EFFECT OF INTEREST RATE ON EXCHANGE RATE MANAGEMENT IN NIGERIA

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DECLARATION

I Musa Abdulhamid Auyo, hereby declare that this research work is the product of my own independent research effort undertaken under the supervision of Dr. Aliyu Rafindadi Sanusi and Dr Lawong Damian Bernsah. I also declare that this research work has not been presented anywhere neither does it form the basis for the award of any degree, diploma, certificate, associate or fellowship titles in this or any other University or any other similar institution of higher studies.

_____	_____	_____
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CERTIFICATION/APPROVAL

This is to certify that this thesis titled "EFFECT OF INTEREST RATE ON EXCHANGE RATE MANAGEMENT IN NIGERIA" submitted to the Department of Economics and School of Post Graduate Studies Ahmadu Bello University, Zaria, Kaduna-Nigeria for the award of M.Sc. Economics is an independent research work carried out by MUSA ABDULHAMID AUYO, and this research work has not been presented anywhere neither does it form the basis for the award of any degree, diploma, certificate, associate or fellowship titles in this or any other University or any other similar institution of higher studies.

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DEDICATION

This Thesis is dedicated to my parents Mal. Musa K.U. Auyo and Haj. Maryam Isa Auyo for their Patience, support and encouragement during the course of my study.

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All praises be to Allah (SWT), and may His blessings be Upon His messenger- prophet Muhammad (PBUH). My unreserved appreciation goes to my parents, may Allah (SWT) be merciful to them. Also I wish to express my appreciation to my Supervisors, Dr. Aliyu Rafindadi Sanusi and Dr Lawong Damian Bernsah whom have put their effort and time to building me academically and morally in a very soft manner like a son and father, may Allah (SWT) be merciful to them and bless their children. I will not forget to express my sincere gratitude to the entire staff of the Department of Economics, Ahmadu Bello University, Zaria for building student of outstanding academic and moral character. Lastly, I wish to express my gratitude to all those whom have contributed, in one way or the other, in making this research work a reality.

ABSTRACT

Despite the fact that in Nigeria Monetary Policy (Interest rate policy) has been a policy tool for managing the exchange rate, Nigeria has continued to witness depreciating value of its domestic currency in recent times. This cannot be disconnected to the fact that the monetary policy has proved ineffective in managing exchange rate over the period under study. Thus, this study buttress other factors which can possibly enhance the interest rate defense of a currency in Nigeria. These factors; level of capital account openness, and level of corporate debt have not been given emphasis in the literature in terms of studies conducted using Nigerian data on how the exchange rate in Nigeria can be effectively managed or defended using Nigerian data. Therefore, this study examines the effect of interest rate on exchange rate management in Nigeria in the context of capital account liberalisation and corporate debt level. In doing so, this study utilized annual time series data sourced from CBN and WDI from 1981 to 2015 to estimate a Vector Error Correction Model (VECM). The long-run findings show appreciation of the domestic currency, implying that high level of corporate debt and capital account openness alone are notenough to induce capital outflows and hence, depreciate the domestic currency as interest rate rises. However in the short-run increase in interest rate induces depreciation of the domestic currency even though less if the capital account is liberalised and also more if there is high level of corporate debt. Therefore, sequel to the findings of this studyit is recommended that,interest rate policies that aim at increasing the value of the domestic currency must focus on liberalising the capital account as well as ensuring lower leverage ratio (low debt level) in the corporate sector while interest rate is increased to attract investors.

Table of Contents

Title Page……..……..i

Declaration.....ii

Certification/approval.....iii

Dedication.....iv

Acknowledgement v

Abstract vi

CHAPTER ONE 1

Introduction 1

1.1 Background of the study.....1

1.2 Statement of the problem.....3

1.3 Research objective 4

1.4 Research hypothesis 4

1.5 Justification for the study 5

1.6 Scope of the study 6

1.7 Organization of the study 7

CHAPTER TWO 8

Literature review 8

2.0 Introduction.....8

2.1 Overview of exchange rate and interest rate policy in Nigeria.....8

2.2 Conceptual literature 9

2.3 Theoretical literature 12

2.4 Empirical Literature 19

CHAPTER THREE.....28

Methodology 28

3.0 Introduction.....28

3.1 Theoretical framework: 28

3.2 Model Specification 32

3.3 Stochastic Properties of the Data 34

3.4 Estimation Techniques 39

3.5 Source of data 42

3.6 Limitations 42

CHAPTER FOUR 43

Data presentation and analysis 43

4.0 Introduction 43

4.1 Stochastic Properties of the data test Results 43

4.2 Long Run (L-R) Estimates of effect of interest rate on exchange rate in Nigeria. 48

4.3 Short-Run Dynamics 49

CHAPTER FIVE 56

Summary, Conclusion and Recommendations 56

5.0 Introduction 56

5.1 Summary 56

5.2 Conclusion 59

5.3 Recommendations 60

5.4 Further Research 60

References 61

Appendix 66

CHAPTER ONE

Introduction

1.1 Background of the study

The integration of financial markets and high capital mobility made possible by the increasing globalization of world economies has exposed economies, especially developing ones, to the volatility of capital flows which often leads to severe financial crises. Nevertheless, no matter the nature of capital flows, they are expected to influence monetary aggregates such as net Foreign Assets (NFA), exchange rates and inflation among others. In Nigeria, the removal of certain laws and subsequent entrenchment of investment friendly laws as well as the introduction of structural reforms facilitated the substantial flow of capital.

Presently, the world economy is suffering from post-global financial and economic crises that originated from the sub-prime mortgage lending crisis in the USA in 2007. The magnitude of the damages it has caused the world economy is yet to be fully quantified. Therefore, these crises have resulted in increasing cases of bailout plans for banks and investment companies by governments in the USA, Europe, Asia and Nigeria through partial nationalization and outright buy-over, thereby, questioning the power of capitalist system in resource allocation.

However, until 1986, Nigeria did not record any figure on foreign portfolio investment flow in her Balance of Payments (BOPs) accounts. Although, this was attributable to the non-liberalization of the country‘s money and capital markets as well as the non-disclosure of information on the portfolio investments of Nigerian investors in foreign capital and money markets (CBN 1997:151). As developing countries are attracting great amount of capital flow because of the high interest rates they offer, Nigeria may not be insulated from the increased ravaging impact of capital flows(especially the net portfolio investment (NPI)), if proactive policy measures are not designed and implemented to manage them.

Thus, the consequence of such adverse effect of capital flow raises the need for urgent safety valve for the economy against the possible impact of sudden capital flight, especially on the exchange rate. Exchange rates fluctuate in their actual sense because of the demand and supply involved in the foreign exchange market. As such exchange rate fluctuations expose economic agents to foreign exchange risk which affect the risk and return on investment and such risk also translate to changes in other economic variables such as inflation, trade, exports and output growth etc. (Moosa and Bhatti, 2010)

Furthermore, there are serious policy issues about capital flows because of their potential effects on economic stability, monetary, and exchange rate management and international competitiveness of the economy. Generally, capital flow volatility poses substantial risk and raises greater concern about the excessive exchange rate fluctuation it causes and the corresponding impact of such exchange rate fluctuation on other economic variables, as mentioned above (Kawai and Takagi, 2010).

Thus, the challenge is to understand what drives the capital flows and the impact of its sudden surge or reversal on the economy. In light of the risk associated with capital flow, therefore, it is desirable for a country to have appropriate policies that would respond to such flows, taking into cognizance the determinants of capital flow such as interest rate among others and the effect interest rate have on other economic variables particularly exchange rate.

Therefore, there are a number of theoretical arguments and empirical evidences suggesting that monetary policy, specifically changes in interest rates, can provide an effective means of managing the adverse effect of these capital flows on the exchange rate. For instance Goldfajn and Gupta (1999) find that higher interest rates can be used to hold back fleeing capital and reverse currency undervaluation although not in the presence of banking crisis. In

addition, Adamu (2016) also find that additional monetary tightening can be used as an alternative or complementary tool in achieving exchange rate stability in Nigeria.

Thus, it is against this background that this research aims to examine whether interest rate management of exchange rate is more effective under liberalized or protected capital account amidst the ineffectiveness of monetary policy to manage capital flight and whether the level of corporate debt affects management of exchange rate through interest rate.

1.2 Statement of the problem

The management of exchange rate via interest rate policy has long been attracting attention in the international finance literature. Interest rate affects exchange rate fluctuations via capital flows and one of the theoretical channels through which these capital flows affects the domestic economy is the exchange rate channel. Capital flows affect the exchange rate by changing the relative supply of foreign exchange in the domestic foreign exchange market. Over the years interest rate (monetary policy) has been used to manage capital flows in Nigeria.However the use of interest rate policy has proved ineffective (Agu, 2010, and Okpanachi, 2013).

Despite the fact that policy makers have used interest rate to actively manage exchange rate, such actions have not produced the desired results. This is because the international finance literature, particularly with reference to studies conducted using data from countries aside Nigeria has shown that the effect of interest rate on exchange rate appears to be contingent on a number of factors, including for instance level of capital control (Arnórsson and Zoega, 2015)and the level of corporate debt (Goderis and Loannidou, 2006). These two factors form the basis of our research gaps as they have not been covered within the context of Nigeria. This is evident from the fact that changes in interest rates (both policy rate and other rates (e.g. maximum lending rate)) do not lead to reduction in the depreciation of exchange rate in Nigeria (See appendix 1 – MPR). The exchange rate keeps depreciating with changes in

interest rate, particularly with the much reduction of capital account restriction from 2004 (okpanachi, 2013).This is also evident from the massive increase in Net Foreign Asset (See appendix 1 – NFA).

Therefore, interest rates changes could have significant effect on the stability of the domestic currency depending on the level of capital control and stock of corporate debt obligation.

Therefore, it is in consideration of the research gaps and the weakening fundamentals of the Nigerian economy attributable to the problem raised above and uncertainty of the global economy that has led to the interest in this research by seeking to address the following questions;

i. How does the level of corporate debt affect the relation between interest rate and exchange rate in Nigeria?
ii. What is the effect of interest rate on exchange rate in Nigeria Under a protected and liberalized capital account?

1.3 Research objective

The objectives of this study are;

i. What is the effect of interest rate on exchange rate in Nigeria?
ii. To examine how the level of corporate debt affects the relationship between interest rate and exchange rate in Nigeria.
iii. To examine the effect of interest rate on exchange rate in Nigeria under a protected and liberalized capital account.

1.4 Research hypothesis

The above mentioned research objectives are guided by the following hypothesis;

i. H_0: Interest rate has no significant effect on exchange rate.
ii. H_0: High level of corporate debt has no significant effect on the relationship between interest rate and exchange rate in Nigeria.

iii. H_0: Liberalized capital account has no significant effect on the relation between interest rate and exchange rate in Nigeria.

1.5 Justification for the study

Recently, many developing countries with high interest rates (Nigeria inclusive) have witnessed inflows of foreign capital driven by very lower interest rates in the United States.In such scenarios, countries may resort to capital controls, as did Malaysia and Iceland in 1998 and 2008 respectively. Obadan (2004) stated that capital controls are necessary if other policy measures show limited effectiveness in managing an economy with increased capital inflows. In the same vein (Okpanachi, 2013 and Agu (2010) documented the ineffectiveness of indirect controls such as monetary policy to manage capital flow. As it has been shown above monetary policy left alone is ineffective to manage capital flow and hence fluctuation of exchange rate as a result.

The literature reviewed in this study showed that most research works carry out interest rate management of exchange rate either under the assumption/period of no capital restriction (e.g Basurto and Gosh 2001) or under capital control regime (e.g. Arnórsson and Zoega, 2015) because capital flows have direct effect on exchange rate. However, studies that assume absence of capital restriction fail to recognize that investors might sense desperation of policy makers to make domestic assets more attractive and do away with the adverse effect of increased interest rate on the liquidity position and solvency position of domestic financial institutions. As such investors might not be lured into not pulling out their capital or buying these domestic assets – hence depreciation pressure sets in finally. Conversely, studies that advocate capital restriction in interest defense of a currency fail to recognize that foreigners may have increase in the flow of interest income through the current account – hence the exchange rate falls.

Therefore, it is based on this that, firstly, this study aims to close the gap by incorporating both the two periods together to examine which among the strategies is best fit for exchange rate management in Nigeria. This form the basis for the first objective of this study. This is based on the fact that Nigeria has been deregulating its economy gradually ever since Structural Adjustment Program (SAP) was introduced in July, 1986. This means that Nigeria has been moving from periods of strict capital control to less capital control.

Secondly, these studies also never consider how the level of corporate debt in an economy affects interest rate management of exchange rate or interest defense of a currency. The studies fail to recognize that if investors discover that the level of debt in the economy is high, they will be left with no option than to pull out their capital due to high probability of bankruptcy or default risk. Therefore, by taking into cognizance the effect of debt level in interest defense of currency, this study will strengthen the policy, make it more effective and also not short-lived. And this forms the basis of the second objective for this study.

Therefore, the first research gap is very important to be addressed because it will help monetary authority and policy makers to know whether the use of interest rate to manage exchange rate is effective with or without the use of other measures such as capital controls. The second research gap is also very important to be addressed because it will allow policy makers and monetary authority to know if the existing level of corporate debt will allow effective interest defense of a currency.

The choice of estimation technique is based on the structure of the objectives of the study and behaviour of data. Therefore, the study adopts VECM as used by (Gudmundsson and Zoega, 2016 and caporale *et al*, 2005) among others, however due to the qualitative nature of the second and third objectives, the study incorporates dummy variables into the VECM.

1.6 Scope of the study

Although several foreign exchange policy measureshave been used to manage foreign exchange in Nigeria to make the Naira a competitive, strong and valuable currency in the international arena, however such policy effort seems to be futile from the observation of the depreciating effect the naira has suffered from 1981 to 2015. Therefore, this study is narrowed to the effect of interest rate (a monetary policy tool) on exchange rate in Nigeria from 1981 to 2015 because the use of interest rate policy in modern economic setting is of paramount importance to an economy for effective implementation of monetary policy.

1.7 Organization of the study

This thesis is structured into five chapters. Chapter one is the introductory part which comprises of background to the study, statement of the problem, research objectives, research hypothesis, justification for the study, and organization of the study. Chapter two – literature review comprises of conceptual literature, where key concepts of the study are reviewed to facilitate comprehensive understanding of the thesis, then theoretical literature where relevant theories are reviewed for better understanding of the theoretical background and lastly empirical literature where empirical studies are reviewed to ascertain what the body of knowledge holds within the context of the problem under study. Chapter three – methodology comprises of theoretical framework, research design, techniques of estimation for analysis and source of data for the study. Chapter four comprises of presentation and analysis of results. Lastly, Chapter five comprise of summary, conclusion, and policy recommendation base on the findings of chapter four.

CHAPTER TWO

Literature review

2.0 Introduction

In this section of the study, relevant literature is reviewed on the subject of interest. The review is categorized into three; the first being the conceptual literature which will aid in the understanding of the concepts used in the theoretical and empirical literature. The second is the theoretical literature where related theories are reviewed in order to ascertain their similarities and differences for the choice of a proper framework for the study. Furthermore, the study selects a framework from the set of theories reviewed upon which empirical analysis will be based. Thirdly, the empirical literature provides us with various methods of estimations used by scholars in the research area upon which a technique will also be chosen for this study and the results of their findings upon which the results of this study will be compared to.

2.1 Overview of exchange rate and interest rate policy in Nigeria

Nigeria has undergone substantial exchange rate policy transformation from post-independence when a fixed parity with the British Pound was maintained up to 1973 when it was changed to Naira to floating of the currency in 1986 when Structural Adjustment Program was adopted. The deregulation of the exchange rate system in 1986 led to the introduction of several techniques with the aim of achieving exchange rate stability for the Naira. In September 1986, the Second-tier foreign exchange market was established and later on in 1989 *Bureaux de change* to enlarge the scope of the foreign exchange market. As a result of increased volatility in the exchange rates the foreign exchange market was further liberalized with the introduction of Autonomous foreign exchange market (AFEM) in 1995. And in October, 1999 the Inter-bank foreign exchange market (IFEM) was introduced as a

further deregulation of the market to achieve stability of the exchange rate (Comprehensive information can be found at www.cbn.gov.ng/IntOps/FXMarket.asp). In order to narrow the arbitrage premium between the *Bureaux de change* and inter-bank exchange rates of the market and achieve convergence, Wholesale Dutch Auction system as an exchange rate system was introduced in 2006. The rate at which these measures are introduced shows the determined effort of the monetary authority to combat persistent depreciation and instability of the Naira. As of May 2016 the exchange rate of the Naira had been $/N197.00 and the Monetary policy Committee of Central Bank of Nigeria approved a dual exchange rate system (a greater flexible exchange rate system) in order to curb further depreciation and ensure availability of foreign currencies in the foreign exchange market (CBN, 2016). The various exchange rate systems mentioned above have had implication on economic performance.

Interest rate policy refers to the steps undertaken by monetary authorities in order to support the interest rate level in an economy with the sole aim of achieving macroeconomic objectives of price and exchange rate stability. In Nigeria, prior to the introduction of SAP in 1986 interest rates were fixed by monetary authorities, which resulted to financial repression. With the introduction of SAP, the CBN liberalized interest rate in August, 1987 and continues to fix its Minimum Rediscount Rate (MRR) to the direction of interest rates. In 1991, regulation of interest rate was reintroduced again via the introduction of prescribed deposit rate and maximum lending rate. However, this control was further removed in 1992 and reintroduced in 1995. Although, the interest rate was totally deregulated since October, 1996 and has been the main tool of monetary policy in the present market-based monetary policy framework (Hussainatu, 2009).

2.2 Conceptual literature

Interest rates: interest rate is simply seen as a price paid for the use of capital as a factor of production. Moreover, it is also seen as the price of "waiting" for a factor of production.

Waiting is seen as the service performed by holding assets instead of devoting them to current consumption (Alan, 2004). The fundamental role of interest in an economy is to help allocate financial resources efficiently. Interest rates constitute; Treasury bill rate (TB), interbank call rate (ICR) lending rate (LR) and monetary policy rate (MPR) among others, even though some components differ from country to country. However, of all these interest rates,Treasury bill is the most competitive and representative rate apart from deposit rate in the money market. It is quoted in various maturities ranging from 3-months, 6-months, and 12-moonths deposit rates. It actually determines the portfolio preference of the investing public (Research Department CBN, 2012). This study intends to use Monetary Policy Rate because it is the rate that all other monetary variables are expected to follow. On the other hand, MPR is the rate which Central Bank charges banks and other related financial institutions on loans extended to them, as such, it is closely linked to all money market rates. That is changes in MPR causes changes in all other money market rates. Interest rate is a powerful tool used by policy makers in a liberalized economy. Therefore, interest rates movements are a key indication of the monetary policy stance. Tighter monetary policy entails higher interest rates while easing monetary policy stance entails lower interest rates.

Exchange rate: The foreign exchange rate is the rate at which one currency is exchanged for another (Mishkin, 2004). The exchange rates (prices) are just the expression of one currency in terms of another. The basis of the exchange rate market is derived from demand and supply of currencies initializing from end users. In the 1950s and 1960s, exchange rate theories concentrated on the current account of Balance of Payments, but later theories have placed much greater emphasis on the determinants of the current account. The foreign exchange market consists of two distinct markets; the spot market and the forward market.

Capital flows: This refers to the inflow and outflow of capital from one country to another. It is primarily seen as lending and borrowing between countries (Iyoha, 2004). It does not relate to movement of goods or payment for imports and exports between countries. The capital

flow literature has identified many factors that causes or limits capital flows,one of which is the interest rate. Capital flows comprises of foreign private investment (foreign direct investment and foreign portfolio investment), official development finance (official development assistance and official development flows), private and government capital and remittances (Obadan, 2004).

Capital controls: Capital controls are measures which limit the rights of the residents or non-residents to enter into capital transactions (Ostry,*et al*., 2011). They restrict the flow of capital between countries. Capital controls are now recognized as part of economic policy toolkit for financial stability. Capital controls help manage exchange rate volatility, avoid mismatches of maturity, limit speculative activities in an economy and enhance monetary policy independence (Gallagher, 2011). It also helps reduce real exchange rate pressure. Moreover, conditional on a speculative attack occurring, controls on capital outflow can help slowdown or minimize the loss of reserves or the required increase in interest rates.

Bond: a bond is a debt security issued by government or corporation. According to Kurfi (2003), "a bond is a long-term debt instrument that generally earns a fixed amount to the investor, period after period, until it is finally retired by the issuing firm". Bonds issued by a corporation are called corporate bonds. Corporate bonds are issued by private and public companies. The return on bonds is affected by risk among other factors. The risk associated with a bond increases with increase in duration of maturity. Such risk is compensated by demand of high interest rate by investors. Generally, market interest rates tend to have significant effect on prices of bonds with longer maturity period remaining. Therefore, the price of bonds fluctuates with changes in market interest rates. Thus, changes in interest rates move in opposite direction with prices of bonds and changes in prices of bonds determine changes in bond yield. This phenomenon is known as interest rate risk and is common to type of bonds.

For instance, if a bond offers a coupon rate of 2% and after one year market interest rate decrease to 1%. The bond will still pay a coupon rate of 2% than the 1% coupon rate the new bonds offer in the market. If the 2% coupon rate bond is to be sold, it price will be higher than it was a year ago because it offers a higher coupon rate than the existing bonds in the market. Therefore, the increased price will reduce the yield to maturity of the bond if bought at its high price. Conversely, if interest rates rise say from 2% to 3%. A bond that offers a coupon rate of 2% will find itself competing with new bonds that offer 3% coupon rate if it should be sold at that period. Thus, the bond that offers 2% coupon rate may probably have a decrease in price. Therefore, the yield to maturity of the bond will however increase as the price decreases if it is bought (Comprehensive information can be found at https://www.sec.gov/investor/alerts/ib_interestraterisk.pdf).

2.3 Theoretical literature

The exchange rate literature has shown that interest rate is a key determinant of the behavior of exchange rate. Many theories predict that exchange rate is determined by economic fundamentals, one of which is the interest rate differential.Albeit most of this models do not appear to explain actual movement of the nominal exchange rate.

The theoretical models of exchange rate can be broadly categorized into two: monetary model of exchange rate, which adheres to the classical doctrine of economics, and the models that adhere to the Keynesian economic doctrine such as Mundell-Fleming model (Copeland, 2005).

Monetary model of exchange rate:This model combines the quantity theory of the demand for money and purchasing power parity (PPP) as its building blocks. It also assumes perfect price flexibility in all markets, which presupposes vertical Aggregate supply curve. This model is categorized into that of floating and fixed exchange rate regimes (Copeland, 2005).

Under flexible price monetary model of floating exchange rates, the equilibrium exchange rate is determined by the ratio of money stock to the demand, measured at the foreign price level. The mechanism under this model is expressed in terms of excess demand for money. Therefore, whatever serves to (raise) the ratio will cause appreciation of the foreign currency (depreciation of the domestic currency). The equilibrium exchange rate can be affected by three types of disturbances; increase in world price level, domestic monetary expansion, and rise in real income. Thus, the exchange rate will depreciate (appreciate) when any of the following occurs to the disturbances mentioned above; firstly the domestic money stock increases (decreases) or foreign money stock decreases (increases), secondly, domestic national income falls (rises) or foreign national income rises (falls), and thirdly foreign price level falls (rises) (Copeland, 2005). The last point shows that world inflation has no effect on the domestic economy from policy point of view because the floating exchange rate acts like a device that absorbs and adjust the shocks emanating from either of the countries (or their domestic money markets). This also implies that macroeconomic policy independence is preserved in each country through the flexibility of the exchange rates; therefore, inflation rate can be chosen independently regardless of other actions.

Under fixed exchange rate, the monetary model uses foreign reserves as the absorber of shocks in order to stabilize the foreign exchange markets. Since foreign reserves carry the burden of adjustment to exogenous variable changes, then the policy variable considered is domestic credit not money supply because money supply is seen as an endogenous variable determined by factors that determine Balance of payments. From policy perspective, the equilibrium exchange rate changes with changes in the following variables; domestic credit, income, and foreign price level under monetary model of a fixed exchange rate (Moosa and Bhatti, 2010).

Therefore, this fixed exchange rate model predicts that Balance of payments will deteriorate (rise) and the home country will lose (gain) reserves when; domestic credit increases (decreases), domestic national income falls (rises) or foreign national income rises (falls), and foreign price level falls (rises). This means that a country that pegs its exchange rate ultimately has to accept the world price level. This implies that it will be forced to import inflation from rest of the world. This also directly means it has no control over its monetary policy (Copeland, 2005).

It is worth noting that no fixed exchange rate is forever fixed, as such sooner or later it will be forced to adjust (devaluation or revaluation). Devaluation, (once-and for- all) provides a means of adjustment as it temporarily improves the competiveness of the domestic economy and consequently lead to a Balance of Payments surplus thereby leading to a rise in foreign reserves. However, this price advantage (competitiveness) erodes with ensuing inflation (as stated earlier pegging exchange rate demands a country to accept the world price level, hence import inflation) as time pass by until the economy returns back to its starting point, with higher level of prices, greater foreign reserves and a large nominal money stock but the same real money supply (Copeland, 2005). From the monetarist perspective inflation entails higher price level resulting from increased money supply, and this leads to decrease in interest rates. Thus, decrease in interest rate results in increased investment spending and capital outflow. The increased investment spending leads cause higher importation and hence, deterioration of the BOPs current account. Similarly, increased capital outflow causes deterioration of the BOPs capital account. The overall effect leads of depreciation pressure resulting from increased foreign exchange demand and hence BOPs deficit (Copeland, 2005)

Alternatively, even though devaluation causes improvement in current account via increased exports resulting from temporary price advantage but it also increases real income as a result of investment resulting from increased exports. The increased real income causes increased imports (causing deterioration in current account) which leads to higher demand for foreign

exchange, and hence depreciation pressure. The excess demand for foreign exchange has to be met by the Central Bank by selling it foreign exchange reserve in order to maintain the parity. The sale of foreign exchange reserves leads to it reduction and hence a BOPs deficit follow. Recall that the price advantage is temporary and the devaluation is done once, therefore all the initial gains are temporary while the latter effects persist (Copeland, 2005).

From policy perspective the good news about devaluation is that it works; it increases the price advantage of the country, generate Balance of Payments surplus or reduce the deficit, replenishes foreign reserves or slows down reserve loss in a deficit country. Although, there is a benefit but the bad news is that it does not permanently affect competitiveness and it causes inflation thereby neutralizing the benefit it confers (Copeland, 2005).

Conclusively, within the context of exchange rate determination, the monetary model is grossly inadequate particularly in the long-run given the failure of PPP and its assumption of perfect price flexibility which is always not the case as Keynes argued. The inadequacy of this theory paves way for the emergence of other theories, for example the Mundell-Fleming model. However, within the context of this research this theory is also inadequate from the perspective of the efficacy of each exchange rate regime under conditions of perfect and imperfect capital mobility as highlighted in our problem statement. Under the condition of perfect capital mobility fixed exchange rates are effective because interest rate as the adjusting variable affects the BOPs directly.While in the condition of less than perfect capital mobility interest rates only affect the BOPs via interaction with the goods market and price level in the presence of cycles (Moosa and Bhatti, 2010). Hence, none of the two different exchange rate regimes mentioned above simultaneously accommodate perfect capital mobility and capital restrictions. Also the entire exchange rate determination model outlined here does not consider the effect of existing debt in the economy as considered in our problem statement.

Mundell-Fleming (M-F) model of exchange rate: In the above monetary model the exchange rate is determined under perfect price flexibility. However, in the M-F model, the focus is on completely fixed prices which presuppose a flat Aggregate supply curve, absence of PPP, imperfect capital mobility and static expectations. This model adheres to the Keynesian tradition in the sense that Aggregate supply takes a passive role in fixing the price level, while the level of economic activity is determined by the Aggregate demand (Copeland, 2005).

A distinctive feature of this model is its specification of the external sector of the economy, specifically the current account balance which is determined independently of the capital account balance so that the overall balance achievement requires domestic economic adjustment. Under this model equilibrium requires the goods market and domestic money market to clear as in the IS-LM model while the sum of deficits current and capital account is zero in the open sector. The latter condition equilibrates demand and supply in the currency market. From policy point of view, the effects of monetary and fiscal shocks under both floating and fixed exchange rate regimes can be evaluated (Moosa and Bhatti, 2010).

For instance, under a floating exchange rate in the M-F model, a monetary expansion causes; exchange rate depreciation, rise in income, decrease in interest rates and improvement in the Balance of Payment current account, while a fiscal expansion causes the opposite with the exception of income. However, under a fixed exchange rate of M-F model a monetary expansion causes a short-term fall in interest rate, rise in income and deterioration of the Balance of Payments (BOPs), but in the long-term it causes a fall in foreign reserves with no change in income, interest rate or the BOPs (Copeland, 2005). While a fiscal expansion causes a short-term rise in interest rate, income and BOPs surplus but in the long-run it leads to further increase in income with fall in interest rate as such the BOPs shrinks to zero allowing for a significant current account deficit (Copeland, 2005). This theory is also

inadequate within the context of this research because it assumes less than perfect capital mobility as well as ignores the level of debt in the economy. The inadequacy of this model as mentioned above led to development of another model by Dornbusch in 1976 where other deficiencies of this model are outlined.

Sticky price exchange rate theory: The monetary model described above has been shown to be insufficient in explaining facts not only because it relies on PPP but also because it ignores the role of expectations in the determination of international interest rate differentials (Copeland, 2005). Also the M-F not only ignores the role of expectations but it also assumes a fixed price level which limits its significance to the very shortest horizons only.

The model of sticky prices is a hybrid model which takes into account the limitations of both monetary model and M-F model. In its short-run characteristics, it conforms to Keynesian tradition which stresses the stickiness of prices in the product and labour markets. It also displays the long-run features of the monetary model of exchange rate determination at the same time (Moosa and Bhatti, 2010).

The assumptions underlying this theory are, Uncovered Interest Parity (UIP), *ex ante* Purchasing Power Parity, and sticky prices. This theory emphasizes monetary shocks as central source of short-run fluctuations in interest rate and exchange rate. The channels emphasized by (Dornbusch, 1976) in (Copeland, 2005) are slow price adjustment and exchange rate over shooting. This theory is also inadequate within the context of this research because it ignores the effect of level of debt in the economy.

Moreover, sticky price theory of exchange rate assumes that in product market unlike in financial market – which clears immediately, goods prices do not equilibrate the market immediately because they are not substantially flexible. Therefore, monetary disturbances cause temporary interest rate differentials and may cause the real exchange rate to deviate

temporarily from its long-run equilibrium value. In the absence of further shocks such a temporary deviation is assumed to damp out at a constant rate (Moosa and Bhatti, 2010).

From above it is clearly shown that there is a negative relationship between interest rate and exchange rate. This relationship between interest rates and exchange rates in its pure sense has been given mostly by two theories, uncovered interest parity and sticky price exchange rate theory mentioned above.

Uncovered interest rate parity (UIP): UIP is a parity condition that states that the interest rate differential is equal to the expected change in exchange rates among two countries (Copeland, 2005). Therefore, there is profit making opportunity in the absence of the parity. It is assumed that real exchange rate deviates from temporary equilibrium; as such shocks to real exchange rate often perceived to be caused by monetary policy shocks are expected to reverse themselves. There is also the assumption that capital is freely mobile and financial securities are perfect substitutes. Therefore, investors only hold bonds with the highest expected yield although there is the neglect of transaction cost and risk.

UIP is basically an argument on how short-term interest rates are related to exchange rate. UIP is an important building block of most exchange rate determination theories, for example the overshooting model of Dornbusch (1976) as cited in (Moosa and Bhatti, 2010). This theory is also inadequate within the context of this research because it ignores the effect of level of debt in the economy.

Furthermore, in trying to examine the effect of debt on interest rate policy, this study further considers the liquidity premium of term structure of interest rate which also has the assumption of perfect substitutability of bonds as mentioned above under UIP. The theory states that the interest rates on long-term bonds will equal an average of expected short-term interest rates over the life of the long-term bonds plus a liquidity premium. Thus there is an

influence of expected return on bonds of different maturity, but it allows investors to prefer one bond maturity over the other. Investors tend to prefer short-term bonds because they bear less interest rate-risk. Therefore, interest rate policy in defense of an exchange rate will first affect the yield on bonds of different maturity. Thus, higher interest rates means higher yield which will make domestic bonds attractive and hence exchange rate appreciation (Blanchard, 2009).

It is worth noting that mainstream theory may not be used strictly as a guide to carry out empirical research but it could be helpful in identifying specific relationships between relevant economic variables which could help you build a model.

2.4 Empirical Literature

Most developing countries have experienced massive inflows of capital recently due to the low interest rates offered in United States and other developed countries as stated earlier. However, there are considerable risks that these inflows would turn into outflows when the federal reserve of United States raised its interest rate. These massive inflow and out flow of capital pose significant threat to the stability of a countries' currency, for example; the Asian crisis of 1997-1998 and the Mexican crisis of 1994-1995. The detrimental consequence of currency instability or massive depreciation per se has motivated lot of studies aiming to design the best policy option to deal with or prevent currency crisis.

However, in Nigeria substantial attention have not been given to the study of interest rate defense of a currency. Numerous past studies concentrated on the relationship between monetary policy and exchange rate volatility in Nigeria, for instance;

Adamu (2016) examines the effect of additional monetary tightening (AMT) on the volatility of the Naira exchange rate using GARCH model and finds that AMT can be adopted as an alternative or complementary tool in achieving exchange rate stability in Nigeria, although

cautiously because monetary contraction can hurt investment and spending nature of the economy.

Adeoye and Saibu(2014) examines the interplay between monetary policy shocks and exchange rate volatility in Nigeria using VECM and Granger Causality and finds that exchange rate volatility is more responsive to changes in interest rate though not significant in the short run. The study reiterated that inflation rate, reserves, interest rate and money supply depreciate and cause volatility in nominal exchange rate.

Yinusa and Akinlo(2008)analyse the implication currency substitution and exchange rate volatility for monetary policy in Nigeria using VECM and finds that exchange rate volatility and currency substitution responds to monetary policy with some lags. The means that monetary policy may be effective in dampening exchange rate volatility and currency substation in the medium horizon but might not be effective in the short horizon.

Oloba and Abogan(2013) measures exchange rate volatility using parametric measure (E-GARCH) to measure exchange rate volatility. The study reveal that the standard deviation of exchange rate has been unusually high and unusually low during the period under study. The concluded that exchange rate has been volatile in Nigeria according to the results of the standard deviation estimates.

Ditimi, Nwosa and Olaiya(2011)used OLS technique to examine the effect of monetary policy on macroeconomic variables in Nigeria. The findings of the study show that monetary policy had a positively significant effect on exchange rate and negatively significant effect on money supply.

Hassan, Abubakar and Dantama, (2017)estimated ARCH and ARDL models to investigate the sources of exchange rate volatility in Nigeria from 198Q1 to 2015Q4. The findings of the study reveal that Net Foreign Asset and Interest rate have statistically positive impact on

exchange rate volatility, while fiscal balance, economic openness and oil price have statistically insignificant impact on exchange rate volatility in Nigeria.

In addition, other studies focused on the effect of external debt and external debt servicing on exchange rate in Nigeria, for example, Saheed, Sani and Idakwoji (2015) estimated OLS to examine the impact of public external debt on exchange rate in Nigeria and finds that external debt, debt service payment and foreign reserves are positively significant in explaining exchange rate fluctuation in Nigeria. However, debt service payment was found to have the strongest effect during the period under study. Similarly, Nwanne and Eze (2015) investigated the relationship between external public debt servicing and receipt and exchange rate fluctuation in Nigeria. The results of the study reveal that external debt receipts and external debt servicing have positive and significant Short-run and Long-run relationship with Naira exchange rate fluctuation.

Also, other studies focused on determinants of real exchange rate,for example, Ajao (2015) used GARCH (1, 1) and ECM to investigate the determinants of real exchange rate volatility in Nigeria. The study found that interest rate movements, openness of the economy, government expenditure and lagged exchange rate were the major variables that affect real exchange rate volatility during the period under study.

Furthermore, others focused on the relationship between capital flow and exchange rate in Nigeria, for instance, Ifeakachukwu and Ditimi (2014) employed both Granger Causality and Error Correction Modelling Techniques to examine the impact of capital inflow on exchange rate in Nigeria. The study revealed a causal link between capital inflow and exchange rate. In addition, the Long-run regression showed that FDI had a negative effect on exchange rate, while Portfolio investment had positive impact on exchange rate.

Lastly, a large number of studies have been done on the relationship between trade openness and exchange rate fluctuations in Nigeria, for example, Nkalu, Umara and Asogwa, (2016) examines trade openness and exchange rate fluctuation nexus in Nigeria using OLS and Granger Causality. The study finds that trade openness have a positive significant impact on exchange rate fluctuation in Nigeria.

Therefore, despite the importance of interest rate defense of a currency as has been shown below by the amount of numerous studies conducted in other countries, few studies have been done in Nigeria within this context, for instance, (Adamu, 2016). However, even the study of Adamu (2016) revealed the incapacity of AMT in managing exchange rate volatility in Nigeria by stating it to be an alternative. Thus, other studies argued for the use of direct controls, for instance, Agu (2010) uses a multi-sectoral general equilibrium model to examine the place of risk in capital movements and the effectiveness of fiscal and monetary policy in combating capital flight. He finds that risk and volatility influences outflow of capital. Also capital flight does not respond to indirect controls such as monetary policy but direct controls. Similarly, Okpanachi (2013) using OLS examines the occurrence and intensity of sterilization overtime on capital flows and finds high sterilization intensity even though no indication of sterilization in banks. He therefore not recommends the use of monetary policy to manage capital flows. This is in line with Agu's findings above.

Thus, from above it is clear that there have not been emphasis on the study of interest defense of a currency in Nigeria, particularly in assessing how corporate debt level and level of capital account openness affect the exchange rate management through interest rate policy.

Therefore, different arguments emerged from the literature, Firstly, a lot of studies support higher interest rates policy to defend a currency in the event of speculative attack or massive depreciation, (See for example, (Basurto and Ghosh, 2001) and (Goderis and loannidou,

2006)). However, others argue that it only increases the probability of a successful speculative attack or further depreciate the currency, (See for example, (Furman and Stiglitz, 1998)). Secondly, some studies argue that interest rate defense can only be effective if sound fiscal policies are put in place, for example, Flood and Jeanne (2005). Thirdly, some studies could not even establish any correlation between interest rates and exchange rates from policy perspective (See for example, (Goldfajn and Baig, 1998)).

From the above it can been seen clearly that there is no consensus in the literature on the use of tight monetary policy to defend a currency or decrease the probability of a successful speculative attack on a currency, particularly based on data from other countries. That is, both success and failures have been achieved using interest rate defense. For example, in October 1997 Hong Kong has been successful in defending its currency using higher interest rates while Sweden's success was short-lived in September 1992.

In addition, Goldfajn and Gupta (1999) examines the role played by monetary policy in reestablishing the stability of currency following a large collapse using an unbalanced panel regression model and finds that tight monetary policy facilitates the reversal of currency undervaluation through exchange rate appreciation not through high inflation, although in the presence of banking crisis the results are not robust.

Basurto and Gosh (2001) estimated a monetary model of exchange rate using VAR to examine if higher real interest rates are associated with downward pressure on the exchange rate through large risk premium. Their finding shows that monetary policy tightening is associated with exchange rate appreciation.

Lahiri (2005) examines the output cost of higher interest rates in defending a currency by using first generation model to model the trade-off between credit-crunch and output contraction. He finds that higher interest rates have the capability to delay a crisis if not

raised beyond a certain point deemed optimal because of the large negative output effect it has.

Caporale et al. (2005) used bivariate VECM to examine monetary policy tightening effect on exchange rates during the Asian crisis. The findings show that while monetary policy tightening help defends exchange rate during period of tranquility, it shows reverse effect during Asian crisis. This result shows the impossibility of interest defense of a currency in the presence of speculative attack.

Fratzscher (2012) examines what drive policy makers in their decision to use capital flow restrictions using OLS to estimate the level of capital controls and Logit model to estimate the changes in capital controls. He finds that foreign exchange policy particularly, and concerns about domestic overheating are the motives behind the use of capital controls.

Flood and Jeanne (2005) developed a model and find that interest rate defense of a fixed exchange rate is effective only if the underlying fiscal situation is sound. This paper shows that it is difficult for interest rate policy to affect fixed exchange rate regime and fiscal deficits.

Gudmundsson and Zoega (2016) analysed the effect of interest rate in a capital control regime using VECM and finds that cutting interest rates from a very high level is not likely to make a currency depreciate in an effective capital control regime. However this findings critique the advocates of using higher interest rates to defend a currency because the higher rates increase the flow of interest income to foreigners through the current account, hence depreciating the exchange rate.

Saborowski et al. (2014) examines whether capital outflow restrictions are effective in reducing net capital outflow using panel VAR and finds that it is effective in place of strong macroeconomic fundamentals and institutions.

Arnórsson and Zoega (2015) used Multiple Least Squares regressions to examine the effect of high interest rate on exchange rate accompanied by capital restrictions and show that exchange rate may be stabilized using interest rate when capital controls are not effectively enforced but is not as useful as when the controls are enforced.

Goderis and Loannidou (2006) using a probit model examines whether higher interest rates could help defend a currency by incorporating short-term corporate debt in order to capture balance sheet vulnerabilities. The result of their study shows that higher interest rate lowers the probability of a successful speculative attack if the level of short-term corporate debt is low.

Additionally, Eichengreen and Wyplosz (1993) identify among others increased public debt as a cost of raising interest rate. Also, Obstfeld (1994) in a two period model shows that self-fulfilling currency crisis may result upon accumulation of public debt.

Velesco (1996) developed a model and considers debt level among other variables such as reserves to examine the sustainability of fixed exchange rate in order to determine the available pay-offs for government at any point in time. The result show the existence of the trade-off yet stock of inbuilt debt is a key deciding factor. This implies that fixed exchange rate is hardly sustainable in the presence of high public debt level as such there is possibility of occurrence of self-fulfilling currency crisis. The above analysis show that interest rate defense of an exchange rate may only be possible in the presence of low short-term corporate and public debt if not it may result in the failure of the policy and hence self-fulfilling currency crisis.

Therefore, exchange rate regime seem to be a considerable factor in defense of a currency. As such this study also dwell into alternative exchange rate regimes to see the relationship it has within the context of currency crisis in order to analyze the regime more prone to crises.

Furthermore, experiences of the international financial crisis of the 1990s made many countries to perceive it as a signal to review their economic policies including their exchange rate regime. The choice and consequences of an exchange rate regime has been a central topic in the international finance literature. The influence of International Monetary Fund (hereafter IMF) in the choice of a country has been significant especially in emerging and developing economies. Although, Bird and Rowlands (2009) estimated a probit model across a sample of developing and emerging countries to examine the how exchange rate regime choice affects the chances of a country to accept IMF program. The study finds no evidence of frequent IMF assistance to countries that operate intermediate exchange rate regime.

The following factors are outlined as the determinants of exchange rate regime choice in emerging economies in the literature; macroeconomics performance, integration of the international financial market, and financial sector development among others. Also note that this international financial market integration which encompass free capital mobility make countries to either choose from a floating or fixed exchange rate regime such as currency board or monetary union due to "impossibility trinity" according to which only two goals can be chosen by a country. Therefore, some economists argue that only the two extremes exchange rate regimes are likely to be sustainable in world of increased capital mobility. However, a group of other economists believe that intermediate regime such as the adjustable peg as the only viable option particularly for emerging economies because of the extreme problems that the two extreme regimes pose to emerging markets and developing economies.

Although, the liberalization of capital accounts of emerging and developing economies make the proponents of the Bi-polar view to see emerging markets been drawn to either of the two poles. They argue that adjustable pegs tend to vanish for countries with open capital account. For example, Glick and Hutchison (2005) find that firmly pegged regimes carry the lowest probability of crisis. Klein and Shambaugh (2008) also estimated a panel model to examine

the nature of *de facto* exchange rate regimes by studying the extent they affect exchange rate. Their study finds that fixed exchange rate exhibit a considerable bilateral exchange rate stability than flexible rates both today and in the future. In the same vein, Ghosh (2014) examines the effect openness and exchange rate regimes has on inflation using panel data techniques and finds lower inflation to be associated with fixed exchange rate regime and high capital account openness. This findings also show that fixed exchange rate impose a discipline on central Banks in their quest for monetary policy.

In contrast, Williamson (2000) is of the believe that intermediate regime is a more viable option for emerging markets because it allows them to gain from both the benefits of flexible and fixed exchange rate regime without incurring any of their cost. Also, Masson (2001) is in support of this view in his studies that used historical data to test the Bi-polar view hypothesis. Also, Salins and Bénassy-Quéré (2010) study the case of an intermediate regime in comparison with fixed and flexible regime using Dynamic Stochastic General Equilibrium (DSGE) model by incorporating wage rigidities. The study finds the dominance of intermediate regime among others in the presence of foreign interest shocks and productivity – often a problem face by developing economies. The study also show the significance of free float (with inflation target) if an economy is suffering from demand shocks and foreign price shocks.

Hence, it seems clear that from the above exchange rate regime literature, fixed exchange rate constitute a greater stability even though there is threat of collapse as shown by (Bensaid and Oliver, 1997) in their study motivated by the European Monetary System (hereafter EMS) crisis. They developed a model to show the vicious circle of defending a currency in a fixed exchange rate system using higher interest rates and find that raising interest rates makes a fixed exchange rate system vulnerable to self-fulfilling currency crisis. However, the benefits of intermediate regime can be seen in volatility limitation and the long run equilibrium

reduction in the possibility of exchange rate overshooting, while maintaining discretion over domestic macroeconomic policy conduct even though it has been argued above that it vanishes with increased capital mobility overtime. Also, the flexible regime while maintaining an equilibrium real exchange rate may also be volatile with a great defect hence discourages foreign trade and investment.

Therefore, following the review of both merits and demerits of alternative exchange rate regime, it appears from the literature that fixed exchange rate regime is a more viable option for developing countries because of its increase coordination of member countries and its reputational benefits particularly to inflationary prone countries.

CHAPTER THREE

Methodology

3.0 Introduction

This chapter describes the process through which this research work was carried out. The research design section describes the steps followed in undertaking this research. A brief description of the framework upon which the estimated result will be reflected is given as well as the analytical technique to be used for estimation. The sources of data to be used are also stated.

3.1 Theoretical framework:

The theories reviewed in section 2.3 of the previous chapter have been shown to be inadequate in various capacities to address the problem presented in this research as well as serve as a perfect framework for this study. However, this study will proceed to use UIP theory partially as a basis for its framework even though it neglect the assumption of how capital restriction and level of debt in the economy affects the relationship between interest

rate and exchange rate despite the fact that it assumes perfect substitutability of bonds and that investors hold bonds with the highest expected yield. Therefore, if UIP theory or any other relevant theory is used alone, it will serve as a poor basis for results analysis of this study. Hence, a synthesis or schema of the economic relationship between the variables under study will be used as a framework for this research.

However, UIP is the formal model underlying the hypothesis of impossible trinity, which is a concept that had form the foundations of open economy macroeconomics since 1980s when capital controls had broken down in many countries and conflicts were witnessed between pegged exchange rates and monetary policy independence. The concept of impossible trinity states that it is impossible for a country to have fixed exchange rate, free capital movement and monetary policy autonomy at the same time. This implies that a country can only choose two out of the three (Thanh and Pham, 2010).

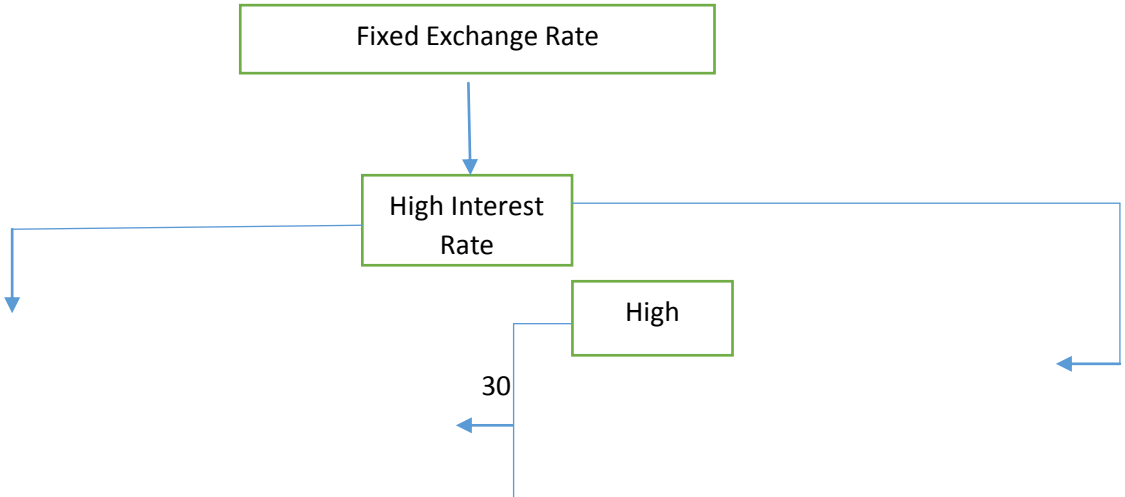
Thus, recall that UIP states that, in the absence of risk premium, arbitrage will ensure that the depreciation or appreciation of a country's currency vis-à-vis another will be equal to the nominal interest rate differential between them. This model implies that under a fixed exchange rate, the two countries' nominal interest rate will be equalised. This also implies that the pegging country has no ability to control its monetary policy. The only way then that the country could have control over its monetary policy and at the same time maintain fixed exchange rate is to prevent arbitrage from taking place in the foreign exchange market by instituting capital controls on international transactions.

Moreover, to understand the "trilemma", imagine a country that fixes its exchange rate against a foreign currency and its open to foreign capital. If in order to bring down inflation its monetary authority sets interest rate above that of the foreign currency, this would attract capital inflow in search of higher returns. That would in turn put appreciation pressure on the currency and the peg would eventually break. Similarly, if interest rates are set below that of

the foreign currency, the domestic currency will suffer from depreciation pressure as capital leaves to seek higher returns elsewhere. As the exchange rate depreciates the country that pegged would have to sell its foreign reserves to buy its currency back. Unless monetary policy is changed, this will continue until the country's reserves are exhausted and eventually causing the currency to devalue, thus breaking one of the goals (i.e. the pegged exchange rate system) among the three impossibilities.

Therefore, the three possible combination of the trio an economy can adopt are;

A. A nation can institute capital controls, fixed its exchange rate and have monetary policy autonomy. In this regard, high interest rate would not have effect on capital movement as well as nominal exchange rate, although there will be decrease in the demand for Money because people will prefer to hold bond and earn much interest. Thus, the decrease in the demand for money will decrease the purchasing power of people and hence leads to fall in price level. In addition, fall in the price level will not translate into change in nominal exchange rate because the exchange rate is fixed, although there will be Balance of Payments Surplus as a result of real appreciation due to high demand of domestic goods by foreigners in order to take advantage of lower prices compared to their country's price level. This is the intuition behind the schema in figure 3.1 below, even though it is adjusted to include the effect of level of domestic corporate debt (low or high) on the exchange rate for a change in interest rate as the objectives of this research demands. For both high and low debt level there is no expectations for change in exchange rate due to capital controls.



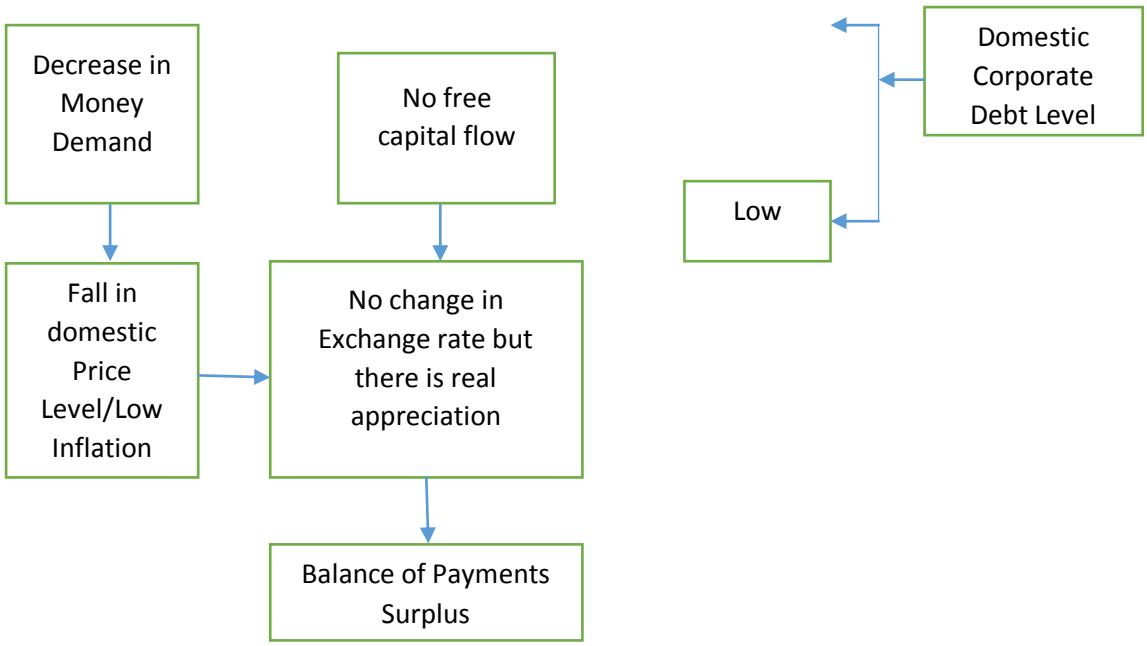
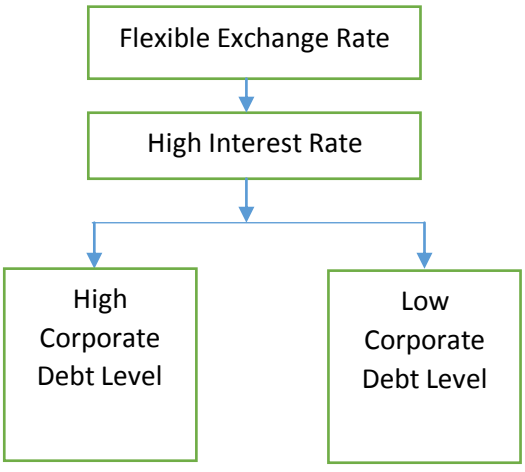


Figure 3.1: Conceptualised relationship between interest rate and exchange rate under a closed capital account

Source: Author's conception

B. A nation can have free capital movement, flexible exchange rate and monetary policy autonomy. In this regard, the currency adjust to the movement of capital (in or out) with no change in Balance of Payments, allowing interest rates to respond to the domestic business cycle. This is the intuition behind the schema in figure 3.2 below, even though it is adjusted to include the effect of level of corporate debt (low or high) on the exchange rate for a change in interest rate as the objectives of this research demands. There is expectation for appreciation or depreciation of the domestic currency for high or low debt level respectively.



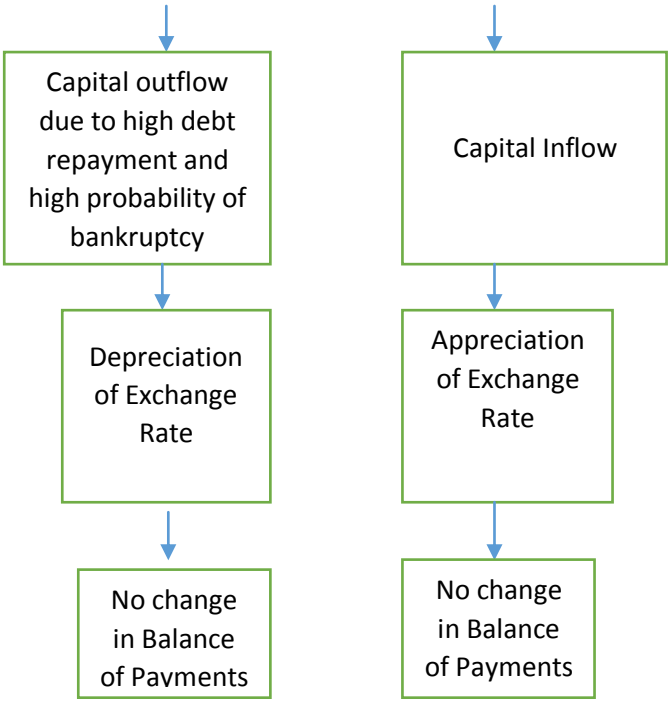


Figure 3.2: Conceptualised relationship between interest rate and exchange rate under an open capital account

Source: Author's conception

C. A nation can have no independent monetary policy, fixed its exchange rate and allow free movement of capital across its borders. In this regard interest rate policy is subordinated to maintaining the peg and hence cannot be used freely for economic stabilisation. Although the peg would be maintained but there would be changes in Balance of Payments position. This intuition is totally disregarded in this study because it has no monetary policy autonomy and this study emphasise on an interest rate policy that can changed independently.

3.2 Model Specification

In order to examine the relationship between interest rate effect on exchange rate and other factors deemed to also affect the exchange rate through interest rate in Nigeria, this study builds the following models base on Friedman (1953) theoretical argument. Friedman (1953) that exchange rate instability is a manifestation of economic volatility. It can be deduced from Friedman's argument that volatility of economic variables that directly or indirectly affect exchange rate causes exchange rate instability. Mordi (2006) also mention the

following economic variables as determinants of exchange rate; GDP growth rate, inflation, BOP Positions, external reserves, interest rate movements, external debt position , productivity, market psychology and expectations socio-political factors, macroeconomic shocks and speculative contagion. Moreover, trade openness is another variable that affect the exchange rate and have been used in other studies for instance, (Hassan, Abubakar and Dantama) and (Ajao, 2015). Therefore, this variable is also used in the model below. Therefore, based on the above built arguments this study formulates the following two models.

$$LEXR = f\ (LMPR, LOPNSS, DC, DC * LMPR, DT, DT * LMPR) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where;

LEXR= Log of Exchange rate

LMPR= Log of Monetary Policy Rate (interest rate)

LOPNSS= Log of Trade Openness

DC= Dummy variable, with 0 for a protected capital account and 1 for liberalized capital account.

DT= Dummy variable, with 0 for a low corporate debt level and 1 for high corporate debt level.

LMPR*DC (MDC) = Interaction Dummy variable between capital account and interest rate.

LMPR*DT (MDT) = Interaction Dummy variable between corporate debt and interest rate.

The relationship between interest rate and exchange rate, corporate debt level as well as degree of capital account liberalisation appears to be a complex one. The stochastic properties of the data were the main reason why many studies use dynamic modelling approach including the use of Vector Error Correction Model (VECM) as used by (Gudmundsson and Zoega, 2016) to analyze the long run relationship. However, other studies used Vector Autoregression (VAR) for example (Basurto and Gosh, 2001) when no long-run effects are detected.

This study adopts the same analytical techniques used in some of the literature reviewed as mentioned above. Moreover, in order to address the objectives of this study, a two-step methodology of VECM was adopted. In the first step, unit root test was performed to determine the order of integration of the variables under study. Owing to fact that the variables are found to be integrated of the same order for example I (1), then the study proceeds to test for long-run relationship using a cointegration technique. As a result of the long-run relationship detected in this step, then the study proceeds to the second step to estimate the long-run parameters using a short-run dynamic model (VECM).

Nevertheless, dummy variables were incorporated to capture the effect of the level of corporate debt as well as degree of capital account openness on exchange rate through interest rate. Firstly, the dummy variable (DC) which reflects regime shift from protected to liberalized capital account within the scope of this was study was structured based on the argument of (Okpanachi, 2013). He highlighted that as the capital market opened up, Nigeria started receiving substantial inflow of portfolio investment particularly from 2004. Secondly, the dummy variable (DT) reflects the level of corporate debt. The corporate debt considered is that of commercial banks only due to data availability. The data is sourced from commercial banks statement of Assets/Liabilities (CBN publication). The steps involve in computing the level of corporate debt(see appendix 2B) are;

i. The extent to which the commercial banks are indebted (leveraged) is captured by the ratio of total debt to total assets.

   The leverage ratio is calculated as; Total Debt/Total Assets.

   Total debt is calculated as; Total liability – Capital – Total deposits, where total deposit is the summation of demand deposits, time, savings and foreign currency deposits and central government deposits. Total deposits however, is part of total liability but does not form part of total debt because the addition or withdrawal of

such deposits is at the discretion of the customer/depositor rather than dictated by contract. Again, deposits are monies that bank owes to the customer (Comprehensive Information can be found at https://thismatter.com/money/banking/bank-balance-sheet.htm).

ii. The average of the ratio was taken in order to determine points of low level corporate debt and high level corporate debt

iii. Lastly, any point below the average is considered low level of corporate debt and any point above the average is considered high corporate debt level.

3.3Stochastic Properties of the Data

3.3.1 The Unit root test

The estimation starts with a unit root test in order to ascertain the stationarity state and the order of integration of the variables included in the model. Most time series data have unit root and using such data in time series modelling might lead to spurious regression (Koop, 2005). To test the order of integration, the study adopts Augmented Dickey-Fuller (ADF) and Zivot Andrews (ZA) unit root test. If there is trend in the series the ADF test statistics will be of the following regression form with intercept and time trend parameters. This is the general model used in testing for unit root (See Harris and Sollis, 2003).

$$\Delta y_t = \alpha_0 + \delta_t + \delta y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta y_{t-j} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 3$$

In contrast, if the series are found not trended the ADF test statistics will be given as;

$$\Delta y_t = \alpha_0 + \delta y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta y_{t-j} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 4$$

Despite the fact that ADF test is widely used for unit root testing, it is not left without limitations. One of the limitations of ADF test is that it has low probability power and size distortions and also Zivot and Andrews (1992) have criticized the Dickey-Fuller approach in

respect of its inability to address the probability of structural break which significantly reduced its power if the stationarity is true. Thus, the Dickey-Fuller approach treats structural breaks as unknown, i.e. they are determined endogenously. Base on this empirical experience this study also adopted Zivot and Andrews (1992) unit root test with structural break among others for a more robust analysis. The Zivot and Andrews (1992) model specification is given as;

$$Model\ A:\ y_t = \mu^A + \theta^A DU_t + \beta^A t + \alpha^A y_{t-1} + \sum_{j=1}^{k} cj\,\Delta y_{t-j} + \varepsilon_t \ldots\ldots 5$$

$$Model\ B:\ y_t = \mu^B + \beta^B t + \gamma^B DT_t^* + \alpha^B y_{t-1} + \sum_{j=1}^{k} cj\,\Delta y_{t-j} + \varepsilon_t \ldots.6$$

$$Model\ C: y_t = \mu^C + \theta^C DU_t + \beta^C t + \gamma^C DT_t^* + \alpha^C y_{t-1} + \sum_{j=1}^{k} cj\,\Delta y_{t-j} + \varepsilon_t \ldots 7$$

The three models (A, B, and C) above are the developed approach for a series endogenous structural breaks test. Model A shows the abrupt change at level of a series, model B shows the unknown break point at a trend function or at slope of an individual series and model C take into account abrupt changes both at a level and slope of the trend function of a series. According to Perron (1989), most time series can be sufficiently modelled either by Model A or Model C. Sen (2003) reveals that the use of model *A* leads to a great loss of power if in fact the break occurs in model *C*. However, the loss of power is minimal if the break occurs in model *A* but model *C* is used. Thus, this suggest that model *C* is superior to *A*, therefore, this study focuses on model *C* in unit root analysis. DU_t and DT_t^* indicates the dummy variable both at level and slope respectively. Where; DU_t =1 if $t>T_B$, 0 otherwise, $DT_t^* = t\text{-}T_B$ if $t>T_B$, 0 otherwise and *k* is the optimal lag.

The Zivot and Andrews models above are estimated sequentially over the possible break points. The break points are ascertained where *t-statistics* is minimized. The lag length was selected based on general to specific procedure by setting *k=4*.

Therefore, should the variables be stationary and ascertained to be integrated of the same order, example I (1), then, the next step in this analytical technique is to test for cointegration.

3.3.2 Cointegration tests

This test is basically behind the idea that if two or more series closely move together in the long-run, the difference between them will be constant even if they are trended. That is, variables are said to be cointegrated if a stationary process I (0) will be realized as a result of linear combination of the variables. The key assumption in experimenting with cointegration is that the variables be of the same order.

In this study, the approach to be adopted is the Johansen and Juselius (1990) and Gregory and Hansen (1996a, 1996b) cointegration technique. The conventional cointegration test such as Johansen (1990) do not take into account possibility of structural breaks in the long-run relationship, thus, they assume that the cointegrating vectors do not vary over time. Owing to the limitation of these conventional cointegration techniques Gregory and Hansen (1996a, 1996b) developed cointegration test that account for one endogenous structural break in the cointegrating equation. Thesetwo different cointegration techniques are explained and specified below

Johansen Cointegration Test (with no structural break)

The Johansen and Juselius (1990) technique proposed two tests in order to confirm the number of cointegration vectors by examining the significance of the characteristic root of the matrix. It is given in terms of trace and mximum-eigen-value test as;

$$\text{Trace statistic} = \lambda_{trace}(r) = -T \sum_{i=r+1}^{n} ln(1-\hat{\lambda}_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 8$$

And

Maximum eigen value test = λ_{max} = (r, r+1) = $-T \ln (1- \hat{\lambda}_{r+1})$ ……9

Where; T is the number of observations and λ_i is the estimated value of the characteristic roots. Therefore, the trace statistics test the null hypothesis that the cointegrating rank is equal to "r" against the alternative that the cointegrating rank is equal to k. while the maximum eigen value test the null hypothesis that the cointegrating rank is equal to "r" against the alternative that the cointegrating rank is equal to "r+1". Justification is based on Johansen and Juselius (1990) critical values, where if both trace and maximum-eigen value statistics are found to be greater than the critical values, we reject the null hypothesis and vice versa.

Gregory-Hansen Cointegration Test (with Structural breaks)

The Gregory and Hansen (1996a, 1996b) technique extend Engle and Granger's (1987) procedure by allowing for structural break in either the intercept or the intercept and the cointegrating coefficient at an unknown time. They proposed residual based tests for the null hypothesis of no cointegration with structural break against the alternative assumptions. They proposed the following four models to account for single endogenous break:

Model 1: Level shift (C)

$$y_t = \alpha_0 + \alpha_1 \Phi_{t\tau} + \beta_1 x_t + \varepsilon_t , \qquad t = 1, \dots, n \qquad \dots\dots\dots\dots\dots\dots\dots 10$$

Where $\Phi_{t\tau}$ is a dummy variable such that $\Phi_{t\tau} = \begin{cases} 1 \; if \; t > n\tau \\ 0 \; if \; t \leq n\tau \end{cases}$

And $\tau \in (0, 1)$ denotes the relative timing of the break point. In model 1, the structural breaks affects the intercept only; α_0 is the intercept before the break and α_1 is the change in intercept at the time of break.

Model 2: Level shift with trend (C/T)

$$y_t = \alpha_0 + \alpha_1 \Phi_{t\tau} + \varphi_1 t + \beta_1 x_t + \varepsilon_t , \qquad t = 1, \dots, n \quad \dots\dots\dots\dots\dots\dots 11$$

In model 2 the break affects only the intercept however it contains a trend.

Model 3: Regime shift where slope and intercept coefficients change (C/S)

$$y_t = \alpha_0 + \alpha_1 \Phi_{t\tau} + \beta_1 x_t + \beta_2 x_t \Phi_{t\tau} + \varepsilon_t , \qquad t = 1, \dots, n \quad \dots\dots\dots\dots\dots 12$$

In model three the structural breaks affects both the intercept and the slope coefficient. β_1 is the cointegrating slope coefficient before the shift and β_2 is the change in the cointegrating slope coefficient at the time of the break.

Model 4: Regime shift where intercept, slope coefficients and trend change (C/S/T)

$$y_t = \alpha_0 + \alpha_1 \Phi_{t\tau} + \varphi_1 t + \varphi_2 t \Phi_{t\tau} + \beta_1 x_t + \beta_2 x_t \Phi_{t\tau} + \varepsilon_t \dots\dots\dots \quad \dots 13$$

For each of the above models, unit root test are performed on the residuals series, ε_t, using ADF*, z_α and z_t tests. Gregory and Hansen (1996) propose the following tests:

$$\boldsymbol{ADF^*} = \inf_{\tau \in T} ADF(\tau)$$

$$Z_\alpha^* = \inf_{\tau \in T} Z_\alpha(\tau)$$

$$Z_t^* = \inf_{\tau \in T} Z_t(\tau)$$

Gregory and Hansen have tabulated critical values by modifying the Mackinnon (1991) procedure. The null hypothesis of Gregory and Hansen tests is that there is a unit root in the residuals and hence there is no cointegration while the alternative hypothesis is that there is no unit root in the residuals and hence there is cointegration with a single unknown break. The null hypothesis is rejected if the statistic ADF^* is smaller than the corresponding critical

values (Saifuzzaman, 2009). The test statistics can also be measured using the Philip test statistics that are denoted as $Z^*_\alpha$and Z^*_t. The above four Gregory and Hansen cointegration models can be extended to occupy more than one but not greater than four explanatory variables.

If the variables are found to be stationary at first difference and have at least a cointegrating vector, then we will resort to the Vector Error Correction Model (VECM) which entails investigating both short-run and long run dynamics of exchange rate with regards to interest rate in Nigeria. The VEC model is presented below.

3.4 Estimation Techniques

3.4.1 Vector Error Correction Model (VECM)

The VECM will be used to model short-run dynamic relationship with long-run equilibrium. The following VECM with deterministic term is considered where the deterministic term can contain a linear trend, constant and seasonal dummy variables (Harris and Sollis, 2003), also see (http://fmwww.bc.edu/EC-C/S2013/823/EC823.S2013.nn10.slides.pdf) for additional information.

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{k-1} \Delta y_{t-k+1} + \Pi y_{t-k} + cd_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots 14$$

Where, Γ_i= - (I-A_1 - . . . A_i) (i=1, ..., k-1) and Π = - (I-A_1 - . . . – A_k). This means that within the context of this model information on short-run and long-run adjustment to changes in $y_t$through the estimates of $\hat{\Gamma}_i$ and $\hat{\Pi}$, respectively. d_t is a vector of deterministic variables, c is the vector of parameter matrix, y_t is (n x1) vector of variables that are integrated of the same order, Δ is the difference operator and k is the optimal lag . Also $\Pi=\alpha\beta'$, where if a model contains y_t , a vector of nonstationary I(1) variables , then Πy_{t-k} contains the stationary

long-run error correction relations and must be stationary for $\varepsilon_t \sim I(0)$ to be white noise. This occurs when $\Pi=\alpha\beta'$ has reduced rank (i.e. there are r ≤ (n-1) cointegrating vectors present). This model assumes that the agents react to disequilibrium error $\beta' y_{t-k}$ via the adjustment coefficient α to restore equilibrium. α represents the speed of adjustment to disequilibrium and β is a matrix of long-run coefficients such that the term $\beta' y_{t-k}$ embedded in the cointegrating equation represents up to (n-1) cointegrating relationships in the model, which ensures that the y_t converge with their long-run steady state solutions (Harris and Sollis, 2003).

In equation 14 above, the variables of interest are; exchange rate, interest rate (mpr), foreign reserves, real gross domestic product, trade openness, external debt, all in logged form (given as vector of y_t) and d_t is a dummy variable.

Nevertheless, an important preliminary step in model building is the selection of the lag order. In this theses, the number of lags to be selected are based on Akaike information criterion (AIC) among other criteria, some of which are, Schwarz information criterion (SIC) and Hannan Quinn (HQ) criterion. All the above criteria add a penalty to the one step ahead MSE which depends on the sample size (*T*), the number of variables (*m*), and the number of lags. The three criteria have different asymptotic properties. While SIC and HQ are consistent model selector (In general for T ≥ 20 SIC and HQ will always choose smaller models than AIC), AIC is inconsistent (in fact, it overestimates the true order with positive probability, however, despite the fact that there is risk of over-fitting the model, but this study definitely wouldn't want to under-fit it) because the penalty function used does not simultaneously go to infinity as $T \to \infty$ and to zero when scaled by *T*.In most cases the Schwarz Criterion (SC) tend to suggest fewer lags than the rest because it places harsher penalty on larger lags. This Criterion is therefore, often considered to be suited for small sample analysis where the degrees of freedom are an issue (Gujarati, 2004).

However, consistency is not the only yardstick to use since consistent methods may have poor sample properties (Ivanov and Kilian, 2001),a comprehensive information can also be found at (http://apps.eui.eu/Personal/Canova/Articles/ch4.pdf). Additionally, one should not look at these criteria as an adjunct to the various specification tests mentioned above. Some of these criteria are purely descriptive and may not have strong theoretical properties. Some of them may even be open to the charge of data mining. Therefore, no one of these criteria is necessarily superior to the others (Gujarati, 2004). The AIC is written as;

$$\ln AIC = \left(\frac{2k}{n}\right) + \ln\left(\frac{RSS}{n}\right)$$

Where ln AIC is natural log of AIC and 2k/n is the penalty factor. In comparing two or more models, the model with the lowest value of AIC is preferred.

Despite the fact that the selection of lag length using information criteria is of paramount importance, Koop (2005) suggested the useof sequential lag selection strategy, for instance, choosing a maximum possible lag length, $P_{\max,}$that seems reasonable.

Also, it is well known in the literature that the variables in VAR/VECM are or may be individually statistically insignificant due to over parameterization, but collectively they may be significant on the basis of standard F-test owing to fact that, the nature of the VAR/VECM is that they are jointly determined. Thus, the goal is to find important interrelationships among the variables (Gujarati, 2004). In order to obtain a parsimonious model many forecasters purge the insignificant coefficients from the VAR/VECM (that is, using the Hendry General to Specific Framework) as it is also applied in this study(Enders, 2015). Therefore, the controversies raised above show that the individual coefficients in the estimated VAR/VECM are often difficult to interpret, as such, the practitioners of this technique often resort to the estimation of Impulse Response Function (IRF) particularly in a VAR set up. In order to affirm that the model parameters are stable, this study further

explores the stability of the model. The stability condition for VAR (restricted or unrestricted) requires that the roots of the related characteristic equation (Inverse root of AR characteristic Polynomial) lie within the unit circle, if satisfied, the variables will be jointly covariance stationary, or 'non-explosive'.

3.5 Source of data

The data for all the variables of concern to be used for this study are secondary data and are sourced from Central Bank of Nigeria statistics data baseand World Development Indicators (WDI, 2015) data bank (See appendix 2). The study used yearly data series for the period of 1981 to 2015.

3.6 Limitations

Indeed, despite the fact that the sample size was large enough and the estimation technique was aligned to the structure of the research objectives and the nature of the data, this study is not left without setbacks. The major setback experienced by this study is none availability of data to update the research up to 2017 as at the time of the presentation of this thesis.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.0 Introduction

This chapter involves the presentation, interpretation and analysis of the results obtained from the estimation techniques used in the previous chapter. However, the chapter starts by

presenting the stationarity property of the variables used in the analysis because it is the starting point of any time series analysis then followed by the analysis of the econometric results.

4.1 Stochastic Properties of the data test Results

4.1.1 Unit Root Test Results

As conventionally known, the first step in a time series analysis is to ascertain the level at which the variables under study are stationary as well as their integration component. A variable is said to be stationary if it has a zero mean, constant variance and the covariance between two periods is based on the lag and not time at which it was measured (Gujarati,2004). In other words a variable is stationary if it is time invariant. To test the stationarity or otherwise of the variables used in this study as well as the order of integration, the study adopts the Augmented Dickey Fuller (ADF) and Zivot and Andrews (ZA) unit root test. The results of the test are presented in table 4.1.1a below.

Table 4.1.1a

ADF

Variables	**Intercept**		**Trend & Intercept**		**None**		**Decision**
	Level	**First**	**Level**	**First**	**Level**	**First**	
LEXR	-2.02	-4.95*	-1.04	-5.40*	1.61	-4.01*	I(1)
LMPR	-2.92***	-6.99*	-2.92	-7.03*	0.06	-7.09*	I(1)
LOPNSS	-1.88	-7.48*	-1.81	-4.36*	-0.15	-7.57*	I(1)

Source; Computation from E-views 9.0

Note: * denotes 1% level of significant, ** denotes 5% level of significant and *** denotes 10% level of significance I(0) means that the series is integrated in level and I(1) means the series is integrated at first difference. However, only 5% level of significance is considered. And the lag selection criterion used is SBC/SIC. Values are rounded up to 2 decimal place. See appendix 3A for the full test results.

Table 4.1.1b

ZIVOT-ANDREWS UNIT ROOT TEST (MAX. LAGS 4)					
Variables	**Trend and Intercept: Model C**				**Decision**
	Level	**Break date**	**1st diff.**	**Break date**	
LEXR	-3.75	1999	-6.08*	1988	I(1)
LMPR	-3.75	1989	-7.46*	1994	I(1)
LOPNSS	-4.39	1995	-5.32**	2004	I(1)

Source; Computation from E-views 9.0

Note: * denotes 1% level of significant, ** denotes 5% level of significant and *** denotes 10% level of significance I(0) means that the series is integrated in level and I(1) means the series is integrated at first difference. However, only 5% level of significance is considered. Remember from the previous chapter only model C was stated to be considered. Values are rounded up to 2 decimal place. See appendix 3B for the full test results.

Table *4.1.1a*, and *4.1.1b*, above presents the ADF and ZA unit root test results. In both the test the null hypothesis of non-stationarity of the series is rejected if the computed tau (τ) statistic is more negative than the critical tau τ values or if the probability value of the t-statistic is less than 0.05. The results show that LEXR, LMPR, and LOPNSS are stationary at first difference because while ADF and ZA test statistic values at level are less than their respective critical values at 5% level of significance their ADF and ZA test statistic values at first difference are greater than their respective critical values at 1 and 5% level of significance. Thus, the study concludes that the variables are integrated of order one, that is, I (1).

4.1.2 Cointegration test results

Regressing a non-stationary series on another non-stationary culminates into spurious regression, however, if a linear combination of the non-stationary series is found to be stationary, the regression is no longer spurious but cointegrated (Gujarati, 2004). From the above unit root test results, since all the variables are found to be non-stationary at level at least at 5% level of significance, they became stationary after first differencing, meaning they are integrated of order one. Thus, the study proceeds to examine their cointegrating relationship.The cointegrating relationship is examined using Johansen-Juselius and Gregory

Hansen Cointegration test because all the variables are integrated of the same order, that is, I (1). The results are presented below.

Johansen Cointegration Test (No structural break)

Table 4.2.1b below presents the result of the Johansen cointegration test under both Trace and Maximum-Eigen Value test. The null hypothesis of the cointegrating equations is rejected if the Trace and Max.-Eigen statistic is greater than the critical value at 5 percent level of significance. From the results in table 4.1.2a below, Trace and Max.-Eigen statistic indicates that there are two cointegrating equations at 0.05 level of significance. These two cointegrating equations are identifiable as, the first one being the exchange rate model and the second one being the interest rate model. This is because the respective adjustment coefficients corresponding to the two equations are both negative and statistically significant. In addition the signs of the other elements of the vector appear to respectively belong to the exchange rate and interest rate models. The lag length used based on the minimum value of Akaike Information Criterion (AIC) is 4 (See appendix 4 for full test results).

TABLE 4.1.2a **JOHANSEN COINTEGRATION TEST RESULT (ONE LAG INTERVAL)**

Hypothesized No. of CE(s)	**Trace Statistic**	**0.05 Critical Value**	**Max-Eigen Statistic**	**0.05 Critical Value**
None *	108.1764	29.79707	88.09557	21.13162
At most 1*	20.08082	15.49471	19.75480	14.26460
At most 2	0.326016	3.841466	0.326016	3.841466

Source; Computation from E-views 9.0
*Note: * denotes rejection of the hypothesis at the 0.05 level. See appendix 5A for full test results.*

Gregory-Hansen Cointegration Test (With structural break)

Also, displayed below is the Gregory-Hansen Cointegration test for its various models.

Table 4.1.2b LEVEL SHIFT MODEL RESULTS

1981-2015	Dependent Variables included in the test						
Independent	1	2	3	4	5	6	7
Variables	LEXR	LEXR	LEXR	LEXR	LEXR	LEXR	LEXR
LMPR	LMPR	LMPR	LMPR	LMPR	LMPR	LMPR	LMPR
LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS
DC		DC		DC			
MDC			MDC	MDC			
DT					DT		DT
MDT						MDT	MDT
ADF* (T-Statistic)	**-4.37* [1999]**		**-5.02* [1995]**		**-4.39* [1999]**	**-4.45* [1999]**	**-4.64* [1999]**
Z_t* (T-Statistic)	**-4.43* [1999]**	**No result**	**-4.68* [1999]**	**No result**	**-4.46* [1999]**	**-4.52* [1999]**	**-4.71* [1999]**
Z_a* (T-Statistic)	**-25.86*[1999]**		**-27.46*[1999]**		**-26.04*[1999]**	**-26.40*[1999]**	**-28.13*[1999]**

Source; Computation from STATA 14.
** ** *** denotes rejection of the null hypothesis at 1, 5 and 10% level of significance respectively. The figures in parenthesis are breakpoints date. See appendix 5Bi for full test results.*

Table 4.1.2b above shows that all the different combinations of the independent variables in Gregory-Hansen model with level shift are significant at 1% level of significance as indicated by the ADF*, Z_t* and Z_a* statistic. This means that all the variables used in this study are cointegrated in the presence of structural breaks. The breakpoints appeared to be in the year 1999.

Table 4.1.2c REGIME SHIFT/ SLOPE MODEL RESULTS

1981-2015	Dependent Variables included in the test						
Independent	1	2	3	4	5	6	7
Variables	LEXR	LEXR	LEXR	LEXR	LEXR	LEXR	LEXR
LMPR	LMPR	LMPR	LMPR	LMPR	LMPR	LMPR	LMPR
LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS
DC		DC		DC			
MDC			MDC	MDC			
DT					DT		DT
MDT						MDT	MDT
ADF* (T-Statistic)	**-3.01* [1997]**	**-1.18* [1985]**			**-3.11* [1997]**	**-3.03* [1997]**	**-3.11* [1997]**
Z_t^* (T-Statistic)	**-5.69* [1997]**	**-5.83* [1997]**	**No result**	**No result**	**-4.78* [1997]**	**-4.93* [1997]**	**-4.79* [1997]**
Z_a^* (T-Statistic)	**-33.89*[1997]**	**-34.62*[1997]**			**-28.04*[1997]**	**-28.79*[1997]**	**-28.38*[1997]**

Source; Computation from STATA 14

** ** *** denotes rejection of the null hypothesis at 1, 5 and 10% level of significance respectively. The figures in parenthesis are breakpoints date. See appendix 5Bii for full test results.*

Table 4.1.2c above shows that all the different combinations of the independent variables in Gregory-Hansen model with regime shift/slope are significant at 1% level of significance as indicated by the ADF*, Z_t^* and Z_a^* statistic. This means that all the variables used in this study are cointegrated in the presence of structural breaks. The breakpoints appeared to be in the year 1997, however with an exception in second combination where the ADF* shows a breakpoint in the year 1985.

Table 4.1.2d REGIME TREND SHIFT MODEL RESULTS

1981-2015	Dependent Variables included in the test						
Independent	1	2	3	4	5	6	7
Variables	LEXR	LEXR	LEXR	LEXR	LEXR	LEXR	LEXR
LMPR	LMPR	LMPR	LMPR	LMPR	LMPR	LMPR	LMPR
LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS	LOPNSS
DC		DC		DC			
MDC			MDC	MDC			
DT					DT		DT
MDT						MDT	MDT
ADF* (T-Statistic)	**-5.57* [1999]**	**-4.79* [2011]**			**-5.93* [1999]**	**-6.00* [1999]**	**-6.74* [1999]**
Z_t^* (T-Statistic)	**-5.66* [1999]**	**-5.65* [1999]**	**No result**	**No result**	**-6.02* [1999]**	**-6.09* [1999]**	**-6.84*[1999]**
Z_a^* (T-Statistic)	**-32.74*[1999]**	**-32.69*[1999]**			**-34.77*[1999]**	**-35.52*[1999]**	**-40.60*[1999]**

Source; Computation from STATA 14
** ** *** denotes rejection of the null hypothesis at 1, 5 and 10% level of significance respectively. The figures in parenthesis are breakpoints date. See appendix 5Biii for full test results.*

Table 4.1.2d above shows that all the different combinations of the independent variables in Gregory-Hansen model with regime shift are significant at 1% level of significance as indicated by the ADF*, Z_t^* and Z_a^* statistic. This means that all the variables used in this study are cointegrated in the presence of structural breaks. The breakpoints appeared to be in the year 1997, however with an exception in second combination where the ADF* shows a breakpoint in the year 2011.

4.2Long Run (L-R) Estimates of effect of interest rate on exchange rate in Nigeria.

The inclusion of the Dummies and their interactions with interest rate in the Johansen and Gregory Hansen Cointegration test suggest that, even in the presence of possible structural breaks in the relationship between interest rate and exchange rate, there is some evidence of long run equilibrium relations. This is consistent with the theoretical idea of Uncovered

Interest Parity that the impossibility of arbitrage in a liberalised capital flows would guarantee a defined relationship between interests rate (differentials) and the exchange rate (depreciations). The long run estimates from the VEC model are given in the equation below;

$$LEXR = 85.16 - 42.40LMPR* + 8.03LOPNSS** \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 12$$

** & ** indicates statistical significance at 1 and 5 per cent respectively*

Having established the presence of long-run relationship, the next step is to examine the nature of this long-run relationship as well as the short-run dynamics which defines the adjustment process towards the long-run relationship. From the estimates of the long-run, interest rate (mpr) was found to have a significant negative effect on the exchange rate in Nigeria, implying that, a percentage increase on interest rate, on average, will tend to lead to about 42.4% appreciation of the exchange rate in Nigeria in the long-run.In addition, trade openness was found to have a significant positive effect on the exchange rate of the Naira, that is, a percentage increase on trade openness on average, will tend to lead to about 8.03% depreciation of the Exchange rate of the Naira in the long-run. This is also in line with the conceptualisation presented in figure 3.2 that under some conditions high interest rates can lead to depreciation rather than appreciation of the domestic currency.

4.3 Short-Run Dynamics

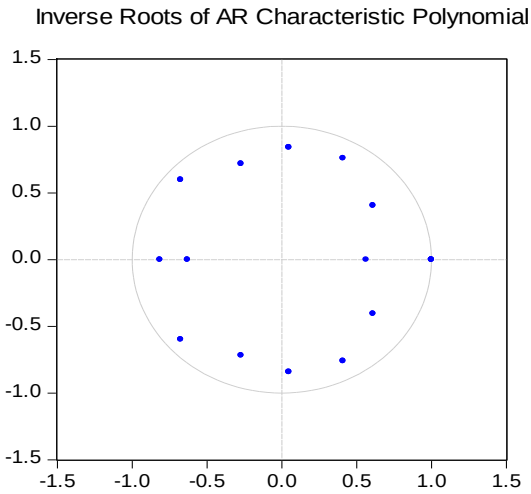
Having established the long-run estimates of the model, the next step in the analysis is the examination of short run dynamics of the models. The study adopts VECM which was specified in the previous chapter should there be cointegration among the variables. A superb feature of the VECM is that it presents the short-run relationship among the variables as well as the Error Correction Term (ECT). The ECT is the speed of adjustment that captures the speed at which the economy converges to long-run equilibrium in a year (in annual analysis), following a shock in the economy. The VECM result is presented below;

Table 4.3.1 VECM RESULTS

1981-2015		*Dependent Variable*Δ(LEXR)		
Variables	**Coefficient**	**T-Statistic**	**Std. Error**	**Prob.**
ECM(-1)	-0.028415	-3.852722	0.007375	0.0023
Δ(LEXR(-1))	-0.322581	-1.679573	0.192062	0.1189
Δ (LEXR(-2))	-0.538596	-2.900025	0.185721	0.0133
Δ (LEXR(-3))	-0.215685	-1.063988	0.202714	0.3083
Δ (LEXR(-4))	-0.361448	-1.938396	0.186468	0.0765
Δ (LMPR(-1))	1.189616	3.467649	0.343061	0.0047
Δ (LMPR(-2))	1.101227	3.552780	0.309962	0.0040
Δ (LMPR(-3))	0.865438	3.164916	0.273447	0.0081
Δ (LMPR(-4))	0.448953	1.951258	0.230084	0.0748
Δ (LOPNSS(-1))	-0.307120	-1.667282	0.184204	0.1213
Δ (LOPNSS(-2))	-0.240339	-1.217875	0.197343	0.2467
Δ (LOPNSS(-3))	-0.304206	-1.562748	0.194661	0.1441
Δ (LOPNSS(-4))	0.183951	1.083416	0.169788	0.2999
DC	1.106159	1.324004	0.835465	0.2102
LMPR*DC(MDC)	-0.546963	-1.659261	0.329642	0.1230
DT	-1.285581	-1.793652	0.716740	0.0981
LMPR*DT(MDT)	0.809267	2.557177	0.316469	0.0251
C	-0.180523	-0.781086	0.231118	0.4499
R-Squared		0.818167		
R-squared Adjusted		0.560570		
F-statistic		3.176151		
Prob.(F-statistic)		0.023609		
D.W statistic		2.502525		
Residual Diagnostics Test	**Statistic**	**Prob. Chi-Square**	**Decision**	
LM Serial Correlation	1.341378	0.0419	Reject H_0	
BPG Heteroskedasticity	0.454257	0.8038	Accept H_0	
Jarque-Berra Normality test	1.618095	0.445282	Accept H_0	

Source; Computation from E-views 9.0
Note: AIC was used as the lag selection criterion to select 4 lags as the optimal lag length. See appendix 6 for this estimates.

Following the explanation made in the previous chapter, displayed below is the inverse root graph for the model estimated in table 4.3.1



The inverse root graph above show that the VEC model estimates presented in table 4.3.1 is stable since none of the roots of the related characteristic equation (dots in the above graph) lies outside the unit circle of the graph.

However, to analyse the short-run dynamic adjustment process of the exchange rate and interest rate relationship, we use Hendry General to Specific methodology to derive a parsimonious form of the unrestricted VEC shown in table 4.3.2 below from 4.3.1 above.

Table 4.3.2 PARSIMONNIOUS VECM RESULTS

1981-2015	*Dependent Variable*Δ **(LEXR)**			
Variables	**Coefficient**	**T-Statistic**	**Std. Error**	**Prob.**
ECM(-1)	-0.023656	-3.437044	0.006883	0.0028
Δ (LEXR(-2))	-0.490237	-3.178577	0.154232	0.0049
Δ (LEXR(-4))	-0.425325	-2.717872	0.156492	0.0137
Δ (LMPR(-1))	0.633931	2.473085	0.256332	0.0230
Δ (LMPR(-2))	0.938768	3.600955	0.260700	0.0019
Δ (LMPR(-3))	0.576473	2.916076	0.197688	0.0089
Δ (LMPR(-4))	0.451678	2.400196	0.188184	0.0268
Δ (LOPNSS(-4))	0.450126	3.425527	0.131403	0.0028
LMPR*DC(MDC)	-0.115691	-2.135093	0.054185	0.0460
LMPR*DT(MDT)	0.189157	2.598338	0.072799	0.0176
C	0.017403	0.090152	0.193045	0.9291
R-Squared		0.692703		
R-squared Adjusted		0.530968		
F-statistic		4.282944		
Prob.(F-statistic)		0.003151		
D.W statistic		2.611564		
Residual Diagnostics Test	**Statistic**	**Prob. Chi-Square**	**Decision**	
LM Serial Correlation test	1.184800	0.1596	Accept H_0	
BPG Heteroskedasticity test	5.096670	0.0558	Accept H_0	
Jarque-Berra Normality test	0.313153	0.855066	Accept H_0	

Source; Computation from E-views 9.0
Note: See appendix 7 for the full test results of the residual diagnostics

Table 4.3.2 above displays the short-run dynamics and ECM. The ECM, that is, adjustment or loading factor has the expected sign (negative) and statistically significant at 1 per cent. The ECM coefficient of -0.024 shows about 2.4%convergence towards long-run equilibrium following a shock in the economy in a period of one year. This implies that about 2.4%disequilibrium in the short-run processes will converge into a long-run equilibrium

within one year.Thus, the coefficient of the lagged error correction term indicates a slow convergence to long-run equilibrium.

In addition, the results show that most of the lags of the variables, as well as the interaction dummies, are significant at 1 and 5% respectively. The dependent variable, that is, exchange rate, exhibit significant persistence for both 2^{nd} and 4^{th} period lag. This implies that increase in exchange rate (depreciation of exchange rate) in the previous periods result in the appreciation of exchange rate in the current period. In addressing the first objective the interest rate also appears to be positive and significant in the adjustment process, suggesting that up to 4^{th} lag of the interest rate is important in adjusting the exchange rate towards its long-run path. Thus, the short-run effect is positive, suggesting that increase in interest rate induces depreciation, rather than appreciation in the short-run, in the short-run which contrary to economic theory where increase in domestic interest rate relative to foreign interest rate induces appreciation, however, like most other economic relations, this relation is only an approximation to reality and does not always hold.

Therefore, as it has been earlier shown in section 2.3, the interest rate parity condition is related to how short-term interest rates are related to the exchange rate. It has also been shown that financial investors hold bonds with the highest expected yield and neglect transaction cost, risk, and liquidity (the easiness to buy or sell an asset). However, in reality investors not only care about expected return but also care about risk and liquidity sometimes. This is because these factors play a major role in the determination of investment decision and exchange rate movements.

In terms of risk for instance, perception that risk has decreased may lead many foreign investors to buy assets in a country, leading to a large demand of the country's currency and hence appreciation follows. In contrast, perception that risk has increased may lead same investors to sell all the assets they have bought in that country no matter how rewarding the interest rate is, leading to a low demand and high supply of the country's currency and hence

depreciation follows. These type of episodes have been witnessed by Latin America and Emerging Asian economies. During these episodes the interest rate parity condition fails and the exchange rate depreciates a lot without any change in domestic or foreign interest rates.

In addressing the second objective, interaction dummy (DT*LMPR) shows that the marginal effect of interest rate on exchange rate of the Naira is 0.823 or 82.3% for high corporate debt. This implies that the effect of interest rate on exchange rate when level of corporate debt is high is greater than when it is low by about 0.189 or 18.9%. This suggest that high interest rate will not produce the desired result of appreciating the domestic currency that economic theory postulates in the presence of high level of corporate debt obligation. Rather, the high interest rates will put depreciation pressure on the domestic currency because investors will pull out their capital out of the country due to fear of high debt repayment and probability of bankruptcy. Therefore, such capital flight will increase the supply of domestic currency and increase the demand for foreign currency, and thus, the domestic currency eventually depreciates due to low demand. Therefore, this study emphasise on maintaining a low debt level for a viable exchange rate.

In addressing the third objective, the interaction dummy (DC*LMPR) shows that the marginal effects of interest rate on exchange rate of the Naira is 0.518 or 51.8% for a liberal capital account. This implies that the effect of interest rate on exchange rate when capital account is liberalised is lower than when it is closed by about 0.116 or 11.6%. This suggest that high interest rates will reduce the severity of depreciation on the domestic currency in the presence of a liberal capital account. This is because the free mobility of capital provided will give investors around the globe a chance to invest in Nigeria and also reduce the risk investors might perceive about their capital being trapped due to stringent policies. Therefore, increase in capital inflow in Nigeria will lead to the increase in the demand for Nigerian Naira and hence reduces the depreciation pressure.

However, the advocates of capital account restriction think of how to prevent "sudden stops"in the event investors perceived a high profile risk approaching their investment. But they fail to consider the depreciation that may occur through the increase flow of interest income through the current account. Therefore, this study gives much emphasis on capital account liberalisation in the short-run.

Lastly, the 4^{th} period lag of trade openness appears to be positive and significant, suggesting that increase in trade openness, on average, will lead to about 45% depreciation on the exchange rate of the Naira.This is also in line with the conceptualisation presented in figure 3.2 that under some conditions high interest rates can lead to depreciation rather than appreciation of the domestic currency.

Moreover, the last segment of table 4.3.2, that is, starting from R-Squared to Normality test displays the model fitness test and residual diagnostics test of the parsimonious model. The R-squared of the model appears to be more than 60%, implying that there exist goodness of fit in the model. This means that about69% of variation in the dependent variable are explained by the independent variables. The R-squared shows the explanatory power of the independent variables on the dependent variable. The F-statistic shows that the model is fit and that the independent variables are jointly statistically significant in explaining the dependent variable. The F-statistic of the model suggest that the overall regression of the model is significant at 1%. The residual diagnostic tests for the validity of the OLS assumptions suggests the absence of such econometric problems.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter being the last in this study aims to summarise the study from the first chapter down to the fourth chapter while giving much emphasis on the major findings of the study. Also this chapter concludes the study by addressing the objectives the study set out to achieve. Lastly, the chapter ends with policy recommendations for stakeholders.

5.1 Summary

This study emanates out of the international finance literature reviewed on interest rate defense of a currency where observations were made on the economic crisis of the 1990s experienced by many countries, particularly emerging economies, such as Mexico (1994-95), Argentina (2001), and Emerging Asian Economies (1997-98). The main causes of this currency crisis were identified to be capital flows of large short-term nature followed by what is referred to as “Sudden Stops”, that is, massive reversals.

Thus, with Central Banks of the affected countries not been able to hold the line, their currencies depreciated sharply. In this vein, capital flow which is in most cases determined by the prevailing interest rate is seen as a factor that has impact on exchange rate fluctuations, and exchange rate fluctuations expose economic agents to foreign exchange risk which directly affect their investment decisions. Hence, since interest rate is one of the major factors that determines capital flow, then it also determines exchange rate fluctuations and can be used to manage exchange rate volatility.

However, prior to the above brief historical background on currency crisis experienced by some countries an extant literature was reviewed as earlier stated. Thus, it is within the literature reviewed that this study buttress the opinion of various scholars on interest defense of a currency. The various opinions of the scholars show that there is no consensus in the

literature and hence, there is a gap to be filled by upcoming scholars. The opinions of the scholars are grouped into three;

i. Advocates of interest defense of a currency (e.g. Basurto and Gosh, 2001)
ii. Opponents of interest defense of a currency (e.g. Furman and Stiglitz, 1998)
iii. Advocates of interest defense of a currency with fiscal strength as a condition (e.g. Flood and Jeanne, 2005) and (Arnorsson and Zoega, 2015).

Even though there is no consensus in the literature some success have been achieved using interest defense of a currency, for example Hong Kong in 1997.

Despite the fact that policy makers have made a lot of attempt to use interest rate to actively manage exchange rate, such actions have not produced the desired results in most cases as evident from the literature. This is because the effect of interest rate on exchange rate appeared to be contingent on a number of factors, for instance, level of corporate debt obligation and level of capital control.

Thus, it is against these contingencies which were identified as research gap in the literature and filled by this study within the Nigerian context that this study adopted a Vector Error Correction Model (VECM) as an estimation technique to analyse the effect of exchange rate management in Nigeria with regards to the presence of high or low debt level and liberalised or restricted capital account. The VECM was augmented to include dummy variables in order to address the qualitative nature of the factors which serve as the research gap. That is, a dummy DT was used to represent level of corporate debt obligation while DC was used to represent level of capital control.

Accordingly, to a great extent the research findings do confirm the expectations from the extant literature, even though the approach is unique for the case of Nigeria. The key findings of this study are;

i. The relationship between interest rate and exchange rate in Nigeria appears to depend on the extent of capital account openness and level of corporate debt.

ii. In the short-run increase in interest rate appears to be associated with depreciation rather than appreciation which is consistent with the findings of (Furman and Stiglitz, 1998) and the conceptualisation presented in figure 3.2, that under the conditions of high corporate debt and free capital flow in a flexible exchange rate regime, increase in interest rate would cause depreciation rather than appreciation of the exchange rate. However, the depreciation has been shown to be lesser than that which capital controls are instituted.

iii. The marginal effect of interest rate on exchange rate of the Naira is 51.8% for a liberal capital account and only 63.4% for a closed capital account. This implies that the liberalisation of capital account decreases the depreciation impact of high interest rate on exchange rate by 11.6%. Thus, for every 1% increase in interest rate the exchange rate of the Naira depreciates by 51.8%. This also confirms the findings of (Goldfajn and Gupta, 1999) and the conceptualisation presented in figure 3.2.

iv. The marginal effect of interest rate on exchange rate of the Naira is 82.3% for high corporate debt level and only 63.4% for low corporate debt. This implies that high corporate debt level increases the depreciation impact of high interest rate on exchange rate by 18.9%. Thus, for every 1% increase in interest rate the exchange rate of the Naira depreciates by 82.3%. This also confirms the findings of (Goderis and Loannidou, 2006) and the conceptualisation presented in figure 3.2.

v. In the long-run after all adjustments have taken place, exchange rate appears to appreciate by about 42.4% on average, for every 1% increase in interest rate. This also confirms the findings of Adamu(2016) and Basurto and Gosh(2001).

Thus, the findings of this study appears to agree with previous studies in the literature because of the continuous push for the liberalisation of the Nigerian economy by the United States and western bloc to conform with global best practices.

5.2 Conclusion

Despite the fact that existing body of knowledge is filled with lots of empirical work, there is yet no consensus reached, thereby gives room for contribution.

Thus, this study examines the relationship between interest rate and exchange rate in Nigeria by incorporating corporate debt level and level of capital account liberalisation.

Therefore, the findings of this study revealed the existence of long-run relationship between interest rate and exchange rate through cointegration test. It shows that in the long-run there exist a negatively statistically significant relationship between interest rate and exchange rate in Nigeria. This is consistent with the traditional model in which rise in interest rate raises capital inflows and appreciate the domestic currency. In the context of the conceptual scheme presented in figure 3.2, this implies that high level of corporate debt and capital account openness (in the presence of economic turmoil) are not enough alone to induce capital outflows as interest rate rises (to inflate interest repayments and pull out investment).

However, in the short-run, that is,in the adjustment process, the relationship between interest rate and exchange rate is revealed to be positive and statistically significant in Nigeria. This suggest that increase in interest rate induces depreciation of the domestic currency, even though the depreciation is less if the capital account is liberalised and also more if there is high corporate debt.

Conclusively, the depreciation of the domestic currency in the short-run which is less in place of a liberal capital account has been shown to gradually transform into appreciation of the domestic currency when the capital account is fully liberalised in the long-run (a state where the economy has attain its full employment level). Also, the significant depreciation revealed

as a result of high corporate debt level in the short-run has been shown to transform gradually into appreciation of the domestic currency in the long-run (a state where the economy has attain its full employment level and economic stability is achieved).

5.3 Recommendations

Sequel to the conclusions stated above, this study therefore recommends that the government and relevant stakeholders should consider increase interest rate, liberalised capital account and low corporate debt (low leverage ratio) as options for effective management of exchange rate via interest rate adjustment policy because of the long-run value the domestic currency will gain.

5.4 Further Research

This study suggest that corporate debt level is a determining factor for in using interest rate to manage exchange rate in Nigeria. Therefore since aggregate debt stock in economics is of different categories, the effect of other types of debts (for instance, public debt level) on interest rate defense of a currency in Nigeria should set the foundation for further research.

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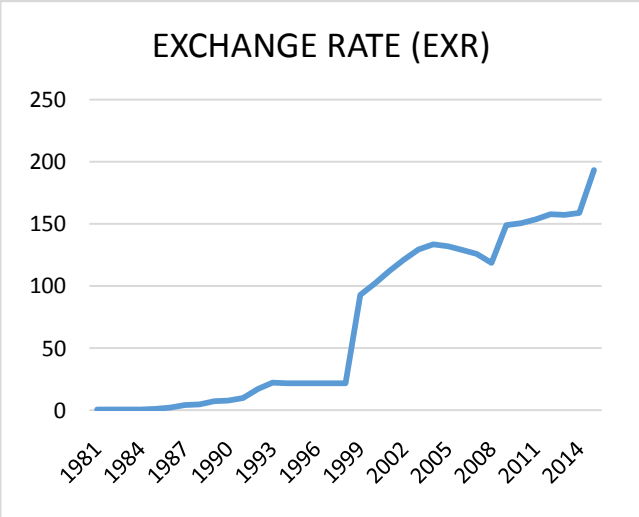
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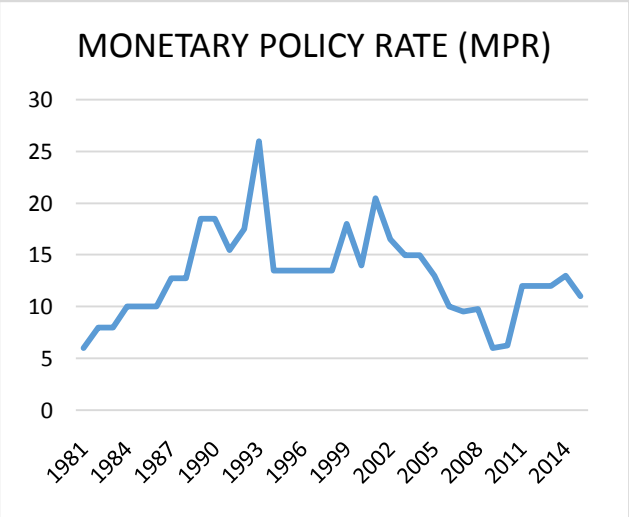
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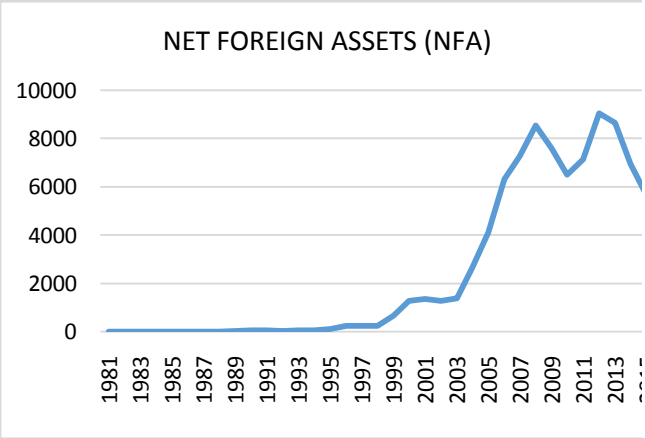
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Appendix

1. Graphs







2. Data

A. Annual data series with DC as a dummy representing regime shift

DATE	LEXR	LMPR	LOPNSS	DC
1981	-0.4943	1.791759	2.801927	0
1982	-0.39616	2.079442	2.505107	0
1983	-0.32283	2.079442	2.30908	0
1984	-0.26801	2.302585	2.256247	0
1985	-0.11227	2.302585	2.279226	0
1986	0.703394	2.302585	1.996388	0
1987	1.390759	2.545531	2.961777	0
1988	1.5122	2.545531	2.799271	0
1989	2.000344	2.917771	3.053571	0
1990	2.084155	2.917771	3.438523	0
1991	2.293494	2.74084	3.566825	0
1992	2.850614	2.862201	3.646334	0
1993	3.093362	3.258097	3.418724	0
1994	3.085852	2.60269	3.040889	0
1995	3.085852	2.60269	4.076143	0
1996	3.085852	2.60269	3.902774	0
1997	3.085852	2.60269	3.927257	0
1998	3.085852	2.60269	3.544788	0
1999	4.529297	2.890372	3.65464	0
2000	4.626004	2.639057	3.749271	0
2001	4.717992	3.020425	3.680385	0
2002	4.795544	2.80336	3.358285	0
2003	4.862572	2.70805	3.659798	0
2004	4.894104	2.70805	3.638761	1
2005	4.883915	2.564949	3.809244	1
2006	4.857108	2.302585	3.594575	1
2007	4.834956	2.251292	3.612016	1
2008	4.775477	2.277267	3.708961	1
2009	5.003142	1.791759	3.459762	1
2010	5.01262	1.832581	3.609378	1
2011	5.036053	2.484907	3.729347	1
2012	5.059422	2.484907	3.547589	1
2013	5.058226	2.484907	3.428849	1
2014	5.066086	2.564949	3.273013	1
2015	5.264136	2.397895	3.05212	1

B. Data for computed corporate debt level (commercial banks debt) or leverage ratio

Date	Total Assets/Liability(L)	Capital(C)	Total deposits(TD)	DEBT= L-C-TD	L.R=DEBT/ T. ASSET	Average	DUMMY(DT)
1981	19.5	0.5	10.7	8.3	0.425	0.459	0
1982	22.7	0.7	12.0	10.0	0.441	0.459	0
1983	26.7	0.8	13.9	12.0	0.448	0.459	0
1984	30.1	1.0	15.7	13.4	0.446	0.459	0
1985	32.0	1.1	17.6	13.3	0.415	0.459	0
1986	39.7	1.3	18.1	20.3	0.511	0.459	1
1987	49.8	1.5	23.1	25.2	0.505	0.459	1
1988	58.0	1.9	29.1	27.0	0.465	0.459	1
1989	64.9	2.7	27.2	35.0	0.539	0.459	1
1990	83.0	3.7	38.8	40.4	0.488	0.459	1
1991	117.5	4.3	52.4	60.8	0.517	0.459	1
1992	159.2	3.8	76.1	79.3	0.498	0.459	1
1993	226.2	4.4	112.4	109.3	0.483	0.459	1
1994	295.0	5.4	144.1	145.5	0.493	0.459	1
1995	385.1	6.5	182.4	196.2	0.509	0.459	1
1996	458.8	8.7	220.3	229.7	0.501	0.459	1
1997	584.4	17.7	280.0	286.7	0.491	0.459	1
1998	694.6	25.6	327.0	342.0	0.492	0.459	1
1999	1,070.0	31.5	516.8	521.8	0.488	0.459	1
2000	1,568.8	44.2	775.9	748.7	0.477	0.459	1
2001	2,247.0	75.2	975.5	1196.4	0.532	0.459	1
2002	2,766.9	101.3	1,209.7	1455.9	0.526	0.459	1
2003	3,047.9	122.7	1,417.1	1508.0	0.495	0.459	1
2004	3,753.3	142.3	1,778.7	1832.3	0.488	0.459	1
2005	4,515.1	172.3	2,155.2	2187.6	0.485	0.459	1
2006	7,172.9	170.5	3,379.3	3623.1	0.505	0.459	1
2007	10,981.7	153.0	5,255.9	5572.8	0.507	0.459	1
2008	15,919.6	210.9	8,252.9	7455.7	0.468	0.459	1
2009	17,522.9	219.5	9,601.8	7701.5	0.440	0.459	0
2010	17,331.6	249.7	10,610.2	6471.6	0.373	0.459	0
2011	19,396.6	220.2	12,131.5	7044.9	0.363	0.459	0
2012	21,288.1	188.4	14,245.1	6854.7	0.322	0.459	0
2013	23,098.8	209.6	16,699.0	6190.2	0.268	0.459	0
2014	25,778.6	271.6	17,922.8	7584.2	0.294	0.459	0
2015	28,312.4	224.6	17,290.8	10797.0	0.381	0.459	0

3. Unit Root tests

A. Augmented Dickey Fuller Unit Root Test

Unit Root Test of LEXR

Null Hypothesis: LEXR has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.605787	0.9710
Test critical values:	1% level	-2.634731	
	5% level	-1.951000	
	10% level	-1.610907	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.016121	0.2788
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.039485	0.9246
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

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

Null Hypothesis: D(LEXR) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.013700	0.0002
Test critical values:	1% level	-2.636901	
	5% level	-1.951332	
	10% level	-1.610747	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.954776	0.0003
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.395457	0.0006
Test critical values:	1% level	-4.262735	
	5% level	-3.552973	
	10% level	-3.209642	

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

Unit Root Test of LMPR

Null Hypothesis: LMPR has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.058925	0.6948
Test critical values:	1% level	-2.634731	
	5% level	-1.951000	
	10% level	-1.610907	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.922254	0.0532
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.921440	0.1687
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

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

Null Hypothesis: D(LMPR) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.090994	0.0000
Test critical values:	1% level	-2.636901	
	5% level	-1.951332	
	10% level	-1.610747	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.992999	0.0000
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.034845	0.0000
Test critical values:	1% level	-4.262735	
	5% level	-3.552973	
	10% level	-3.209642	

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

Unit Root Test of LOPNSS

Null Hypothesis: LOPNSS has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.152032	0.6238
Test critical values:	1% level	-2.634731	
	5% level	-1.951000	
	10% level	-1.610907	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.878561	0.3380
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.808918	0.6782
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

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

Null Hypothesis: D(LOPNSS) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.569615	0.0000
Test critical values:	1% level	-2.636901	
	5% level	-1.951332	
	10% level	-1.610747	

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

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.477091	0.0000
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

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

Null Hypothesis: D(LOPNSS) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.362482	0.0083
Test critical values:	1% level	-4.284580	
	5% level	-3.562882	
	10% level	-3.215267	

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

B. Zivot Andrews Unit Root Test

Unit root test of LEXR

Zivot-Andrews Unit Root Test
Date: 05/05/17 Time: 10:05
Sample: 1981 2015
Included observations: 35
Null Hypothesis: LEXR has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1999

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-3.747221	2.59E-06
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 05/05/17 Time: 10:05
Sample: 1981 2015
Included observations: 35
Null Hypothesis: DLEXR has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1988

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-6.080384	0.172904
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Unit Root Test of LMPR

Zivot-Andrews Unit Root Test
Date: 05/05/17 Time: 10:05
Sample: 1981 2015
Included observations: 35
Null Hypothesis: LMPR has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1989

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-3.753813	0.422816
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 05/05/17 Time: 10:05
Sample: 1981 2015
Included observations: 35
Null Hypothesis: DLMPR has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1994

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-7.460325	0.112558
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Unit Root Test of LOPNSS

Zivot-Andrews Unit Root Test
Date: 05/05/17 Time: 10:05
Sample: 1981 2015
Included observations: 35
Null Hypothesis: LOPNSS has a unit root with a structural break in both the intercept and trend
Chosen lag length: 1 (maximum lags: 4)
Chosen break point: 1995

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-4.398019	0.014070
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 05/05/17 Time: 10:05
Sample: 1981 2015
Included observations: 35
Null Hypothesis: DLOPNSS has a unit root with a structural break in both the intercept and trend
Chosen lag length: 4 (maximum lags: 4)
Chosen break point: 2004

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-5.315855	0.042079
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

4 Lag selection criteria test

VAR Lag Order Selection Criteria
Endogenous variables: LEXR LMPR LOPNSS
Exogenous variables: DC DC*LMPR DT DT*LMPR
Date: 06/27/17 Time: 15:00
Sample: 1981 2015
Included observations: 31

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-83.41212	NA	0.095020	6.155621	6.710712	6.336567
1	6.064056	138.5438*	0.000539	0.963609	1.935020*	1.280265
2	17.71068	15.77930	0.000476*	0.792859	2.180589	1.245224*
3	24.83246	8.270446	0.000591	0.914035	2.718084	1.502110
4	39.21135	13.91506	0.000492	**0.567010***	2.787377	1.290794

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

5 Cointegration Test

A. Johansen-Juselius Test

Date: 06/27/17 Time: 11:55
Sample (adjusted): 1986 2015
Included observations: 30 after adjustments
Trend assumption: Linear deterministic trend
Series: LEXR LMPR LOPNSS
Exogenous series: DC DC*LMPR DT DT*LMPR
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.946950	108.1764	29.79707	0.0000
At most 1 *	0.482369	20.08082	15.49471	0.0095
At most 2	0.010808	0.326016	3.841466	0.5680

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.946950	88.09557	21.13162	0.0000
At most 1 *	0.482369	19.75480	14.26460	0.0061
At most 2	0.010808	0.326016	3.841466	0.5680

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

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

LEXR	LMPR	LOPNSS
0.187679	7.957923	-1.507466
-1.881135	-6.235455	9.856017
-6.089376	-0.364013	15.23197

Unrestricted Adjustment Coefficients (alpha):

D(LEXR)	-0.151404	-0.069852	-0.008780
D(LMPR)	-0.162146	0.001371	0.000682
D(LOPNSS)	-0.062951	-0.103657	0.012406

1 Cointegrating Equation(s): Log likelihood 80.11775

Normalized cointegrating coefficients (standard error in parentheses)

LEXR	LMPR	LOPNSS
1.000000	42.40172	-8.032139
	(3.57591)	(1.82766)

Adjustment coefficients (standard error in parentheses)

D(LEXR)	-0.028415
	(0.00738)

D(LMPR)	-0.030431	
	(0.00211)	
D(LOPNSS)	-0.011815	
	(0.01038)	

2 Cointegrating Equation(s): Log likelihood 89.99515

Normalized cointegrating coefficients (standard error in parentheses)

LEXR	LMPR	LOPNSS
1.000000	0.000000	-5.002564
		(0.58894)
0.000000	1.000000	-0.071449
		(0.03417)

Adjustment coefficients (standard error in parentheses)

D(LEXR)	0.102986	-0.769299
	(0.06377)	(0.34101)
D(LMPR)	-0.033010	-1.298894
	(0.02126)	(0.11371)
D(LOPNSS)	0.183179	0.145391
	(0.08798)	(0.47052)

B. Gregory-Hansen Test

I

. ghansen LEXR LMPR LOPNSS , break (level) lagmethod (aic) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Level Number of obs = 35

Lags = 0 chosen by Akaike criterion Maximum Lags = 5

	Test	Breakpoint	Date	Asymptotic Critical Values		
	Statistic			1%	5%	10%
ADF	-4.37	1999	1999	-5.44	-4.92	-4.69
Zt	-4.43	1999	1999	-5.44	-4.92	-4.69
Za	-25.86	1999	1999	-57.01	-46.98	-42.49

. ghansen LEXR LMPR LOPNSS DC, break(level) lagmethod(aic) maxlags(5)

adf(): 3301 subscript invalid

main(): - function returned error

<istmt>: - function returned error

r(3301);

. ghansen LEXR LMPR LOPNSS mdc, break (level) lagmethod (aic) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Level Number of obs = 35

Lags = 0 chosen by Akaike criterion Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-5.02	1985	1985	-5.77	-5.28	-5.02
Zt	-4.68	1999	1999	-5.77	-5.28	-5.02
Za	-27.46	1999	1999	-63.64	-53.58	-48.65

. ghansen LEXR LMPR LOPNSS DC mdc, break(level) lagmethod(aic) maxlags(5)

adf(): 3301 subscript invalid

main(): - function returned error

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r(3301);

. ghansen LEXR LMPR LOPNSS DT, break (level) lagmethod (aic) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Level Number of obs = 35

Lags = 0 chosen by Akaike criterion Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-4.39	1999	1999	-5.77	-5.28	-5.02
Zt	-4.46	1999	1999	-5.77	-5.28	-5.02
Za	-26.04	1999	1999	-63.64	-53.58	-48.65

. ghansen LEXR LMPR LOPNSS mdt, break (level) lagmethod (aic) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Level Number of obs = 35

Lags = 0 chosen by Akaike criterion Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-4.45	1999	1999	-5.77	-5.28	-5.02
Zt	-4.52	1999	1999	-5.77	-5.28	-5.02
Za	-26.40	1999	1999	-63.64	-53.58	-48.65

. ghansen LEXR LMPR LOPNSS DT mdt, break (level) lagmethod (aic) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Level Number of obs = 35

Lags = 0 chosen by Akaike criterion Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-4.64	1999	1999	-6.05	-5.56	-5.31
Zt	-4.71	1999	1999	-6.05	-5.56	-5.31
Za	-28.13	1999	1999	-70.18	-59.40	-54.38

II

. ghansen LEXR LMPR LOPNSS, break (regime) lagmethod (fixed) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime Number of obs = 35

Lags = 5 chosen by user Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-3.01	1997	1997	-5.97	-5.50	-5.23
Zt	-5.69	1997	1997	-5.97	-5.50	-5.23
Za	-33.89	1997	1997	-68.21	-58.33	-52.85

. ghansen LEXR LMPR LOPNSS DC, break (regime) lagmethod (fixed) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime Number of obs = 35

Lags = 5 chosen by user Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-1.18	1985	1985	-6.51	-6.00	-5.75
Zt	-5.83	1997	1997	-6.51	-6.00	-5.75
Za	-34.62	1997	1997	-80.15	-68.94	-63.42

. ghansen LEXR LMPR LOPNSS mdc, break(regime) lagmethod(fixed) maxlags(5)

main(): 3301 subscript invalid

<istmt>: - function returned error

r(3301);

. ghansen LEXR LMPR LOPNSS DC mdc, break(regime) lagmethod(fixed) maxlags(5)

main(): 3301 subscript invalid

<istmt>: - function returned error

r(3301);

. ghansen LEXR LMPR LOPNSS DT, break (regime) lagmethod (fixed) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime Number of obs = 35

Lags = 5 chosen by user Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-3.11	1997	1997	-6.51	-6.00	-5.75
Zt	-4.78	1997	1997	-6.51	-6.00	-5.75
Za	-28.04	1997	1997	-80.15	-68.94	-63.42

. ghansen LEXR LMPR LOPNSS mdt, break (regime) lagmethod (fixed) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime Number of obs = 35

Lags = 5 chosen by user Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-3.03	1997	1997	-6.51	-6.00	-5.75
Zt	-4.93	1997	1997	-6.51	-6.00	-5.75
Za	-28.79	1997	1997	-80.15	-68.94	-63.42

. ghansen LEXR LMPR LOPNSS DT mdt, break (regime) lagmethod (fixed) maxlags (5)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime Number of obs = 35

Lags = 5 chosen by user Maximum Lags = 5

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-3.11	1997	1997	-6.92	-6.41	-6.17
Zt	-4.79	1997	1997	-6.92	-6.41	-6.17
Za	-28.38	1997	1997	-90.35	-78.52	-75.56

III

. ghansen LEXR LMPR LOPNSS, break (regimetrend) lagmethod (downt) level (0.99) trim(0.1)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime and trend Number of obs = 35

Lags = 0 chosen by downward t-statistics Maximum Lags = 2

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-5.57	1999	1999	-6.45	-5.96	-5.72
Zt	-5.66	1999	1999	-6.45	-5.96	-5.72
Za	-32.74	1999	1999	-79.65	-68.43	-63.10

. ghansen LEXR LMPR LOPNSS DC, break (regimetrend) lagmethod (downt) level (0.99) trim(0.1)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime and trend Number of obs = 35

Lags = 0 chosen by downward t-statistics Maximum Lags = 2

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-4.79	2011	2011	-6.89	-6.32	-6.16
Zt	-5.65	1999	1999	-6.89	-6.32	-6.16
Za	-32.69	1999	1999	-90.84	-78.87	-72.75

. ghansen LEXR LMPR LOPNSS mdc, break (regimetrend) lagmethod (downt) level (0.99) trim(0.1)

main(): 3301 subscript invalid

<istmt>: - function returned error

r(3301);

. ghansen LEXR LMPR LOPNSS DC mdc, break (regimetrend) lagmethod (downt) level (0.99) trim(0.1)

main(): 3301 subscript invalid

<istmt>: - function returned error

r(3301);

. ghansen LEXR LMPR LOPNSS DT, break (regimetrend) lagmethod (downt) level (0.99) trim(0.1)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime and trend Number of obs = 35

Lags = 0 chosen by downward t-statistics Maximum Lags = 2

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-5.93	1999	1999	-6.89	-6.32	-6.16
Zt	-6.02	1999	1999	-6.89	-6.32	-6.16
Za	-34.77	1999	1999	-90.84	-78.87	-72.75

. ghansen LEXR LMPR LOPNSS mdt, break (regimetrend) lagmethod (downt) level (0.99) trim(0.1)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime and trend Number of obs = 35

Lags = 0 chosen by downward t-statistics Maximum Lags = 2

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-6.00	1999	1999	-6.89	-6.32	-6.16
Zt	-6.09	1999	1999	-6.89	-6.32	-6.16
Za	-35.52	1999	1999	-90.84	-78.87	-72.75

. ghansen LEXR LMPR LOPNSS DT mdt, break (regimetrend) lagmethod (downt) level (0.99) trim(0.1)

Gregory-Hansen Test for Cointegration with Regime Shifts

Model: Change in Regime and trend Number of obs = 35

Lags = 0 chosen by downward t-statistics Maximum Lags = 2

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-6.74	1999	1999	-7.31	-6.84	-6.58
Zt	-6.84	1999	1999	-7.31	-6.84	-6.58
Za	-40.60	1999	1999	-100.69	-88.47	-82.30

6 VECM Results

Vector Error Correction Estimates
Date: 06/29/17 Time: 06:34
Sample (adjusted): 1986 2015

Included observations: 30 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LEXR(-1)	1.000000
LMPR(-1)	42.40172 (3.57591) [11.8576]
LOPNSS(-1)	-8.032139 (1.82766) [-4.39476]
C	-85.15644

Error Correction:	D(LEXR)	D(LMPR)	D(LOPNSS)
CointEq1	-0.028415 (0.00738) [-3.85272]	-0.030431 (0.00211) [-14.4076]	-0.011815 (0.01038) [-1.13774]
D(LEXR(-1))	-0.322581 (0.19206) [-1.67957]	0.074130 (0.05500) [1.34774]	0.747708 (0.27042) [2.76503]
D(LEXR(-2))	-0.538596 (0.18572) [-2.90003]	0.136590 (0.05319) [2.56810]	0.061891 (0.26149) [0.23669]
D(LEXR(-3))	-0.215685 (0.20271) [-1.06399]	0.092626 (0.05805) [1.59553]	0.618268 (0.28541) [2.16622]
D(LEXR(-4))	-0.361448 (0.18647) [-1.93840]	0.062226 (0.05340) [1.16525]	0.355318 (0.26254) [1.35339]
D(LMPR(-1))	1.189616 (0.34306) [3.46765]	0.197800 (0.09825) [2.01331]	-0.801105 (0.48302) [-1.65854]
D(LMPR(-2))	1.101227 (0.30996) [3.55278]	0.159616 (0.08877) [1.79813]	-0.069369 (0.43642) [-0.15895]
D(LMPR(-3))	0.865438 (0.27345) [3.16492]	0.178138 (0.07831) [2.27477]	-0.270207 (0.38500) [-0.70183]
D(LMPR(-4))	0.448953 (0.23008) [1.95126]	0.192527 (0.06589) [2.92187]	-0.094169 (0.32395) [-0.29069]
D(LOPNSS(-1))	-0.307120 (0.18420) [-1.66728]	-0.187276 (0.05275) [-3.55009]	-0.289841 (0.25935) [-1.11756]
D(LOPNSS(-2))	-0.240339 (0.19734) [-1.21787]	-0.006937 (0.05652) [-0.12274]	-0.004730 (0.27785) [-0.01702]
D(LOPNSS(-3))	-0.304206	0.103298	-0.007466

	(0.19466)	(0.05575)	(0.27408)
	[-1.56275]	[1.85297]	[-0.02724]
D(LOPNSS(-4))	0.183951	0.053126	0.332370
	(0.16979)	(0.04862)	(0.23906)
	[1.08342]	[1.09258]	[1.39034]
C	-0.180523	-0.271725	-0.198525
	(0.23112)	(0.06619)	(0.32541)
	[-0.78109]	[-4.10536]	[-0.61008]
DC	1.106159	-1.965751	-1.908725
	(0.83546)	(0.23926)	(1.17630)
	[1.32400]	[-8.21590]	[-1.62265]
DC*LMPR	-0.546963	0.813803	0.800245
	(0.32964)	(0.09440)	(0.46412)
	[-1.65926]	[8.62047]	[1.72420]
DT	-1.285581	-1.501992	0.750423
	(0.71674)	(0.20526)	(1.00914)
	[-1.79365]	[-7.31747]	[0.74362]
DT*LMPR	0.809267	0.672697	-0.316585
	(0.31647)	(0.09063)	(0.44558)
	[2.55718]	[7.42238]	[-0.71051]
R-squared	0.818167	0.976819	0.657962
Adj. R-squared	0.560570	0.943980	0.173407
Sum sq. resids	0.555956	0.045596	1.102108
S.E. equation	0.215243	0.061642	0.303055
F-statistic	3.176151	29.74560	1.357869
Log likelihood	17.25579	54.76868	6.991441
Akaike AIC	0.049614	-2.451245	0.733904
Schwarz SC	0.890333	-1.610527	1.574622
Mean dependent	0.179214	0.003177	0.025763
S.D. dependent	0.324702	0.260438	0.333331
Determinant resid covariance (dof adj.)		1.50E-05	
Determinant resid covariance		9.61E-07	
Log likelihood		80.11775	
Akaike information criterion		-1.541184	
Schwarz criterion		1.121091	

7 Residual Diagnostics Test

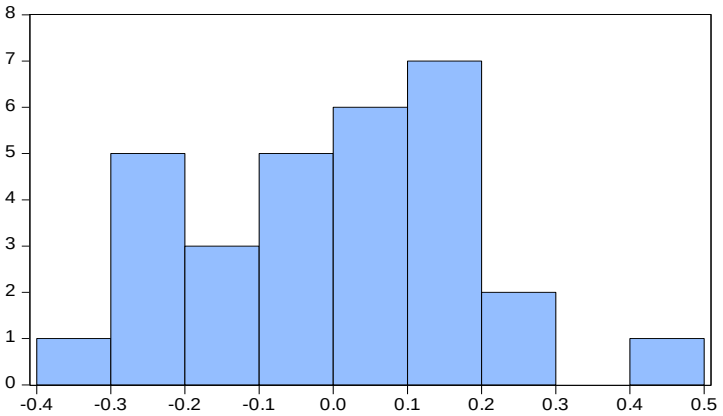
Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.184800	Prob. F(2,17)	0.3298
Obs*R-squared	3.670082	Prob. Chi-Square(2)	0.1596

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	5.096670	Prob. F(16,13)	0.0025
Obs*R-squared	25.87506	Prob. Chi-Square(16)	0.0558
Scaled explained SS	7.788077	Prob. Chi-Square(16)	0.9549

Jarque-Bera Normality Test



Series: Residuals
Sample 1986 2015
Observations 30

Mean	-1.93e-15
Median	0.018891
Maximum	0.408953
Minimum	-0.380406
Std. Dev.	0.179996
Skewness	-0.017971
Kurtosis	2.500770
Jarque-Bera	0.313153
Probability	0.855066