent study, Ozsoz and Akinkunmi (2011) also demonstrated the positive effects of international oil prices on Nigeria's exchange rate.

Using monthly panel of G7 countries Chen and Chen (2007) investigate the long run relationship between real oil price and real exchange rates and they found that real oil prices is a dominant cause of real exchange rate movements. Olomola (2006) investigated the impact of oil price shocks on aggregate economic activity in Nigeria. Using quarterly data from 1970 to 2003. He discovered that contrary to previous empirical findings, oil price shocks do not affect output and

inflation in Nigeria significantly. However oil price shocks were found to significantly influence the exchange rate.

In Bahrain Johansen co integration test is used to examine the co integrating relationship between the real GDP, real effective exchange rate and real oil price of a country. Real GDP of Bahrain is more elastic to changes in international oil prices than real exchange rate (Al – Zee, 2011). Research conducted on Vietnam from the period of 1995 to 2009 using the vector autoregressive model (VAR) produce results that suggest that both oil prices and the real effective exchange rates have strong significant impact on economic activity.

Habib and Kalamova (2007) investigate the effect of oil price on the real exchange rate of three countries Norway, Saudi Arabia and Russia. In case of Russia a positive long run relationship was found between oil price and exchange rate and no impact of oil price on exchange rate was found for Norway and Saudi Arabia.

Aliyu (2009) and Rickne (2009) believe that this is caused because of lack on strong institutions and total dependency on oil exports. Aliyu (2009) recommends larger divergence of the economy through the investment in top prolific sector to reduce the adverse effect of oil price shocks and the exchange rate volatility. Oil price has a strong influence on oil dependent countries and their currency is referred to as oil currency whereas for countries like Norway and Canada which are developed and have strong institutions there are weak influences of oil price on exchange rate and economic activities in this countries.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter deals with issues relative to specification of appropriate model, description, description of variables, technique of estimation, method of data analysis and sources of data. Section 3.2 talks about the theoretical framework used in the research, section 3.3 looks at the model specification this gives us full detail on the model adopted in the research process, the data sources and the variable description and the a priori expectation is also discussed in this section, section 3.4 gives full detail on the research methodology adopted.

3.2 THEORETICAL FRAME WORK

The theoretical framework of this study is based on Generalized Autoregressive Conditional Heteroskedasticity modeled by Tim Bollerslev (1986) and Exponential General Autoregressive Conditional heteroskedastic modeled by Daniel Nelson (1991). The models are used to estimate the relationship between oil price changes and exchange rate.

Bollerslev introduced the GARCH model by extending the work of Robert Engle (1982) framework and has been popular since the early 1990s. The daily nominal return on exchange rate is denoted as $grex_t$, while the daily nominal return on oil price is denoted as $groil_t$

The daily returns are computed as follows:

$$g_{rex_t} = \log\left(\frac{er_t}{er_{t-1}}\right) \quad (1)$$

$$g_{roil_t} = \log\left(\frac{brent_t}{brent_{t-1}}\right) \quad (2)$$

g_{rex_t} Is an indicator for the daily returns on exchange rate, while er_t represents naira-dollar exchange rates for period's t and er_{t-1} is the lag of naira-dollar exchange rates. For the nominal oil returns, g_{roil_t} , represents the daily returns on oil price, $brent_t$ is the daily spot price for Brent crude oil for the periods t and $brent_{t-1}$ is the lag of the daily spot price for Brent crude oil.

GARCH (1, 1) specification takes the form:

$$a + \zeta g_{roil_t} + \mu_t, \mu_t \sim N(0, \delta^2) \quad (3)$$

$$h_t = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta h_{t-1}$$

The equation of the mean is a function of a constant, one regressor and an error term. The error term μ_t is called white noise $(0, \delta_t^2)$. The variance equation for GARCH (1, 1) is written as a function of a constant term, the ARCH term which means autoregressive conditional heteroskedasticity captures reports about volatility from the earlier period measured as the lag of squared residuals from the mean equation and the last forecast period. The coefficients α_1 and β are positive to make sure the conditional variance h_t is always positive (Roman, 2010). The non-negativity restrictions are considered necessary to guarantee that $h_t > 0$ in all periods and the upper bound $\alpha + \beta < 1$ is required in order to make the h_t stationary and consequently the unconditional variance finite (Soderlind, 2011). The condition $\alpha + \beta < 1$ may not be met due to

persistent instability of many financial time series but a unity sum of both α_i and β_j leading to the integrated GARCH (IGARCH). Nevertheless even if a GARCH is not covariance stationary, Nelson (1990), Bougerol and Picard (1992) and Lumsdaine (1991) and Wang (2003) observed that standard asymptotically based inference procedures are generally valid.

An alternative GARCH equation, the (GARCH-M) GARCH-in-mean is also considered in this study, by incorporating the conditional variance in to the mean equation and it takes the following form.

$$grex_t = \alpha + \zeta groil_t + \lambda h_t + \mu_t \quad (5)$$

Higher order GARCH (q, p) can be estimated with the variance equation taking the form:

$$h_t = \alpha_0 + \sum_{i=1}^q \alpha_i \mu_{t-1}^2 + \sum_{i=1}^p \beta_i h_{t-i} \quad (6)$$

Nelson (1991) first brought up the Exponential GARCH or EGARCH model as an alternative to the GARCH model due to the perceived problems with standard GARCH (q, p) model. The EGARCH captures asymmetric responses of the time varying variance to shocks and ensures variance is positive. The representation of the EGARCH variance takes the form:

$$\ln(\delta_t^2) = \alpha_0 + \phi \ln(\sigma_{t-1}^2) + \gamma \frac{\mu_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \chi \left[\frac{\mu_{t-1}}{\sqrt{\delta_{t-1}^2}} - \sqrt{2/\pi} \right] \quad (7)$$

The parameters to be estimated are α_0 , ϕ , γ and χ . The left hand side is the log of the conditional variance; hence the leverage effect is exponential as opposed to quadratic with the estimates of the conditional variance guaranteed to be positive. Also being written in terms of log make $h_t > 0$

hold without any restrictions on parameters. According to Wang et al (2011), the EGARCH benefits from the non-negativity constraint which Nelson believed is too restrictive in linear GARCH model which requires all the explanatory variables in a GARCH to be positive. α_0 represents the mean of the volatility equation, ϕ denotes the size effects which shows how much volatility increases notwithstanding the shock direction. The estimate of χ is used to evaluate the different perceptions of shocks. The absolute value of $\chi < 1$ ensures stationary and periodicity for EGARCH (P, Q).

γ is the asymmetric response parameter, it is the sign effect which determines whether positive shocks gives rise to higher volatility than negative shock or vice versa. According to Soderlind (2011), the EGARCH (exponential GARCH) is an asymmetric model; the $|\mu_{t-1}|$ term is symmetric which means that both positive and negative values of μ_{t-1} influence volatility in the same way. The linear term in μ_{t-1} modifies this to make the effect asymmetric. If $\gamma < 0$, then the volatility increases more in response to a negative μ_{t-1} than to a positive μ_{t-1} .

3.3 MODEL SPECIFICATION

In line with the GARCH model theory which makes the exchange rate dependent on the oil price. A model was constructed to include: FOREX supply and demand for external reserves.

$$Vol_EXR = f(oilp, er, int) \quad (8)$$

$$Vol_EXR = \beta_0 oilp^{\beta_1} er^{\beta_2} int^{\beta_3} \quad (9)$$

$$\log Vol_EXR_t = \beta_0 + \beta_1 \log oilp_t + \beta_2 \log er_t + \beta_3 \log int_t + \mu_t \quad (10)$$

Where:

β_0 : constant term

$\beta_1 - \beta_3$: elasticity coefficients

μ : stochastic disturbance term

The A priori expectation provides expected signs and significance of the value of the coefficient of the model parameters to be estimated in light of economic theory and empirical evidence.

There are sound theoretical reasons for believing strong positive links exist between oil price and exchange rate. While, negative links exist between the explained variable, external reserves and FOREX supply.

$$\beta_1 > 0, \beta_2 > 0 \text{ and } \beta_3 < 0$$

1. The coefficient of the oil price is expected to be positive that is the slope of the coefficient $\beta_1 > 0$ which shows that ceteris paribus a country dependent on a resource, for it major revenue will definitely affect the exchange rate of the country and influences its movement, causing it to move in the same direction that it moves.
2. The coefficient of the interest rate is expected to be positive. Higher interest rates attract foreign investments and lead to currency demand increase, which in turn results in exchange rate increase.
3. The coefficient of the external reserves is expected to be negative $\beta_3 < 0$ which shows that an increase in foreign reserves will lead to a decrease in exchange rate volatility.

3.3.1 DATA SOURCES AND DESCRIPTIONS

VARIABLE	DESCRIPTION/ MEASUREMENTS	DATA SOURCES
OIL PRICE (oilp)	The price of crude oil is stated in US dollars. Oil price is the price at which oil is sold per barrel each day in the international oil market. It is measured in US dollars	BP statistical review of energy 2012
EXTERNAL RESERVES (er)	This is the amount of revenue saved by country from trading with other nations. It is measured in US dollars millions	CBN statistical bulletin 2011
Interest rate (int)	It is the charge for borrowing money, usually measured as the percentage ratio between the sum payable to the lender and the amount borrowed, at an annual rate. The amount of money contractually promised at certain specified future dates as a proportion of the principal borrowed.	CBN statistical bulletin 2011
EXCHANGE RATE (vol_exr)	It is the price of a country currency expressed in terms of one unit of another country's currency. It is measure as the exchange rate of the naira to the dollar.	Figures for exchange rate derived from CBN statistical bulletin while volatility figures are conditional variances generated using E-Views 5.0

3.4 RESEARCH METHODOLOGY

The econometric technique used is the johansen maximum likelihood estimation method and also to test for co integration the vector error correction model (VECM) is employed. The Eviews 5.1 software package would be used for estimation. The choice of this co integration is as a result of the following things:

1. Most time series data are not stationary that is they do not have a constant mean, a constant variance and a constant auto variance for every successive lag) so the use of the OLS method of estimation would only yield unauthentic results.
2. Co integration view is a convenient approach for the estimation of long run parameters with unit root.
3. The co integration approach provides a direct test of the economic theory and enables utilization of the estimated long run parameters into the estimation of the short run disequilibrium relationships
4. The traditional approach is criticized for ignoring the problems caused by the presence of unit roots variables in the data generating process. However both unit root and co integration have important implications for the specification and estimation of dynamic models

UNIT ROOT TEST OR THE TEST FOR STATIONARITY

The unit root test is carried out before the co integration method of analyses can be carried out; this is because it is necessary to test for the presence of a unit root in a variable. A unit root test tests whether time series variable is non-stationary using autoregressive model. A test that is very popular and valid for large samples is the Augmented dickey fuller (ADF) and another test that can be used is Phillips Perron test. They are used to determine the order of integration of a variable.

The test states that if a particular series say Y has to be differenced n times (number of times, 1, 2, 3... n) before it becomes stationary then Y is said to be integrated of order n (it is written as $I(n)$). If the series is stationary at level it is said to be integrated to order 0 ($I(0)$), that is there is

no unit root. If a variable is differentiated once in order for it to be stationary it is said to be integrated to order 1 that is $I(1)$.

The test statistics of the estimated coefficient of Y_t is then used to test the null hypothesis that the series is non-stationary (has unit root). If the absolute value of the test statistics is higher than the absolute value of the critical T value (which could be at 1, 5, or 10 percent) then the series is said to be stationary, therefore we reject the null hypothesis, otherwise it has to be differentiated until it is stationary.

JOHANSEN TEST FOR COINTEGRATION

Co integration is basically based on the idea that there is a long run co movement between trended economic time series so that there is a common equilibrium relation which the time series have a tendency to revert to, therefore even if certain time series, they are non-stationary, a linear combination of them may exist that is stationary

A lot of economic series behave like $I(1)$ processes that is they seem to drift all over the place, but another thing to notice is that they seem to drift in such a way that they do not drift away from each other. Formulating it statistically you will come up with a co integration model.

Johansen test named after Soren Johansen, is procedure, is a procedure for testing co integration of several $I(1)$ time series. This test permits more than one co integrating relationships, so it's more applicable than the Engle-Granger test which is OLS based. There are two types of Johansen test, Trace and Maximal Eigen value which are used to test for co integration and they are also used to determine the number of co integrating vectors. Both tests do not always indicate the same number of co integrating vectors. The trace test is a joint test, the null hypothesis is that the number of co integrating vectors is less than or equal to r against a general alternative

hypothesis that there are more than r . the Maximal Eigen value test conducts separate test on each Eigen value. The null hypothesis is that r co integrating vectors present against the alternative that there are $(r+1)$ present. If there are g variables in the system of equations, there can be a maximum of $g-1$ co integrating vectors.

ADVANTAGES OF THE USE OF JOHANSEN TECHNIQUE

1. The core benefit of Johansen Vector Autoregressive estimation procedure in the testing and estimation of the numerous long-run equilibrium relationship.
2. It allows testing of various economic hypotheses via linear restrictions in co integration space is possible when using johansen estimation method.

CRITICISMS OF THE JOHANSEN TECHNIQUE

1. The result can be sensitive to the number of lags included in the test and the presence of autocorrelation
2. Higher requirements in Johansen's estimation method for the number of observations than the Engle-granger procedure usually necessitates, the use of quarterly or monthly time series data, which are not always readily available.
3. If the two test statistics differ, which one gives the correct results?
4. Problems identifying (multiple) co integration vectors with theoretical economic relationships are possible using Johansen method.

HOW TO OVER COME THE WEAKNESS

1. By identifying co integrating vectors, if the model is consistent with economic theory, it should consist of two or more single equations.

2. The problem can be corrected by a lag length test which would estimate vector auto-regression using undifferentiated data.

THE VECTOR ERROR CORRECTION MODEL

This is basic VAR, with an error correction term incorporated into the model. The reason for the error correction term is the same as with the standard error correction model, it measures any movements away from the long run equilibrium and measures the speed of adjustment of the short run dynamics to the long run equilibrium time path. The coefficient is expected to be negatively signed. The vector error correction model would be used to analyze the short run relationship between the world crude oil price and the Nigerian exchange rate.

GARCH (1,1) MODEL

The exchange rate volatility aspect of the model is estimated using the GARCH (1,1) model of estimation. It is believed that the GARCH model can generate good estimates of exchange rate volatility (Egwaikhide and Udoh, 2008)

The GARCH model was developed independently by Bollerslev (1986) and Taylor (1986). It is used by several professionals in several areas including, trading, investing, hedging and dealing. The process for GARCH model involves three steps: estimate the best fitting autoregressive model, compute autocorrelations of the error term and lastly test for significance. GARCH method presumably captures risk in each period more sensibly than simply rolling standard deviations which gives equal weights to correlated shocks and single outliers. Development of

the model is premised on two different specifications. There is one for the conditional mean and another for the conditional variance (Onwusor, 2007).

The GARCH model allows the conditional variance to be dependent upon previous own lags, so that the conditional variance in the case is:

$$\delta_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta \delta_{t-1}^2$$

δ_t^2 is known as the conditional variance. Since it is one period ahead estimate for the variance calculated is based on any past information thought relevant.

Adapting GARCH model used by Papertrou to model oil price volatility, the mean equation of the GARCH model is specified as:

$$\Delta lex_t = \alpha_0 + \alpha_1 \Delta lex_{t-1} + \mu_t$$

In the mean equation, ΔLEX represents the rate of increase in the exchange rate expressed as the difference of the logarithm of the exchange rates; and μ_t is a random error that is Gaussian in nature implying that the error term is dependent upon itself.

The exchange rate that is used is sourced from the CBN website and the GARCH model is used to generate the conditional variance series that is subsequently used as the exchange rate volatility time series data from 1980 to 2011

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

In the previous chapter a model was specified to find out the effect of oil price on exchange rate volatility in Nigeria. This chapter focuses on the presentation, analysis and interpretation of data.

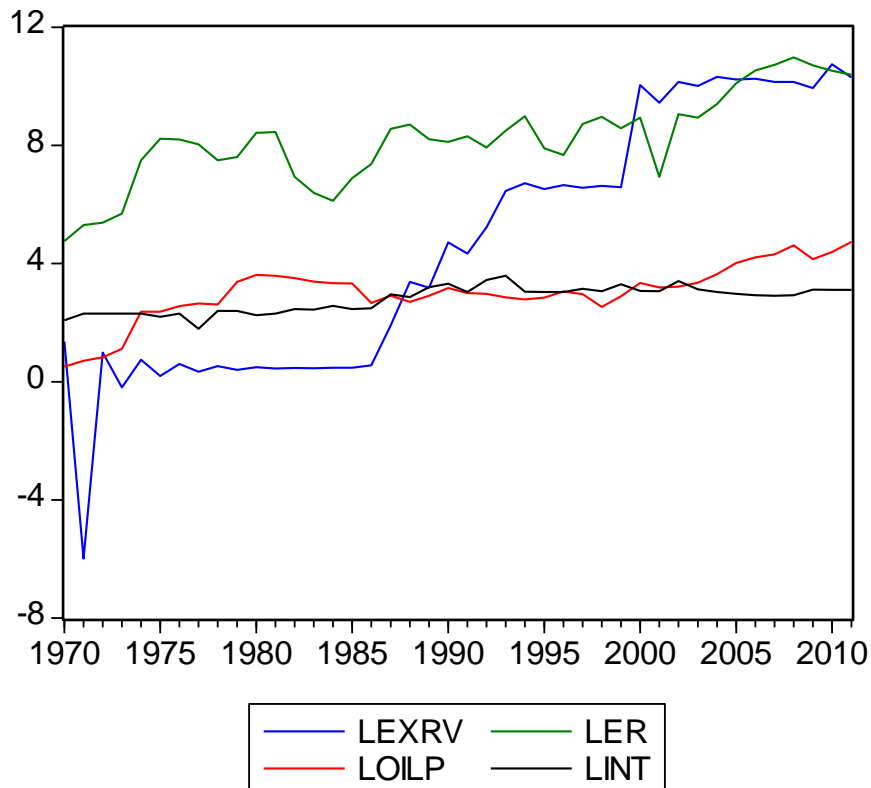
To this end the chapter is divided into two main sections:

1. Descriptive analysis
2. Econometric analysis

The descriptive analysis helps us ascertain the trend of relationship among the variables employed in this study; most importantly, the pattern of relationship between exchange rate volatility and its determinants.

The econometric analysis would help us achieve the objective of finding if oil price influences exchange rate volatility in Nigeria. Therefore the econometric analysis would investigate the short run and long run effects of oil price on exchange rate volatility.

4.2 Trend and Descriptive analysis



The figure above shows the trend in the exchange rate volatility, oil price, external reserves and interest rate between 1970 and 2011. From the graph it can be observed that the exchange rate volatility on the average has been increasing. It increased suddenly from 1970 to 1972. It remained fairly steady from 1975 to 1986 and .from 1987 to 2011 it steadily increased.

From the graph it can be observed that the oil price increased from the year 1973 to 1975. This is due to the oil shocks during that period. It kept on increasing until 1985 when it became fairly stable till 2001 when it move up very fast.

The external reserves have been moving up and down over the years quite frequently but fell down hard in between 1980 and 1985 this is because of the deficits that had to be financed by the reserve. It also went down hard in the year 2000. From the graph above it can be observed that interest rate has been fairly stable increasing only a bit occasionally.

Table 4.2.2 Descriptive Statistic of Tables

	LEXRV	LOILP	LER	LINT
MEAN	4.593674	3.031512	8.217029	2.78981
MEDIAN	4.524582	3.026665	8.266310	2.941717
MAXIMUM	10.74158	4.733124	10.97632	3.586016
MINIMUM	-5.981081	0.512824	4.757376	1.791759
STD DEV	4.384517	0.947471	1.519066	0.433827
SKEWNESS	-0.054155	-0.836974	-0.216131	-0.292339
KURTOSIS	1.946100	4.115855	2.782401	2.041773
JARQUE BERA	1.964263	7.082890	0.409850	2.205082
PROBABILITY	0.374512	0.028971	0.814708	0.332021

Source: computed by author using E-views 5.0

The first two descriptive statistics that is the mean and median are measures of central tendency for all the variables. The LEXRV has the highest standard deviation (deviation from the mean) while LINT has the lowest standard deviation.

The Jarque Bera is a test for normality of the distribution where the null hypothesis is that the distribution of the sample is a normal one. If the probability value of the Jarque bera test is significant, then the null hypothesis is rejected and the alternative is accepted which says that the sample is not normally distributed. If each variable is statistically significant (indicated by a zero probability), then the series is not normally distributed. Therefore the farther the probability statistic of a variable is to zero, the lower the value of its Jarque Bera statistic and the more normally distributed it is (and vice versa). From the results above, the Jarque Bera tests shows that the null hypothesis is strongly accepted for all the distribution. Hence, the variables can be

described to be normally distributed in the following order (from the highest to the lowest): external reserves, exchange rate volatility, interest rate and oil price.

4.3 Econometrics Analysis

4.3.1 Test for Unit Root

Unit root test is carried out to determine if the variables are stationary and if not, to determine their order of integration (i.e. number of times they are to be differenced to achieve stationarity). In standard econometric analysis of the data used in research, a stationary test was carried out; this is due to the fact that most time series data are non-stationary. The Augmented Dickey Fuller test (ADF) test for unit roots and the Phillips Perron (PP) test were conducted for at the time series employed in the study. The Augmented Dickey Fuller (ADF) result and the Phillips Perron (PP) test show that LEXRV, LOILP, LER AND LINT are all integrated series of order I (1). The results are shown in tables 4.3.2

Table 4.3.2: Augmented Dickey - Fuller and Phillips Perron test for unit root

Variables	Augmented Dickey Fuller test (ADF)				Phillips Perron PP			
	Level	Order of Integration	First difference	Order of Integration	Level	OI	First Difference	OI
LEXRV	-1.062207	I(0)	-18.62853*	I(1)	-0.529109	I(0)	-16.39442*	I(1)
LOILP	-2.137543	I(0)	-6.058508*	I(1)	-2.137724	I(0)	-6.058478*	I(1)
LER	-2.207279	I(0)	-6.719037*	I(1)	-2.166444	I(0)	-7.124260*	I(1)
LINT	-2.048322	I(0)	-9.138885*	I(1)	-1.878074	I(0)	-9.863937*	I(1)

Source: Computed by Author using E-views 5.1

* Variable stationary at 1%, 5% and 10% critical values.

** Variables stationary at 5% and 10% critical values

*** Variables stationary at 10% critical values

The table above shows that all the variables are not stationary at level. This can be seen by comparing the observed values (in absolute terms) of the Augmented Dickey fuller (ADF) test AND Phillips Perron test statistics with the critical value (also in absolute terms) at 1%, 5% and 10% level of significance. As a result of this, the variables were differenced once and from the table above it can be seen that the variables are stationary at first difference, since all the variables are integrated of the same order.

Johansen Maximum likelihood Test of Cointegration

The major aim of this test is to find out if a linear combination of the integrated variable is becomes stationary over the long-run, if it is, then it means cointegration exists among the variables, this further implies that there exist a long run relationship among the variables. The johansen co integration test commenced with the test for the number of co integrating relations or rank using Johansen's maximum Eigen value and the trace test. The results are shown on tables 4.3.2 below

Number of cointegrating equation H_0 :	Trace Statistic		Maximum Eigen value	
	Statistic	0.05 Critical value	Statistic	0.05 Critical value
None	79.88171	63.87610	40.88306	32.11832
At most 1*	38.99865*	42.91525*	18.28741*	25.82321*
At most 2	20.71124	25.87211	14.19844	19.38704
At most 3	6.512805	12.51798	6.512805	12.51798

Source: Computed by the Author using E-views 5.0

*Reject H_0 for the cointegrating rank test (Trace and Maximum Eigen Value) Statistic

The hypotheses are stated below

H_0 : there is no cointegrating relationship among the integrated variables

H_1 : there is a cointegrating relationship among the integrated variables

The two tests produced the same result. The trace test rejected the null hypothesis (H_0) that there is no cointegrating relationship between the variables and the test base on the maximum Eigen value also rejected the null hypothesis. They both show that there is one cointegrating equation at the 0.05 level of significance. Since the two tests are giving the same result, it shows that there is a cointegrating equation. The result of the cointegration test showed that LEXRV, LOILP, LER AND LINT have equilibrium condition which keeps them in proportion to each other in the long run.

The exactly identifying estimates of the johansen Maximum likelihood estimates showing the cointegrating coefficients normalized to LEXRV are shown below. They are very useful in understanding the long run relationships among cointegrating variables.

Table 4.3.4 Normalized cointegrating coefficients

Variables	LEXRV	LOILP	LER	LINT
Coefficients	1.000000	2.860249	-0.531970	-0.532029
Standard Error		(0.3.1751)	(0.29149)	(0.91854)
		9.0083	-1.70905	0.0012114

Source: Computed by author using E-views 5.

The model is in double logged form, the co-efficient estimates can be interpreted in terms of long run elasticity and the t-statistics is used to determine the statistical significance of each variable. Based on the rule of thumb, a variable is said to be statistically significant if the absolute value of its t-statistic is approximately 2 or above.

The major relationship of interest is that which exists between oil price and exchange rate volatility in Nigeria. From the table oil price is elastic in relation to exchange rate volatility, meaning that in the long run, a change in oil price will cause a more than proportionate change in

exchange rate volatility and the t-statistic of LOILP shows that the co-efficient is statistically significant.

4.3.5 The vector error correction model

The ECM coefficient is known as the speed adjustment factor, it tells how fast the system adjusts to restore equilibrium. It captures the reconciliation of the variables over time from the position of disequilibrium to the period of equilibrium (Ogundipe, Ojeaga and Ogundipe, 2013). The result of the vector correction model (VECM) is shown on table 4.3.5 the basic criteria for analyzing VECM are:

1. The VECM must lie between 0 and 1
2. It must be negative for it to be meaningful

If it is positive there is no error correction and it diverges and the T-statistic must be significant i.e. it must be greater than 2.

Table 4.3.5 VECM result

Variables	ECM(-1)	T-statistic
D(LEXRV)	-0.633566	-10.2559
D(LOILP)	-0.037631	-1.11319
D(LER)	-0.011029	-0.13882
D(LINT)	-0.012318	-0.60156

Source: Computed by author using E-views 5.

The speed of adjustment co-efficient for LEXRV is -0.633566. The VECM is correctly signed and in terms of magnitude it lies between 0 and 1. This significance supports cointegration and as it shows that there exists a long run steady equilibrium between exchange rate volatility and the explanatory variables. Precisely the error correction model in this equation means that about

63.35% of errors generated between each period are correlated in subsequent periods. This result is sizeable and also significant judging from the value of the T-statistic [-10.2559].

4.4 Findings and Economic interpretation

The study was carried out majorly to determine the effects of oil price on exchange rate volatility in Nigeria. The result obtained is in line with the expectation of the study. It showed that a proportionate change in oil price leads to a more than proportionate change in exchange rate volatility by 2.86. This indicates a change in international oil price will have a greater effect than expected on exchange rate volatility in Nigeria. In the long run the coefficient of elasticity of 2.8% implies that exchange rate volatility is elastic to changes in the oil price since the coefficient is greater than one. It is statistically significant based on the t-statistic.

Crude oil is the mainstay of Nigeria's economy. It affects all her economic activities and influences are macroeconomic variable including exchange rate.

The result obtained showed that a proportionate change in external reserves leads to a less than proportionate change in exchange rate volatility. This is in line with the expectation of the study. This means that a change in external reserves for Nigeria will have less than the expected change in exchange rate volatility in Nigeria. In the long run the coefficient of elasticity of 0.53% implies that exchange rate volatility is inelastic to changes in the exchange rate volatility since the coefficient is less than one. Based on the rule of thumb that a variable is said to be statistically significant if the absolute value of the t-statistic is approximately 2 or above, that means a significant relationship exist between external reserves and exchange rate volatility.

According to Ketil (2004) a reasonable level of external reserves is sufficient to reduce a country's exchange rate volatility. Nigeria's external reserves increases when oil revenue increase and this eternal reserves can be used to reduce exchange rate volatility

A proportionate change in oil price leads to a less than proportionate change in interest rate. This is not in line with the expectation of the study. This means that a change in Nigeria's interest rate will have a smaller effect than expected on exchange rate volatility. In the long run the coefficient of elasticity of 0.53% implies that exchange rate volatility is inelastic to changes in Nigeria's interest rate since the coefficient is less than one. This implies that a change in Nigeria's interest rate will not have a significant impact on exchange rate volatility in Nigeria and it is not statistically significant looking at the t-statistic.

When a country's interest rate is high, it attracts investment from abroad which increases its exchange rate but when inflation in the country is high like in Nigeria, it mitigates the influence of interest rate on exchange rate.

4.5 Conclusion

This chapter focused on the analysis and the interpretation of data. The chapter started with the descriptive analysis of the variables next was the analysis of the data which included unit root tests on the variables to be used in the study. The Augmented Dickey Fuller (ADF) and the Phillips Perron (PP) tests were used to find out if the variables were stationary and to what degree. The variables where then found to be stationary at first difference, then the johansen test of cointegration was performed on the integrated variables, they were found to be cointegrated and so the normalized coefficient were then reported. The result of oil price, external reserves and interest rate did not follow the a priori expectations and the probable reasons were given

looking at the Nigerian situation. The Vector Error Correction Model (VECM) was employed to reconcile the short run deviations to the long run equilibrium path. The ECM(-1) coefficient of the vector of concern (DLEXRV) was rightly signed. The result appeared sizeable judging from the value of the T-statistic. Therefore the alternative hypothesis that oil price has a significant influence on exchange rate volatility should be accepted.

CHAPTER FIVE

SUMMARY, RECOMMENDATION AND CONCLUSION

5.1 SUMMARY

This research study set to find out if oil price as a significant influence on exchange rate volatility in Nigeria over the periods 1970 -2010 by analyzing time series data. It also looks at other factors that can influence exchange rate in Nigeria like external reserves and interest rate.

To achieve these objectives, a model was formulated based on GARCH model. In the model exchange rate volatility was the dependent variable and the independent variables were oil price, external reserves and interest rate. After the review of relevant literature and the necessary empirical analyses it was observed that a proportionate change in oil price will lead to a more than proportionate change in exchange rate volatility.

5.2 POLICY RECOMMENDATIONS

In the words of Jin (2008), Exchange rate volatility increases the risk and uncertainty of external transactions and predisposes a country to exchange rate related risks. For the purpose of this research work, the following strategies are suggested to reduce exchange rate volatility in Nigeria.

1. Ketil (2004) research on the effect of external reserves on exchange rate volatility after enforcing controls for the endogeneity induced by the exchange rate regime that can affect both reserves and exchange rate showed that a high level of external reserves reduce exchange rate volatility. Therefore Nigeria government should take advantage of

increases in the price of oil price by Nigeria external reserves and reduce exchange rate volatility.

2. Research carried out on exchange rate volatility by Adeoye and Atanda showed that there is presence and persistency of volatility shocks in the nominal and real exchange rates for naira vis-à-vis U.S dollar in Nigeria between 1986 and 2008. This implies that the conservative monetary management policies put in place for stabilizing the exchange rate of a unit U.S dollar to naira over the years has been ineffective. There is a need for FOREX management measures particularly in terms of meeting the high demand for foreign currency which characterized and order the performance and trade balance and overall economic performance in Nigeria. There is also the need for sound monetary policy to attain stability in the exchange rate.
3. According to the Brahmhatt et al (2010), resources that a gift by God to a country prices and revenues are a lot unpredictable because of the small diminutive supply elasticity of natural resource yield. Assuming government expenditure is closely aligned to revenue from natural resource, the revenue will become more unpredictable. Expenditure instability, will in turn cause instability in the real exchange rate. A bulky body of empirical work records the terrible effect of the impact of economic volatility on investment and growth. Therefore Nigeria government should look for new ways to diversify the economy from dependence on oil and explore other sectors like manufacturing sector and agricultural sector to reduce volatility in the economy and the overall effect on it.

4. Lastly, higher revenue gotten from increases in oil prices should be invested in different areas of the economy as the exchange rate of a country is affected by state of the economy.

5.3 LIMITATIONS TO THE STUDY

The limitations of this study were mostly data related. I originally wanted to use FOREX supply as one of the independent variables but the data available was only from the year 1996 to 2011. Another limitation was error in estimation a characteristic of secondary data.

5.4 SUGGESTIONS FOR FURTHER STUDY

An interesting variant to this study would be an in-depth review of past approaches to controlling or reducing exchange rate volatility in countries that have Dutch disease and lessons that can be learnt to develop strategies and approaches that will reduce exchange rate volatility in Nigeria.

5.5 CONCLUSION

This research project looked at oil price in Nigeria and its effect on exchange rate volatility in Nigeria. The policy discussed and recommended if carried out will help Nigeria take advantage of increases in oil price and help reduce exchange rate volatility which in turn will improve economic growth in Nigeria.

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APPENDIX

Year	EXR	OILP (\$)	ER (US Millions)	INT (%)
1970	0.7143	1.67	116.4	8.00
1971	0.6955	2.03	200.8	10.00
1972	0.6579	2.29	217	10.00
1973	0.6579	3.05	295.7	10.00
1974	0.6299	10.73	1789	10.00
1975	0.6159	10.73	3736	9.00
1976	0.6265	12.87	3624	10.00
1977	0.6466	14.21	3079	6.00
1978	0.606	13.65	1795	11.00
1979	0.5957	29.25	2007	11.00
1980	0.5464	36.98	4567	9.50
1981	0.61	36.18	4683	10.00
1982	0.6729	33.29	1027	11.75
1983	0.7241	29.54	597.6	11.50
1984	0.7649	28.14	456.6	13.00
1985	0.8938	27.75	981.8	11.75
1986	2.0206	14.46	1577	12.00
1987	4.0179	18.39	5213	19.20
1988	4.5367	15.00	6022	17.60
1989	7.3916	18.30	3663	24.60
1990	8.0378	23.85	3358	27.70
1991	9.9095	20.11	4052	20.80
1992	17.2984	19.61	2783	31.20
1993	22.0511	17.41	4902	36.09
1994	21.8861	16.25	7944	21.00
1995	21.8861	17.26	2695	20.79
1996	21.8861	21.16	2158	20.86
1997	21.8861	19.33	6124	23.32
1998	21.8861	12.62	7815	21.34
1999	92.6934	18.00	5309	27.19
2000	102.1052	28.42	7591	21.55
2001	111.9433	24.23	1027	21.34
2002	120.9702	25.04	8592	30.19
2003	129.3565	28.66	7642	22.88
2004	133.5004	38.13	12063	20.82
2005	132.147	55.69	24321	19.49
2006	128.6516	67.07	37456	18.70
2007	125.8331	74.48	45394	18.36

2008	118.5669	101.43	58473	18.70
2009	148.9017	63.35	44702	22.62
2010	150.298	81.05	37356	22.51
2011	153.8616	113.65	32580	22.39

EXCHANGE RATE VOLATILITY

Dependent Variable: EXR

Method: ML - ARCH (Marquardt) - Normal distribution

Date: 04/24/13 Time: 18:35

Sample: 1970 2011

Included observations: 42

Convergence achieved after 40 iterations

Variance backcast: ON

GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.699363	0.414845	1.685839	0.0918
Variance Equation				
C	0.344220	0.027485	12.52408	0.0000
RESID(-1)^2	0.998412	0.292765	3.410284	0.0006
GARCH(-1)	-0.588157	0.388953	-1.512153	0.1305
R-squared	-0.578519	Mean dependent var		43.90908
Adjusted R-squared	-0.703139	S.D. dependent var		57.49835
S.E. of regression	75.03785	Akaike info criterion		7.301867
Sum squared resid	213965.8	Schwarz criterion		7.467360
Log likelihood	-149.3392	Durbin-Watson stat		0.030250

UNIT ROOT TEST

AUGMENTED DICKEY FULLER AT LEVELS

LEXRV (EXCHANGE RATE VOLATILITY)

Null Hypothesis: LEXRV has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.062207	0.7215
Test critical values: 1% level	-3.600987	
5% level	-2.935001	
10% level	-2.605836	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LEXRV)

Method: Least Squares

Date: 04/18/13 Time: 13:23

Sample (adjusted): 1971 2011

Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEXRV(-1)	-0.068533	0.064519	-1.062207	0.2947
C	0.523337	0.399047	1.311465	0.1974
R-squared	0.028117	Mean dependent var		0.218056
Adjusted R-squared	0.003197	S.D. dependent var		1.775462
S.E. of regression	1.772622	Akaike info criterion		4.030347
Sum squared resid	122.5453	Schwarz criterion		4.113936
Log likelihood	-80.62211	F-statistic		1.128283
Durbin-Watson stat	2.465028	Prob(F-statistic)		0.294675

LOILP (OIL PRICE)

Null Hypothesis: LOILP has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.137543	0.2317
Test critical values: 1% level	-3.600987	
5% level	-2.935001	
10% level	-2.605836	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LOILP)

Method: Least Squares

Date: 04/18/13 Time: 13:32

Sample (adjusted): 1971 2011

Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOILP(-1)	-0.111988	0.052391	-2.137543	0.0389
C	0.437780	0.163721	2.673936	0.0109
R-squared	0.104870	Mean dependent var		0.102934
Adjusted R-squared	0.081918	S.D. dependent var		0.318075
S.E. of regression	0.304768	Akaike info criterion		0.509022
Sum squared resid	3.622468	Schwarz criterion		0.592611
Log likelihood	-8.434944	F-statistic		4.569090
Durbin-Watson stat	1.963446	Prob(F-statistic)		0.038879

LER (EXTERNAL RESERVES)

Null Hypothesis: LER has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.207279	0.2069
Test critical values: 1% level	-3.600987	
5% level	-2.935001	
10% level	-2.605836	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LER)

Method: Least Squares

Date: 04/18/13 Time: 13:17

Sample (adjusted): 1971 2011

Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LER(-1)	-0.167231	0.075763	-2.207279	0.0332
C	1.502686	0.628607	2.390500	0.0218
R-squared	0.111052	Mean dependent var		0.137417
Adjusted R-squared	0.088258	S.D. dependent var		0.751761
S.E. of regression	0.717820	Akaike info criterion		2.222355
Sum squared resid	20.09537	Schwarz criterion		2.305944
Log likelihood	-43.55828	F-statistic		4.872083
Durbin-Watson stat	2.050632	Prob(F-statistic)		0.033246

LINT (INTEREST RATE)

Null Hypothesis: LINT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic
Augmented Dickey-Fuller test statistic	-2.048322
Test critical values: 1% level	-3.600987
5% level	-2.935001
10% level	-2.605836

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINT)
Method: Least Squares
Date: 04/18/13 Time: 13:28
Sample (adjusted): 1971 2011
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic
LINT(-1)	-0.161683	0.078934	-2.048322
C	0.474909	0.222216	2.137148

R-squared	0.097131	Mean dependent var
Adjusted R-squared	0.073980	S.D. dependent var
S.E. of regression	0.217783	Akaike info criterion
Sum squared resid	1.849751	Schwarz criterion
Log likelihood	5.343196	F-statistic
Durbin-Watson stat	2.540762	Prob(F-statistic)

AUGUMENTED DICKEY FULLER TEST AT FIRST DIFFERENCE

LEXRV (EXCHANGE RATE VOLATILITY)

Null Hypothesis: D(LEXRV) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-18.62853	0.0001
Test critical values: 1% level	-3.60593	
5% level	-2.936942	
10% level	-2.606857	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LEXRV,2)

Method: Least Squares

Date: 04/18/13 Time: 13:24

Sample (adjusted): 1972 2011

Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LEXRV(-1))	-1.530217	0.082144	-18.62853	0.0000
C	0.531379	0.146854	3.618420	0.0009
R-squared	0.901304	Mean dependent var		0.172441
Adjusted R-squared	0.898707	S.D. dependent var		2.893044
S.E. of regression	0.920756	Akaike info criterion		2.721463
Sum squared resid	32.21607	Schwarz criterion		2.805907
Log likelihood	-52.42926	F-statistic		347.0223
Durbin-Watson stat	1.038131	Prob(F-statistic)		0.000000

LOILP (OIL PRICE)

Null Hypothesis: D(LOILP) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.058508	0.0000
Test critical values: 1% level	-3.605593	
5% level	-2.936942	
10% level	-2.606857	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LOILP,2)

Method: Least Squares

Date: 04/18/13 Time: 13:33

Sample (adjusted): 1972 2011

Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOILP(-1))	-0.988643	0.163183	-6.058508	0.0000
C	0.099525	0.053918	1.845852	0.0727
R-squared	0.491336	Mean dependent var		0.003571
Adjusted R-squared	0.477950	S.D. dependent var		0.451144
S.E. of regression	0.325965	Akaike info criterion		0.644653
Sum squared resid	4.037620	Schwarz criterion		0.729097
Log likelihood	-10.89306	F-statistic		36.70552
Durbin-Watson stat	1.986547	Prob(F-statistic)		0.000000

LER (EXTERNAL RESERVES)

Null Hypothesis: D(LER) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.719037	0.0000
Test critical values: 1% level	-3.605593	
5% level	-2.936942	
10% level	-2.606857	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LER,2)

Method: Least Squares

Date: 04/18/13 Time: 13:19

Sample (adjusted): 1972 2011

Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LER(-1))	-1.083867	0.161313	-6.719037	0.0000
C	0.139327	0.123278	1.130182	0.2655
R-squared	0.542970	Mean dependent var		-0.017044
Adjusted R-squared	0.530943	S.D. dependent var		1.117954
S.E. of regression	0.765662	Akaike info criterion		2.352555
Sum squared resid	22.27706	Schwarz criterion		2.436999
Log likelihood	-45.05110	F-statistic		45.14546
Durbin-Watson stat	2.005726	Prob(F-statistic)		0.000000

LINT (INTEREST RATE)

Null Hypothesis: D(LINT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-9.135885	0.0000
Test critical values: 1% level	-3.605593	
5% level	-2.936942	
10% level	-2.606857	

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

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LINT,2)

Method: Least Squares

Date: 04/18/13 Time: 13:29

Sample (adjusted): 1972 2011

Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LINT(-1))	-1.364651	0.149373	-9.135885	0.0000
C	0.029582	0.034018	0.869600	0.3900
R-squared	0.687151	Mean dependent var		-0.005712
Adjusted R-squared	0.678918	S.D. dependent var		0.377230
S.E. of regression	0.213754	Akaike info criterion		-0.199274
Sum squared resid	1.736251	Schwarz criterion		-0.114830
Log likelihood	5.985488	F-statistic		83.46439
Durbin-Watson stat	2.231960	Prob(F-statistic)		0.000000

JOHANSEN COINTEGRATION

Date: 04/24/13 Time: 18:49
 Sample (adjusted): 1972 2011
 Included observations: 40 after adjustments
 Trend assumption: Linear deterministic trend (restricted)
 Series: LEXRV LOILP LER LINT
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.775360	100.6576	63.87610	0.0000
At most 1	0.396440	40.92732	42.91525	0.0780
At most 2	0.321660	20.73092	25.87211	0.1911
At most 3	0.122050	5.206622	12.51798	0.5670

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

* denotes rejection of the hypothesis at the 0.05 level

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.775360	59.73033	32.11832	0.0000
At most 1	0.396440	20.19640	25.82321	0.2321
At most 2	0.321660	15.52429	19.38704	0.1668
At most 3	0.122050	5.206622	12.51798	0.5670

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

* denotes rejection of the hypothesis at the 0.05 level

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

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

LEXRV	LOILP	LER	LINT	@TREND(71)
-0.642668	-1.838192	0.341880	0.341918	0.286848
0.622188	-1.135163	0.284261	-3.261714	-0.135822
0.391137	0.514593	-1.511504	-0.961435	-0.007859
0.271540	-0.230130	0.338657	3.283883	-0.197350

Unrestricted Adjustment Coefficients (alpha):

D(LEXRV)	0.985837	-0.110518	-0.001007	-0.014676
D(LOILP)	0.058554	0.187405	0.008561	0.022795
D(LER)	0.017162	0.109011	0.393889	-0.029786
D(LINT)	0.019167	0.021685	-0.012482	-0.063212

1 Cointegrating Equation(s): Log likelihood -73.64276

Normalized cointegrating coefficients (standard error in parentheses)

LEXRV	LOILP	LER	LINT	@TREND(71)
1.000000	2.860249	-0.531970	-0.532029	-0.446339
	(0.31751)	(0.21849)	(0.68217)	(0.03612)

Adjustment coefficients (standard error in parentheses)

D(LEXRV)	-0.633566
	(0.06178)
D(LOILP)	-0.037631
	(0.03380)
D(LER)	-0.011029
	(0.07945)
D(LINT)	-0.012318
	(0.02048)

2 Cointegrating Equation(s): Log likelihood -63.54456

Normalized cointegrating coefficients (standard error in parentheses)

LEXRV	LOILP	LER	LINT	@TREND(71)
1.000000	0.000000	0.071767	-3.407895	-0.307108
		(0.29495)	(0.95362)	(0.04960)
0.000000	1.000000	-0.211078	1.005460	-0.048678
		(0.10809)	(0.34946)	(0.01817)

Adjustment coefficients (standard error in parentheses)

D(LEXRV)	-0.702329	-1.686703
	(0.08430)	(0.20359)
D(LOILP)	0.078970	-0.320368
	(0.03725)	(0.08996)
D(LER)	0.056796	-0.155292
	(0.10932)	(0.26402)
D(LINT)	0.001174	-0.059848
	(0.02831)	(0.06837)

3 Cointegrating Equation(s): Log likelihood -55.78241

Normalized cointegrating coefficients (standard error in parentheses)

LEXRV	LOILP	LER	LINT	@TREND(71)
1.000000	0.000000	0.000000	-3.415212	-0.300222
			(0.88819)	(0.03154)
0.000000	1.000000	0.000000	1.026979	-0.068933
			(0.35005)	(0.01243)
0.000000	0.000000	1.000000	0.101949	-0.095958
			(0.74572)	(0.02648)

Adjustment coefficients (standard error in parentheses)

D(LEXRV)	-0.702723	-1.687221	0.307145
	(0.09200)	(0.20929)	(0.14847)
D(LOILP)	0.082319	-0.315962	0.060351
	(0.04063)	(0.09242)	(0.06556)
D(LER)	0.210860	0.047401	-0.558510
	(0.09943)	(0.22618)	(0.16045)
D(LINT)	-0.003708	-0.066271	0.031583
	(0.03082)	(0.07012)	(0.04974)

VECTOR ERROR CORRECTION MODEL

Vector Error Correction Estimates

Date: 04/24/13 Time: 18:51

Sample (adjusted): 1972 2011

Included observations: 40 after adjustments

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

Cointegrating Eq:	CointEq1
LEXRV(-1)	1.000000
LOILP(-1)	2.860249
	(0.31751)
	[9.00839]
LER(-1)	-0.531970
	(0.21849)
	[-2.43473]
LINT(-1)	-0.532029
	(0.68217)
	[-0.77990]
@TREND(70)	-0.446339

	(0.03612)			
	[-12.3561]			
C	3.669848			
Error Correction:	D(LEXRV)	D(LOILP)	D(LER)	D(LINT)
CointEq1	-0.633566 (0.06178) [-10.2559]	-0.037631 (0.03380) [-1.11319]	-0.011029 (0.07945) [-0.13882]	-0.012318 (0.02048) [-0.60156]
D(LEXRV(-1))	-0.207647 (0.04782) [-4.34212]	0.013242 (0.02617) [0.50601]	-0.018308 (0.06151) [-0.29767]	-0.002241 (0.01585) [-0.14140]
D(LOILP(-1))	1.140596 (0.34247) [3.33054]	0.134628 (0.18740) [0.71840]	0.299412 (0.44046) [0.67977]	-0.198850 (0.11352) [-1.75174]
D(LER(-1))	-0.261295 (0.13928) [-1.87603]	-0.085299 (0.07622) [-1.11918]	-0.116586 (0.17914) [-0.65082]	-0.058424 (0.04617) [-1.26550]
D(LINT(-1))	0.595449 (0.44043) [1.35198]	0.084882 (0.24101) [0.35220]	0.687585 (0.56646) [1.21383]	-0.405817 (0.14599) [-2.77981]
C	0.485217 (0.10287) [4.71681]	0.094267 (0.05629) [1.67464]	0.101912 (0.13231) [0.77027]	0.058951 (0.03410) [1.72888]
R-squared	0.896469	0.068199	0.073492	0.312620
Adj. R-squared	0.881244	-0.068830	-0.062759	0.211534
Sum sq. resids	12.56607	3.762737	20.78668	1.380635
S.E. equation	0.607939	0.332669	0.781903	0.201512
F-statistic	58.88088	0.497697	0.539390	3.092633
Log likelihood	-33.59995	-9.482884	-43.66620	10.56917
Akaike AIC	1.979998	0.774144	2.483310	-0.228459
Schwarz SC	2.233330	1.027476	2.736642	0.024873
Mean dependent	0.520233	0.100627	0.127228	0.020151
S.D. dependent	1.764137	0.321779	0.758465	0.226939
Determinant resid covariance (dof adj.)		0.000894		
Determinant resid covariance		0.000467		
Log likelihood		-73.64276		
Akaike information criterion		5.132138		
Schwarz criterion		6.356576		

