ANALYSIS OF KEY DETERMINANTS OF EXCHANGE RATE STABILITY IN NIGERIA: An Autoregressive Distributed Lag (ARDL) and Nonlinear Autoregressive Distributed Lag (NARDL) Approach

Ilu, Ahmad Ibraheem

Bayero University Kano

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ANALYSIS OF KEY DETERMINANTS OF EXCHANGE RATE STABILITY IN NIGERIA

(1986-2018)

By

AHMAD IBRAHEEM ILU

SPS/17/MEC/00029

BEING A RESEARCH SUBMITTED FOR INTERNAL DEFENSE TO THE DEPARTMENT OF ECONOMICS, BAYERO UNIVERSITY, KANO, FOR THE AWARD OF MASTER OF SCIENCE DEGREE (M.Sc) IN ECONOMICS

SUPERVISOR:

Professor. Badayi M. Sani

MARCH, 2020.

DECLARATION

I, Ahmad Ibraheem Ilu, declare that this research work is my own and all the sources that I used or quoted have been indicated and acknowledged by means of completed references under the supervision of Professor Badayi M Sani. This dissertation has not, either in whole or part, been submitted for a degree or certificate at another university.

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Ahmad Ibraheem Ilu

SPS/17/MEC/00029

CERTIFICATION

This is to certify that the research work for this dissertation and the subsequent preparation of this dissertation by Ahmad Ibraheem Ilu (SPS/17/MEC/00029) were carried out under my supervision.

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Professor Badayi M Sani Date
(Supervisor)

APPROVAL PAGE

This research work has been examined and found to have met the requirement for the award of the degree of Masters of Science in Economics (M.Sc) in ECONOMICS at the Department of Economics, Bayero University Kano, Nigeria.

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External Examiner

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Date

Internal Examiner

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Professor Badayi M. Sani (Main Supervisor) Date

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Professor Badayi M. Sani
Head of Department Date

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Date

SPS Board Representative

DEDICATION

This research work is dedicated to my Parents: Alhaji Ibraheem Ilu and Hajiya Aisha Ibraheem Ilu and the entire families of Alhaji Ilu Ahmad Dambazau and Alhaji Hamza Abubakar.

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ABSTRACT

This study analytically examines the key determinants of exchange rate stability in Nigeria which encompass GDP, Interest rate, Inflation rate, and Oil prices. Using annual data for the years from 1986 to 2018. For the period under review numerous theories were discussed in this study. At the onset this study began its analysis by conducting descriptive statistics of the time series. The standard deviation indicates that exchange rate is more volatile than all the series followed by oil price. The skewedness statistic reveals that only GDP was found to be negatively skewed all other variables remains positively skewed. The Jarque- Bera statistic indicates that Exchange rate, inflation rate and oil price were found to be normally distributed. Ramsey test affirms a linear relationship between exchange rate and GDP, Interest rate, Inflation rate, and Oil prices while the BDS test repudiate the claim and asserts that the relationship is nonlinear. The study in a bid to ascertain the true value of parameters employs both linear and nonlinear time series models to guide its analysis and empirical investigations. In the linear component, stationary analysis is performed by using ADF, PP and KPSS unit root test and the ARDL bounds testing approach for a long run relationship between the variables while in the nonlinear integral the KSS nonlinear unit root test and the NARDL bounds test was upheld. Bounds test establishes across the two models that long run relationship exist between exchange rate and its determinants. The empirical findings indicate that in the ARDL model the short run estimates reveals negatively related and statistically insignificant Oil prices, statistically insignificant and negatively related inflation and interest rates and GDP was found to be positively related and statistically significant to exchange rate. In the NARDL cluster the short run estimates of the model reveals that past values of exchange rate have a negative influence on exchange rate. After decomposing oil price into positive and negative shocks, it was found that positive oil price shocks on exchange rate is negatively related and statistically significant while the negative oil price shocks were found to be the reverse scenario of positive shocks. In same vein GDP was found to be negatively related and statistically significant to exchange rate. The long run estimates are a bit consistent with the short run estimates. All other variables except positive oil price shocks were found to be positive and negatively related and statistically insignificant with exchange rate. Furthermore, CUSUM and CUSUMSQ tests reveals both models are dynamically stable. Finally, the study recommends that the CBN and the Federal Government to intensify efforts to revamp other sectors of the economy, embed them to a medium-long term diversification plan to revive agricultural sector, improve and efficient taxation, and solidify the economy as a service oriented and financially developed economic clime.

Keywords: Exchange rate, Oil price, GDP, Interest rate, Inflation rate, ARDL and NARDL

CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND OF THE STUDY

Exchange rate is an important economy metric as it reflects underlying strength and competitiveness with world economies. Exchange rate refers to the rate at which one currency exchange for another (Jhingan M.L, 2003). Stability of exchange rate is a vital macroeconomic goal which monetary policy authorities and Economists seeks to achieve upon implementing a policy. In every nation the sellers of foreign currency constitute the supply while the buyers of foreign exchange constitute the demand side. Therefore, the supply of foreign exchange is derived from oil export, Non-oil export, transfer /flow of financial assets to Nigeria's capital market, expenditure of foreign tourist in Nigeria, unilateral transfer from Nigerians in Diaspora. On the other hand, the demands for foreign exchange consist of payment for imports, financial commitment to international organization, repayment of external debt and granting of financial assistance to foreign countries.

As a general rule when the home currency depreciates it will result in cheaper export goods, higher import prices i.e. cost push inflation and balance of payment deficit. Also when the home currency appreciates it result to lower import prices and higher domestic prices making them unattractive in the International market.

Exchange rate together with other macroeconomic variables such as Gross domestic product(GDP), Inflation rate, interest rate, balance of payment, external reserve, unemployment rate…are important economy metrics as they reflect underlying strength and competitiveness with world economies. Exchange rate has a bilateral/feedback relationship with most of these macroeconomic variables when it's tweaked its effect will result on another macroeconomic variable's movement and as such the stability of exchange rate is a vital macroeconomic objective which all monetary policy authorities (Central Banks) seeks to achieve upon implementation

In Nigeria some of these macroeconomic variables directly affect exchange rate while some affects it indirectly. While some macroeconomic variables are generally agreed to determine exchange rates globally, some are only peculiar to Oil producing nations like Nigeria such as oil price fluctuations. Due to mono-economic nature and import dependency of Nigeria economy whenever there are fluctuations in global oil prices it results in swings in the exchange rate. Crude oil being the Nigeria's biggest

source of revenue that constitutes its largest amount of export which yield a substantial amount of foreign receipt that when there is volatility in crude oil prices it leads to fluctuations and disequilibrium in macroeconomic performances.

The principal macroeconomic factors that determine exchange rate in Nigeria's economic setting include Gross domestic product (GDP), Oil price, balance of payment, interest rate, money supply, inflation rate, trade openness, productivity differentials When there's a change\adjustment in each of these variables, it will definitely and consequently result in exchange rate variability.

Literally the dependence of the Nigerian economy on oil proceeds as the major source of revenue is capable of raising suspicion about the impact of oil price volatility on macroeconomic volatility in the country. Macroeconomic volatility implies the vulnerability of macroeconomic variables to shocks. It is the tendency of macroeconomic variables such as GDP, inflation, exchange rate, interest rate to be unstable and weak in terms of withstanding shock. It is a situation whereby little shock in the economy subjects the macroeconomic variables to fluctuations and uncertainty.

The importance of exchange rate stability in the attainment of macroeconomic policy objectives in both developed and developing economies cannot be over emphasized. Exchange rate is one of the determinants used in assessing the performance of an economy. A very strong exchange rate is a reflection of a strong and viable economy. On the other hand, a very weak currency is a reflection of a very vulnerable and weak economy. Governments, particularly in developing economies over the years have adopted different exchange rate management policies with a View to achieve realistic and stable exchange rate. Thus, most of these countries experienced high exchange rate fluctuation which translates into high degree of uncertainty or volatility. Exchange rate volatility is associated with unpredictable movements in the relative price in the economy. It also refers to the swings or fluctuations in the exchange rate over a period of time or deviations from a benchmark or equilibrium exchange rate. Exchange rate volatility is an important contributor to risk in the financial world. During the period of excessive movements in exchange rates, foreign trade and investments could be affected negatively (Mordi, 2006).

Therefore, policy makers must stay focused and keep these aforementioned factors in favorable conditions so that exchange rate effectively reflects strong condition of an economy. In a bid to achieve exchange rate stability, Nigeria's monetary authorities have adopted various exchange rate regimes\ arrangements. It shifted from fixed exchange rate system in 1980s.

Between 1970 and mid 1980 Nigeria exchange rate policy shifted from fixed exchange rate to a pegged arrangement and finally, to the various types of the floating regime since 1986 following the adoption of the Structural Adjustment Program (SAP).

Exchange rate variability and fluctuations aggravate balance of payment position, increase inflation rate, change in gross domestic product and interest rate.

When there's adjustment\instability in this variables producers and investor's confidence is weaken because it affects their projected (planned) revenue and cost inducing their profit margin.

Exchange regimes equally plays an important role in the determination process. In a fixed exchange rate regime, economic agents adjust prices rapidly because they perceive any change in exchange rate to be permanent. However, in a flexible exchange rate regime, economic agents do not adjust their prices swiftly because they perceive changes to be temporary. In a high income country, economic agents do not adjust prices rapidly in response to exchange rate changes because higher incomes create opportunity for higher degree of competition in the domestic market, thereby constraining the pricing power of firms. On the other hand, in low income countries, the reverse is the case (Razafimahefa, 2012)

The Intensive understanding of the mechanics of the aforestated determinants of exchange rate stability is the main thrust of this research work.

1.1 STATEMENT OF PROBLEM

Several factors have been attributed to determination of exchange rate stability in Nigeria. These factors have contributed to overvaluation and depreciation of Nigerian currency over time since Post-Independence. (Benson , U.O and Victor, E.O, 2012) and (Aliyu S. , 2009) noted that despite various efforts by the government to maintain a stable exchange rate, the naira has depreciated throughout the 80's to date

The issue of exchange rate management and macroeconomic performance in developing countries has received considerable attention and generated much debate. The debate focuses on the degree of fluctuations in the exchange rate in the face of internal and external shocks. It is believed that exchange rate movements would create domestic economic distortions and affect a country's economic competitiveness. There appears a consensus view on the fact that devaluation or depreciation could boost domestic production through stimulating the net export component. This is evident through the increase in international competitiveness of domestic industries leading to the diversion of spending from foreign goods whose prices become high, to domestic goods.

However, despite the general notion that exchange rate depreciation will rise export and curb importation doesn't necessarily hold for Nigeria's case as the country lacks appropriate and sufficient productive capabilities to leverage the fall in value of domestic currency to attract more foreign demand for domestically produced goods.

As illustrated by (Guitan, 1976) and (Dornbusch, 1988) the success of currency depreciation in promoting trade balance largely depends on switching demand in proper direction and amount as well as on the capacity of the home economy to meet the additional demand by supplying more goods. On the whole, exchange rate fluctuations are likely, in turn, to determine economic performance. It is therefore necessary to evaluate the effects of exchange rate fluctuations on output growth and price inflation. The changes in exchange rates will have both favorable and unfavorable impacts on economic activities and living standard of the public because of the largely globalized trade and finance involving the exchange of currencies

Nigeria's exchange rate changes have been a subject of debate among policy makers, concerned monetary authorities and academics because of the recognition of the vital role exchange rate regime plays in the achievement of sustainable growth. Government and monetary authorities in Nigeria, over the years have done a lot of work in the area of finding the appropriate exchange rate management, given the peculiarities of the economy. Since the adoption of the Structural Adjustment Program in 1986, Nigeria has adopted different types of exchange rate regimes, ranging from floating exchange rate regimes to fixed/pegged regimes.

(Sanusi, 2004) Opined the importance of maintaining a realistic exchange rate for naira, and also the need to minimize distortions in production and consumption, increase the inflow of non-oil export receipts and attract foreign direct investment

The determination of exchange rates is one of the most commonly researched areas in (Muço, M., P. Sanfey and A. Taci, 2004) the behavior of exchange rate is one of the unsettled issue of economic and finance related researches. Due to the enormous significance of the exchange rate in an economy, no one can deny the meaning to know the foreign exchange rate market behavior. So it is very important to study about the determinants of exchange rate as well as foreign exchange market behavior in details Uddin et'al,(2014).

(Aliyu S. U., 2011) Identified the determinants of real exchange rate as including terms of trade, index of crude oil volatility, index of monetary policy performance and government fiscal stance while Omojimite (2011) identified the price of oil and openness of the economy as significant determinants. Also, government expenditure, money supply, real interest rate, productivity index and openness of the economy influenced the real exchange rates volatility in Nigeria (Ajao, G. M. and Igbekoyi, E. O., 2013).

Fact and figures reveals that the combined effects of a sharp decline in crude oil prices, accumulated government deficits, rising inflation and unemployment rates plunged in the country into recession in the midst of 2016. With a recoded growth rates of 0.36% and -2.06% in the first and second quarters in 2016 respectively. (Ekpo, 2017; Tule, 2017) asserted that negative growth rate was consecutively recorded in third quarter of 2016. The aftermath of recessionary turbulence was followed by a massive depreciation of the Naira from N197/$1 in the Interbank segment of the market to a whooping N305/$1, 35.4 % drop. The margin was outrageously wide in the parallel market with the dollar trading at N520/$1 as of January 2017 over 70% exchange rate premium between the interbank window and the parallel market.

Exchange rate, oil prices, interest rate, inflation rate and other volatile macroeconomic variables might possess nonlinearities in their dynamic pattern which might encompassed asymmetry, amplitude dependence and volatility clustering. The existence of nonlinearities in the data generating process (DGP) necessitated the evolution and development of nonlinear time series models to capture those inherent asymmetries. The most popular nonlinear models include Kapetanios et al (2003) Unit root test, Kruse (2011) unit root test, Shin et'al (2011) Nonlinear ARDL (NARDL), Hamilton (1989) Markov Switching model (MS). Both Kapetanios et'al (2003) and (Kruse, 2011) used exchange rate in a pioneer application of their developed nonlinear unit root testing frameworks.

The concept of Exchange rate has vast empirical investigations in the literature. The works of (Muco et'al,2004; Arslaner et'al, 2014; Nageye and Ibrahim, 2017; Ngozi et'al (2016); Eltayeb,2016; Asher,2012; Dada and Oyeranti,2012; Nucu,2011; Immimole and Enoma,2011; and Aliyu,2011) all have empirically examined the relationship between exchange rate and core macroeconomic variables, yet some vacuums/gaps still exist in both literature and the Methodology. The above listed studies have ignored the notion of nonlinear trends in the series as most of them did employ linear statistical approach /techniques in testing the unit root process in the series which could to a great extend lead to misspecification of the relationship and misleading /erroneous statistical inferences especially if the trend in the series follows a nonlinear process.

Hiemstra and Jones (1994) opined that applying a linear approach while the relationship is in fact nonlinear leads to a serious statistical problem, namely a low power in detecting a nonlinear causal relation. Similarly, Enders (2004) posited that using linear estimation techniques may not be appropriate and may lead one to inappropriate policy conclusion. Lately nonlinear models have nowadays proved both statistically efficient and robust as they produce good estimators of the

unknown parameters with relatively small data sets, greater parsimony, easier interpretations and prediction.

Hence this study shall attempt to extend the current literature by exploring nonlinear time series models in a bid to ascertain the factual estimates of exchange rate, GDP, inflation rate, interest rate and Oil price.

1.2 RESEARCH QUESTIONS

This study intends to answer the following research question:

i. From the point of view of economic theory and empirical research can GDP, Inflation rate, interest rate and Oil price constitute key determinants of exchange rate stability?
ii. Does nonlinear relationship exist between GDP, inflation rate, interest rate, Oil price and exchange rate in Nigeria?
iii. Does long run relationship exist between GDP, inflation rate, interest rate, Oil price and exchange rate in Nigeria?
iv. What is the causal relationship among GDP, inflation rate, interest rate, Oil price and exchange rate in Nigeria?

1.3 OBJECTIVES OF THE STUDY

The general objective of this study is to examine and analyze the macroeconomic determinants of exchange rate stability in Nigeria. Specifically, the study shall attempt to

i. To ascertain based on economic theory and empirical research how GDP, inflation rate, interest rate, Oil price determines exchange rate stability in Nigeria.
ii. To identify the existence of nonlinear relationship between GDP, inflation rate, interest rate, Oil price and exchange rate in Nigeria
iii. Evaluate the existence of long run relationship between GDP, inflation rate, interest rate, oil price and exchange rate in Nigeria.
iv. Analyze the causal relationship among GDP, inflation rate, interest rate, Oil price and exchange rate in Nigeria.

1.4 FORMULATION OF HYPOTHESES

With reference to the above outlined statement of the problem and research objectives the study provided below.

i. $H0_1$; GDP, inflation rate, interest rate and Oil price are not key determinants of exchange rate stability in Nigeria.

H1; GDP, inflation rate, interest rate and Oil price are key determinants of exchange rate stability in Nigeria.

ii. Ho_2; There is no nonlinear relationship between GDP, inflation rate, interest rate, Oil price and exchange rate in Nigeria.
H1; nonlinear relationship between GDP, inflation rate, interest rate, Oil price and exchange rate in Nigeria.

iii. $H0_3$; There is no long run relationship among GDP, inflation rate, interest rate, Oil price and exchange rate in Nigeria.

H1; Long run relationship among GDP, inflation rate, interest rate, Oil price and exchange rate coexist in Nigeria.

1.5 JUSTIFICATION OF THE STUDY

The Exchange rate alongside inflation rate, interest rate and Oil Price are paramount to Nigeria's economic strength and underlying competiveness with world economies. However, these so-called variables are so volatile and vulnerable in nature and possess the potency to dampen macroeconomic performance. Apparently, since our economy is an import dependent and relatively mono economic these factors play a vital role in determining the fate of Nigeria's economic growth and their relevancy calls for stringent policy mix to gauge and keep them on check regularly to avert macroeconomic distortions.

This research work is believe to be of immense and enormous significance as well as resourceful to fellow existing and potential researchers, policy makers, monetary authorities, capital market stakeholders. Also this study will be of great importance to Non-Economist/Finance readers by providing them with in-depth knowledge in the mechanics of exchange rate.

1.6 SCOPE AND LIMITATIONS OF THE STUDY

This study shall cover the period of 1986-2018; a sample size of 32 years is long enough for time series analysis. The choice of this period is largely informed by data availability, given the intended econometric technique; ARDL is relatively more efficient in the case of small and finite sample data sizes; this research work seeks to employ in carrying out analysis and also due to the fact that Nigerian economy has practiced different types of exchange rate regimes within the given period.

1.7 ORGANISATION OF THE STUDY

The study is structured into five chapters as follows

Chapter one encompassed background of the study, statement of research problem, research objectives, formulation of hypothesis, significance of the study. Furthermore, chapter two consists of the theoretical framework, empirical literature and determinants of exchange rate. Moreover, chapter three states the intended methodology, identifications of the variables to be used, sources of data and econometric method to be used in analyzing data. Also Chapter Four Offers analysis on collected data and testing of formulated hypothesis. Finally, Chapter five the last section finally draws summary and conclusion of the whole study and make recommendation based on findings.

CHAPTER TWO

LITERATURE REVIEW

2.0 CONCEPT OF EXCHANGE RATE

The currencies of most countries are fully convertible to another, some at a fixed ratio and others at a ratio subject to daily fluctuations. This ratio is the number of units of one currency that are exchangeable for unit of another is termed as change rate. Exchange rate implies the price of one currency in terms of another. It is the ratio between a unit of one currency and the amount of another currency for which that can be exchanged at a particular time. (Ozturk.I, 2006)Posits that exchange rate like other economic variables which Include interest rate, inflation rate, Balance of payment (BOP), GDPR, unemployment rate, and money supply etc. are strong macroeconomic indicator for assessing the overall performance of an economy. Exchange rate can either appreciate or depreciate, appreciation in the exchange rate occurs if less units of domestic currency i.e. Naira, exchanges for a unit of foreign currency while depreciation is when more unit of domestic currency exchanges for a unit of foreign currency.

2.0.1 TYPES OF EXCHANGE RATE

I. Fixed exchange rate: A fixed exchange rate is a type of Exchange rate regime where a currency's value is fixed against either the value of a single currency or to a basket of other currencies or to another measure of value such as gold. There are benefits and risks of pegging a currency. A fixed exchange is usually used to stabilize the value of a currency by directly fixing its value in a predetermine ratio to a different, more stable or more internationally prevalent currency or currencies. There is no element of market interplay (DD&SS) on determine value unlike the flexible regime. This makes track and investment between two currencies easier and more predictable. A fixed exchange rate system can also be used as a means to control the behavior of currency such as by limiting rates of inflation. A pegged currency is dependent on its reference value to dictate how its current worth is defined at any given time. In a fixed exchange rate system, a country's central bank typically uses an open market mechanism and is committed at all times to buy\sell its currency at a fixed price in order to maintain its pegged ratio. Balance of payment, interest rate, inflation rate and other economic variables minimally influenced the value of domestic currency. It is the system in operation in Nigeria before adoption of SAP.

II. Floating exchange rate: The floating exchange rate system a currency's value is allowed to fluctuate in response to foreign exchange market mechanism. A

currency that uses a floating exchange rate is known as flexible. A flexible currency is contrasted with a fixed currency whose value is tied to that of another currency, basket of currencies or gold. In the modern world most of the world's currencies are floating such currencies include the most widely traded currencies the united states dollar, Euro, Japanese Yen, British pound, Canadian dollar, and French franc. The Canadian dollar most closely resembles a pure floating currency because the Canadian central bank rarely interferes with its price since it officially stopped doing so in 1998. The United States dollar runs a close second with very little change in its foreign reserve. This system came into existence due to collapse of Breton woods system which occurred due to dollar crisis in 1971. The main principle and mechanism of this system is that it uses the Smithsonian invisible hands of demand and supply in determine currency value. In a case of extreme appreciation or depreciation the central bank will intervene to stabilize the currency which we will consider as managed float. This system is strongly influenced by balance of payment position, inflation, interest rate and economic performance. However, in his empirical findings Ghosh (1997) found no major differences in output growth across foreign exchange rate regimes but his result shows that fixed regimes are related to higher investment, low productivity growth, lower inflation and higher volatility of growth and employment. Reference to Nigerian economy the system is adopted after the intervention and implementation of the Structural adjustment program (SAP) at 1986s.

III. Cross Exchange Rate: A cross exchange rate is the exchange rate between two currencies to a third currency. That is, the exchange rate between two currencies expressed in terms of the exchange rate between them and a third currency. For example, given the US dollar/naira and Pounds Sterling/naira exchange rates, the dollar/pounds exchange rate becomes the cross exchange rate. It can be calculated as the ratio of the US dollar to the Nigerian Naira divided by the ratio of the pounds to the Nigerian Naira (two different currencies compared to a third currency).

IV. Average Exchange Rate: Average exchange rates are the arithmetic average of the daily and monthly exchange rates during a given period. The average exchange rate is determined by dividing the sum of the exchange rate by the number of units that make up the period. For example, 30 days in a month for the monthly average exchange rate or twelve months for annual average exchange rate.

V. Exchange Rate Premium The exchange rate premium measures the spread between the recognized official market exchange rate and the Bureau de Change (BDC) rate. The exchange rate premium can also be measured by the

differential between the official and inter-bank market exchange rates. The exchange rate premium helps to evaluate the stability in the foreign exchange market. The exchange rate premium is not expected to go beyond 5 per cent for the foreign exchange market to be considered stable.

2.0.2 DETERMINANTS OF EXCHANGE RATE MOVEMENT

Movements in exchange rate are not only determined by the forces of demand and supply, but also by the wellbeing of the economy, particularly, in a floating exchange rate regime. In this regard, the amount of goods and services a country produces and sells (exports) to the rest of the world and the amount of foreign exchange earnings and level of external reserves are very important. Thus, where a country exports exceeds its imports, the country earns more foreign exchange and increases its external reserves. The rise in external reserves makes the domestic currency to appreciate and stronger in value. However, when a country's exports are less than imports, the country draws down on its foreign reserves to pay for the extra imports. This will cause the external reserves to reduce and if the trend persists, the domestic currency is likely to depreciate in value and becomes weaker.

I. Exchange rates and Inflation rates

Inflation is the persistence and sustain rise on general price level which leads to fall in purchasing power and value of money. Basically there's a negative relationship between general price level and purchasing power. Also the higher the exchange rate, the higher the inflation, hence the more home currency depreciates the more the inflation rate increase and ultimately made import price so higher and domestically produced goods cheaper.

For most import dependent nation like Nigeria the most common inflation is cost push inflation. Exchange rate fluctuation influence domestic prices through inflation. Generally when a currency depreciates it will result in higher import prices, while lower export price if the country is an international price taker, the potentially higher cost of imported input associated with an exchange rate depreciation increases marginal cost and leads to higher prices of domestically produced good Also import competing firms might increases prices in response to foreign competitors prices to improve profit margins (Kandil .M, 2004).

Exchange pass through (ERPT) is generally used to refer to the effect of exchange rate changes on import and export prices, consumer prices, investments or trade volumes (Frimpong, S. and Adam, A.M., 2010). (Goldberg, Pinelopi K. and Michael M. Knetter , 1997) Referred ERPT as the percentage change in local currency import prices resulting from a one per cent change in the exchange rate between the exporting and importing economies

(Woo, 1984) Refers to four channels in which exchange rate influences domestic inflation.

- The prices of imported goods directly affect the consumer price index,
- The prices of imported goods directly affect the cost of domestic goods,
- The fluctuations in the exchange rate, directly affect the current account thus the total demands and the changes in the total demands are affected.
- The effect of foreign commodities on increasing prices.

In addition to the above mentioned imported cost and imported input cost channels, there is also a real balance channel. Accordingly, the devaluation will increase the prices of the goods subject to the trade compared to the goods that are not subject to the trade, which will lead to an increase in the overall level of prices. As the weight of the goods used in the consumer basket increases, the increase in the general level of prices is higher.

Previous literature have explored the relationship between exchange rate and inflation, some researchers found a positive relationship between exchange rate and inflation (Muço et al.,2004) and some other researchers found a negative relationship (Arslaner, F., K. Dogan, A. Nuran and H.K. Suleyman, 2014).

II. Exchange rates and Interest rates

Theoretically interest rate is the opportunity cost of holding money, it has positive relationship to saving and negative relationship to investment. Interest, inflation rate are all highly correlated. By manipulating interest central exert influence over both inflation and exchange rate and changing interest impact inflation and currency values. Higher interest rate offer lenders in an economy higher returns relative to other countries therefore higher interest rate attracts foreign capital and cause exchange rate to raise. Impact of higher interest is mitigated, however if inflation in the country is much higher in other or if additional factors serve to drive the currency down. Conversely, opposite relationship exists for decreasing interest rate that is lower interest rate tends to decrease exchange rate.

When a country experiences a recession its interest rate is likely to fall, decreasing its chances to acquire capital. As a result, its currency weakens in comparison to other countries therefore lowering the value of its currency.

(Llaudes, 2007) Studied the effects and transmission mechanism of unexpected monetary shocks in an open economy setting within the context of a VAR framework for 15 OECD countries. The study considered an economy with two sectors namely, tradable and non-tradable and employed a recursive identification scheme based on the cholesky decomposition and the structural VAR (SVAR) methodology. The author found evidence that both the tradable and non-tradable

sectors were sensitive to the effects of monetary policy. Contractionary monetary policy shock that raises the level of the interest rate causes an appreciation of the exchange rate, while tradable and non-tradable output decrease in all countries in the sample.

III. Exchange rates and GDP

The impact of the productivity differential on the real exchange rate is expected to follow the well-known Balassa- Samuelson doctrine, which states that relatively larger increases in productivity in the traded goods sector is associated with a real appreciation of the currency of a country. If a country experiences an increase in the productivity of the tradable sector (relative to its trading partners), real exchange rate would tend to appreciate, because the productivity gains would push up the wages in the tradable sector which would lead to demand-driven faster increase in the price of non-tradable in the domestic economy relative to its trading partners (Mc Donald and Ricci, 2003). GDP rises when the value and volume of a country's exports exceed the value and volume of their foreign imports.

Similarly in a study conducted by (Aliyu S. , 2009) on the Impact of Oil Price Shock and Exchange Rate Volatility on Economic Growth in Nigeria using VECM shows that Nigeria's GDP increases more by oil price increase than by exchange rate appreciation and this is consistent with the expectation.

Generally speaking, GDP can affect currency exchange rates in three main ways. Firstly, when a country's GDP rises, its currency's worth also rises. It works the same way in the other direction, too. When a country's GDP falls, its currency also weakens.

Secondly, investors and international corporations use GDP to inform many of their investment decisions. Investors usually prefer putting their money in countries that indicate high GDP growth rates. Because investment usually strengthens the currency of that country, be it portfolio or foreign direct investment (FDI) GDP has an indirect influence over it through affecting investment decisions.
Thirdly, most national central banks, including the US Federal Reserve, also take GDP growth rates into consideration when deciding whether or not they should change interest rates.

IV. Exchange rates and Oil Price

Relatively in Nigeria, Oil price's paramountcy cannot be overemphasized in determination of exchange rate movement and overall macroeconomic performance as it constitutes a significant portion of the country's foreign receipts and a larger

volume in its export. However, Oil price is stochastic and highly volatile in nature as its deviation affect exchange rates given the direction of change either increase or decrease. An oil price increase, all things being equal, should be considered positive in oil exporting countries and negative in oil importing countries, while the contrary should be expected when the oil price decrease. In Nigeria, higher oil revenue leads to exchange rate appreciation while lower oil revenue leads to depreciation of the local currency (Naira ₦) vis-à-vis the United States' dollar ($).

Jin (2008) posited that sharp increase in the international oil prices and violent fluctuation of the exchange rate are generally regarded as factors discouraging economic growth.

2.0.3 CONCEPT OF EXCHANGE RATE STABILITY AND VOLATILITY

The stability of exchange rate remains a core macroeconomic objective monetary authorities seeks to achieve as a vital measure to insure the economy against risk and uncertainty that foster adverse effects on consumption, production, capital inflows and investment decisions in the economy.

A stability of exchange rate is achieved when the rate is devoid of rapid fluctuations or when the rate fluctuates within a prescribed bands\limit. The attainment of stability is dependent upon a number of factors such as supply and demand for foreign exchange, the type of exchange rate regime adopted, and the balance of payment position the complementary monetary and fiscal policies on ground. However, exchange rate stability does not connote fixity. IF they are fluctuations on a smaller rate and the divergence between various rates is also small we can call the exchange rate stable.

Volatility of the exchange rate: The exchange rate changes very often; it moves from minute to minute, hour to hour and day to day under a floating exchange rate regime. When there are large swings in the exchange rate over a period of time, the exchange rate is considered volatile. Thus, exchange rate volatility is a measure of the degree or frequency by which the price of the foreign exchange changes over time. The larger the magnitude of the price change, or the more speedily it changes over a period, the more volatile the

Exchange rate is. If the price increases or falls with very wide margins over a period, it shows that the exchange rate is unstable or volatile and the foreign exchange market is said to be experiencing volatility.

Volatility causes panic in the foreign exchange market because the users and traders of foreign exchange are uncertain of what to expect in the market on a daily basis. Some of the users most affected by exchange rate volatility are investors and international traders. They could lose money if the exchange rate falls below their

expectations. In either situation, the monetary authority or central bank can intervene to control exchange rate volatility and avoid panic in the foreign exchange market. Conversely, investor stand to gain if the exchange rate is above their expectation.

2.0.4 OVERVIEW OF THE FOREIGN EXCHANGE MANAGEMENT IN NIGERIA

Foreign exchange rate management is defined as the sum total of the institutional framework and measures put in place to gravitate the exchange rate towards desired levels in order to stimulate productive sectors curtail inflation, ensure internal balance, improve the level of exports, attracts direct foreign investment, proper and efficient utilization of scarce foreign currency.

Exchange rate management policy in Nigeria has passed through four major stages which are fixed parity solely with the British pound sterling and U.S dollar (1959-1 985) secondly, in adoption of second tier foreign exchange market(SFEM) 1986-1994, Thirdly introduction of autonomous foreign exchange market (AFEM) 1995-1999 Lastly introduction of the interbank foreign exchange market (IFEM) 2000-2010.Thefirst stage of the Nigerian exchange rate policy begun operations in 1959 with the establishment of the central bank of Nigeria (CBN) it is same year Nigerian pound was introduced and its value was fixed and pegged to British sterling pounds, later Nigerian pound was pegged to US$. In 1962 Nigerian officials unpegged the Nigerian pound from the pound sterling; on 1973 the Nigerian currency was decimalized and changed from the pound to Naira. Nigerian government decided to discontinue any direct relationship between the naira and either sterling pound or the US ($). This led to the policy of progressive appreciation of the naira in 1974/1975. This policy was greatly enhanced by the oil boom. The Naira was pegged to a basket of the currencies of seven Nigeria's major trading partners – united kingdom, united states, Germany (German mark), France (franc CFA), Japan (Yen),Switzerland(Swiss franc) and Netherlands (Dutch guilder).exchange rate stability was the main objective of the reform. It was believed that the Naira would thereafter be stable since a loss in value due to devaluation of one currency in the basket would be compensated by the appreciation of another currency in the basket.

In 1986, a two tier exchange rate system was introduced in an attempt to find a realistic value for the Naira. Specifically, the second tier foreign exchange market (SFEM) was setup to determine the exchange rate of the Naira through market forces. The major advantage of the system is that it would stimulate domestic based production and promotion of exports through the alteration of relative prices in favor of home -based production. Prior to the invention of structural adjustment program in 1986 the Nigerian economy operates a fixed exchange rate system, according to Dornbusch (1988) pegging the currency can lead to overvaluation of the Naira.

However, some of the macroeconomic problem noticed include heavy reliance on imported consumer goods, high proportion of public sector contribution in GDP, adverse balance of payment position, domestic production was discouraged due to overvaluation imports became cheaper than domestically produced goods. All this led to unfavorable balance of payment and thereby increasing BOP crisis which was later transformed into a debt crisis that economy has been facing over the years. It led to depletion and decumulation of the external reserve which was accumulated during the oil boom. As a consequence of this factors led to formulation of economic stabilization act on 1982 as a short term measure to address these crises and by 1985 austerity measures were introduced due to persistence of the crisis.

However, when the above problems persisted up to 1986, with the new government in power a long-term strategy was thought for the countries which give birth to the IMF/World bank assisted structural adjustment program (SAP) as to deal with prolonged and persistent economic crisis of the period. The main objectives of SAP were to reduce over reliance on imports, diversify the productive base of the economy by restructuring over production and consumption patterns. Among its strategies were the reduction of public expenditure, withdrawal of subsidies, privatization and commercialization of public enterprise, deregulation of foreign exchange market, stoppage of non-statutory transfer to the state governments, strict external debt control and management and adjustment of rate of exchange of the Naira (devaluation of Naira).

As a more principle toward a more market oriented economy. A flexible exchange rate was adopted where the demand for imports and the supply of exports were expected to determine the equilibrium exchange rate. As a result, the SFEM was guided to determine exchange rate through the Dutch Auction System (DAS). Initially the Naira was exchanged at N1.32 to $1. There's continued pressure of demand in foreign exchange which lead to N17/$1. After the devaluation of naira by the administration led by Major General Ibraheem Babangida hundred percent the trend of depreciation continued. By 1999, the Naira was exchanged at 82/$1 (CBN, 1999) by December 2010 the exchange rate revolved around N149/$1 (CBN, 2010). The value of Naira persistently tends to depreciate despite all efforts made by the Apex monetary authority in achieving stable exchange rate at N156/$1 in 2013 (CBN,2014). The rate was N190/$1 in 2015 in at official price but at the parallel market it hit up to N320/$1.

2.1 THEORETICAL LITERATURE

Apparently there are numerous theories attributed to exchange rate determination the likes of the Mint parity theory, Purchasing power parity (PPP), Balance of payment theory (BOP), Monetary Approach, Portfolio Balance Approach, law of

one price, Mundell-Fleming Models, Salter-Swan (Dependent-economy) Models, Three-Good Model and Edward's Theoretical Models. However, in the cause of this research work we shall only concentrate on few amongst them.

2.1.0 The Mint Parity Theory

The earliest theory of foreign exchange has been the mint parity theory. This theory was applicable for those countries which had the same metallic standard (gold or silver). Under the gold standard, countries had their standard currency unit either of gold or it was freely convertible into gold of a given purity. The value of currency unit under gold standard was defined in terms of weight of gold of a specified purity contained in it. The central bank of the country was always willing to buy and sell gold up to an unlimited extent at the given price. The price at which the standard currency unit of the country was convertible into gold was called as the mint price.

2.1.1 The Purchasing Power Parity Theory

The Purchasing Power Parity (PPP) developed by the school of Salamanca in the 16th century and was augmented into its modern form by Swedish Economist Gustav Cassel in 1918.

This theory states that the equilibrium rate of exchange is determined by the equality of the purchasing power between the currencies of two nations. It emphasized that the rate of exchange between two paper currencies is determined by the internal price levels in two countries.

There are two versions of the purchasing power parity theory**:**
(i) The Absolute Version and

(ii) The Relative Version.

(i) The Absolute Version: According to this version of the purchasing power parity theory, the rate of exchange should normally reflect the relation between the internal purchasing power of the different national currency units. In other words, the rate of exchange equals the ratio of outlay required to buy a particular set of goods at home as compared with what it would buy in a foreign country in absolute terms.

(ii) The Relative Version:

The relative version of Cassel's purchasing power parity theory attempts to explain the changes in the equilibrium rate of exchange between two currencies. It relates the changes in the equilibrium rate of exchange to changes in the purchasing power

parities of currencies. In other words, the relative changes in the price levels in two countries between some base period and current period have vital bearing upon the exchange rates of currencies in the two periods. This version takes account of relative changes between base period and current purchasing power which have crucial bearing on the equilibrium rate of exchange. The exchange rate in the current period (R_1) is determined by the equilibrium rate of exchange in the base period (R_0) and the ratio of price indices of current and base period in one country to the ratio of price indices of current and base period in another country.

Mathematically expressed as

$$\mathbf{R1} = \boldsymbol{R0} \cdot \frac{\mathbf{PB1}}{\mathbf{PB0}} \times \frac{\mathbf{PA0}}{\mathbf{PA1}}$$

2.1.2 The Balance of payment Theory (B.O.P)

The balance of payments theory of exchange rate maintains that rate of exchange of the currency of one country with the other is determined by the factors which are independent of internal price level and money supply. It emphasized that the rate of exchange is influenced, in a significant way, by the balance of payments position of a country. The relative sizes of export and import conjointly determine exchange rate of between two currencies.

A deficit in the balance of payments of a country signifies a situation in which the aggregate demand for foreign goods exceeds the aggregate supply of domestic goods in the international market. In other words, the excess of demand for foreign exchange over the supply of foreign exchange is coincidental to the BOP deficit. The demand pressure results in an appreciation in the exchange value of foreign currency. As a consequence, the exchange rate of home currency to the foreign currency undergoes depreciation. Whilst A balance of payments surplus signifies an excess of aggregate supply of foreign goods over the aggregate demand for it. In such a situation, there is a depreciation of foreign currency but an appreciation of the currency of the home country.

They are number of approaches to correcting BOP disequilibrium in an economy the Marshal-Lerner's elasticity approach and absorption approach.

Marshall-Lerner Condition

The elasticity approach to BOP is associated with the Marshall-Lerner condition which was worked out independently by these two economists. It studies the conditions under which exchange rate changes restore equilibrium in BOP by devaluing a country's currency. This approach is related to the price effect of devaluation. Thus devaluation helps to improve BOP deficit of a country by increasing its exports and reducing its imports. The condition is effective when

$e_x + e_m > 1$ The sum of price elasticities of demand for exports and imports in absolute terms is greater than unity, devaluation will improve the country's balance of payments.

Absorption Approach

The absorption approach emphasizes changes in real domestic income as a determinant of a nation's balance of payments and exchange rate. The absorption approach hypothesizes that a nation's current account balance is determined by the difference between real income and absorption, which can be written as:

$$Y - A = (c + i + g + x) - (c + i + g + m) = x - m$$

If real income rises faster than absorption, then the current account improves

$$\Delta Y > \Delta A = \Delta CA > 0$$

If real income rises slower than absorption, then the current account worsens

$$\Delta Y < \Delta A = \Delta CA < 0$$

The approach hypothesizes that relative changes in real income or output and absorption determine a nation's balance-of-payments and exchange-rate performance.

2.1.3 Monetary Approach to Rate of Exchange

In contrast with the BOP theory of foreign exchange, in which the rate of exchange is determined by the flow of funds in the foreign exchange market, the monetary approach postulates that the rates of exchange are determined through the balancing of the total demand and supply of the national currency in each country. The monetary approach to prices and exchange rates suggests that all things being equal, increase in the rate of money supply growth is proportional to increase in the rate inflation (Price rise) and the rate of exchange rate depreciation. The approach shows that, in the long run, all nominal variables- the money supply, interest rate, price level and exchange rate are interlinked.

2.1.4 The Portfolio Balance Approach

In view of the deficiencies in the monetary approach, some scholars have attempted to explain the determination of exchange rate through the portfolio balance approach which is more realistic monetary approach.

The portfolio balance approach brings trade explicitly into the analysis for determining the rate of exchange. It considers the domestic and foreign financial assets such as bonds to be imperfect substitutes. The essence of this approach is that the exchange rate is determined in the process of equilibrating or balancing the demand for and supply of financial assets out of which money is only one form of asset.

This approach postulates that an increase in the supply of money by the home country causes an immediate fall in the rate of interest, which consequently leads to fall in returns of domestic denominated assets as it leads to a shift in the asset portfolio from domestic bonds denominated in home currency to foreign bonds. The substitution of foreign bonds for domestic bonds results in an immediate depreciation of home currency. This depreciation, over time, causes an expansion in exports and reduction in imports. It leads to the appearance of a trade surplus and consequent appreciation of home currency, which offsets part of the original depreciation.

2.2 EMPIRICAL LITERATURE

Previous literature has explored the relationship between exchange rate and its macroeconomic determinants, some researchers found a positive relationship between exchange rate and inflation and interest rates (Muço et al., 2004) and some other researchers found a negative relationship (Arslaner et al., 2014. In a nutshell the reviewed empirical literatures with respect to this research work were found to be mix and multifaceted in terms of variables employed and methodology adopted. Given this observation it's safe to say the concept of exchange rate determination is highly diverse.

In a study conducted by (Mohamed Isse Ibrahim and Ahmed Ibrahim Nageye , 2017) in Somalia using ordinary least square (OLS) found that trade balance, money supply and external debt has a negative significant relationship to exchange rate in Somalia while Governments expenditure has a positive relationship to exchange Ngozi et'al In their co-joint study of Real Effective Exchange Rate Misalignment in Nigeria using Autoregressive distributed lag (ARDL) Cointegration procedure ascertain that terms of trade and degree of trade openness are significant determinants of the REER, implying that trade policies matter for Naira REER movements. The error

correction model indicated that 3.3% of disequilibrium error is corrected within a quarter.

Likewise (Eltayeb, 2016) in his study of determinants of exchange rate in Sudan using Autoregressive distributed lag model (ARDL) study aimed to investigate the effects of growth rate of real gross domestic product (GDP), real money supply (M), inflation rate (INF), and trade openness (OP) on exchange rate (EXR) stability in Sudan. The results reveal that, there is a long run relationship between exchange rate and its determinants and statistically significant. An increase in growth rate of real GDP leads to stability in EXR. The coefficient of error correction model reveals that exchange rate (EXR) will restore back to its equilibrium with speed of adjustment of 23.2% whenever there is a shock to its equilibrium.

(Ajao and Igbokoyi , 2013) Investigated the degree of influence of real exchange rate, productivity, trade openness and government expenditure, real interest rate and money supply on real exchange rate volatility in Nigeria for the period between 1981 and 2008. Using GARCH and ECM, their empirical results indicates that real exchange rate, trade openness, government expenditure, real interest rate have positive impact on exchange rate volatility in Nigeria with exception of money supply and productivity.

(Asher, 2012) Examine the impact of exchange rate fluctuations on the Nigerian economic growth for period of 1980-2010, the result showed that real exchange rate has a positive effect on economic growth. In a similar study (Akpan, 2008) investigated foreign exchange market and economic growth in an emerging petroleum based economy from 1970-2003 in Nigerian, He found that positive relationship exist between exchange rate and economic growth for countries dependent on one export commodity such as oil like Nigeria.

Contrarily, (Dada A. and Oyeranti A., 2012)examined the effect of exchange rate volatility on economic growth in Nigeria using annual data for the period of 1970-2009. using vector Auto- regressive(VAR) technique the study revealed that economic growth is negatively related to exchange rate in the short run while in the long run, a positive relationship between the two variables.

Moreover, (Nucu, 2011)examined the influence of gross domestic product (GDP), inflation rate, money supply, interest rates and balance of payments on exchange rate of Romanian against the most important currencies (EUR, USD) for the period 2000-2010 and found an inverse relationship between exchange rate (EUR/RON) GDP, and money supply. While a direct relationship was found between EUR/RON, Inflation and Interest rate.

Relatively, (Imimole B and Enoma A, 2011) examined the impact of exchange rate depreciation on inflation in Nigeria for the period of 1986-2008 using Autoregressive distributed lag Cointegration procedure. The research found that naira depreciation has positive and significant long run effect on inflation in Nigeria. This implies that exchange rate depreciation can bring about an increase in inflation.

(Mapenda, 2010) Used the Johansen approach and the Vector Error Correction Model (VECM) to evaluate the long-run determinants of the exchange rate in Ghana and Nigeria, using the terms of trade, trade restrictions, domestic interest rates, foreign aid inflow, income, money supply, world inflation, government consumption expenditure, world interest rates, capital controls and technological progress. His empirical results for Ghana revealed that any increase in government consumption expenditure, the terms of trade, net foreign aid inflow and openness significantly led to currency depreciation, while an increase in world cocoa prices appreciated the Ghanaian currency. On the other hand, an increase in world oil prices and government consumption expenditure appreciated the Nigerian currency, whereas a rise in net foreign assets devalued the Naira. His work finally showed that the Naira exchange rate was overvalued within the period 1980 to 1983 and undervalued within the period 1984 to 1991.

A study conducted by (Aliyu S. , 2009) using quarterly data from 1986-2007 in Nigeria via the Johansen VAR-based cointegration technique observed that oil price shock and appreciation in the level of exchange rate exert positive impact on real economic growth in Nigeria. The study further showed that Nigeria's GDP increases more by oil price increase than by exchange rate appreciation.

In a study (J.Frankel, 2007) revealed that real exchange rate is positively related to terms of trade, real interest rate differential and lagged real exchange rate, while capital account, per capita income and risk premium have negative effect on real exchange rate

Moreover (P.Takaendesa, 2006) has found a negative correlation between real exchange rate and economic growth in his panel study of 33 developing countries Nigeria inclusive furthermore he opined that large swings in real exchange rate has greater uncertainty in relative prices resulting in problem such as greater risk, shorter investment horizon and high adjustment cost as production moves back and forth from tradable to non-tradable and financial instability as expectations of exchange rate changes lead to interest rate volatility.

CHAPTER THREE

METHODOLOGY

This chapter examines and specifies the method and procedures used in collecting as well as analyzing data. Statistical and econometrics techniques are employed as basic tools in analyzing data. However, the research attempts to give a detailed analysis on how economic determinants (variables) affect exchange rate stability on Nigerian economy within the period of study using unit root test econometric, cointegration, error correction mechanism, granger causality and various post estimation diagnosis.

3.1 RESEARCH DESIGN

This research is designed at whether real exchange rate is significantly determined RGDP, interest rate, inflation and Oil price. Virtually this research work is a quantitative research that requires time series data to carry out its estimations and analysis. Given this notion the time frame for the time series data to be collected ranges from 1986-2018 for all the variables mentioned above.

3.2 TYPE AND SOURCES OF DATA

The study will use secondary data for its analysis. The relevant time series data are extracted from the Statistical Bulletin of the Central Bank of Nigeria (2018) and from Organization of Petroleum Exporting Countries (OPEC) statistical bulletin (2018) for the sake of reliability and authentication. The study utilized annual time series data which was readily available for all the variables. The data collected are; RGDP, Inflation rate, Interest rate and Oil price for the period under review.

3.3 METHOD OF DATA ANALYIS

Preliminary this research shall begin its analysis by testing the descriptive statistics and unit root test and later proceed to Ramsey Test and the BDS Test as a linearity test to ascertain if the relationship among the variables under consideration are linear or otherwise in order to apply the appropriate estimation procedure. If the results from the tests signifies a linear relationship an ARDL model will be uphold whilst otherwise a Non-linear ARDL will be adopted. Cointegration test and ECM models shall be applied to determine the existence of long run and short run relationships, CUSUM test to test for model stability and a Granger Causality relationship to investigate the causal relationship and its direction.

3.3.1 Unit root test

In an attempt to determined and identify the economic determinants of exchange rate stability in Nigeria, a unit root test is first employed. Unit root means the

observed time series is no stationary, while if its mean is reverting it follows that the variable will return to its trend path overtime and it might be possible to forecast future trend, it's referred to as stationary if its mean, variance and auto-covariance remains constant overtime. One of the most widely used unit root test is the Augmented-Dickey fuller (ADF) and Phillips Peron test.

The Augmented Dickey-Fuller (ADF) (1981) tests for Unit Root

Let's consider an AR(1) process

$\gamma_t = \emptyset_1 + \rho\gamma_{t-1} + \mu_t$……. (1)

$\gamma_t - \gamma_{t-1} = \emptyset_1 + \rho y_{t-1} - y_{t-1} + \mu_t$…….. (2)

$\Delta y_t = \emptyset_1 + (\rho - 1)\gamma_{t-1} + u_t$……..... (3)

$\Delta y_t == \emptyset_1 + \delta yt\text{-}1 + \mu_t$……..... (4)

If $\partial = 0$ ---- H0------->Non Stationary

If $\partial < 0$ ----HI--------->Stationary

Three forms of unit root are

$\Delta Y_t = \mu + \delta_t + \rho Y_{t-1} \sum_{i=1}^{\rho-1} \bar{И}_i \Delta Y_{t-1} + \varepsilon_t$----------->Deterministic trend

$\Delta Y_t = \mu + \rho Y_{t-1} \sum_{i=1}^{\rho-1} \bar{И}_i \Delta Y_{t-1} + \varepsilon_t$----------> Random Walk with drift

$\Delta Y_t = \rho Y_{t-1} \sum_{i=1}^{\rho-1} \bar{И}_i \Delta Y_{t-1} + \varepsilon_t$----------> Random Walk without drift

In practice, a DF or ADF value with less than its critical value shows that the underlying series is non-stationary. Contrarily, when a DF or ADF value that is greater than its critical value shows that the underlying series is stationary. However, the null hypothesis cannot be rejected about non-stationarity based on ADF test, since its power is not strong as such. This decision can be verified using other related tests, such as Kwiatkowski-Phillips-Schmidt-Shin (1992) (KPSS) or Philips-Perron (PP) test. PP test has the same null hypothesis as ADF, and its asymptotic distribution is the same as the ADF test statistic. But in the case of KPSS test, the null hypothesis is different; it assumes stationarity of the variable of interest. The results from ADF test differ from KPSS as KPSS does not provide a p-value, showing different critical values instead. In this case, the test statistic (LM-test) value is compared with the critical value on desired significance level. If the test statistic is higher than the critical value, we reject the null hypothesis and when test statistic is lower than the critical value, we cannot reject the null hypothesis.

However, when there i as conflicting of the tests, it all depends on the researchers aim and objective. In general, the null hypothesis for ADF reads that the series is non- stationary while KPSS reads that the series is stationary. For the treatment of serial correlation, PP reads that there is no serial correlation (non-parametric) while ADF reads that there is serial correlation (parametric).

3.3.2 Nonlinear Unit Root Test

The suspicion of the existence of nonlinear trends and nonlinear dynamics necessitated Kaptenios, Shin and Snell (2013) proposed the nonlinear framework for testing unit root in the series. The framework emphasized that the Data Generating Process (DGP) follows a nonlinear trend, the series possess follows an Exponential Smooth Autoregressive (ESTAR) process.

Kaptenios et'al argued that ADF lacks power in rejecting unit root when applied in testing Purchasing Power Parity(PPP) Providing some evidence of nonlinear mean reversion. The time series process, say *yt*, behaves like a random walk if *yt* was close to some location parameter *c* and it is mean-reverting if *yt* departs from *c*. In the exponential smooth transition model the degree of mean-reversion depends on the squared difference between $yt_j 1$ and *c*. When modeling real exchange rates for example, the economic intuition behind this specification is that the real exchange rate is nonstationary if it was quite close its long run equilibrium value in the last period and that there are driving forces like arbitrage that leads to mean-reversion if the real exchange rate departs from its long run equilibrium. Moreover, arbitrage may not be profitable if the departure is small. Therefore, the degree of mean-reversion is small as well and vice versa. These facts make this ESTAR specification quite attractive for modeling economic time series like real exchange and interest rate, unemployment rates and log dividend yields.
The ESTAR specification is formally given by

$$\Delta Y_t = \alpha Y_{t-1} + \emptyset Y_{t-1}(1 - \exp\{-\gamma(Y_{t-1} - C)^2\}) + \varepsilon_t$$

Kapetnios et'al assumes the locational parameter to be zero, therefore the model becomes;

$$\Delta Y_t = \alpha Y_{t-1} + \emptyset Y_{t-1}(1 - \exp\{-\gamma {Y^2}_{t-1}\}) + \varepsilon_t$$

To get rid of nuisance parameter, first order Taylor approximation leads to an auxiliary regression.

$$\Delta Y_t = \beta 1 Y_{t-1} + v_t$$

The unit root test is carried out by estimating the auxiliary regression and computing a Dickey-Fuller type t-test labelled as

$$KSS = \frac{\beta 1}{\sqrt{Var(\beta 1)}} = \frac{\sum_{t-1}^{T} Y^3{}_{t-1}\ \Delta Y_t}{\sqrt{\sigma^2\ \varepsilon^T{}_{t-1}\ Y^3{}_{t-1}}}$$

The null and alternative hypothesis are

H0: = 0
against the alternative
H1: = 0

3.3.3 Ramsey RESET Test

The Ramsey's RESET (Regression Specification Error Test) could be applied to test nonlinearity in a relationship involving time series. In statistics, the Ramsey Specification Error Test (RESET) is a

Misspecification test for linear regression usually employed for testing the following types of

Specification errors:

i. Omitted variables; X does not include all relevant variables.

ii. Incorrect functional form; some or all of the variables in Y and X should be transformed to Logs, powers, reciprocals, or some other mathematical forms.

$y = ax + \gamma 1 y\hat{}2 + \cdots + \gamma k{-}1 y\hat{}k + \varepsilon$

The test is an F-test that tests the null hypothesis that $\gamma 1$through $\gamma k{-}1$ are zero. If the null-hypothesis, that all the γ coefficients are zero is rejected (i.e. if the p-value of the F-statistic is significant), then the model suffers from Misspecification.

3.3.4 Brock, Dechert and Scheinkman (BDS) TEST

To test for a nonlinear effect of Crude oil price volatility on Nigeria's Naira (₦) per US dollar ($) exchange rate, this paper used the nonparametric method known as the BDS test. The BDS test developed by Brock, Dechert and Scheinkman (1987). To determine whether a nonlinear model is suitable for the data. According to (Brooks, 2008), the decision should come from the financial theory; nonlinear model should be used where financial theory suggests that the relationship between the variable requires a nonlinear model. Notwithstanding, linear vs. nonlinearity choice can be made partly on statistical grounds deciding whether a linear specification is sufficient to describe all of the most important features of the data at hand. Although there are quite some tests for detecting a nonlinear pattern in time series data for researchers. According to (Zivot and Wang, 2006) BDS is unarguably the most popular test for nonlinearity.

The econometric specification of the test can be expressed below as

$$BDS_{m.M}(r) = \sqrt{M}\ \frac{C_{m(r)} - C1^{r}(r)}{(\sigma_m \cdot M^{(r)})} \quad \text{---------- (1)}$$

Where M is the surrounded points of the space with m dimension, r denotes the radius of the sphere centered on the,

Thus, the null and alternative hypothesis of the BDS test for detecting nonlinearity is as follows;

H_0: The series are linearly dependent

H_1: The series are not linearly dependent

3.4 MODEL SPECIFICATION

This study is employed both the Autoregressive Distributed Lag model (ARDL) NON-Autoregressive Distributed Lag model (NARDL) this commensurate with the study of (Eltayeb, 2016) who also applied same estimation model in Sudan for the period of (1991-2016) using exchange rate as dependent variable whilst GDP, money supply, trade openness and inflation rate as explanatory variables. In respect to this study his model will be uphold but with some little modifications of substituting money supply with interest rate and addition of oil price as another explanatory variable, given the fact Nigeria's is a mono-economic country in which crude oil constitute its substantial amount of export and generate huge amount of foreign receipts.

3.4.1 Autoregressive Distributed Lag (ARDL)

ARDL approach developed by Pesaran et al. (2001), ARDL cointegration technique does not require pretests for unit roots unlike other techniques. Consequently, ARDL cointegration technique is preferable when dealing with variables that are integrated of different order, I(0), I(1) or combination of the both and, robust when there is a single long run relationship between the underlying variables in a small sample size. The long run relationship of the underlying variables is detected through the F-statistic (Wald test). In this approach, long run relationship of the series is said to be established when the F- statistic exceeds the critical value band. The major advantage of this approach lies in its identification of the cointegrating vectors where there are multiple cointegrating vectors. However, this technique will crash in the presence of integrated stochastic trend of I(2). To forestall effort in futility, it may be advisable to test for unit roots, though not as a necessary condition. Based on forecast and policy stance, there is need to explore the necessary conditions that give rise to ARDL cointegration technique in order to avoid its wrongful application, estimation, and interpretation. If the conditions are not followed, it may lead to

model misspecification and inconsistent and unrealistic estimates with its implication on forecast and policy.When one cointegrating vector exists, Johansen and Juselius(1990) cointegration procedure cannot be applied. Hence, it become imperative to explore Pesaran and Shin (1995) and Pesaran et al (1996b) proposed Autoregressive Distributed Lag (ARDL) approach to cointegration or bound procedure for a long- run relationship, irrespective of whether the underlying variables are I(0), I(1) or a combination of both. In such situation, the application of ARDL approach to cointegration will give realistic and efficient estimates. Unlike the (Johansen and Juselius, 1990) cointegration procedure, Autoregressive Distributed Lag (ARDL) approach to cointegration helps in identifying the cointegrating vector(s). That is, each of the underlying variables stands as a single long run relationship equation. If one cointegrating vector (i.e the underlying equation) is identified, the ARDL model of the cointegrating vector is reparametrized into ECM. The reparametrized result gives short-run dynamics (i.e. traditional ARDL) and long run relationship of the variables of a single model. The re-parameterization is possible because the ARDL is a dynamic single model equation and of the same form with the ECM. Distributed lag Model simply means the inclusion of unrestricted lag of the regressors in a regression function. This cointegration testing procedure specifically helps us to know whether the underlying variables in the model are cointegrated or not, given the endogenous variable. However, when there are multiple cointegrating vectors ARDL Approach to cointegration cannot be applied. Hence, Johansen and Juselius (1990) approach becomes the alternative.

ARDL method yields consistent and robust results because it allows describing the existence of an equilibrium-relationship in terms of long-run and short-run dynamics without losing long- run information (Pesaran et al., 2001). The adoption of ARDL technique will make this commensurate with the works of (Eltayeb, 2016) and (Imimole B and Enoma A, 2011) whom also used ARDL as their estimation technique in their respective study.

Thus, this study tests the existence of the long-run relationship (co-integration) using bound testing (ARDL) technique for co-integration.

Reference to this study the model is specified as

EXR = f (RGDP, INFR, INTR, OP) ---------- (5)

The econometric model expressing the relationship between exchange rate and its determinants is given in equation (6) as follows.

$EXR_t = \alpha_0\ \alpha_1 GDP\ \alpha_2 INF\ \alpha_3 INT\ \alpha_4\ OP$ ---------- (6)

$EXRt\ =\ a0 + RGDPt + INFRt + INRt + OPt + \varepsilon t$---------- (7)

EXRt: Exchange rate at time, t.

RGDPt: Growth rate of real gross domestic product at time, t.

INRt: Interest rate, at time t.

INFt: Inflation rate at time t.

OPt: Oil Price, at time t.

εt: The error term at time, t. is serially uncorrelated disturbance with zero mean and constant variance.

ARDL approach proposed by Pesaran et al. (2001) was formulated in equation (7) to examine the long-run relationship among

$$\Delta EXR_t = \alpha_0 + \partial_1 EXR_{t-1} + \partial_2 RGP_{t-1} + \partial_3 INFR_{t-1} + \partial_4 INTR_{t-1} + \partial_5 OP_{t-1} + \sum_{i=0}^{n} \beta_1 \Delta EXR_{t-1} + \sum_{i=0}^{n} \beta_2 \Delta GDP_{t-1} + \sum_{i=0}^{n} \beta_3 \Delta INFR_{t-1} + \sum_{i=0}^{n} \beta_4 \Delta INTR_{t-1} + \sum_{i=0}^{n} \beta_5 \Delta OP_{t-1} + \varepsilon_t \text{ ---------- (7)}$$

Where: The optimal lag length n determined using Akaike Information Criteria (AIC), Δ denotes the first difference operator. The Expressions with the summation sign (∂1-∂5) represent the long-run relationship. The remaining expressions (β1-β5) correspond to the short-run dynamics of the model.

After formulating ARDL model which describe the relationship between the variables, then the long-run relationship model for exchange rate and its determinants can be estimated as in equation (8):

$$\Delta EXR_t = \alpha_0 + \partial_1 EXR_{t-1} + \partial_2 RGP_{t-1} + \partial_3 INFR_{t-1} + \partial_4 INTR_{t-1} + \partial_5 OP_{t-1} \text{ ---------- (8)}$$

In order to estimate the short-run dynamics, the error correction model (ECM) was expressed in equation (9)

$$\Delta EXR_t = \alpha_0 + \sum_{i=0}^{n} \beta_1 \Delta EXR_{t-1} + \sum_{i=0}^{n} \beta_2 \Delta GDP_{t-1} + \sum_{i=0}^{n} \beta_3 \Delta INFR_{t-1} + \sum_{i=0}^{n} \beta_4 \Delta INTR_{t-1} + \sum_{i=0}^{n} \beta_5 \Delta OP_{t-1} + \lambda ECM_{t-1} \text{ ---------- (9)}$$

Where: ECMt−1: The lagged error-correction term, λ: Parameter indicating the speed of adjustment back to long run equilibrium after short run shock, λ was expected to have negative sign and significant for the long run equilibrium. The larger the error correction coefficient indicates faster adjustment back to long run equilibrium after short run shock.

3.3.4 Non Linear Autoregressive Distributed Lag (NARDL)

Given the tendency of the presence of asymmetries and other stylized effects in the series, Shin et'al (2011) proposed the NARDL as an extension of the conventional

ARDL model to capture the long run impact of positive and negative effects of the independent variables on the dependent variable in a relationship.

$$c = f(\gamma . \rho)$$

$$C_t = \beta_0 + \beta_1 \gamma_t + \beta_2 \rho_t + \varepsilon_t$$

Therefore, this facilitates the examining positive and negative effects of the explanatory variable where the short run and long run nonlinearities are introduced through positive and negative partial sum decomposition of the explanatory variable. The NARDL approach is helpful in solving the issue of non-normality which arise due to outliers by capturing the asymmetries in the speed of adjustment. The cointegration testing or the bounds test procedure as well is same to that of a linear ARDL model, where the calculated F Statistic is contrasted against I (0) and I (1) critical values. F-test for joint significance of lagged variables, also known as a bound test. The criterion/rule of thumb for acceptance or rejection of H0 is that if the F-statistic is below the lower bound, the null hypothesis of no long-run relationship cannot be rejected while if, F-statistic that is greater than the upper bound means that the null hypothesis can be rejected, signifying the existence of a long-run relationship. However, if the F-statistic falls between the lower and upper bound, the result is said to be inconclusive. Even though the cointegration analysis using the ARDL model is suitable for small sample studies such as this, the critical values provided by Pesaran et al. are generated with a sample size of 1000 observations along with 40,000 replications. Reference to this notion, this study will instead use the (Narayan, 2005) critical value for the lower bound and the upper bound. The Narayan critical values provide the lower bound and the upper bound value for small sample sizes ranging from 30 to 80 with a 5-observation interval. Kriskkumar and Naseem,2019 employed the NARDL in their study of the Analysis of oil Price effect on Economic Growth of 3 ASEAN Net Oil Exporters namely Brunei, Malaysia and Vietnam. Also Miloud and Abdallah (2016) adopted the NARDL in their study on the nexus between oil price and inflation in Algeria.
Recalling equation 7 in order to test the asymmetric assumption, which is postulated, in the NARDL model, which is an asymmetric expansion of the linear ARDL model, the NARDL methodology allows the decomposition of the independent variables into both positive and negative partial sum of processes to investigate the nonlinear characteristics

$$\Delta EXR_t = \alpha_0 + \partial_1 EXR_{t-1} + \partial_2 RGP_{t-1} + \partial_3 INFR_{t-1} + \partial_4 INTR_{t-1} + \partial_5 OP_{t-1} + \sum_{i=0}^{n} \beta_1 \Delta EXR_{t-1} + \sum_{i=0}^{n} \beta_2 \Delta GDP_{t-1} + \sum_{i=0}^{n} \beta_3 \Delta INFR_{t-1} + \sum_{i=0}^{n} \beta_4 \Delta INTR_{t-1} + \sum_{i=0}^{n} \beta_5 \Delta OP_{t-1} + \varepsilon_t$$

∴

$$POS = \sum_{j=1}^{n} \Delta OILPRICE_j^{+} = \sum_{j=1}^{t} max(\Delta OILPRICEj, 0)$$

$$NEG = \sum_{j=1}^{n} \Delta OILPRICE_j^{-} = \sum_{j=1}^{t} max(\Delta OILPRICEj, 0)$$

where POS and NEG are partial sum processes of positive and negative changes in Oilprice$_t$, respectively. Replacing Oilprice$_t$, variable with POS and NEG, the specifications becomes

$\Delta EXR_t = \alpha_0 + \partial_1 EXR_{t-1} + \partial_2 RGP_{t-1} + \partial_3 INFR_{t-1} + \partial_4 INTR_{t-1} + \partial_5 POS_{t-1} + \partial_6 NEG_{t-1} + \sum_{i=0}^{n} \beta_1 \Delta EXR_{t-1} + \sum_{i=0}^{n} \beta_2 \Delta GDP_{t-1} + \sum_{i=0}^{n} \beta_3 \Delta INFR_{t-1} + \sum_{i=0}^{n} \beta_4 \Delta INTR_{t-1} + \sum_{i=0}^{n} \beta_5 \Delta POS_{t-1} + \sum_{i=0}^{n} \beta_5 \Delta NEG_{t-1} + \varepsilon_t$ ----------(10)

3.3.5 Vector Error Correction (VECM) Technique

This is a cointegration technique which is applied when they are multiple cointegtrating vectors unlike the ARDL Bounds test that is applicable to a single cointegration vector. So basically this is a Vector Autoregressive (VAR) based cointegration technique. The VECM is used only when the variables have a long run relationship, i.e. if evidence of long run relationship exists among the non-stationary variables in Y_t. The error correction mechanism (ECM) presupposes that variable Y_t has an equilibrium path, in the short run there are adjustment to deviation from the long run path which are defined by the long run causality. The error correction model equation is as follows:

$EXR_t = \alpha + \sum^{k-1}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{k-1}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{k-1}_{i=0} \beta_3 \Delta INFR_{t-i} + \sum^{k-1}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{k-1}_{i=0} \beta_5 \Delta OP_{t-I} + \lambda_1 ECTt_{-1} + \mu_{1t}$ ---------- **(11)**

$RGDP_t = \partial + \sum^{k-1}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{k-1}_{i=0} \beta_3 \Delta INFR_{t-i} + \sum^{k-1}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{k-1}_{i=0} \beta_5 \Delta OP_{t-I+} + \sum^{k-1}_{i=0} \beta_1 \Delta EXR_{t-i} + \lambda_2 ECT_{t-1} + \mu_2 t$---------- **(12)**

$INFR_{=} \emptyset + \beta_3 \Delta INFR_{t-i} + \sum^{k-1}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{k-1}_{i=0} \beta_5 \Delta OP_{t-I} + \sum^{k-1}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{k-1}_{i=0} \beta_2 \Delta RGDP_{t-i} + \lambda_3 ECT_{t-1} + \mu_3 t$---------- **(13)**

$INTR_t = \Theta + \sum^{k-1}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{k-1}_{i=0} \beta_5 \Delta OP_{t-I} + \sum^{k-1}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{k-1}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{k-1}_{i=0} \beta_3 \Delta INFR_{t-i} + \lambda_4 ECT_{t-1} + \mu_4 t$---------- **(14)**

$OP_t = \Upsilon + \sum^{k-1}_{i=0} \beta_5 \Delta OP_{t-I} + \sum^{k-1}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{k-1}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{n}_{i=0} \beta_3 \Delta INFR_{t-i} + \sum^{k-1}_{i=0} \beta_4 \Delta INTR_{t-i} + \lambda_5 ECT_{t-1} + \mu_{5t}$---------- **(15)**

Where λ= speed of adjustment

$ECT_{t-1} = \Delta EXR_t - \alpha_0 - \sum^{n}_{i=0} \beta_1 \Delta EXR_{t-i} - \sum^{n}_{i=0} \beta_2 \Delta RGDP_{t-i} - \sum^{n}_{i=0} \beta_3 \Delta INFR_{t-i} - \sum^{n}_{i=0} \beta_4 \Delta INTR_{t-i} - \sum^{n}_{i=0} \beta_5 \Delta OP_{t-I}$ ---------- **(16)**

3.3.6 Granger Causality Test

The Granger causality (or the endogeneity of the dependent variable) test is applied by calculating the p-value based on the null hypothesis that the set of coefficients of the independent variables are not significantly different from zero. If the null hypothesis is not rejected, then it can be concluded that the independent variables do not Granger-cause the dependent variable. For instance, if the p-value of the Y_t (Y_t as an independent variable in the equation) is significant at the 5% level (i.e., H0: βiðLÞ ¼ 0, where i refers toY_t, is rejected at a 5% significant level), and the X_t is the dependent variable of the equation, then we can say that there is a short-run causal effect running from Y_t toX_t. The nature of relationship maybe unidirectional (left-right / right-left), bidirectional (feedback) or neutrality causality. The Granger causality can be expressed as:

$EXR_t = \sum^{n}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{n}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{n}_{i=0} \beta_3 \Delta INFR_{t-i} + \sum^{n}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{n}_{i=0} \beta_5 \Delta OP_{t-I} + \sum^{k-1}_{i=0} \beta_6 \Delta TO_{t-I} + \mu_{1t}$ ---------- **(16)**

$RGDP_t = \sum^{n}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{n}_{i=0} \beta_3 \Delta INFR_{t-i} + \sum^{n}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{n}_{i=0} \beta_5 \Delta OP_{t-I} + + \sum^{k-1}_{i=0} \beta_6 \Delta TO_{t-I} \sum^{n}_{i=0} \beta_1 \Delta EXR_{t-i} + \mu_2 t$ ---------- **(17)**

$INFR_t = \sum^{n}_{i=0} \beta_3 \Delta INFR_{t-i} + \sum^{n}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{n}_{i=0} \beta_5 \Delta OP_{t-I} + \sum^{n}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{n}_{i=0} \beta_2 \Delta RGDP_{t-I} + \sum^{k-1}_{i=0} \beta_6 \Delta TO_{t-I} + \mu_3 t$ ---------- **(18)**

$INTR_t = \sum^{n}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{n}_{i=0} \beta_5 \Delta OP_{t-I} + \sum^{n}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{n}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{n}_{i=0} \beta_3 \Delta INFR_{t-i} + \mu_4 t$ ---------- **(19)**

$OP_t = \sum^{n}_{i=0} \beta_5 \Delta OP_{t-I} + \sum^{k-1}_{i=0} \beta_6 \Delta TO_{t-I} + \sum^{n}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{n}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{n}_{i=0} \beta_3 \Delta INFR_{t-i} + \sum^{n}_{i=0} \beta_4 \Delta INTR_{t-i} + \mu_{5t}$ ---------- **(20)**

$TO_t = \sum^{k-1}_{i=0} \beta_6 \Delta TO_{t-I} + \sum^{n}_{i=0} \beta_1 \Delta EXR_{t-i} + \sum^{n}_{i=0} \beta_2 \Delta RGDP_{t-i} + \sum^{n}_{i=0} \beta_3 \Delta INFR_{t-i} + \sum^{n}_{i=0} \beta_4 \Delta INTR_{t-i} + \sum^{n}_{i=0} \beta_5 \Delta OP_{t-I} + \mu_{5t}$ ---------- **(21)**

3.4 Measurement of Variables and Sources of Data

3.4.1 Exchange Rate: An exchange rate is the value of one nation's Currency versus the currency of another nation or economic zone. Exchange rate is the rate at which one currency will be exchanged for another. It is also regarded as the value of one country's currency in relation to another currency. Rate of exchange between two or more currencies are determine through either fixed system where Central Bank of a country pegged a home currency to a basket of other major currencies or a floating mechanism where the market forces of demand and supply are allowed to determine the price of one currency in terms of another without any restriction. In Nigeria a managed float system is adopted to determine exchange rates where the Central

Bank is considerably allowed to intervene or manipulate the free market. Reference to this study it's the target variable and the regressand, the data on monthly average of exchange rate of ₦/$ is obtained from CBN's 2018 Statistical bulletin.

3.4.2 RGDP: Gross domestic product is the total value of all economic activities be it production, consumption, investment that took place in an economy over a period of time be it annually or quarterly. Real gross domestic product is an inflation-adjusted measure that reflects the value of all goods and services produced by an economy in a given year, expressed in base-year prices, and is often referred to as "constant-price," "inflation-corrected" GDP or "constant dollar GDP." The RGDP is also used as a proxy for economic growth which can be a positive or a negative number given the prevailing economic realities at any different time. The GDP growth rate is mathematically calculated as

$$RGDP = \frac{\text{Nominal GDP}}{\text{GDP DEFLATOR}} \times 100$$

Reference to this research work data on RGDP was sourced from CBN's 2018 Statistical bulletin computed via 2010 Constant prices.

3.4.3 Inflation Rate: Inflation is defined as the persistent and sustained rise in the general price level which lead to a fall in the value of money. During inflation large amount of money purchased fewer bundles of goods and service, it affects the purchasing power of money in an economy. The data on inflation rate was also obtained from CBN's Annual statistical bulletin which was initially obtained from National Bureau of Statistics (NBS) and computed via Year-on-Year changes. Mathematically expressed as $inflation\ rate = \frac{CPI_{t-}\ CPI_{t-1}}{CPI_{t-1}} \times 100$

3.4.4 Interest Rate: Interest rate is equally and important variable in this study which relates investors returns on assets and cost of credit which have a crucial bearing on exchange rate. It is also referred to as Monetary Policy Rate (MPR) which alongside money supply are determine by the Central Bank depending on the prevailing economic activities and macroeconomic objective. For the period under review of this study, data on interest rate is also obtained from Central Bank database.

3.4.5 Oil Price: Oil prices are determined by global oil trade deals which is mostly traded on a futures contract. Forces of demand and supply and market sentiments are the major determinants of oil price, however organizations and institutions like the OPEC and the American government can considerably influence oil prices. Oil prices are also defined by the grades of oil that its API gravity (relative density to water), sulfur content (sweet/sour). API of more than 10% is considered light and vice versa while sulfur content of less than 0.5% is considered sweet. Light and sweet crude tends to be more expensive than heavy and sour crude which requires

more technicalities to refine into gasoline or diesel. Given the differentials in grade they are various benchmarks such as the West Texas Intermediate (WTI), Brent, Bonny light and OPEC reference basket(ORB) which are captured by $/barrel. Reference to this study data on Oil prices is obtained from OPEC's 2018 Annual Statistical bulletin.

Table 3.1: Definition of Variables and Data Source

Variables	Measurements	Data source
Exchange Rate	Pre-Determined by CBN on a ₦/$ basis	CBN Statistical Bulletin (2018)
RGDP	$RGDP = \frac{\text{Nominal GDP}}{\text{GDP DEFLATOR}} \times 100$ Computed via 2010 constant prices	CBN Statistical Bulletin (2018)
Inflation Rate	$Inf\ rate = \frac{CPI_{t-}\ CP_{\ t-1}}{CPI_{t-1}} \times 100$ Computed via 2010 constant prices	CBN Statistical Bulletin (2018)
Interest Rate	Predetermined by CBN Bi-monthly during MPC alongside CRR and liquidity ratio.	CBN Statistical Bulletin (2018)
Oil Price	Forces of demand and supply. $/barrel via ORB	OPEC Statistical Bulletin (2018)

CHAPTER FOUR

Data Analysis and Presentation

4.0 INTRODUCTION

This chapter presents the results obtained from various estimation techniques and diagnostic tests employed in the study as specifed in chapter three. Descriptive statistics, Ramsey Reset test and Brock, Dechert and Scheinkman (BDS) test are firstly presented. Broadly the estimated results are presented in two (2) distinct Panels; Panel A reports the Linear model and its associative diagnostic tests which include linear unit root test, the Autoregressive Distributive Lag (ARDL) model, Stability test Normality test, Serial Correlation test, Heteroscedasticity test, Fully Modify Ordinary Least Square (FMOLS) Model (to check the robustness of ARDL), Causality Test based on Error Correction Model. While Panel B presents the Nonlinear unit root test, Nonlinear Autoregressive Distributive Lag (NARDL) model approach to cointegration test, Stability test, dynamic multiplier, Normality test, Serial Correlation test, Heteroscedasticity test.

4.1 DESCRIPTIVE STATISTICS

Table 1

	EXCH_R	GDP_RATE	INF_R	INT_R	OIL_PRICE
Mean	1475.260	4.981203	22.08129	18.44645	42.11161
Median	124.2760	4.600000	12.54000	17.95000	23.19000
Maximum	305.00	10.50000	76.80000	31.65000	109.4500
Minimum	4.120300	-1.550000	3.600000	9.930000	11.91000
Std. Dev.	7662.659	2.847941	21.21725	4.662507	32.19128
Skewness	5.293876	-0.018091	1.523531	0.541040	0.998409
Kurtosis	29.02804	2.598074	3.848913	3.534373	2.548189
Jarque-Bera	1019.848	0.210353	12.92343	1.881248	5.413908
Probability	0.000000	0.900166	0.001562	0.390384	0.066740
Sum	45733.0	154.4173	684.5200	571.8400	1305.460
Sum Sq. Dev.	1.76E+09	243.3231	13505.15	652.1691	31088.35
Observations	31	31	31	31	31

Source: Authors' computation

Table 1 above reports the descriptive statistics which shows that interest rate has the least mean value (18.45) while exchange rate has the highest maximum value. Also exchange rate has the highest standard deviation which implies that it's substantially more volatile than the other series in the study. Further It can be observed that all

series are positively skewed with the exception of GDP while the in terms of kurtosis exchange rate, inflation rate and interest rate were found to be leptokurtic distributed while GDP and oil price are observably platykurtic distributed. On normality based on the probability of Jarque-Bera statistics only GDP and Inflation rate were found to be normally distributed while others were found non-normal.

4.2 RAMSEY TEST (RESET)

Table 2- Ramsey TEST

TEST STATISTIC	VALUE	DF	PROBABILITY
t-statistic	1.919010	12	0.0791
F-statistic	3.682599	(1, 12)	0.0791

Source: Authors' computation

Table 2 above reports the Ramsey test which check for specification of the model, omitted variables and incorrect functional form in the regression model. Both t-statistics and F-statistics affirmed that the null hypothesis is accepted that $\gamma 1$through $\gamma k-1$ are zero meaning that the model is free from specification bias. More broadly acceptance of the null hypothesis that the series is linearly dependent.

4.3 BDS TEST

Table 3- BDS TEST

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
2	**0.077664**	**0.017981**	**4.319324**	**0.0000**
3	**0.162662**	**0.029346**	**5.542996**	**0.0000**
4	**0.230324**	**0.035915**	**6.413061**	**0.0000**
5	**0.257658**	**0.038501**	**6.692323**	**0.0000**
6	**0.260227**	**0.038216**	**6.809394**	**0.0000**

Source: Authors' computation

Contrary to the findings of Ramsey test the BDS test reported in table 3 indicates the rejection of the null hypothesis that the series are linearly dependent. This signifies that there is nonlinear/asymmetric effect of oil prices, inflation rate, interest rate and GDP on exchange rate in Nigeria. This calls for the estimation of nonlinear model in a bid to explore the asymmetric effects. In a nutshell mix result were found in the above tests of linearity conducted in the series.

PANEL A – LINEAR MODEL

4.4 LINEAR UNIT ROOT TEST

Table 4- Unit root test

VARIABLE	ADF	PPP	KPSS
EXCHANGE RATE	-16.69141*	-13.64012*	0.500000*
OIL PRICE	-4.786289*	-4.734854*	0.080156**
INTEREST RATE	-9.696140*	-6.041637*	0.252045*
GDP	-9.126637*	-8.817269*	0.458424*
INFLATION RATE	-3.051917**	-6.867523*	0.110069**

Source: Authors' computation ***, **, * level of significance at 1%,5%,10% respectively.

The result discussion begins with a pretesting for the stationarity of the variables using the augmented Dickey and Fuller (1981), Phillips and Perron (1988) and the KPSS test developed by Kwiatkowski, Phillips, Schmidt and Shin (1992) unit root test. However, The KPSS is found to have very large powers over the conventional unit root test; as such it is used to serve as complementary to the results of ADF and PP tests. Thus, a variable is said to be stationary when its mean, variance, and covariance are time invariant. This is necessary in order to verify the level of integration of the series and to also avoid spurious result. Furthermore, the empirical framework of ARDL adopted in the study does not allow the use of I(2) series. Only purely I(0) or purely I(1) or mutually cointegration of the two is allowed (Pesaran et al., 2001). Based on the reported values for all the four variables tested, they were found to be stationary after taking their first differences. None of them was found integrated of I (2) which gracefully warrant us to estimate both ARDL and NARDL.

4.5 RESULT OF ARDL

Table 5- ARDL BOUNDS TEST

Critical values	I(0) Bound	I(1) Bound	F Statistic
1 %	3.74	5.06	
2.5%	3.25	4.49	7.455783

5%	2.86	4.01	
10 %	2.45	3.52	

Source: Author calculation using e-views

The results of the ARDL bounds testing approach to cointegration are reported in Table 5 the computed F-statistic exceeds any of the upper critical bound. The computed F-statistic value here is **7.455783** which is clearly above all the conventional acceptance level of significance values in the upper bound I (1) Bound. Exchange rate as a dependent variable is cointegrated with oil price, interest rate, inflation rate and GDP as explanatory variables. In a nutshell the relationship between Exchange rate and oil price, interest rate, inflation rate and GDP has a long run relationship in Nigeria.

Table 6- SHORT RUN ANALYSIS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH_R(-1))	-0.355788	0.260281	-1.366939	0.1932
D(EXCH_R(-2))	-0.001679	0.000819	-2.049829	0.0596
D(EXCH_R(-3))	-0.000860	0.000517	-1.662969	0.1185
D(OIL_PRICE_INDEX)	-0.055907	0.265086	-0.210901	0.8360
D(INT_R)	1.017668	1.534223	0.663311	0.5179
D(INF_R)	0.120830	0.281320	0.429509	0.6741
D(GDP_RATE)	-4.081902	1.921624	-2.124194	0.0520
D(@TREND())	8.586168	3.204193	2.679667	0.0180
CointEq(-1)	-0.577088	0.272188	-2.120183	0.0500

Given the affirmation of the existence of long run relationship in the stated model it's therefore essential to estimate both the short run and long runs levels. Table 6 reported the short run estimate of the model. Observably the impact of all the three lagged values of exchange rate with the current the current exchange is negative and only in the second lag it was found to be statistically significant. Holding other variables constant the impact of oil price on exchange rate is negative but statistically insignificant. A 1% increase in oil price will lead to a fall in exchange rate by 5.5% in the short run. Moreover, interest rate was found to be positively related to exchange rate however it was found to be statistically insignificant. Similarly, inflation rate was found to be positively related to exchange rate in the short run. A 1% fall in inflation will stimulate an appreciation in exchange rate in the short run by 12% although the relationship is statistically insignificant. In other terms a unit rise in inflation will lead to a depreciation in exchange rate by 12% in Nigeria Further GDP was found to be negatively and statistically insignificant related to exchange

rate in Nigeria. A unit rise in GDP will stimulate an appreciation of the Nigerian Naira. The estimate of ECM_{t-1} term is negative and significant at 5% level. The ECM_{t-1} term is -0.577 that is variations in exchange rate are corrected by approximately 58% annually. It is an indication of moderately fast and significant adjustment process for Nigerian economy in any shock to exchange rate model. In summation only the second lag of exchange rate and GDP were found to be statistically significant in the estimated model.

Table 7- LONG RUN ANALYSIS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL_PRICE_INDEX	-1.165656	0.440320	-2.647293	0.0191
INT_R	1.763453	2.437003	0.723616	0.4812
INF_R	-0.954036	0.686384	-1.389945	0.1863
GDP_RATE	-13.391020	10.227404	-1.309327	0.2115
C	-28.681616	87.569660	-0.327529	0.7481
@TREND	14.878441	2.783517	5.345194	0.0001

The long run levels presented in table 7 shows that oil price is consistently negative and statistically significant relationship with exchange rate in the long run. Contrary interest rate was found to be negatively and statistically insignificant relationship with exchange rate similar to that in short run. A unit rise in interest rate will lead to depreciation of exchange rate. Further inflation rate was found to be negatively and statistically insignificant relationship related to exchange rate in Nigeria in the long horizon. A 1% fall in inflation will lead to 95% appreciation of the Naira in the long run. Finally, GDP is negatively related to exchange rate however the relationship is statistically insignificant. A 1% rise in GDP will stimulate a fall in exchange rate, that is to say a rise in growth rate of the economy will leads to appreciation of Naira.

4.6 FULLY MODIFIED OLS (FMOLS)

Table 8- FULLY MODIFIED OLS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL_PRICE_INDEX	-60.50816	37.08403	-1.631650	0.1153
INT_R	-1042.492	253.5520	-4.111552	0.0004
GDP_RATE	-254.0223	332.2800	-0.764482	0.4517
INF_R	134.2619	45.27773	2.965297	0.0066
C	21798.04	5739.343	3.798003	0.0008

Source: Author calculation using Eviews

The robustness of the ARDL long rung coefficient is checked with Fully Modified Least Squares (FMOLS) presented in table 8. The findings of the FMOLS are consistent with the long run estimates of the ARDL. The signs of ARDL coefficients are similar to the coefficients of the FMOLS long run model but the magnitudes may

differ. Moreover, in most cases, the magnitudes of ARDL are smaller than the magnitudes of the long run FMOLS coefficients, which imply that the variables have a stronger impact in the long run. In the FMOLS estimates of interest rate and inflation rate were found to be statistically significant at 1% level while oil price and GDP were found to be statistically insignificant even at the 10% level.

Table 9- DIAGNOSTIC CHECKS

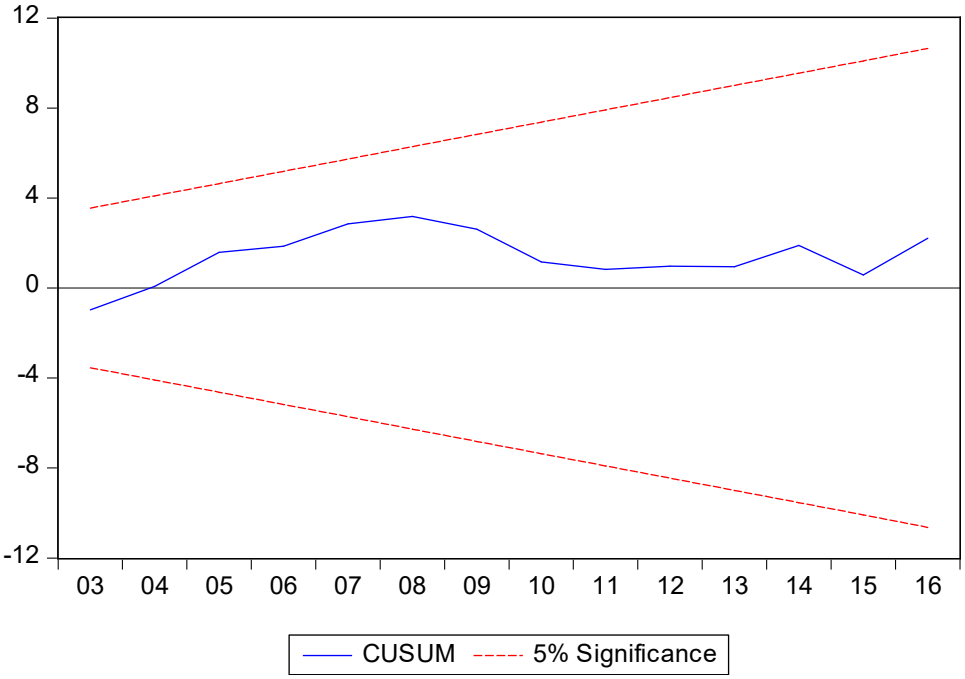
STATISTICAL TEST	F-stastistic	Prob
NORMALITY	1.6424	0.4398
SERIAL CORRELATION	1.236220	0.3250
HETEROSCEDASTICITY	0.900344	0.5676

Source: Author calculation using Eviews

Table 9 displayed the post estimation diagnostic checks such as normality, serial correlation and heteroscedasticity. The results of diagnostic tests such as normality of residual term, LM for serial correlation, for specification bias and heteroscedasticity test to attest constant variance and time invariant variance showed that the model has passed all diagnostic tests successfully. There is no problem of serial correlation and, autoregressive conditional heteroscedasticity. The residual term is normally distributed and the model is well articulated.

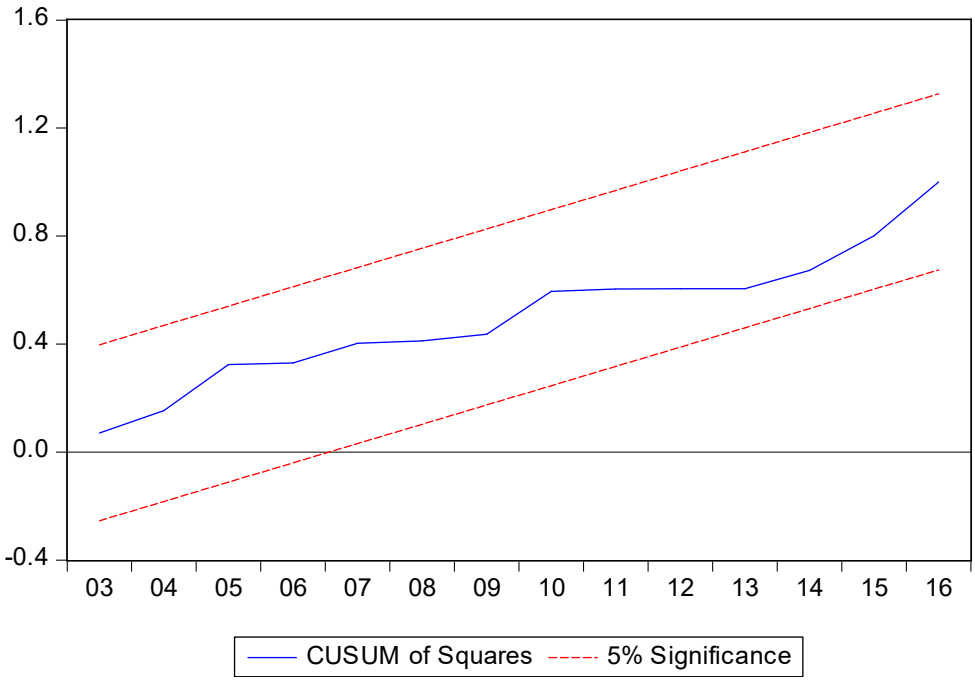
ARDL MODEL STABILITY

Figure 1- CUSUM TEST



The results of stability tests such as CUSUM and CUSUMQ tests are given in Fig 1 and 2 respectively. it's found that both graphs do not exceed critical bounds (red lines) at 5% level. This confirms that the ARDL estimates are reliable and consistent. The tests find coefficients instable if the cumulative sum goes outside the area between the two critical bounds. The CUSUM test is based on W_t statistics which is expressed as: $W_t = \sum_{r=k+1}^{t} \frac{W_r}{S}$, for $t = k + 1$, …, T, w is recursive residual, s is the standard deviation of the recursive residuals W_t. The CUSUMSQ tests is based on the recursive regression residuals, and the tests also incorporate the short-run dynamics to the long-run through residuals. The statistics are updated recursively and plotted against the break points of the model. Provided that the plots of these statistics fall inside the critical bounds of 5% significance, one assumes that the coefficients of a given regression are stable. Thus, the coefficients are stable as evident from fig 2.

Figure 2- CUSUM Q



PANEL B- NONLINEAR MODEL

4.7 Kapetanios, Shin & Snell (KSS, 2003) test results

Table 10- KSS Nonlinear Unit root test

VARIABLE	KSS	1% Critical Value	5% Critical Value	10% Critical Value
EXCHANGE RATE	**-1.242**	**-3.531**	**-2.859**	**-2.547**
OIL PRICE	**-1.740**	**-3.531**	**-2.859**	**-2.547**
INTEREST RATE	**-4.236**	**-3.531**	**-2.859**	**-2.547**
GDP	**-3.104**	**-3.702**	**-2.974**	**-2.637**
INFLATION RATE	**-3.804**	**-4.012**	**-3.295**	**-2.955**

Source: Author's computation using STATA 14.0

4.8 RESULT OF NARDL

Table 11- NARDL BOUNDS TEST

Critical values	**I(0) Bound**	**I(1) Bound**	**F Statistic**
1 %	**3.93**	**5.23**	**7.757724**
2.5%	**3.49**	**4.67**	
5%	**3.12**	**4.25**	
10 %	**2.75**	**3.79**	

Source: Author calculation using e-views

Having estimated the linear ARDL this research work is determined to estimate the NARDL in a bid to accurately measure the determinants of exchange rate stability in Nigeria and as well offer feasible policy conclusions and recommendations. As with the ARDL, the NARDL model also commenced its analysis by running the Bounds test to in a bid to investigate whether the model has a long run relationship

more formally cointegration. Computed F-statistic is contrasted against the critical values in the upper bound I(1). Clearly the Computed F-statistic value here is **7.455783** which is clearly above all the conventional acceptance levels of significance values in the upper bound I (1) Bound. Exchange rate as a dependent variable is cointegrated with oil price, interest rate, inflation rate and GDP as explanatory variables. In a nutshell the relationship between Exchange rate and oil price, interest rate, inflation rate and GDP has a long run relationship in Nigeria. Broadly in Nonlinear terms Exchange rate has a long run relationship with oil price, interest rate, inflation rate and GDP in Nigeria.

The short run estimates of the NARDL are given by Table 12. Observably the lagged values of exchange rate have negative impact on the current exchange rate. Although the first lag value has a statistically insignificant relationship with current exchange and found statistically significant at the second and third lags. Further the increase in oil price or a positive change in oil prices has a negative and statistically significant relationship with exchange rate which implies a 1% rise in Oil price will lead to 94% appreciation of the Naira while a fall or negative change in oil prices has a positive and statistically insignificant relationship with exchange rate. A 1% drop in oil prices will cause a depreciation of the Naira by approximately 61%. Moreover, interest rate and inflation rate were found to be positively related to and both are statistically insignificant to impact on exchange rate. Finally, a rise in growth rate of the economy will stimulate an appreciation of exchange rate, this implies that a negative and statistically significant relationship between GDP and exchange rate in Nigeria in the short run.

Table 12- SHORT RUN ANALYSIS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH_R(-1))	-0.238531	0.241445	-0.987932	0.3412
D(EXCH_R(-2))	-0.003327	0.001303	-2.553905	0.0240
D(EXCH_R(-3))	-0.001641	0.000691	-2.374062	0.0337
D(OIL_PRICE_INDEX_POS)	-0.941993	0.319316	-2.950038	0.0113
D(OIL_PRICE_INDEX_NEG)	0.609539	0.355696	1.713652	0.1103
D(INT_R)	1.974379	1.431742	1.379004	0.1912
D(GDP_RATE)	-5.134541	1.990653	-2.579325	0.0229
D(INF_R)	0.369110	0.305178	1.209492	0.2480
D(@TREND())	14.853311	4.591038	3.235284	0.0065
CointEq(-1)	-0.734736	0.253634	-2.896836	0.0125

Source: Author calculation using E-views

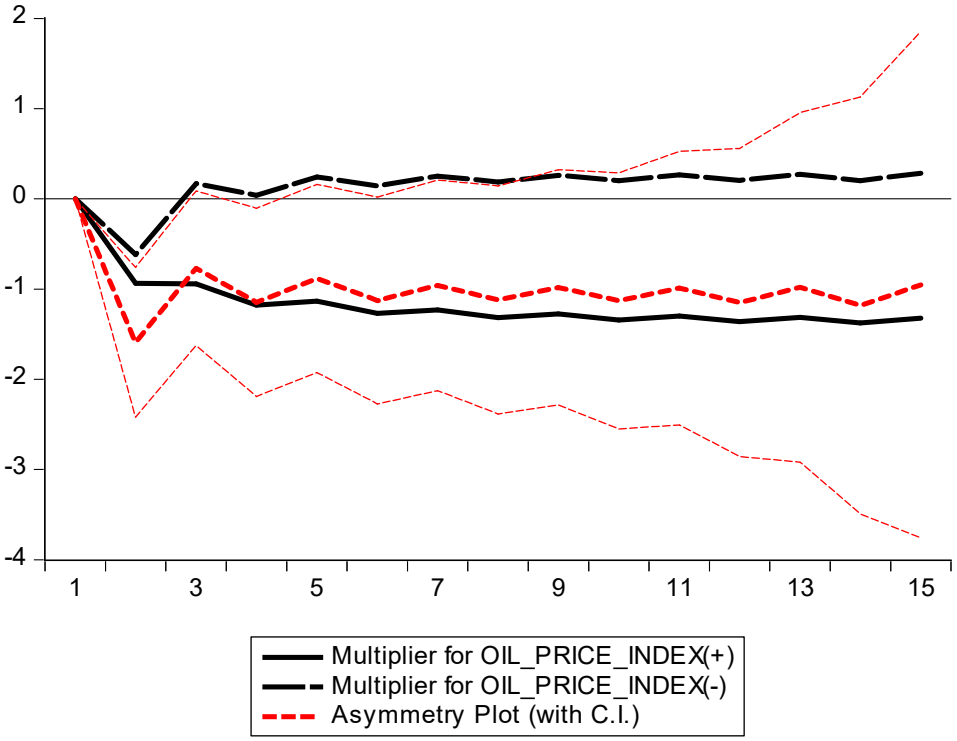
Table 13-LONG RUN ANALYSIS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL_PRICE_INDEX_POS	-1.282084	0.334499	-3.832845	0.0021
OIL_PRICE_INDEX_NEG	-0.266266	0.578921	-0.459936	0.6532
INT_R	2.687196	1.705150	1.575929	0.1391
GDP_RATE	-12.302822	7.014856	-1.753824	0.1030
INF_R	-0.425624	0.438619	-0.970373	0.3496
C	-135.188897	60.490383	-2.234882	0.0436
@TREND	20.215851	4.218495	4.792196	0.0004

Source: Author calculation using E-views

Table 13 present the long run estimate of the NARDL, consistently the positive change or rise in oil price maintains a negative and statistically significant relationship with exchange rate similar to that found in the short run estimate. While the negative change or a fall in oil prices diverges to a negative and statistically insignificant relationship with exchange rate contrary to the trend path found in the short run estimate. This implies a 1% fall in oil price will lead to a further fall in exchange rate by approximately 27%. Further in the long run, interest rate was found to be positively and statistically insignificant relationship to exchange rate while GDP and inflation rate were both found to be negatively and statistically insignificant related to exchange rate.

Figure 3- NARDL DYNAMIC MULTIPLIER

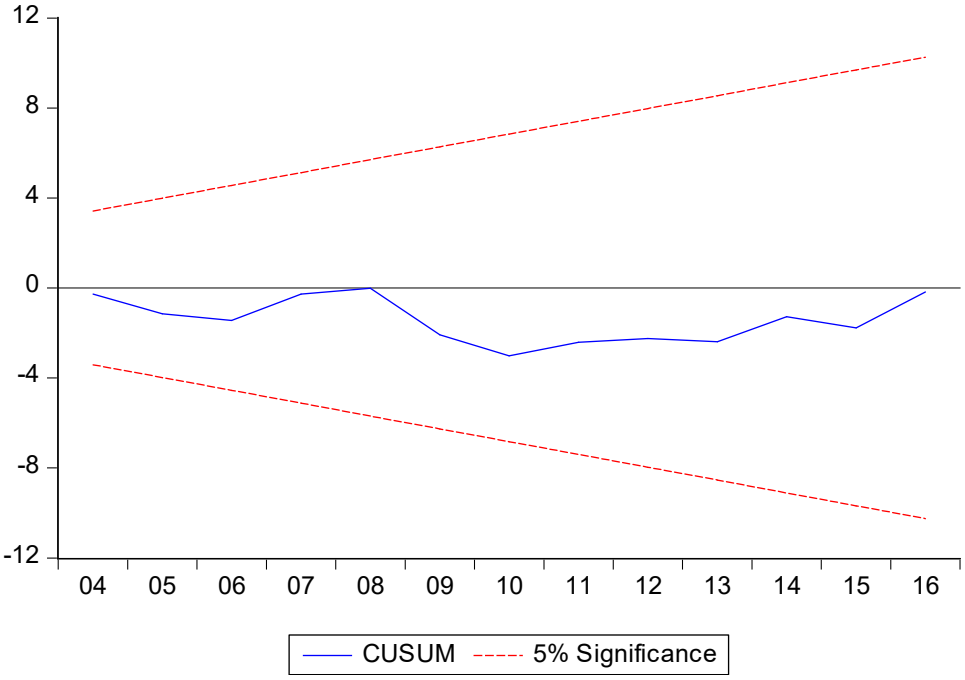


The above short run and long run estimates indicated the presence of asymmetries in oil price shocks on exchange rate in Nigeria. In a bid to assess the adjustment of asymmetry in the existing long-run equilibrium after passing to a new long-run equilibrium due to negative and positive shocks, a dynamic multiplier graph is plotted for NARDL as shown in figure 3. Here, the asymmetry curves show the linear mixture of the dynamic multipliers due to positive and negative oil price shocks. Positive and negative change curves indicate the evidence about the asymmetric adjustment of exchange rate to positive and negative oil price shocks at a given period. From the above diagram the positive shock is denoted by the black line and the negative shock by the dashed black line while the dashed red line captured the asymmetric effect.

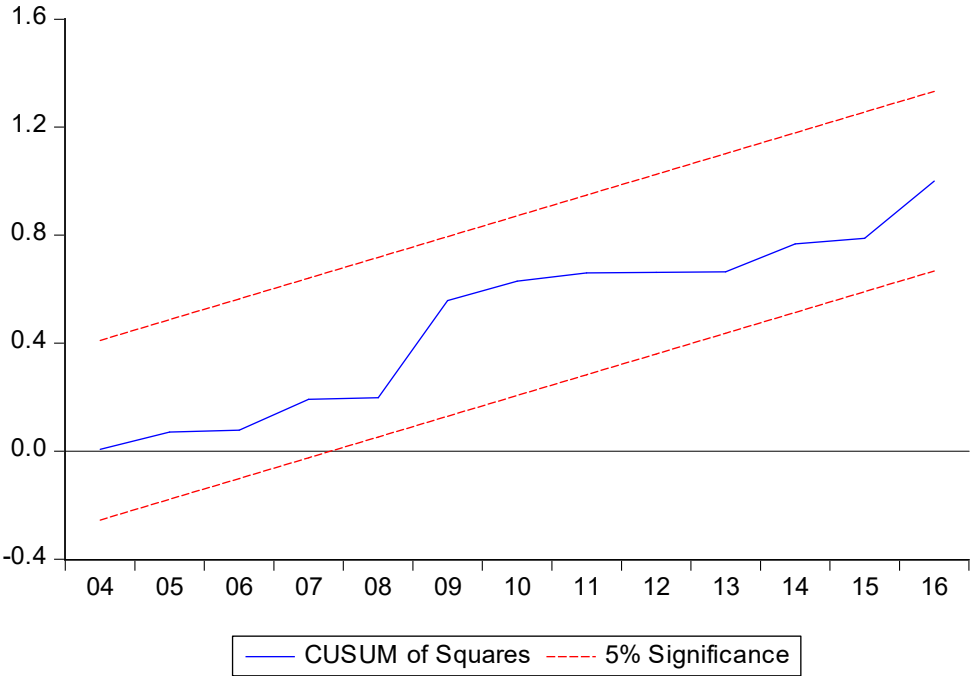
The difference between the positive component and negative component curve of Oil price represent an asymmetry curve, which indicates the linear mixture of the dynamic multipliers linked with positive and negative oil price shocks. The positive change curve gives information about the asymmetric adjustment of exchange rate to positive oil price shock at a given forecasting horizon, while the negative variation curve gives knowledge about the asymmetric adjustment of exchange rate to negative oil price shock at a forecasting horizon. The overall intuition is that positive oil price shocks have a deeper impact on exchange rate in the long run compared to the negative oil price shocks.

$$Oil\ price\ (POS) - Oil\ price\ (NEG) = Asymmetric\ Effect$$

Figure 4- CUSUM TEST



CUSUM Q



The results of stability tests such as CUSUM and CUSUMQ tests are given in Fig 4 and 5 respectively. it's found that both graphs do not exceed critical bounds (red lines) at 5% level. This confirms that the ARDL estimates are reliable and consistent.

Table 14- DIAGNOSTIC CHECKS

STATISTICAL TEST	F-stastistic	Prob
NORMALITY	1.6631	0.4353
SERIAL CORRELATION	3.8876	0.0528
HETEROSCEDASTICITY	0.91409	0.5631

Source: Author calculation using Eviews

The results of diagnostic tests such as normality of residual term, LM for serial correlation, Heteroscedasticity for testing time invariant variance are presented in Table 9. Fortunately, it has been confirmed that the model is free of serial or autocorrelation and homoscedastic variance. However, the residuals of the error term were non-normally distributed.

Table 15- Granger Causality

Null Hypothesis	Prob	Direction of Causality
OIL_PRICE_INDEX does not Granger Cause EXCH_R	0.0023	Unidirectional causality $Oil\ Price \rightarrow Exchange\ Rate$
EXCH_R does not Granger Cause OIL_PRICE_INDEX	0.8653	
INT_R does not Granger Cause EXCH_R	2.E-05	Bidirectional causality $Interest\ Rate \rightarrow Exchange\ Rate$ $Exchange\ Rate \rightarrow Interest\ rate$
EXCH_R does not Granger Cause INT_R	0.4973	
GDP_RATE does not Granger Cause EXCH_R	0.7179	Unidirectional causality $Exchange\ Rate \rightarrow GDP$
EXCH_R does not Granger Cause GDP_RATE	0.01950	
INF_R does not Granger Cause EXCH_R	0.0019	Unidirectional causality $Inflation \rightarrow Exchange\ Rate$
EXCH_R does not Granger Cause INF_R	0.1321	

Source: Authors Computation using Eviews

Table 15 reports the Granger Causality test between the variables. It can be observed that no case of neutrality was found, three cases of unidirectional causality was found and only one case of bidirectional causality was ascertained.

Oil price was found to granger cause exchange rate, signifying exchange rate as an endogenous variable. Feedback causality was found between exchange rate and interest rate, this entails both variables are complementing each other. Exchange rate was found to granger cause GDP, in this scenario exchange rate influences or has an exogenous impact on GDP and finally Inflation rate was found to have an impact on exchange rate in Nigeria.

4.9 COMPARATIVE ANAYLSIS

This section is devoted to making a comparative study between the two models estimated; the ARDL and the NARDL. Both models affirm the existence of cointegration between the variables at the 1% level using the bounds test. Short run analysis of the ARDL found all the three lagged values of exchange rate to be negative and only the second lag was found significant at the 10% level, further findings from the model are negatively related and statistically insignificant Oil prices, statistically insignificant and negatively related inflation and interest rate and GDP was found to be positively related and statistically significant at 10%.

The ECM was found to be 57% convergence rate. While in the NARDL, the short run analysis ascertains all the three lagged values of exchange rate to be negative with only the second and third lags been statistically significant. Further estimate reveals positive oil price changes to be negative and statistically significant while

negative oil price changes to be positive and statistically insignificant. Inflation and interest rates were found positive and statistically insignificant, whereas GDP was found negative and statistically significant at 5% level. The ECM was found to be 73% convergence rate. This implies that speed of adjustment in NARDL is higher than in ARDL.

The long run estimate of the ARDL reveals oil price to be the only statistically significant variable while in the NARDL positive oil price shocks remains the statistically significant variable. The Aikake information criterion (AIC) of the NARDL is **8.671276** while the AIC in ARDL is **20.46026,** given this values it's safe to say the NARDL gives better fit of Exchange rate in Nigeria based upon its minimum AIC.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 INTRODUCTION

This chapter consists of summary and conclusions drawn from the major findings of the study. Furthermore, it offers recommendations for policy formulation and suggestions for future research.

5.1 Summary of Major Findings

This study analyzed the key determinants of exchange rate stability in Nigeria. Right from the onset the variables were subjected to both linear and nonlinear unit root tests in a bid to investigate their trend path and time series properties and avoid spurious regression. All the four variables used in the analysis are found stationary at first difference. Still on the pretest, the Ramsey and BDS test were conducted to check for linearity or otherwise. conflicting result was found that is, Ramsey test indicates linear model while BDS contradict and implies Non linearity. These two conflicting result calls for estimating both Linear and Nonlinear model.

Bounds test establishes across the two models that long run relationship exist between exchange rate and its determinants. In the ARDL model the short run estimates reveals negatively related and statistically insignificant Oil prices, statistically insignificant and negatively related inflation and interest rates and GDP was found to be positively related and statistically significant at 10% While the long run, oil price was found to be the negatively related to exchange rate and GDP, inflation and interest rates to be positively related to exchange rate.

The aftermath of the ARDL model upholds that there is no problem of serial correlation and, autoregressive conditional heteroscedasticity. The residual term is normally distributed and the model is well articulated. Moreover, the results of ARDL stability tests such as CUSUM and CUSUMSQ tests found that the graphs do not exceed critical bounds (red lines) at 5% level. This confirms that the ARDL estimates are reliable and consistent.

In the NARDL cluster the short run estimates of the model reveals that past values of exchange rate have a negative influence on exchange rate. After decomposing oil price into positive and negative shocks, it was found that positive oil price shocks on exchange rate is negatively related and statistically significant while the negative oil price shocks were found to be the reverse scenario of positive shocks. In same vein GDP was found to be negatively related and statistically significant to exchange rate. The long run estimates are a bit consistent with the short run estimates. All

other variables except positive oil price shocks were found to be positive and negatively related and statistically insignificant with exchange rate.

Similarly, the aftermath of the NARDL model upholds that there is no problem of serial correlation and, autoregressive conditional heteroscedasticity. The residual term is normally distributed and the model is well articulated. Moreover, the results of ARDL stability tests such as CUSUM and CUSUMSQ tests found that the graphs do not exceed critical bounds (red lines) at 5% level. This confirms that the ARDL estimates are reliable and consistent.

Lastly, granger causality test was conducted, Oil price was found to granger cause exchange rate, signifying exchange rate as an endogenous variable. Feedback causality was found between exchange rate and interest rate, this entails both variables are complementing each other. Exchange rate was found to granger cause GDP, in this scenario exchange rate influences or has an exogenous impact on GDP and finally Inflation rate was found to have an impact on exchange rate in Nigeria.

5.2 Conclusions

This study analyzed the key determinants of exchange rate stability in Nigeria. Mechanics of different theories were elaborately discussed in the study. Right from the onset few research objectives were listed and consistently using Econometrics techniques all were achieved and fulfilled. Descriptive and summary statistics were conducted. The exchange rate model was found to have a conflicting trend path. The Ramsey test shows that it is a linear type model while the BDS test contradicts and imply Nonlinear within the model.

Both ARDL and NARDL estimates upholds that oil price plays a crucial role in determining exchange rate stability in Nigeria. An increase in oil price leads to exchange rate appreciation and vice versa. The granger causality test reports one case of bidirectional relationship and 3 cases of unidirectional relationship. Both models are free from serial correlation, heteroscedasticity, non-normal residuals and all are correctly specified.

5.2 Recommendations

Based upon the empirical findings, this study would like to proffer recommendations as follows.

Firstly, the study recommends that more credence should be given to asymmetric models for modeling exchange rate stability /volatility in Nigeria. Oil price may be considered as relevant variable in the analysis of exchange rate fluctuations in Nigeria.

Secondly, the CBN and the Federal Government to intensify efforts to revamp other sectors of the economy, embed them to a medium-long term diversification plan to revive agricultural sector, improve and efficient taxation, and solidify the economy as a service oriented and financially developed economic clime. Successful diversification of the economy will improve foreign receipts which will consequently stabilize the exchange rate and mitigate the vulnerability of its adverse effect on stock market thereby boosting investor's confidence and enhancing more funds inflow into the capital market.

Therefore, this study recommended that government should encourage the export promotion strategies in order to maintain a surplus balance of trade and also conducive environment, adequate security, effective fiscal and monetary, as well as infrastructural facilities should be provided so that foreign investors will be attracted to invest in Nigeria.

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APPENDIX

UNIT ROOT TEST

EXCHANGE RATE

ADF

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-16.69141	0.0001
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCH_R,2)
Method: Least Squares
Date: 01/30/20 Time: 23:25
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH_R(-1))	-1.499915	0.089861	-16.69141	0.0000
C	-1364.696	975.9142	-1.398377	0.1726

R-squared	0.905723	Mean dependent var	-1379.254
Adjusted R-squared	0.902472	S.D. dependent var	17399.12
S.E. of regression	5433.658	Akaike info criterion	20.10095
Sum squared resid	8.56E+08	Schwarz criterion	20.19347
Log likelihood	-309.5648	Hannan-Quinn criter.	20.13111
F-statistic	278.6033	Durbin-Watson stat	0.533587
Prob(F-statistic)	0.000000		

PP

Null Hypothesis: D(EXCH_R) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*

Phillips-Perron test statistic		-13.64012	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Residual variance (no correction)	27619825
HAC corrected variance (Bartlett kernel)	45894276

Phillips-Perron Test Equation
Dependent Variable: D(EXCH_R,2)
Method: Least Squares
Date: 01/30/20 Time: 23:26
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH_R(-1))	-1.499915	0.089861	-16.69141	0.0000
C	-1364.696	975.9142	-1.398377	0.1726

R-squared	0.905723	Mean dependent var	-1379.254
Adjusted R-squared	0.902472	S.D. dependent var	17399.12
S.E. of regression	5433.658	Akaike info criterion	20.10095
Sum squared resid	8.56E+08	Schwarz criterion	20.19347
Log likelihood	-309.5648	Hannan-Quinn criter.	20.13111
F-statistic	278.6033	Durbin-Watson stat	0.533587
Prob(F-statistic)	0.000000		

KPSS

Null Hypothesis: D(EXCH_R) is stationary
Exogenous: Constant
Bandwidth: 31 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.500000
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	1.14E+08
HAC corrected variance (Bartlett kernel)	3569240.

KPSS Test Equation
Dependent Variable: D(EXCH_R)
Method: Least Squares
Date: 01/30/20 Time: 23:26
Sample (adjusted): 1987 2018
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.402491	1919.831	0.004898	0.9961

R-squared	0.000000	Mean dependent var	9.402491
Adjusted R-squared	0.000000	S.D. dependent var	10860.20
S.E. of regression	10860.20	Akaike info criterion	21.45435
Sum squared resid	3.66E+09	Schwarz criterion	21.50015
Log likelihood	-342.2696	Hannan-Quinn criter.	21.46953
Durbin-Watson stat	2.500052		

OIL PRICE

ADF

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.786289	0.0006
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OIL_PRICE_INDEX,2)
Method: Least Squares
Date: 01/30/20 Time: 23:30
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OIL_PRICE_INDEX(-1))	-0.895750	0.187149	-4.786289	0.0000
C	1.452566	2.641436	0.549915	0.5866

R-squared	0.441325	Mean dependent var	0.354839
Adjusted R-squared	0.422061	S.D. dependent var	19.27243
S.E. of regression	14.65135	Akaike info criterion	8.269283
Sum squared resid	6225.202	Schwarz criterion	8.361799
Log likelihood	-126.1739	Hannan-Quinn criter.	8.299441
F-statistic	22.90856	Durbin-Watson stat	1.935050

Prob(F-statistic)	0.000046

PP

Null Hypothesis: D(OIL_PRICE_INDEX) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.734854	0.0006
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Residual variance (no correction)	200.8130
HAC corrected variance (Bartlett kernel)	170.5914

Phillips-Perron Test Equation
Dependent Variable: D(OIL_PRICE_INDEX,2)
Method: Least Squares
Date: 01/30/20 Time: 23:29
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OIL_PRICE_INDEX(-1))	-0.895750	0.187149	-4.786289	0.0000
C	1.452566	2.641436	0.549915	0.5866

R-squared	0.441325	Mean dependent var	0.354839
Adjusted R-squared	0.422061	S.D. dependent var	19.27243
S.E. of regression	14.65135	Akaike info criterion	8.269283
Sum squared resid	6225.202	Schwarz criterion	8.361799
Log likelihood	-126.1739	Hannan-Quinn criter.	8.299441
F-statistic	22.90856	Durbin-Watson stat	1.935050
Prob(F-statistic)	0.000046		

KPSS

Null Hypothesis: D(OIL_PRICE_INDEX) is stationary
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.080156
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	196.7096
HAC corrected variance (Bartlett kernel)	189.1158

KPSS Test Equation
Dependent Variable: D(OIL_PRICE_INDEX)
Method: Least Squares
Date: 01/30/20 Time: 23:28
Sample (adjusted): 1987 2018
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.634375	2.519022	0.648813	0.5212

R-squared	0.000000	Mean dependent var	1.634375
Adjusted R-squared	0.000000	S.D. dependent var	14.24974
S.E. of regression	14.24974	Akaike info criterion	8.182106
Sum squared resid	6294.708	Schwarz criterion	8.227910
Log likelihood	-129.9137	Hannan-Quinn criter.	8.197289
Durbin-Watson stat	1.770806		

GDP RATE

ADF

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.126637	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP_RATE,2)
Method: Least Squares

Date: 01/30/20 Time: 23:31
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP_RATE(-1))	-1.467264	0.160767	-9.126637	0.0000
C	0.002740	0.476928	0.005746	0.9955

R-squared	0.741753	Mean dependent var	0.139722
Adjusted R-squared	0.732848	S.D. dependent var	5.134979
S.E. of regression	2.654105	Akaike info criterion	4.852433
Sum squared resid	204.2840	Schwarz criterion	4.944949
Log likelihood	-73.21272	Hannan-Quinn criter.	4.882591
F-statistic	83.29550	Durbin-Watson stat	1.401995
Prob(F-statistic)	0.000000		

PP

Null Hypothesis: D(GDP_RATE) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.817269	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Residual variance (no correction)	6.589806
HAC corrected variance (Bartlett kernel)	7.706238

Phillips-Perron Test Equation
Dependent Variable: D(GDP_RATE,2)
Method: Least Squares
Date: 01/30/20 Time: 23:32
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP_RATE(-1))	-1.467264	0.160767	-9.126637	0.0000
C	0.002740	0.476928	0.005746	0.9955

R-squared	0.741753	Mean dependent var	0.139722
Adjusted R-squared	0.732848	S.D. dependent var	5.134979
S.E. of regression	2.654105	Akaike info criterion	4.852433
Sum squared resid	204.2840	Schwarz criterion	4.944949
Log likelihood	-73.21272	Hannan-Quinn criter.	4.882591

F-statistic	83.29550	Durbin-Watson stat	1.401995
Prob(F-statistic)	0.000000		

KPSS

Null Hypothesis: D(GDP_RATE) is stationary
Exogenous: Constant
Bandwidth: 28 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.458424
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	8.562506
HAC corrected variance (Bartlett kernel)	0.858384

KPSS Test Equation
Dependent Variable: D(GDP_RATE)
Method: Least Squares
Date: 01/30/20 Time: 23:33
Sample (adjusted): 1987 2018
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.055085	0.525557	-0.104813	0.9172

R-squared	0.000000	Mean dependent var	-0.055085
Adjusted R-squared	0.000000	S.D. dependent var	2.972998
S.E. of regression	2.972998	Akaike info criterion	5.047770
Sum squared resid	274.0002	Schwarz criterion	5.093574
Log likelihood	-79.76432	Hannan-Quinn criter.	5.062953
Durbin-Watson stat	2.889216		

INTEREST RATE

ADF

Null Hypothesis: D(INT_R) has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.696140	0.0000
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INT_R,2)
Method: Least Squares
Date: 02/05/20 Time: 15:06
Sample (adjusted): 1994 2018
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INT_R(-1))	-3.851462	0.397216	-9.696140	0.0000
D(INT_R(-1),2)	2.318931	0.340077	6.818834	0.0000
D(INT_R(-2),2)	1.902113	0.290200	6.554490	0.0000
D(INT_R(-3),2)	1.483227	0.225280	6.583916	0.0000
D(INT_R(-4),2)	0.997031	0.189452	5.262701	0.0001
D(INT_R(-5),2)	0.571604	0.141168	4.049096	0.0008
D(INT_R(-6),2)	0.264769	0.097165	2.724930	0.0144
C	-1.460903	0.337756	-4.325321	0.0005

R-squared	0.925983	Mean dependent var	-0.275600
Adjusted R-squared	0.895505	S.D. dependent var	4.871897
S.E. of regression	1.574870	Akaike info criterion	4.000560
Sum squared resid	42.16368	Schwarz criterion	4.390601
Log likelihood	-42.00700	Hannan-Quinn criter.	4.108741
F-statistic	30.38245	Durbin-Watson stat	1.481882
Prob(F-statistic)	0.000000		

PP

Null Hypothesis: D(INT_R) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.041637	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Residual variance (no correction)	9.947884
HAC corrected variance (Bartlett kernel)	9.479597

Phillips-Perron Test Equation
Dependent Variable: D(INT_R,2)
Method: Least Squares
Date: 02/05/20 Time: 15:07
Sample (adjusted): 1988 2018
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INT_R(-1))	-1.087220	0.180449	-6.025067	0.0000
C	0.012741	0.586167	0.021737	0.9828

R-squared	0.555906	Mean dependent var	-0.130000
Adjusted R-squared	0.540592	S.D. dependent var	4.811139
S.E. of regression	3.260973	Akaike info criterion	5.264269
Sum squared resid	308.3844	Schwarz criterion	5.356784
Log likelihood	-79.59617	Hannan-Quinn criter.	5.294427
F-statistic	36.30143	Durbin-Watson stat	2.064987
Prob(F-statistic)	0.000001		

KPSS

Null Hypothesis: D(INT_R) is stationary
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.252045
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	10.20600
HAC corrected variance (Bartlett kernel)	8.487596

KPSS Test Equation
Dependent Variable: D(INT_R)

Method: Least Squares
Date: 02/05/20 Time: 15:09
Sample (adjusted): 1987 2018
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.127188	0.573782	0.221665	0.8260

R-squared	0.000000	Mean dependent var	0.127188
Adjusted R-squared	0.000000	S.D. dependent var	3.245801
S.E. of regression	3.245801	Akaike info criterion	5.223353
Sum squared resid	326.5920	Schwarz criterion	5.269157
Log likelihood	-82.57365	Hannan-Quinn criter.	5.238536
Durbin-Watson stat	2.127840		

INFLATION RATE

ADF

Null Hypothesis: D(INF_R) has a unit root
Exogenous: Constant
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.051917	0.0427
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF_R,2)
Method: Least Squares
Date: 02/05/20 Time: 15:15
Sample (adjusted): 1990 2016
Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF_R(-1))	-1.070709	0.350832	-3.051917	0.0057
D(INF_R(-1),2)	-0.094980	0.266740	-0.356079	0.7250
D(INF_R(-2),2)	-0.002540	0.161420	-0.015734	0.9876
C	0.515916	3.263513	0.158086	0.8758

R-squared	0.643192	Mean dependent var	1.818519
Adjusted R-squared	0.596652	S.D. dependent var	26.45803
S.E. of regression	16.80342	Akaike info criterion	8.616995

Sum squared resid	6494.162	Schwarz criterion	8.808971
Log likelihood	-112.3294	Hannan-Quinn criter.	8.674080
F-statistic	13.82013	Durbin-Watson stat	1.755790
Prob(F-statistic)	0.000023		

PP

Null Hypothesis: D(INF_R) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.867523	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

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

Residual variance (no correction)	292.7194
HAC corrected variance (Bartlett kernel)	301.2624

Phillips-Perron Test Equation
Dependent Variable: D(INF_R,2)
Method: Least Squares
Date: 02/05/20 Time: 15:12
Sample (adjusted): 1988 2016
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF_R(-1))	-1.146533	0.166185	-6.899158	0.0000
C	-1.466395	3.292641	-0.445355	0.6596

R-squared	0.638062	Mean dependent var	-1.500000
Adjusted R-squared	0.624657	S.D. dependent var	28.94200
S.E. of regression	17.73139	Akaike info criterion	8.655023
Sum squared resid	8488.863	Schwarz criterion	8.749319
Log likelihood	-123.4978	Hannan-Quinn criter.	8.684555
F-statistic	47.59839	Durbin-Watson stat	1.939495
Prob(F-statistic)	0.000000		

KPSS

Null Hypothesis: D(INF_R) is stationary
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.110069
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	381.5223
HAC corrected variance (Bartlett kernel)	174.5765

KPSS Test Equation
Dependent Variable: D(INF_R)
Method: Least Squares
Date: 02/05/20 Time: 15:11
Sample (adjusted): 1987 2016
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.295000	3.627112	0.081332	0.9357

R-squared	0.000000	Mean dependent var	0.295000
Adjusted R-squared	0.000000	S.D. dependent var	19.86651
S.E. of regression	19.86651	Akaike info criterion	8.848713
Sum squared resid	11445.67	Schwarz criterion	8.895420
Log likelihood	-131.7307	Hannan-Quinn criter.	8.863655
Durbin-Watson stat	2.054852		

ssur EXCHR , constant maxlag(3)

Kapetanios, Shin & Snell (2003) test results for 1990 - 2018

Variable name: EXCHR

Ho: Unit root

Ha: Stationary nonlinear ESTAR model

OLS demeaned data

Criteria Lags KSS stat. p-value 1% cv 5% cv 10% cv

FIXED 3 -1.242 0.691 -3.531 -2.859 -2.547

AIC 0 0.030 0.947 -3.772 -3.053 -2.713

SIC 0 0.030 0.945 -3.702 -2.974 -2.637

GTS05 0 0.030 0.945 -3.707 -2.982 -2.644

GTS10 2 -1.252 0.714 -3.747 -3.028 -2.690

kssur INTR , constant maxlag(3)

Kapetanios, Shin & Snell (2003) test results for 1990 - 2018

Variable name: INTR

Ho: Unit root

Ha: Stationary nonlinear ESTAR model

OLS demeaned data

Criteria Lags KSS stat. p-value 1% cv 5% cv 10% cv

FIXED 3 -4.236 0.002 -3.531 -2.859 -2.547

AIC 0 -4.419 0.002 -3.772 -3.053 -2.713

SIC 0 -4.419 0.002 -3.702 -2.974 -2.637

GTS05 0 -4.419 0.002 -3.707 -2.982 -2.644

GTS10 0 -4.419 0.002 -3.747 -3.028 -2.690

kssur OILPRICEINDEX , constant maxlag(3)

Kapetanios, Shin & Snell (2003) test results for 1990 - 2018

Variable name: OILPRICEINDEX

Ho: Unit root

Ha: Stationary nonlinear ESTAR model

OLS demeaned data

Criteria	Lags	KSS stat.	p-value	1% cv	5% cv	10% cv
AIC	0	-1.756	0.470	-3.772	-3.053	-2.713
SIC	0	-1.756	0.439	-3.702	-2.974	-2.637
GTS05	0	-1.756	0.441	-3.707	-2.982	-2.644
GTS10	0	-1.756	0.461	-3.747	-3.028	-2.690

. kssur OILPRICEINDEX , trend maxlag(3)

Kapetanios, Shin & Snell (2003) test results for 1990 - 2018

Variable name: OILPRICEINDEX

Ho: Unit root

Ha: Stationary nonlinear ESTAR model

OLS detrended data

Criteria	Lags	KSS stat.	p-value	1% cv	5% cv	10% cv

FIXED	3	-2.314	0.311	-3.997	-3.294	-2.959
AIC	1	-2.463	0.332	-4.329	-3.581	-3.219
SIC	0	-1.989	0.524	-4.270	-3.490	-3.117
GTS05	0	-1.989	0.527	-4.266	-3.496	-3.124
GTS10	0	-1.989	0.555	-4.301	-3.547	-3.184

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kssur INFR , trend maxlag(3)

(2 missing values generated)

Kapetanios, Shin & Snell (2003) test results for 1990 - 2016

Variable name: INFR

Ho: Unit root

Ha: Stationary nonlinear ESTAR model

OLS detrended data

Criteria	Lags	KSS stat.	p-value	1% cv	5% cv	10% cv
FIXED	3	-3.804	0.016	-4.012	-3.295	-2.955
AIC	2	-3.695	0.041	-4.365	-3.600	-3.231
SIC	0	-3.194	0.089	-4.303	-3.507	-3.126
GTS05	2	-3.695	0.035	-4.300	-3.512	-3.132
GTS10	2	-3.695	0.039	-4.336	-3.566	-3.195

. kssur GDPRATE , constant maxlag(3)

Kapetanios, Shin & Snell (2003) test results for 1990 - 2018

Variable name: GDPRATE

Ho: Unit root

Ha: Stationary nonlinear ESTAR model

OLS demeaned data

Criteria	Lags	KSS stat.	p-value	1% cv	5% cv	10% cv
FIXED	3	-2.403	0.136	-3.531	-2.859	-2.547
AIC	2	-2.690	0.105	-3.772	-3.053	-2.713
SIC	0	-3.104	0.038	-3.702	-2.974	-2.637
GTS05	2	-2.690	0.091	-3.707	-2.982	-2.644
GTS10	2	-2.690	0.100	-3.747	-3.028	-2.690

ESTIMATION OUTPUT

NARDL

BOUNDS TEST

ARDL Bounds Test
Date: 01/30/20 Time: 23:03
Sample: 1990 2016

Included observations: 27
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	7.757724	5

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.75	3.79
5%	3.12	4.25
2.5%	3.49	4.67
1%	3.93	5.23

Test Equation:
Dependent Variable: D(EXCH_R)
Method: Least Squares
Date: 01/30/20 Time: 23:03
Sample: 1990 2016
Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH_R(-1))	-0.367067	0.274317	-1.338111	0.2038
D(EXCH_R(-2))	-0.003029	0.001537	-1.970627	0.0704
D(EXCH_R(-3))	-0.001469	0.000803	-1.828788	0.0905
D(OIL_PRICE_INDEX_NEG)	0.216778	0.424014	0.511253	0.6177
D(GDP_RATE)	-5.795314	2.274847	-2.547562	0.0243
D(INF_R)	0.401568	0.370271	1.084526	0.2978
C	-35.46498	79.28270	-0.447323	0.6620
@TREND	11.78443	5.862758	2.010048	0.0656
OIL_PRICE_INDEX_POS(-1)	-0.790628	0.397714	-1.987933	0.0683
OIL_PRICE_INDEX_NEG(-1)	-0.197829	0.488065	-0.405333	0.6918
INT_R(-1)	0.550022	1.834450	0.299829	0.7690
GDP_RATE(-1)	-10.85110	3.475863	-3.121844	0.0081
INF_R(-1)	-0.416057	0.310890	-1.338277	0.2037
EXCH_R(-1)	-0.613334	0.360785	-1.699999	0.1129

R-squared	0.814405	Mean dependent var	11.02247
Adjusted R-squared	0.628810	S.D. dependent var	26.02729
S.E. of regression	15.85722	Akaike info criterion	8.671276
Sum squared resid	3268.867	Schwarz criterion	9.343191
Log likelihood	-103.0622	Hannan-Quinn criter.	8.871072
F-statistic	4.388080	Durbin-Watson stat	2.652652
Prob(F-statistic)	0.006019		

ECM

ARDL Cointegrating And Long Run Form
Dependent Variable: EXCH_R
Selected Model: ARDL(4, 0, 1, 0, 1, 1)
Date: 01/30/20 Time: 23:04
Sample: 1986 2018
Included observations: 27

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH_R(-1))	-0.238531	0.241445	-0.987932	0.3412
D(EXCH_R(-2))	-0.003327	0.001303	-2.553905	0.0240
D(EXCH_R(-3))	-0.001641	0.000691	-2.374062	0.0337
D(OIL_PRICE_INDEX_POS)	-0.941993	0.319316	-2.950038	0.0113
D(OIL_PRICE_INDEX_NEG)	0.609539	0.355696	1.713652	0.1103
D(INT_R)	1.974379	1.431742	1.379004	0.1912
D(GDP_RATE)	-5.134541	1.990653	-2.579325	0.0229
D(INF_R)	0.369110	0.305178	1.209492	0.2480
D(@TREND())	14.853311	4.591038	3.235284	0.0065
CointEq(-1)	-0.734736	0.253634	-2.896836	0.0125

Cointeq = EXCH_R - (-1.2821*OIL_PRICE_INDEX_POS -0.2663
*OIL_PRICE_INDEX_NEG + 2.6872*INT_R -12.3028*GDP_RATE
-0.4256*INF_R -135.1889 + 20.2159*@TREND)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL_PRICE_INDEX_POS	-1.282084	0.334499	-3.832845	0.0021
OIL_PRICE_INDEX_NEG	-0.266266	0.578921	-0.459936	0.6532
INT_R	2.687196	1.705150	1.575929	0.1391
GDP_RATE	-12.302822	7.014856	-1.753824	0.1030
INF_R	-0.425624	0.438619	-0.970373	0.3496
C	-135.188897	60.490383	-2.234882	0.0436
@TREND	20.215851	4.218495	4.792196	0.0004

BDS

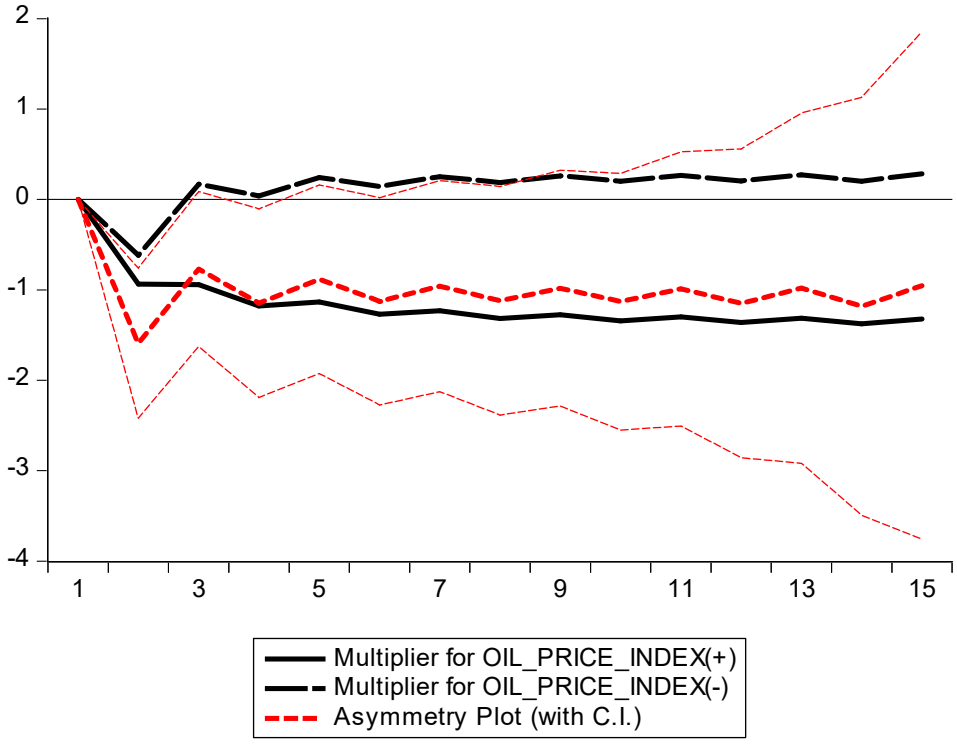
BDS Test for RESID02
Date: 01/30/20 Time: 22:49
Sample: 1986 2018
Included observations: 33

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
2	0.013018	0.014265	0.912559	0.3615
3	0.013374	0.023147	0.577764	0.5634
4	0.001317	0.028160	0.046772	0.9627
5	-0.016670	0.030009	-0.555485	0.5786
6	-0.020142	0.029616	-0.680113	0.4964

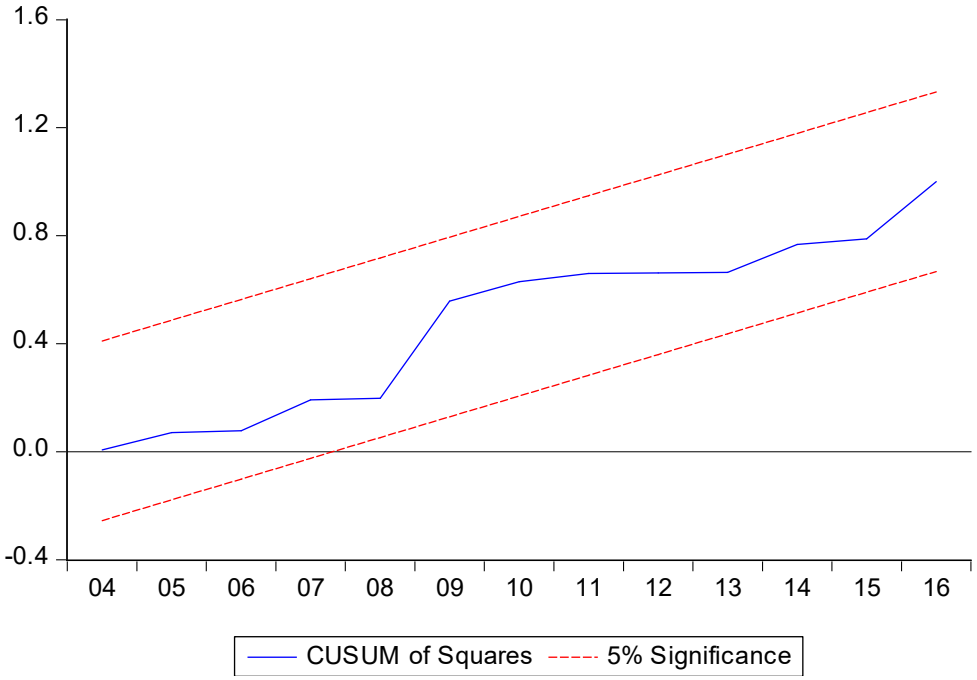
Raw epsilon	14.29180		
Pairs within epsilon	515.0000	V-Statistic	0.706447
Triples within epsilon	10539.00	V-Statistic	0.535437

Dimension	C(m,n)	c(m,n)	C(1,n-(m-1))	c(1,n-(m-1))	c(1,n-(m-1))^k
2	160.0000	0.492308	225.0000	0.692308	0.479290
3	104.0000	0.346667	208.0000	0.693333	0.333293
4	65.00000	0.235507	192.0000	0.695652	0.234190
5	37.00000	0.146245	176.0000	0.695652	0.162915
6	19.00000	0.082251	158.0000	0.683983	0.102393

Dynamic Multipliers



CUSUM Q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1.2
0.8
0.4
0.0
-0.4
04
05
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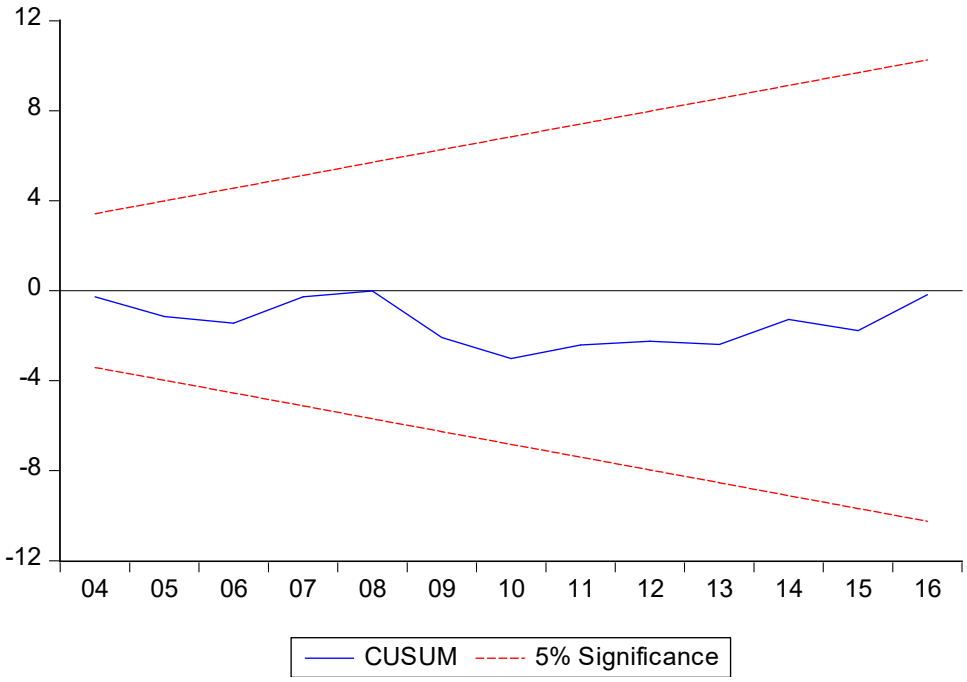
16
CUSUM of Squares
5% Significance

CUSUM


12
8
4
0
-4
-8
-12
04
05
06
07
08
09
10
11
12
13
14
15
16
CUSUM
5% Significance

ARDL

BOUNDS TEST

ARDL Bounds Test
Date: 01/30/20 Time: 23:08
Sample: 1987 2016
Included observations: 30
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	7.455783	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Test Equation:
Dependent Variable: D(EXCH_R)
Method: Least Squares
Date: 01/30/20 Time: 23:08
Sample: 1987 2016
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP_RATE)	-399.8977	501.9450	-0.796696	0.4341
D(INF_R)	181.8495	70.51872	2.578741	0.0171
C	25822.72	7865.033	3.283231	0.0034
OIL_PRICE_INDEX(-1)	-110.3089	46.09380	-2.393139	0.0257
GDP_RATE(-1)	-64.01576	605.4072	-0.105740	0.9167
INF_R(-1)	98.13341	77.67780	1.263339	0.2197
INT_R(-1)	-1148.562	331.6776	-3.462886	0.0022
EXCH_R(-1)	-1.171719	0.198711	-5.896589	0.0000

R-squared	0.783347	Mean dependent var	10.02932
Adjusted R-squared	0.714412	S.D. dependent var	11228.45
S.E. of regression	6000.526	Akaike info criterion	20.46026
Sum squared resid	7.92E+08	Schwarz criterion	20.83391
Log likelihood	-298.9039	Hannan-Quinn criter.	20.57980
F-statistic	11.36358	Durbin-Watson stat	1.636076
Prob(F-statistic)	0.000005		

ECM

ARDL Cointegrating And Long Run Form
Dependent Variable: EXCH_R
Selected Model: ARDL(1, 0, 1, 1, 0)
Date: 01/30/20 Time: 23:08
Sample: 1986 2018
Included observations: 30

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OIL_PRICE_INDEX)	-140.963785	58.559420	-2.407192	0.0249
D(GDP_RATE)	24.547965	562.336066	0.043654	0.9656
D(INF_R)	267.283127	75.708941	3.530404	0.0019
D(INT_R)	-1241.923592	385.876736	-3.218446	0.0040
CointEq(-1)	-1.136243	0.200911	-5.655470	0.0000

Cointeq = EXCH_R - (-124.0613*OIL_PRICE_INDEX + 369.9928
*GDP_RATE + 83.5182*INF_R -1093.0085*INT_R + 23491.1688)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL_PRICE_INDEX	-124.061269	49.819386	-2.490221	0.0208
GDP_RATE	369.992796	599.230504	0.617447	0.5433
INF_R	83.518208	66.249300	1.260666	0.2206
INT_R	-1093.008509	317.641201	-3.441016	0.0023
C	23491.16882 0	7396.226127	3.176102	0.0044

BDS

BDS Test for RESID04
Date: 01/30/20 Time: 23:12
Sample: 1986 2018
Included observations: 33

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
2	0.077664	0.017981	4.319324	0.0000
3	0.162662	0.029346	5.542996	0.0000
4	0.230324	0.035915	6.413061	0.0000
5	0.257658	0.038501	6.692323	0.0000
6	0.260227	0.038216	6.809394	0.0000

Raw epsilon	5861.276		
Pairs within epsilon	683.0000	V-Statistic	0.710718
Triples within epsilon	16515.00	V-Statistic	0.554362

Dimension	C(m,n)	c(m,n)	C(1,n-(m-1))	c(1,n-(m-1))	c(1,n-(m-1))^k
2	259.0000	0.595402	313.0000	0.719540	0.517738
3	214.0000	0.527094	290.0000	0.714286	0.364431
4	177.0000	0.468254	264.0000	0.698413	0.237930
5	144.0000	0.410256	241.0000	0.686610	0.152598
6	115.0000	0.353846	219.0000	0.673846	0.093619

SERIAL CORRELATION- LM TEST

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.191534	Prob. F(2,20)	0.8272
Obs*R-squared	0.563803	Prob. Chi-Square(2)	0.7543

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 01/31/20 Time: 14:29
Sample: 1987 2016
Included observations: 30
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH_R(-1)	-0.037038	0.280404	-0.132089	0.8962
OIL_PRICE_INDEX	4.356416	61.27515	0.071096	0.9440
INT_R	-15.15931	401.6392	-0.037744	0.9703
GDP_RATE	-40.75320	587.9523	-0.069314	0.9454
GDP_RATE(-1)	-87.06849	645.8281	-0.134817	0.8941
INF_R	3.823555	78.89939	0.048461	0.9618
INF_R(-1)	2.061929	75.35784	0.027362	0.9784
C	596.2845	9074.762	0.065708	0.9483
RESID(-1)	0.065866	0.352060	0.187088	0.8535
RESID(-2)	0.151389	0.251208	0.602646	0.5535

R-squared	0.018793	Mean dependent var	-2.36E-12
Adjusted R-squared	-0.422750	S.D. dependent var	5385.321
S.E. of regression	6423.560	Akaike info criterion	20.63453
Sum squared resid	8.25E+08	Schwarz criterion	21.10160
Log likelihood	-299.5180	Hannan-Quinn criter.	20.78395
F-statistic	0.042563	Durbin-Watson stat	1.494423
Prob(F-statistic)	0.999982		

HETEROSCEDASTICITY

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	8.129088	Prob. F(7,22)	0.0001
Obs*R-squared	21.63536	Prob. Chi-Square(7)	0.0029
Scaled explained SS	37.86094	Prob. Chi-Square(7)	0.0000

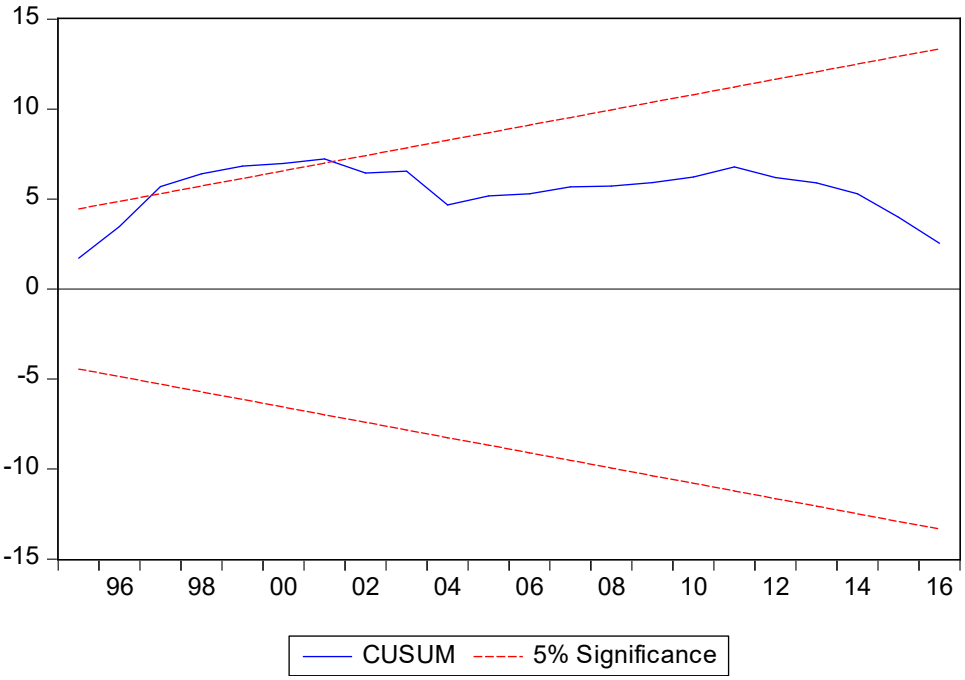
Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 01/31/20 Time: 14:31
Sample: 1987 2016
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.61E+08	61921793	4.215168	0.0004
EXCH_R(-1)	-1568.680	1432.988	-1.094692	0.2855
OIL_PRICE_INDEX	-1363727.	417673.3	-3.265056	0.0035

INT_R	-11716684	2752254.	-4.257122	0.0003
GDP_RATE	-1266963.	4010845.	-0.315884	0.7551
GDP_RATE(-1)	4545496.	4323883.	1.051253	0.3046
INF_R	3084097.	539991.8	5.711378	0.0000
INF_R(-1)	-1761187.	495550.3	-3.554002	0.0018

R-squared	0.721179	Mean dependent var	28034955
Adjusted R-squared	0.632463	S.D. dependent var	72742575
S.E. of regression	44100063	Akaike info criterion	38.26500
Sum squared resid	4.28E+16	Schwarz criterion	38.63865
Log likelihood	-565.9750	Hannan-Quinn criter.	38.38453
F-statistic	8.129088	Durbin-Watson stat	1.503214
Prob(F-statistic)	0.000066		

CUSUM



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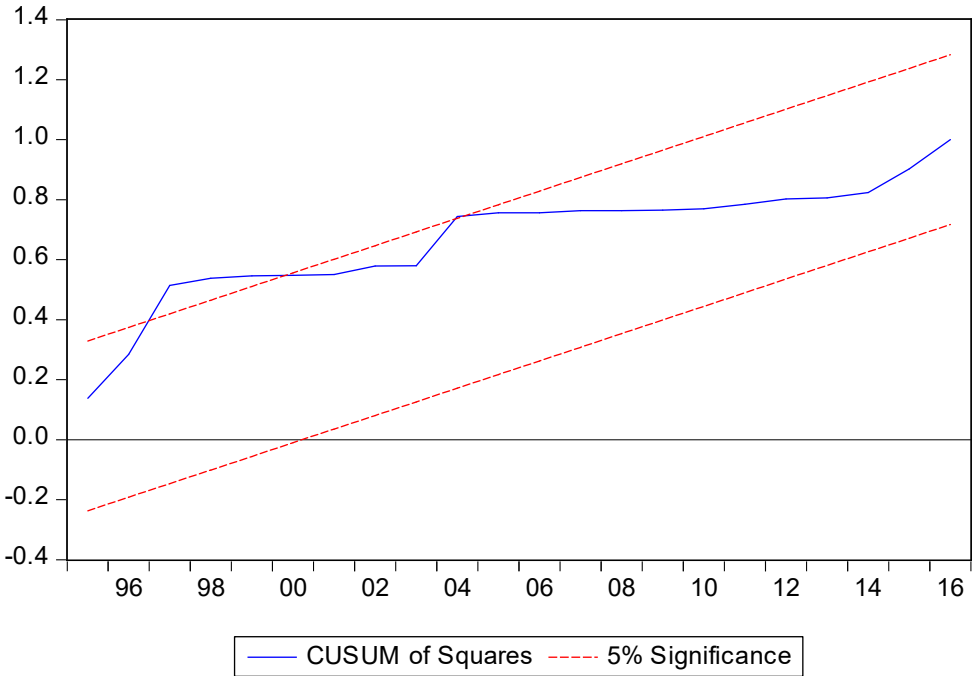

Ramsey RESET Test
Equation: NARDL03
Specification: EXCH_R EXCH_R(-1) EXCH_R(-2) EXCH_R(-3) EXCH_R(-4) OIL_PRICE_INDEX_POS OIL_PRICE_INDEX_NEG OIL_PRICE_INDEX_NEG(-1) INT_R GDP_RATE GDP_RATE(-1) INF_R INF_R(-1) C @TREND
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.919010	12	0.0791
F-statistic	3.682599	(1, 12)	0.0791

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	600.9248	1	600.9248
Restricted SSR	2559.079	13	196.8522
Unrestricted SSR	1958.154	12	163.1795

Unrestricted Test Equation:
Dependent Variable: EXCH_R
Method: ARDL
Date: 02/05/20 Time: 10:41
Sample: 1990 2016
Included observations: 27
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic):

Fixed regressors: C @TREND

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
EXCH_R(-1)	0.127025	0.215818	0.588576	0.5671
EXCH_R(-2)	0.032545	0.244008	0.133377	0.8961
EXCH_R(-3)	0.000378	0.000939	0.402870	0.6941
EXCH_R(-4)	0.000466	0.000878	0.531123	0.6050
OIL_PRICE_INDEX_POS	-0.444177	0.389636	-1.139981	0.2765
OIL_PRICE_INDEX_NEG	0.423413	0.338061	1.252477	0.2343
OIL_PRICE_INDEX_NEG(-1)	-0.030701	0.552982	-0.055519	0.9566
INT_R	1.416670	1.335554	1.060736	0.3097
GDP_RATE	-1.597412	2.585007	-0.617953	0.5482
GDP_RATE(-1)	-1.830171	2.101798	-0.870765	0.4010
INF_R	0.046256	0.324818	0.142407	0.8891
INF_R(-1)	-0.438360	0.239997	-1.826523	0.0927
C	-47.24301	63.52785	-0.743658	0.4714
@TREND	8.862050	5.217224	1.698614	0.1151
FITTED^2	0.001808	0.000942	1.919010	0.0791

R-squared	0.985143	Mean dependent var	109.4733
Adjusted R-squared	0.967810	S.D. dependent var	71.19925
S.E. of regression	12.77417	Akaike info criterion	8.232909
Sum squared resid	1958.154	Schwarz criterion	8.952818
Log likelihood	-96.14427	Hannan-Quinn criter.	8.446976
F-statistic	56.83683	Durbin-Watson stat	2.811966
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Pairwise Granger Causality Tests
Date: 02/11/20 Time: 19:45
Sample: 1986 2018
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
OIL_PRICE_INDEX does not Granger Cause EXCH_R	31	7.73659	0.0023
EXCH_R does not Granger Cause OIL_PRICE_INDEX		0.14544	
INT_R does not Granger Cause EXCH_R	31	16.4660	2.E-05
EXCH_R does not Granger Cause INT_R		0.71763	0.4973
GDP_RATE does not Granger Cause EXCH_R	31	0.33575	0.7179
EXCH_R does not Granger Cause GDP_RATE		4.60124	0.0195
INF_R does not Granger Cause EXCH_R	29	8.25389	0.0019
EXCH_R does not Granger Cause INF_R		2.20477	0.1321
INT_R does not Granger Cause OIL_PRICE_INDEX	31	0.02246	0.9778
OIL_PRICE_INDEX does not Granger Cause INT_R		3.24426	0.0552
GDP_RATE does not Granger Cause OIL_PRICE_INDEX	31	0.18666	0.8308
OIL_PRICE_INDEX does not Granger Cause GDP_RATE		2.62655	0.0914

INF_R does not Granger Cause OIL_PRICE_INDEX	29	0.31468	0.7330
OIL_PRICE_INDEX does not Granger Cause INF_R		0.35526	0.7046
GDP_RATE does not Granger Cause INT_R	31	0.12196	0.8857
INT_R does not Granger Cause GDP_RATE		0.31784	0.7305
INF_R does not Granger Cause INT_R	29	0.03595	0.9647
INT_R does not Granger Cause INF_R		4.42299	0.0232
INF_R does not Granger Cause GDP_RATE	29	0.11483	0.8920
GDP_RATE does not Granger Cause INF_R		4.14549	0.0284

DATA SET

YEARS	EXCH.R	INT.R	INF.R	GDP RATE	OIL PRICE INDEX	Trade Openness	OIL PRICE*
1986	4.1203	9.93	9.7	3.7	14.44	9.135845723	0.229224377
1987	4.2761	13.96	61.2	0.5	17.75	19.49533511	-0.162253521
1988	4.7748	16.62	44.7	9.2	14.87	16.94060969	0.232683255
1989	7.3934	20.44	3.6	7.3	18.33	34.18261725	0.265139116
1990	8.0089	25.3	23	8.3	23.19	30.92474008	-0.128934886
1991	9.8805	22.04	8.8	4.6	20.2	37.02160486	-0.047029703
1992	19.389	24.76	61.3	3	19.25	38.22738831	-0.12987013
1993	21.8861	31.65	76.8	2.7	16.75	33.71975493	-0.065074627
1994	21.8861	20.48	57.42	1.3	15.66	23.05923645	0.069604087
1995	21.8861	20.23	72.73	2.2	16.75	39.52837841	0.221492537
1996	21.8861	19.84	29.29	3.4	20.46	40.25772925	-0.088954057
1997	21.8861	18.18	10.67	3.2	18.64	51.46101079	-0.361051502
1998	94.898	20.29	7.86	2.4	11.91	39.27860747	0.390428212
1999	102.4773	21.27	6.62	2.8	16.56	34.45783118	0.653985507
2000	116.6	23.44	6.94	3.9	27.39	48.99559947	-0.160277474
2001	126.5553	24.77	18.87	4.6	23	49.68050029	-0.00826087
2002	132.8552	20.71	12.88	3.5	22.81	40.03516859	0.213941254
2003	130.8392	17.95	14.03	10.5	27.69	49.33496486	0.360057783
2004	128.83	16.9	15	5.3993	37.66	31.89587044	0.343335104
2005	124.276	17.8	17.86	10.335	50.59	33.05946007	0.205771892
2006	117.7243	16.9	8.22	6.221	61	42.5665658	0.131803279
2007	149.355	16.94	5.42	6.972	69.04	39.33693151	0.362108922
2008	149.06	15.48	11.58	5.98	94.04	40.79683535	-0.352828584
2009	150	18.36	12.54	6.96	60.86	36.05871041	0.271442655
2010	146.2	17.58	13.72	7.161	77.38	43.32075684	0.388730938
2011	146.2	16.02	10.8	7.356	107.46	53.27795833	0.018518519
2012	150.2	12	12.2	6.322	109.45	44.53236805	-0.032709
2013	156	12	10.67	7.161	105.87	31.04885995	-0.090488335
2014	190	12	11	6.3	96.29	30.88519372	-0.486031779
2015	192	14	10.55	2.7	49.49	21.44692967	-0.178015761
2016	305	14	18.55	-1.55	40.68	20.72251888	0.288839725
2017	305	14		0.805887	52.43	26.347599	0.272935342
2018	305	14		1.937268	66.74	33.0012587	-1