EFFECT OF ADDITIONAL MONETARY TIGHTENING ON EXCHANGE RATE VOLATILITY IN NIGERIA

By

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Declaration

I declare that the work in this thesis entitled, *"Effect of Additional Monetary Tightening on Exchange Rate Volatility in Nigeria"* has been carried out by me in the Department of Economics under the supervision of Dr. Aliyu R. Sanusi and Dr. B. Damian Lawong. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

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Certification

This thesis entitled, "EFFECT OF ADDITIONAL MONETARY TIGHTENING ON EXCHANGE RATE VOLATILITY IN NIGERIA" by Faith Bawa ADAMU meets the regulations governing the award of the degree of M.Sc. Economics of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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Dedication

This thesis is dedicated to the Lord Jesus Christ (Jeremiah 1:5& 10).

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Abstract

CBN typically intervenes directly in the foreign exchange market to ensure that the value of the Naira is stable. However, direct foreign exchange purchases and sales by the monetary authorities could be very costly and are hardly effective in reducing exchange rate volatility when the local currency is under pressure to depreciate. Researchers have found that this kind of interventions have little or no desired effect, and may lead to undesired volatility in the exchange rate. In an environment of tight monetary policy, additional monetary tightening could have effect on the exchange rate. If this is so, then reserve loss in period of speculations can be prevented. This study sets out to examine if Additional Monetary Tightening (AMT) can be used to achieve exchange rate stability in Nigeria, as a potential substitute or complementary tool to the direct intervention. The study identified the period of AMT from 2007- 2015, capturing the periods by the use of dummy variable. The variables of the study includes Monetary Policy Rate (MPR), Cash Reserve Requirement(CRR), Liquidity Ratio(LR), Upper interest rate Corridor (UCORR), and Lower interest rate Corridor (LCORR), were estimated using GARCH (2,2) with lag of one period for all the variables and was found to be appropriate. The result shows that AMT is negative and statistically significant at 10% in reducing the exchange rate volatility in the variance equation and also negative and significant at 1% in appreciating the exchange rate in the mean equation. Although all variables were correctly signed in the variance equation except CRR, only AMT, and LR, were statistically significant at 10% and 1% respectively in the variance equation. This suggests that, AMT can be adopted as an alternative/complementary tool in attaining exchange rate stability in Nigeria. From these findings, the study recommends that where it is feasible, CBN should consider AMT as a useful tool for exchange rate management

and prevent reserve loss. This also suggests that CBN must use this tool cautiously since AMT can hurt the economy via investment and spending.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The management of exchange rate is a very important policy objective of the central bank as it serves as the signal of the health of the economy and a crucial variable for the attainment of both internal and external balance. Exchange rate management is usually achieved through the monetary policy actions (direct or indirect) of the central bank and these actions determines the size and growth rate of money supply in an economy which in turn affects the interest rate and interest rate itself is a major determinant of exchange rate. Monetary policy entails any action of the central bank which controls the size, availability and cost of money in order to attain her set objectives towards the growth and the stability of the economy in which the exchange rate becomes a key target variable (Sloman, 2003). Monetary policy uses a variety of tools to influence outcomes like exchange rates and other policy variables. The monetary authority has the ability to alter the money supply and thus influence interest rate to achieve these policy goals. Therefore, changes in interest rates are implicitly view as a sort of monetary policy stance.

Historically, price and financial stability were the core objectives of central banking, but at the cost of some over simplification, central banking gravitated towards a 'narrow view' heavily focused on price stability (Borio, 2011). There is now however, a shift back towards a 'broader view' more in line with the historical and most prominently, financial stability has returned to the core of the research program and policy debate in monetary economics. Goodhart (2010) has argued that the international financial crisis marked the end of an epoch that started in the early

1980s in which the primary role of central bank was to conduct monetary policy and the assumption was that financial stability would follow from the achievement of price stability and the self-equilibrating property of the financial market. Goodhart, therefore suggested that the next epoch of central banking should be marked by a search for new tools and frameworks for maintaining financial stability- a return to what he describes as the "essence of central banking" (Plessis and Rietveld, 2013).

Before the 2008 global financial crisis, monetary policy exclusively focused on price stability across the globe while financial stability has mostly faded into the background, and sometimes completely ignored (Borio, 2011). The global financial crisis proved the inefficiency of monetary policies that are conducted without considering financial risks and signified the need to observe financial stability along with price stability. To this extent, it was well understood that a policy rate that yields price stability may not necessarily provide financial stability. Therefore, it has been essential for central banks to utilize more than one policy instrument. After the global financial crisis, it was also well understood by both academics and policy makers that price and financial stability are integral to the well functioning of the domestic and global financial markets. Therefore, finding a solution on how to incorporate financial stability in the implementation of monetary policy without diluting the price stability objective has become a significant concern for central bank authorities (Ergun, Akcelik, Oduncu, and Taskin, 2013).

According to Akcelik, Aysan and Oduncu (2013), the key indicators for price and financial stability include expectations, credit growth, and exchange rate. Therefore, exchange rate plays an increasingly important role in monetary decisions in recent years. This has reflected not only the development during the global financial crisis, but also features of the current conjuncture.

Central banks are now concerned about the impact of heightened exchange rate volatility on macroeconomic and financial stability. Many central banks have begun to give greater merit in stabilizing exchange rate than in the past (Filardo and Dubravko, 2011). Exchange rate is therefore a crucial factor in the maintenance of both price and financial stability.

In Nigeria, the adoption of the Structural Adjustment Program (SAP) as a condition for obtaining the International Monetary Fund (IMF) loan in order to correct the deficit recorded by the country as a result of the oil glut had several policy options included in it, among which include; the deregulation of external trade and payment arrangement, the adoption of a market determined exchange rate for the Naira and a greater reliance on market forces as a major determinant of economic activities. But the market determined exchange rate brought about an era of depreciations and volatility in the exchange rate, therefore the menace of nominal exchange rate fluctuations was first noticed in Nigeria with the introduction of SAP in 1986 (Shawon, 2012). Since then, the Naira exchange rate has come to depend on a number of variables including the volume of forex inflows, demand for forex, and its determining factors such as expectations.

The achievement of a stable exchange rate in Nigeria has not been an easy task. The two exchange rate regimes (fixed and floating) have not yet yielded the optimum result. Since the Structural Adjustment Program reform in 1986 the Naira exchange rate has been highly unstable. A huge real and nominal depreciation was recorded which resulted in a near realistic value for the Naira. For instance, between 1986 and 2011 the Naira had depreciated by 98.68% (Zubair, 2013) and the volatility of Naira vis- a-viz the US dollar between 1986 and 2012 was about 25%, while in the decade preceding SAP it was just 2% (Olanipekun, 2013). Indicating that exchange rate was highly volatile after SAP. The reasons attributed to that may include the fact that the

Nigerian economy was characterized by structural rigidities and bottlenecks. Most of its imports and exports are characterized by low elasticities either on the demand or the supply side or both. Expectedly, bi-weekly forex data revealed the existence of a gap between the demand and supply for foreign exchange in Nigeria (Dalhatu, 2012). Usually, where supply gaps exist, attempt to defend the exchange rate by the authorities can be costly as it may require the use of the Nation's foreign exchange reserves to supply the foreign exchange market in order to stabilize the exchange rate and defend the Naira. This is costly and may only deplete the Nation's foreign exchange reserves, given the low imports demand elasticities.

In Nigeria, the monetary authorities have also shown great concern towards exchange rate management which is mainly to reduce the widening gap between the official and parallel rates, avoid the frequent fluctuations in its value through the various strategies adopted under SAP with the various modifications of procedures thereafter. This is because of the capacity of the exchange rate to influence other domestic rate, which therefore makes its management of great importance. The tight monetary stance adopted by the Monetary Policy Committee (MPC) which began in the third quarter of 2010 was informed by the uptick in inflation and pressure on the Naira exchange rate (Central Bank of Nigeria (CBN), 2013).

There are usually two ways central banks can influence the exchange rate. Central bank can influence the exchange rate by directly intervening in the foreign exchange market. Purchase or sale of foreign currency affects the relative supplies of domestic currency and therefore the exchange rate. The central bank can also use monetary policy to influence the exchange rate. Monetary policies, changes the domestic money supply to influence the quantity of Naira in circulation or via changes in interest rate to influence the cost of Naira. Raising interest rate or

reducing the domestic money supply (i.e. tightened monetary policy), could reduce the rate of domestic currency depreciation by reducing the relative supply of Naira in the foreign exchange market (uncovered interest rate parity) and increase the relative supply of foreign currencies. Monetary policy tightening is typically occasioned by price considerations. Therefore, in an already tight monetary policy environment, further tightening could provide an effective tool in reducing exchange rate volatility. If so, it could serve as an indirect intervention in foreign exchange management.

The current exchange rate strategy in Nigeria which seeks to stabilize the Naira within a certain band has occasionally achieved this via exchange rate intervention (direct intervention) in the foreign exchange market and this has entailed huge cost to the monetary authority and the economy at large. The Central Bank of Nigeria (CBN) stepped up intervention early 2014 and may seem to have enough ammunition (reserves) to continue to support the Naira for sometime even though at the expense of gradually declining foreign reserves (Gadio, 2014). One important shortcoming of direct foreign exchange interventions is that they hardly work. In fact, bulk of the empirical evidence suggests that direct foreign exchange interventions have little systematic influence on the near term nominal exchange rate in the direction intended by the central banks. There are also evidence that such interventions may have unintended effect in the sense that it can lead to undesired volatility in the exchange rate (Miyajima, 2013). The recent development in the global economy, therefore, calls for caution in the use of this method of defending the Naira exchange rate, rather, ways to curb the excess demand of foreign exchange and encourage the inflow of foreign funds into the Nigerian foreign exchange market, which the indirect exchange rate strategy (Additional Monetary Tightening, i.e. AMT) entails can be an alternative measure for exchange rate stability. In addition, if AMT is effective, then it can be use to help

sustain the growth of foreign reserves as well as save the CBN the cost involved in the direct interventions.

1.2 The Statement of Research Problem

The exchange rate liberalization of the 1980's was aimed at stimulating non-oil exports and accelerating economic growth through the attraction of foreign capital, investment and at the same time discourage capital outflow, this is because of its ability to align the exchange rate with its equilibrium level. But the performance of the Naira exchange rate since the adoption of SAP has rather been poor; it has gone through series of depreciations and fluctuations that have not allowed the above mentioned objectives to be achieved.

Although exchange rate fluctuations are an essential feature of the flexible exchange rate regime, excessive fluctuations as the rate moves from one equilibrium to another can have adverse effects on the economy. Excessive volatility of the exchange rate can disrupt production and breeds uncertainties and risks. It can also breed negative sentiments into other sector of the economy including the stock market, especially where capital accounts are liberalized. This is why central banks typically intervene in the foreign exchange market to ensure that its movement to new equilibrium is orderly. However, direct foreign exchange purchases and sales in the foreign exchange market by the central banks have two important problems associated with them. First, when the local currency is under pressure to depreciate, especially where the pressure is speculations, sales of foreign exchange by central banks could be very costly in at least two ways. It costs the intervening bank huge sums and also depletes its foreign exchange reserves. Secondly, direct foreign exchange interventions are hardly effective in reducing exchange rate volatility. Researches have found that direct foreign exchange interventions have

little or no desired effect, and may lead to undesired volatility in the exchange rate (Miyajima, 2013). In fact, Simwaka and Mkandawire (2012) have found evidence that Reserve Bank of Malawi's interventions were associated with increased volatility of the Kwacha. Thus, there is a need to examine the effect of an indirect intervention of additional monetary tightening on exchange rate volatility.

In Nigeria, the recent decline in the CBN's reserves has been attributed to the depletion of the Excess Crude Account and increase sales of dollar by the CBN in its quest to stabilize the Naira exchange rate (Chukwunyem, 2014). The fear is that if the apex bank maintains the policy of continuously using the reserves to defend the Naira, the reserves would be further depleted with dire consequences for the economy.

Theoretically, AMT can replicate the intended effects of intervention in situations where the domestic currency is under pressure to depreciate. This works by curbing the excessive demand for foreign exchange and also encourages capital inflows, which in turn increases the supply of foreign funds into the foreign exchange market, rather than through increase sales of foreign exchange by the CBN, thereby preventing reserve loss. This study sets out to examine whether additional monetary tightening can be effective in reducing exchange rate volatility in Nigeria, as a potential substitute or complementary action to direct intervention. In other words, the research problem this study seeks to address is, if AMT is an effective alternative or complementary measure in achieving exchange stability in Nigeria. From the problem statement, the following research questions emerged.

1.3 Research Question

The questions this research study seeks to answer are;

i. When are the periods of additional monetary tightening in Nigeria from 2007 -2015?

ii. What is the trend between additional monetary tightening and exchange rate volatility in Nigeria?

iii. What is the effect of additional monetary tightening on exchange rate volatility in Nigeria?

iv. To what extent can additional monetary tightening be used as an alternative or complementary measure for achieving exchange rate stability in Nigeria?

1.4 Objectives of the Study

The broad objective of this study is to assess the effect of additional monetary tightening (indirect intervention) on the volatility of the Naira exchange rate. The specific objectives are;

i. To identify the periods of additional monetary tightening in Nigeria from 2007-2015.

ii. To examine the trend between additional monetary tightening and exchange rate volatility in Nigeria.

iii. To examine the effect of additional monetary tightening on exchange rate volatility in Nigeria.

iv. To examine to what extent additional monetary tightening can be used as an alternative or complementary measure for achieving exchange rate stability in Nigeria.

1.5 Research Hypothesis

The hypothesis of the study is;

H0: Additional monetary tightening is not significant in reducing exchange rate volatility in Nigeria.

H1: Additional monetary tightening is significant in reducing exchange rate volatility in Nigeria.

1.6 Justification of the Study

The pursuance of exchange rate stability via the direct intervention in the foreign exchange market by purchase and sales of currencies has entailed a huge cost for the CBN, the intervening banks and the economy at large. Empirical evidences have suggested that this kind of intervention hardly works and has little systematic influence on the near term nominal exchange rate (Miyajima, 2013). Direct interventions may also have unintended effect and lead to undesired volatility in the exchange rate. Thus, the need to examine the effect of an indirect intervention, which the tool of AMT entails, on exchange rate volatility in Nigeria. The increasing openness, the expansion of the economy and depleting reserves, which has become a challenge for the CBN to seek other alternative or complementing approach to manage the Naira exchange rate, motivated this study.

Many studies have used several methodologies to determine the effect of monetary tightening on exchange rates. For instance time series relationship with VAR by studies like Goldfajn and Baig (1999) and other used an event study approach (Goldfajn and Gupta, 1999 and Ergun *et'al*, 2013). The event study approach looks at a number of tightening episodes and its impact on the

exchange rate, which is the approach this study takes in modeling exchange rate volatility with GARCH (2,2) to examine the effect of exchange rate volatility in Nigeria.

Whether or not AMT impact on exchange rate volatility affects monetary policy in two ways; first, since this study found AMT to be significant, it can be an alternative or complementary tool for exchange rate management, thereby prevent reserve loss. Secondly, the empirical knowledge of the effect of AMT highlights the caution with which it can be use since AMT itself can hurt the economy in terms of output, hence resulting in an unintended effect on exchange rate volatility and the economy as a whole.

The contribution of this study is its recommendation of a potential alternative tool for forex intervention, based on the theoretical and methodological modification of the study which provides empirical evidence on the use of the tool of AMT or the indirect intervention. This study therefore provides requisite information for the formulation and implementation of policies as regards to exchange rate management in Nigeria. The estimates of the model are important for the Monetary Policy Committee in formulating monetary stance and the preconditions needed for AMT to work.

1.7 Scope and Limitation of the Study

This research study will cover the period from the inception of the current monetary policy framework that uses the Monetary Policy Rate (MPR) and standing facilities (Interest rate corridors) by the CBN which is from 2007- 2015 i.e. when CBN began to use MPR as a tool for monetary policy and other monetary policy instruments. The selection of the period is so that we will be able to observe the relationship between the various episodes of additional monetary

tightening and its effects on the exchange rate. The study is limited to the impact of additional monetary tightening stance on the exchange rate volatility and not its adverse effect on the economy's real sector (GDP) or even other variables.

1.8 Organization of the Study

This research study is organized into five chapters. Chapter one is comprised of the general introduction of subject matter of the study. Other aspects included in chapter one are, the statement of the research problem and questions, the objectives of the study, the research hypothesis, the justification of the study, scope and limitation of the study and organization of the study. Chapter two which is literature review provides an overview of exchange rate policies in Nigeria, the conceptual literature on exchange rate, exchange rate volatility, monetary policy, and additional monetary tightening. There we also discuss the theoretical literature on exchange rate determination, the theoretical framework for the study and lastly empirical literature of studies on monetary policy tightening and the exchange rate. Chapter three is the research methodology which contains the conceptual framework for analysis, the empirical framework, the sources of data, and estimation technique. Chapter four contains the empirical analysis of the results of the study and also draws implications from the findings of the study. Chapter five comprises of the summary, conclusion and recommendations base on the findings of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this section, the study reviewed the background of the Nigerian foreign exchange market, and also some works in the area of monetary policy and exchange rate, particularly monetary tightening and exchange rate. Here we seek to establish the relationship between monetary policy and exchange rate as well as provide a theoretical basis that helps explain the relationship between monetary policy and exchange rate volatility in Nigeria. This chapter was also aimed at establishing if additional monetary tightening has been considered as an alternative or complementary measure in achieving exchange rate stability by other empirical studies and what their findings were.

2.2 An overview of the Foreign Exchange market in Nigeria

Developing economies at earlier stage of development often intervene to support the pegged exchange rate and likely function as market markers but developed countries central banks intervene to dampen exchange rate volatility (Akanji, 2006). Foreign exchange management is first and foremost management of a monetary indicator. It is often a signal of the stance of monetary policy and if the CBN is to manage price stability then efficient management of the exchange rate has link with price level changes and interest rate management. The development of the Nigerian foreign exchange market to its present state had been influenced by a number of factors which include the changing pattern of international trade, institutional changes in the economy and structural shifts in production (CBN, 2007)

The first to be introduced under the SAP is the Second-tier Foreign Exchange Market (SFEM) in 1986, in which the determination of the Naira exchange rate and allocation of foreign exchange were based on market forces. To further enlarge the scope of the foreign exchange, bureau de change was introduced in 1989 for dealing in privately sourced foreign exchange. SFEM was changed into FEM in 1987 with two components, the official market and autonomous exchange market. The merger of these two markets resulted in IFEM (Inter-bank Foreign Exchange Market) in 1989. IFEM ended in 1990, but was re-introduced again in 1999. Then next was the Retail Dutch Auction System(RDAS) in April 1987, 1990 and 2002, it was introduced in order to curtail the widening gap between the parallel and official rates and the high demand for foreign exchange (Obanda, 2006).

Between 1992/93 deregulated exchange rate was introduced and it led to the discontinuation of the system of pre-determined quotas for banks as such auctions were determined by the rates which emerged in the market. The deregulation of the market allowed the CBN to buy and sell foreign exchange in the market which was expected to satisfy all requests, which did not. Consequently, in 1994 a fixed exchange rate system was again adopted but jettisoned in 1995 in favor of guided deregulation. Later a dual exchange rate emerged with the introduction of Autonomous Foreign Exchange Market (AFEM) in addition to the official exchange rate. AFEM was to operate on the basis of market principles to achieve exchange rate stability, but the CBN could intervene when the need arises. The major goals of the new policy included the deliberate build-up of external reserves, enhance confidence in the economy, strengthen the Naira and pave way for its sustained stability, and ultimate convertibility. Under the AFEM guidelines, the private sectors concern sourced their requirements from the AFEM at market determined rates. The banks were allowed to deal among themselves in autonomously foreign exchange, while

dealing in intervention funds from CBN in the autonomous market was prohibited. The thrust of the policy was retained in 1997 even though substantial liberalization of the foreign exchange practices continued to take place.

In 1998, the bulk of the policy measures in the preceding year were retained while some were further liberalized or fine-tuned to align with developments in the economy. Apart from the institution of an appropriate mechanism for exchange rate determination, other measures increasingly applied in the management of Nigeria's foreign exchange resources included, demand management and supply side policies. Demand management policies were meant to curtail foreign exchange expenditures. This was pursued through external debt management policies as well as fiscal and monetary measures. Despite all these measures, the objectives of exchange rate stability remained elusive and due to this, further reforms measures were undertaken to ensure effective management of foreign exchange. The AFEM was reconstituted in 1999 into IFEM which was intended then to promote inter-bank activities with a view to encourage private sourcing of foreign exchange by the banks. With this, participation in the market was broadened and deepened, thus reveling the CBN as the major supplier of foreign exchange. Therefore, more organizations became eligible to participate and the CBN only intervened to influence the prevailing rate toward achieving the desired objectives. However, the objectives of IFEM were largely unattained as banks accounted for over 90 per cent of the funds traded during the period. The foreign exchange market was therefore characterized by excess demand as well as significant depreciation as evident by the wide arbitrage premium between the official and parallel segments. There was also the emergence of multiple exchange rates as well as many foreign exchange speculators and arbitrageurs and consequent to that, the external

reserves fell from an end December 2001 level of US$100.00 billion to US$8.00 billion as at July 2002 (CBN, 2007).

In a bid to address these adverse developments and achieve sanity in the foreign exchange market, the CBN re-introduced the Dutch Auction System (DAS) in July 2002 with the objective of realigning the exchange rate of the Naira, conserve external reserves, enhance market transparency and curtail capital flight from the country. Under the DAS, CBN intervened twice weekly, and end- users through authorized dealers bought foreign exchange at their bid rates. The rate that cleared the market was adopted as the ruling rate for the period, up to the next auction. DAS brought about a good measure of stability in exchange rate as well as reduction in the arbitrage premium between the official and parallel market rates. By February 2006, the foreign exchange was further liberalized with the introduction of the Wholesale Dutch Auction System (WDAS) based on a two way quote and the CBN remaining an active market participant and could buy or sell forex depending on market conditions, while authorized dealers were now free to buy forex on their own account and also allowed to trade with such funds in the inter-bank market.

The adoption of WDAS was meant to consolidate the gains recorded under the RDAS, enhance market depth as well as achieve convergence in rates between the official and other segments of the market. The operation of the foreign exchange market under WDAS was observed without distortion from January to December 2007. The collapse of the parallel market following the reforms in 2006, gave the impetus for the market to operate without such distortions associated with arbitraging. Also, the robust external reserves guaranteed adequacy in supply of foreign exchange to banks and the end-users, thereby engendering confidence in the market. There were

also some measures observed during this period which supported to strengthen the WDAS with a view to ensuring that its objectives were attained. Some of these measures included the following; Special foreign exchange auctions made to Deposit money banks, direct sales of foreign exchange to licensed Bureau De Change operators, increase in the Basic Travelling Allowance (BTA) from US$2,500.00 bi-annually to US$5,000.00 per quarter and Personal Travelling Allowance (PTA) from US$2,000.00 bi- annually to US$4,000.00 per quarter and the review of the foreign exchange manual to accommodate all transactions that were liberalized (CBN, 2007).

From the above overview of the Nigerian foreign exchange market, one can say that the management of the Naira exchange rate, has majorly been the management of the excess demand for foreign currencies and shortages of its supply through purchase and sales of currencies and its determining factors such as expectations in order to keep the Naira stable and appreciative in value. However, recent happenings within the economy challenges the continuous reliance on the direct intervention, seeing that it has achieved little or no result over the years and since it hardly works. Therefore, there is the need to examine other alternative measure to exchange rate management which the indirect intervention provides.

2.3 Conceptual Literature

2.3.1 The Concept of Monetary Policy and Exchange Rate

Monetary policy has been defined as the deliberate use of instrument (direct and indirect) at the disposal of monetary authorities to influence the quantity, cost and availability of money/credit in order to achieve the macroeconomic objectives of internal and external balances (Ezema,

2009; CBN, 2011, Cited in Yahaya, 2012). This implies that monetary policy constitutes an aspect of macroeconomic management designed to enhance the achievement of predefined goals, for example in this case exchange rate stability. Monetary policy involves the deliberate use of instruments to affect the ultimate goals of monetary policy (for instance, price stability and exchange rate stability) through their influence on the operating targets and intermediate targets. To achieve any policy objective, central banks usually employ operating and intermediate targets to affect the final targets. This is so because monetary policy instruments don't directly impact on the final objectives of monetary policy. The argument is that intermediate goals of monetary policy are nominal anchors and have direct link with the final goals, some of the common intermediate targets include; monetary aggregate, interest rate, exchange rate, inflation and nominal GDP (Yahaya, 2012). Even though monetary policy as a function of the central bank is made to attain the broad goals of monetary policy, there has been a shift towards a 'narrow' view of monetary policy. This narrow view focused more on price stability while financial stability is mostly faded into the background, and sometimes completely ignored. Recently, there is a shift back towards a broader view of monetary policy which is more in line with the historical objectives of central banking and monetary policy (Borio, 2011).

The global financial crisis proved the inefficiency of monetary policies which are conducted without considering financial risk and signified the need to observe financial stability along side with price stability (Ergun *et'al,* 2013). It was also understood that a policy rate that yields price stability may not necessarily provide financial stability. Again, it becomes essential that more than one policy instrument be utilize by the central bank, because price and financial stability are integral to the well functioning of the domestic and global financial markets. Therefore, finding solution on how to incorporate financial stability in the implementation of monetary policy

without diluting the price stability objective has become a significant concern for central bank authorities (Ergun *et'al*, 2013).

Exchange rate therefore becomes a crucial factor in the attainment of both price and financial stability. Odunsola (2006) sees the exchange rate policy as the most suitable economic policy for ensuring internal and external balances. Foreign exchange rate is defined as the price of one currency in terms of another. It is usually expressed as the price of local currency to one unit of a foreign currency, thus the exchange rate between the Naira and the dollar is the amount of Naira needed to purchase one unit of dollar. The demand for foreign exchange is a derived demand, it arises from the import of goods and services by Nigerians and from the flow of capital/investments into Nigeria (Shawon, 2012). Exchange rate can also be expressed in one or two ways, as units of domestic currency per unit of foreign currency; or units of foreign currency per unit of domestic currency. However, since transactions are often carried out in national currencies, the former is generally applied for exchange. In addition, distinction is often made in the foreign exchange market between, buying, selling and central rate (Mordi, 2006).

In order to allow for measurability economists use three separate concepts: (a) the nominal rate of exchange, which is the rate of exchange for any one currency as quoted against any other currency. (b) The effective exchange rate, which is a measure that takes into account the fact that a particular currency varies differently against each of the other currencies. (c) The real exchange rate, which is designed to measure the rate at which home goods exchange for goods from other countries, rather than the rate which the currencies themselves are traded (Griffith and Wall, 1995 as cited in Auwal, 2007).

Exchange rate as used in this study is the price of Naira in terms of foreign currencies particularly, the US dollar. We assumed that the Naira exchange rate is determined in the Nigerian foreign exchange market by the inter play of demand and supply of Naira as well as the foreign exchange.

2.3.2 Exchange Rate Volatility

The exchange rate is the rate at which one currency trades for another on the foreign exchange market and exchange rate volatility is defined as the risk associated with unexpected movements in the exchange rate. Volatility of economic fundamentals such as the inflation rate, interest rate, and the balance of payments, are important sources of exchange rate volatility. More recently, increase cross-border flows that have been facilitated by the trend towards liberalization of the capital account, the advancement in technology, currency speculation have also caused exchange rate to fluctuate (Ozturk, 2006).

Mordi (2006), defined exchange rate volatility as swings or fluctuations over a period of time in exchange rate or the deviations from a benchmark or equilibrium exchange rate. Empirically, volatility is measured in terms of the ‘’coefficient of variation’’ which is the standard deviation divided by the mean of a series. Fluctuations and price volatility may be measured on any time-scale from year-by-year to day-by-day. Volatility over any time interval tends to be higher when supply, demand or both are liable to large random shocks and when the elasticity of both supply and demand is low. Exchange rates are quoted between each major currencies of the world and these rates are constantly changing. Minute by minute, dealers in the foreign exchange markets are adjusting the rate of exchange. It is therefore important for them to ensure that they are not left with large amount of any currency unsold, what they need to do is to balance the supply and

demand of each currency by balancing the amount they purchase to the amount they sell. To do this, they will need to adjust the price of each currency, namely the exchange rate, in line with changes in supply and demand. Not only are there day-to-day fluctuations in exchange rates, but also there are long-term changes in them. One of the problems in assessing what is happening to a particular currency is that its rate of exchange may rise against some currencies (weak currencies) and fall against others (strong currencies). Therefore, in order to gain an overall picture of its fluctuations, it is best to look at a weighted average exchange rate against all other currencies. This is known as the exchange rate index, where the weight given to each currency in the index depends on the proportion of transactions done with the country (Sloman, 2003). In this study however, we shall not be concern about the weighted exchange rate or exchange rate index but the bilateral exchange rate.

Once an exchange rate is not fixed it is subject to variations, thus floating exchange rates tends to be more volatile. The degree of volatility and the extent of stability maintained are affected by economic fundamentals. Strong economic fundamentals are meant to produce favorable economic conditions and outcomes which in turn would appreciate the currency and maintained relative stability in the market. Supporting this argument Friedman, in his 1953 thesis noted that ‘’….instability of exchange rate is a symptom of instability in the under laying economic structure…” (Mordi, 2006). These under laying structure can be related to the structure of development in the foreign exchange market and the structure of the economy in terms of the high demand of foreign exchange which has continued to grow and outstrip supply thereby giving other currency the advantage to appreciate in value while the Naira continues to be volatile and loose value.

There has been excessive volatility of the Naira against major exchange rates in Nigeria since the adoption of flexible exchange rate regimes in 1986. The" Naira", like other currencies, has experienced volatility especially following the liberalization of the foreign exchange market in the mid-1980s. As a result, volatility in the foreign exchange market tends to be high when supply, demand, or exogenous forces contribute large random shocks to the currency market. Therefore, volatility in the exchange rate of a currency is a reflection of different activities revolving around that currency, either domestically or internationally. Exchange rate stability, which is essential for growth is influenced greatly by the appropriate policy mix by governments (and monetary authorities) in their quest to attain macroeconomic targets (Bala and Asemota, 2013).

In theory, a distinction is made between the short-run and long-run equilibrium exchange rate. The short-run refers to that established in a liberalized environment by the interplay of market forces of demand and supply. The long-run equilibrium rate is the rate that would equilibrate the external balance in the medium and long-term as well as facilitate the achievement of macroeconomic stability. The Purchasing Power Parity (PPP) clearly approximates the long-run equilibrium exchange rate (Mordi, 2006). Exchange rate volatility in this study will mean any undesired movement or a fluctuation that is outside the exchange rate band (i.e. the official band) set by the Central bank of Nigeria. Also, it will mean rapid or violent fluctuations as the market rate transit from one equilibrium point to another in the foreign exchange market. The monetary policy review for the second half of 2011 revealed that the Naira was under increasing pressure, and traded outside the band of N150 +/- 3.00%. In the Committee's view, the increasing pressure on the domestic currency emanated from a number of sources not all of which can be addressed by purely monetary interventions. One of such is the concern about the likely impact of a double

dip recession on oil prices and the declining foreign reserves (CBN, 2012). This suggests that since we cannot control what happens externally with oil prices and reserves we should begin to look inward and internally and we can begin by addressing the excess demand for foreign exchange which has characterized the Nigerian economy, which is why this study investigates the effect of additional monetary tightening on exchange rate volatility in Nigeria.

2.3.3 Additional Monetary Tightening

Tightening of monetary policy is a course of action undertaken by the central bank to constrict spending in an economy that is seen to be growing too quickly, or to curb inflation when it is rising too fast. The central bank ‘’makes money tight’’ by raising its key short term interest rate (also known as the overnight target rate), which increases the cost of borrowing and effectively reduces its attractiveness.

Another definition of tight monetary policy or monetary tightening is the restriction of money supply by making it less available in an economy through;

a. Tightening of credit qualifications,

b. Soak up cash by selling government bonds, and or

c. Raising the banks’ reserve requirement.

According to Imoukhuede (2013) monetary tightening could also mean raising interest rate to make a country’s currency attractive vis-à-vis the dollar and other currencies in the world.

Various study have measured monetary tightening in different ways, while Furman and Stiglizt (1998) and Goldfajn and Gupta (1999) measured it as the level of interest rate, Kraay (2001)

defined it as a higher discount rate and slower domestic credit growth. But Gould and Kamin (1999) defined it as movement in international credit spreads and stock prices and to better identify the impact of monetary policies on exchange rate included domestic interest rates. Ergun *et'al* (2013), used interest rate corridor, required reserve, weekly repo rates, funding strategy and other macro prudential tools as well as liquidity policy as a measure of additional monetary tightening.

In this study additional monetary tightening is defined or taken to mean any additional policy measures that further tightens the monetary policy either by making the Naira more costly or less available by the CBN through the use of various monetary policy instruments. In other words, in an already tight monetary policy environment any additional measure or action which further tightens the monetary conditions is considered as an additional tightening of monetary policy. This may entail the CBN retaining the current level of MPR (the policy rate) which may be already tight and further tighten the monetary conditions by using other monetary policy instruments. Therefore, additional monetary tightening was captured by the use of a dummy variable, which takes the value of "1" when there is such an additional tightening and "0" when there is no any additional policy measure to make monetary policy tighter. The variables which were use to identify the episodes of additional tightening included the Monetary Policy Rate (MPR), Cash Reserve Requirement (CRR), Liquidity Ratio (LR), upper interest rate corridor (UCORR) and the lower interest rate corridor (LCORR). These are the key instruments that the Monetary Policy Committee (MPC) uses in taking decisions on whether or not to tighten monetary policy.

For instance, during the second half of 2011, the Central Bank of Nigeria further tightened its monetary policy stance that commenced in September 2010. The MPR was raised three times in the second half of 2011; from 8.00 to 8.75% in July, 9.25% in September and 12.00% in October. In addition, the Cash Reserve Requirement (CRR) which was raised to 4.00% in May was again increased to 8.00% in October. Other measures included a reduction of the foreign exchange net open position of banks from 5.00% to 1.00% in October later increased to 3.00% in the same month. At the MPC Meeting of November 2011, both the MPR and CRR were left unchanged because it was considered that the earlier restrictive measures needed to be allowed to work through to moderate the inflationary impulses on a more sustained basis. However, in order to ensure exchange rate stability in the face of declining external reserves, the foreign exchange mid-point was adjusted from N150.00/US$1.00 to N155.00/US$1.00 while the band of+/- 3.00% was retained (CBN, 2012).

There has been a tightening of monetary policy since the third quarter of 2010 and having achieved a reasonable degree of moderation in the rate of inflation there are compelling arguments to consider easing the monetary policy (See fig.4.2.1). The Monetary Policy Committee noted that the exchange rate has remained within the target range and also that the current monetary conditions are conducive for further tightening using Open Market Operations without recourse to an increase in Monetary Policy Rate. There was however, arguments among the members of Monetary Policy Committee whether to ease or to further tighten monetary policy, the argument to ease is from the perspective to stimulate growth in the real sector whereas that of tightening is to ensure the continued stability of the exchange rate and sustained the build-up of foreign reserve. The reason was that, the fiscal environment in Nigeria is already loose especially as the spending towards the 2015 general elections had commenced. The total

spending by the Federal government including the Subsidy Reinvestment and Empowerment Program (SURE-P), increased by 12% in 2013 in relation to the 2012 budget, also the spending on national security has further loosen the fiscal environment (CBN, 2013). In simple demand and supply analysis, this will put pressure on the demand for foreign goods and services by Nigerians, thereby mounting more pressure on the Naira exchange rate which will result in depreciation and consequently the continuous use of the nation's reserve to defend the Naira. It is in this context that we seek to investigate for an alternative policy that will curtail the excess demand for foreign exchange, achieve relative stability in the Naira exchange rate thereby preventing reserve loss through direct intervention in the foreign exchange market.

2.4 Theoretical Literature

This section reviews a number of theories of exchange rate determination under the flexible system.

The starting point of exchange rate theory is Purchasing Power Parity (PPP). The PPP model is also called the inflationary theory of exchange rate and can be traced back to sixteen century Spain and early seventeen century England, but Swedish economist Cassel (1918) was the first to name the theory Purchasing Power Parity (PPP). Cassel argued that without it, there would be no meaningful way to discuss over-or-under valuation of a currency. The PPP model is a partial equilibrium model of exchange rate determination, since it only considers the goods market.

Under this model, let Pi and Pi* denotes respectively the price level of good "i" in the home currency and foreign currency and "S" denotes the nominal exchange rate that expresses the

price in foreign currency in terms of the domestic currency. Therefore, according to the "law of one price", the price of one good should be equal at home and abroad say

$$P_i = SP_i * \quad (2.4.1)$$

If the prices of each good are equalized between two countries and if the goods basket and their weight in the two countries are the same, then, the absolute PPP holds,

$$SP = P * \quad (2.4.2)$$

Absolute PPP is generally viewed as a condition of good market equilibrium, under which both home and foreign market are integrated into a single market. But since it does not deal with money market and the balance of international payment, it is considered to be only a partial equilibrium theory of exchange rate, not the general one. Again, because the absolute PPP requires many strong impractical preconditions of a competitive product market with implicit assumption of a risk neutral world, in which goods are traded freely without transportation costs, tariffs, export quotas, and so on, it fails in explaining practical phenomenon and even signs of large persistent deviations from absolute PPP are been recorded (Kanamori and Zhao, 2006).

Due to the inability of absolute PPP model to explain practical phenomenon, a more general version of PPP called the relative PPP was introduced, which describes the relationship of prices and the exchange rate in different economies. Generally, relative PPP is derived by assuming that transaction costs are proportionally related to price level. For example, assuming that a commodity's home price at time t is Pt, and the transportation cost is kPt, where k is constant, the foreign price of the commodity is equal to the price of foreign currency multiplied by the exchange rate in terms of home currency, that is

$$P_t + kP_t = (1 + k)P_t \quad (2.4.3)$$

$$(1 + k)P_t = S_t P_t * \quad (2.4.4)$$

By taking the logarithm and then carrying out a differential operation on each side of equation (2.4.4) with regards to time t, we get relative PPP expressed by

$$\frac{\Delta S_t}{S_t} = \frac{\Delta P_t}{P_t} - \frac{\Delta P_t *}{P_t *} \quad (2.4.5)$$

(2.3.5) states that the relative change of the exchange rate equals the difference of the inflation rate between the two economies. Assuming that,

$$\frac{InS_t}{S_t} = s_t , \frac{InP_t}{P_t} = p_t , \frac{InP_t *}{P_t} = p_t *, \quad (2.4.6)$$

(2.4.6) can be expressed as

$$s_t = p_t - p_t * \quad (2.4.7)$$

If absolute PPP holds, then, the real exchange rate equals one. And if relative PPP holds, the real exchange rate should be a constant, and not necessarily equal to one, this theory however, does not explain why the real exchange rate should remain constant over a particular period of time. If an economy adopts a fixed regime, the relative PPP model forecast that the home prices change at the same speed as foreign prices. Conversely, if inflation rates in the two economies are the same, according to relative PPP, the exchange rate should be constant. Empirically, many studies show that neither absolute nor relative PPP holds in the short-run, since adjustment is a time consuming process. Though controversies over PPP remain, according to Pippenger (1993), it seems that only relative PPP can hold in the long-run. This may explain why PPP was thought

by some to be a long-run equilibrium condition, instead of a casual relationship (Hoontrakul, 1999).

In recent years, it was discovered that the world does not work in the way just considered by the PPP model. For instance, with financial liberalization, we have seen volume of international trade in financial assets now dwarfs trade in goods and services. Economists have responded to such real world events by devising several alternative views on the role of the exchange rate as one of many prices in the world-wide market for financial assets. Modern exchange rate models emphasize financial assets market, because goods prices adjust slowly relative to financial asset prices and financial assets are traded continuously each business day. The shift in emphasis from goods market to assets market has important implication. First, exchange rates changes everyday or even every minute as supplies of demand for financial assets of different nations change. Secondly, exchange rates are much more variable than goods prices.

Within the family of assets approach, there are two basic groups, the monetary approach and the portfolio balance approach. In the monetary approach, the exchange rate for any two currencies is determined by relative money demand and relative money supply between the two countries, while the portfolio balance approach allows relative bond supplies and demand as well as relative money market conditions to determine the exchange rate.

As early as the period of the gold standard, monetary policy markers found that exchange rates were influenced by changes in monetary policy. The rise of home interest rate is usually followed by the appreciation of the home currency, and a fall in the home interest rate is followed by a depreciation of the home currency, also indicating that price of assets plays a role in exchange rate variations. Therefore, the interest rate parity condition was developed by

Keynes (1923), as what is called interest rate parity, to link the exchange rate, interest rate and inflation. The interest rate parity is also of two forms i.e. Covered Interest Rate Parity (CIRP) and Uncovered Interest Rate Parity (UCIRP) which can be broadly discussed under the Portfolio balance approach and monetary approach based on the imperfect and perfect substitutability assumption respectively. CIRP describes the relationship of the spot market and the forward market exchange rate with interest rate on bonds in two economies, while UCIRP describes the relationship of the spot and expected exchange rate with nominal interest rate on bonds in two economies. CIRP states that domestic interest rate must be higher than the foreign interest rate by an amount equal to the forward premium (discount) on domestic currency. However, in a rational expectation framework, the forward exchange rate may be strongly influenced by the market expectations about the future exchange rate if new information is taken into consideration (UCIRP). In an uncertain environment, an unhedged interest rate parity condition may hold. This means that agents are indifferent between an investment yielding a complete secure return, on the one hand, and one offering the prospect of an identical return on average, but with the possibility of a much higher or lower return, on the other hand. In other words, they are concerned only with average returns. Therefore, UCIRP, states that the domestic interest rate must be higher than the foreign interest rate by an amount equal to the appreciation rate of foreign currency for equilibrium to be attained in the foreign exchange market. As with PPP, UCIRP conditions are derived under the assumption of no transaction barriers, a perfectly competitive capital market and no arbitrage opportunities at equilibrium. Obviously, these are still a partial equilibrium analysis (Kanamori and Zhao, 2006).

A general exchange rate equilibrium model is the one explained by Mundell-Fleming model of exchange rate determination. The model deals with the equilibrium of the goods market, money

market and balance of payments, but the model lacks micro-foundations to some extent. The Mundell-Fleming model was developed by extending the IS-LM model to the case of an open economy. The IS-LM model considers three markets i.e., goods, money and assets markets and it is used to analyze the impacts of monetary policy and fiscal policy. When goods market is not in full employment equilibrium level, it shows how to use fiscal and monetary policy to adjust an economy to a new full employment equilibrium. Since only two of the three markets are independent, the IS-LM model only establishes a linkage between the money market and goods markets, therefore, in the Mundell-Fleming model, the balance of international payments is considered another equilibrium condition in addition to the money and goods market. One of the most important issues addressed by the Mundell-Fleming model is the so-called trilemma or the "impossibility trinity", which states that perfect capital mobility, monetary policy independence and a fixed exchange rate regime cannot be achieved simultaneously. The model also forecasts that the exchange rate level is perfectly correlated with the level of money supply in the long-run, and thus that monetary policy may only play a trivial role. The implication of the model is that devaluation may lead to further devaluation if fiscal discipline, inflation and balance of payments are not well managed or if the assets market produces a self-fulfilling bubble. This study is not concern with fiscal policy but monetary policy.

The above review demonstrates that each theory holds in a particular setting and explains some macroeconomic phenomena and so, no single theory contains all the factors that may have an impact on foreign exchange rates. The PPP model which is classified into two types (absolute and relative PPP) is reviewed here as a starting point for understanding how exchange rates are determined in the goods markets. It builds linkage between the exchange rate and the prices of goods in two economies. Actually, the minimum preconditions for absolute PPP do not hold

since transport costs, tariffs, and technological and preferential differences exist at all times and places, therefore, absolute PPP is rejected by most empirical surveys. Relative PPP allows exchange rates to deviate from absolute PPP and it is equivalent to the real exchange rate being constant. Therefore, according to Kanamori and Zhao (2006), empirically, both absolute and relative PPP in the short-run are rejected, but some studies found that relative PPP seems to hold in the long-run.

Also, the interest rate parity (CIRP and UCIRP) examines how exchange rates are determined in financial markets and is also thought of as "short-run exchange rate theory", since interest rates change frequently in the short-run. While a lot of evidence supports CIRP as a forward exchange rate pricing model, however, variations in monetary policy, degree of risk aversion, political risks, barriers to capital mobility, and microstructures variations in the market may cause persistent variations in the risk premium over time, the UCIRP lacks support from empirical studies (Kanamori and Zhao, 2006).

The traditional flow model of exchange rate determination is a theory essentially based on the principle of the interplay of demand and supply i.e. interaction between demand and supply in determining the rate of exchange. In the foreign exchange market, equilibrium is maintained in the absence of excess demand as well as excess supply. Disequilibrium (movement) in the rate of exchange occurs when either demand exceeds supply or vice versa in the exchange market thereby resulting in the emergence of another point of equilibrium. However, when there is speculation or expectation of a change in the rate of exchange, this could lead to movement of the equilibrium even without any change in the initial determining factors (Tairu, 2001).

According to Hyung (1972) as cited in Tairu (2001), the economic players in the exchange market are the private and the public sectors. While the private sector operates under a flexible exchange rate system, the public sector transacts under a pegged system of currency exchange. Based on this, the problem of excess or shortage of demand and supply only affects the private sector's currency exchange transactions. In this direction, assuming an excess private demand for foreign exchange denoted as D_e, this excess private demand (D_e) in any short market period depends upon the balance of trade and long-term capital flows denoted by t_c, the international interest rate differentials denoted as r and the price of spot foreign exchange as X_e.

With the above, the world model can be deduced as:

$$D_e = f(t_c, r, x_e) \qquad (2.4.8)$$

Taking the monetary authority's excess demand for foreign exchange (D_m) as an exogenous variable, the model can then be deduced as:

$$D_m = g \qquad (2.4.9)$$

g = an exogenous variable which represents the openness of the economy.

Combining equations (2.4.4) and (2.4.5) and equating to zero, we have:

$$D_e + D_m = 0 \qquad (2.4.10)$$

Equations (2.4.10) serve as the market clearing conditions. This ensures equilibrium in the market. This market clearing equations can be used to remove D_e and D_m resulting in the emergence of a single equation that determines the rate of exchange as an implicit endogenous variable. The equation is written as:

$$EXR = f(t_c, r, x_e) + g = 0 \quad (2.4.11)$$

The model gives a good description of flexible exchange rate system under which the private sector operates.

This theory postulates that exchange rate is in equilibrium when the difference between the demand for and the supply of foreign exchange equals zero. It opines that an increase in domestic interest rate relative to the foreign interest rate results in exchange rate appreciation. This position is logically explained within the premise that an increase in domestic interest rate is capable of inducing capital inflow into the country. As a policy prescription, the traditional flow model postulates that for an economy opting for a strengthened and appreciating exchange rate, there must be an increase in domestic interest rate, reduction in prices and the real growth rate.

The monetary approach to exchange rate determination however, shifted the analysis of exchange rate determination onto the money markets. The model postulates that the relative supply and demand for money between two countries is the basis for the determination of exchange rate and not just the interplay of demand and supply of goods and services between two countries as the traditional flow model views it or just relative prices as the PPP model postulates. The theory views increase in the supply of money as being able to generate inflation hence resulting in exchange rate depreciation. The monetary model opines that a situation of falling prices with a given nominal money supply results in exchange rate appreciation (Olisadebe, 1991). While an increase in domestic interest rate with a given money stock, reduces the demand for money and lowers assets prices, through wealth effect, the fall in prices induces exchange rate appreciation. An increase in domestic interest rate under the traditional flow model

is capable of attracting capital inflow into the country and brings about an appreciation of domestic currency.

The monetary approach is one of the oldest approaches to exchange rate determination. It is used as a yardstick to compare the other approaches to exchange rate determination and the model assumes a simple demand curve for money. The monetary model also assumes a vertical aggregate supply curve which does not imply constancy in the output but a flexible price. The monetary model surpasses the traditional model when analysis of exchange rate is done for an open economy that engages in international trade with other countries rather than a close economy. According to the absolute purchasing power parity, the exchange rate is obtained by dividing the price level of the home country with that of the foreign country i.e. $P=sP^*$,where P stands for the domestic price level and P^* the foreign price level and **s** is the exchange rate. The demand for money equation is given by

$$Md=kpy \qquad (2.4.12)$$

Where k is constant and y is the real income level.

In equilibrium, the demand for money Md=Ms, the supply of money. Hence at the point of intersection of the aggregate demand and the aggregate supply curve

$$Kpy=Ms$$

Or

$$s =Ms/p*ky \qquad (2.4.13)$$

At this point, external equilibrium is obtained in the economy. It is also clear from the above equation that an increase in money supply within an economy would lead to appreciation of the domestic currency. Conversely, international price level as well as the output level will relate inversely with the exchange rate. Let us consider a situation where keeping all parameters fixed, money supply rises in the domestic economy. Since prices are kept constant, excess money supply will inject higher demand for goods and services within the economy. In the face of a fixed output, prices will be pushed up and this will be accompanied by depreciation in the nominal exchange rate. Under a fixed regime the economy takes a somewhat different course (Economy Watch, 2010).

The traditional flow and the monetary theories of exchange rate determination both emphasis on market mechanism. The two theories however, are quite different in terms of real income and interest rate behavior predictions. While the traditional flow model opines that increase in the rate of domestic interest rate causes appreciation of exchange rate by inducing capital inflow into the economy, the monetary model predicts that increase in domestic interest rate lowers money demand, which eventually culminate into exchange rate appreciation. In terms of real income, the monetary model posits that increase in real income induces exchange rate depreciation while the traditional theory concludes that such a phenomenon engenders exchange rate appreciation (Tairu, 2001). Therefore, while the traditional model works through the demand side of the foreign exchange market, the monetary model works through the supply side to affect the exchange rate.

Monetary policy is majorly about two things, one increasing or decreasing the cost of money through the interest rate and two, the availability of money through the use of other instrument of

monetary policy by the monetary authorities and in the case of Nigeria the CBN. The monetary model or approach of exchange rate determination works in the money market via the interest rate which determine the equilibrium of money demand and money supply and this is represented by the real balance. It is with this real balance that economic agents proceed to the foreign exchange market where the demand and supply of foreign exchange is determined via the exchange rate price. In the process where there are gaps, the monetary authorities often intervene by funding the market using the foreign reserve of the country in other to achieve relative stability in the exchange rate.

In Nigeria, the foreign exchange market during the global financial crisis was characterized by very high demand and owing to the fact that the autonomous inflow of foreign exchange declined during this period, the accretion to reserves also reduced drastically such that the CBN became the only source of funding the foreign exchange market. The two options the monetary authorities had was to either intervene and deplete the reserves or allow market forces to do the adjustment (Zubair, 2013).

It must be noted that while this study is in alignment with the postulation of the theory on the exchange rate being determined by market mechanisms since Nigeria operates the flexible exchange rate regime but one that is managed by the CBN, there however, always exist a gap between the demand and supply for foreign exchange in Nigeria and the funding of foreign exchange by the CBN to keep the Naira stable in value has been too costly for the economy and so this study seeks to explore an alternative policy to this problem for the Nigerian economy. This alternative and complementary policy is through the tool of additional monetary tightening to achieve exchange rate stability.

The portfolio balance approach to exchange rate determination as an offshoot of the monetary model has three forms of assets as against the root theory (monetary model) which assumes only currencies as the only form of asset. These forms of assets include the monetary base, domestic and foreign bonds with the usual assumption of imperfect substitution among the assets. Under this approach, exchange rate equilibrium is established when the holdings of these assets are in their desired proportions. Increase in any of the assets for instance, monetary base holdings of government bonds or from current account surplus will cause domestic wealth to increase. The theory postulates that such increase in domestic wealth causes increase in the demand for foreign bonds or assets thereby resulting in capital flight or outflow which invariably manifests in exchange rate depreciation. On the other hand, an increase in private sector holdings of government bonds (increase in domestic government debt) causes a fall in the price of bonds while interest rate raises ultimately results in exchange rate appreciation.

So far, the theories reviewed in this study are all a partial equilibrium analysis of exchange rate determination except the Mundell-Fleming, since all emphasized the role of just one or two markets in exchange rate determination and not all markets in the economy as the Mundell-Fleming model did. However, one similarity in all the theories is the emphasis all the theories made on the role of demand and supply in the different markets in determining the exchange rate between currencies. Their differences is in the various channels through which the exchange rate is been determined , this is to say all the theories are important but some may surpass other when we specify the context of analysis and the policy conditions in the country of study, for instance in Nigeria. Thus for this study, the theoretical underpinning will be the monetary model approach and traditional model to exchange rate determination since the thrust of this study is to seek an alternative or complementary policy to the problem of funding the foreign exchange market

using external reserves through the influence of monetary variables in the money market with the goal of achieving exchange rate stability and appreciation. The choice of these models is due to the emphasis of the interest rate channel and the use of monetary variables in exchange rate determination.

2.5 Theoretical Framework

In this study, the theoretical link between additional monetary tightening and exchange rate is provided by the traditional and monetary model approach of exchange rate determination. While the monetary model postulates that the relative demand and supply of money between two countries is the determinant of exchange rate between the two countries, the traditional model predicts that increase in domestic interest rate relative to foreign interest rate, increases the relative supply of foreign currency, which culminates into appreciation of the domestic currency. Base on the monetary model approach, tight or tighter money raises interest rates, lowers asset prices, which through wealth effect lower money demand and reduces the demand for both local and foreign currencies, also culminating in an appreciation of the domestic currency. Tight money, therefore, works to appreciate the domestic currency by raising (or increasing) the relative supply of foreign currency and lowering (or decreasing) the relative demand for foreign currency. The models works through the money market where the interest rate is determined. An increase in interest rate makes Naira expensive and further tightened policy makes Naira less available. Therefore, the domestic interest rate works to determine the level of capital inflows as well as the equilibrium demand and supply of Naira and foreign exchange.

In the foreign exchange market, the exchange rate is determined through the interplay of demand and supply of foreign exchange. The transmission from the money market to the foreign

exchange market is via the interest rate and determines the real money balance. The interest rate of Naira either makes Naira cheap and available or expensive and less available, and on another hand, the interest rate relates inversely with assets prices. With an increase in real money balance with the economic agents via low interest rate, it will lead to an increase in the demand for foreign exchange and this will be accompanied by a depreciation in the Naira exchange rate vis-à-vis foreign exchange (dollar). The Naira is what is use to buy any foreign exchange therefore, the more wealthier people feel especially through high returns on their assets, it creates an increasing demand for foreign goods and services thus depreciating the Naira. Therefore, a tightened monetary policy which results in decrease in the supply of domestic currency, will leads to lower demand for foreign exchange and then an appreciation in the Naira exchange rate. Also, tighter money will increase the relative supply of foreign currency in the foreign exchange market by increasing capital inflows, this will also culminates in appreciation of the Naira.

2.6 Empirical Literature

Several methodologies have been explored to determine the effect of monetary policy tightening on exchange rates and for the emerging markets these researches have generally taken two approaches. First, is the time series relationship between exchange rates and interest rates which the results from studies have been mixed. For example, Goldfajn and Baig (1999) estimated a VAR with first-differenced, daily nominal interest rates and exchange rates. Dekle, Hsiao and Wang(1999) also estimated with VARS using weekly differences of nominal exchange rates, prices and interest rates and Kapur (2004) used VAR with short-run restrictions (Amato, Filardo, Galati, Peter and Zhu, 2005). Conversely, Zettlemeyer (2000) presented evidence from 3 small open economies, using an empirical approach that does not rely on a VAR-based

identification, rather, the focus was on the immediate response of the exchange rates to shocks associated with particular policy actions, both during "normal" times and at times of pressure on the exchange rate.

Another alternative approach which have been used toward evaluating the impact of interest rates (monetary tightening) on exchange rate is the "event study" approach which involves looking at a large number of tightening episodes and determine whether, in episodes where monetary policy was tightened, exchange rates were more likely to appreciate or relatively stable, than in cases where monetary policy remained loose. Results are also mixed here. For example, Goldfajn and Gupta (1999), studied a large number of episodes where real exchange rates had become highly depreciated relative to their long-term averages, to assess whether or not tighter monetary policy made it more likely that subsequent real appreciation would take place through nominal exchange rate appreciation rather than through higher inflation. Conversely, using this same approach, Furman and Stiglitz (1998) considered cases where short-term nominal interest rate have been substantially devaluated for short periods of time and found that generally, these episodes were associated with exchange rate depreciation and not appreciation as found by Goldfajn and Gupta(1999), whose results shows that, except in circumstances where financial sectors were under stress, tighter monetary policy, did indeed lead to more nominal exchange rate appreciation. Again Ergun *et'al* (2013) in their study also looked at the days or episodes of AMT in Turkey to determine whether the Turkish Lira appreciated and its volatility reduced during the days of AMT and estimated using GARCH technique. Other studies have made use of several techniques such as the Error Correction Model, Bivariant Probit Regression, Panel data Study, Multi- Country Model (MCM), Event study with intraday data, Cointegration, and various regression models. After the study by Engle (1982), exchange rate volatility is

essentially measured by Autoregressive Conditional Heteroskedasticity (ARCH) models and its subsequent generalizations (GARCH, IGARCH, TGARCH e.t.c.).

A survey of literature suggests that the results of studies on monetary tightening and exchange rate are mixed. Some have argued that a significant tightening of monetary policy is necessary in order to stabilize the exchange rate, restore confidence, and lay the ground work for the recovery of economic activity during financial crises. But there are also other strands of studies that found other wise, for instance other studies contend that when financial crisis occurs simultaneously with banking crisis or balance of payment crisis as was the case in Asia, a tightening of monetary policy may be counter-productive. They argue that raising interest rates reduce the confidence of investors and lead to weakening and not strengthening of domestic currency by reducing the ability of borrowers to repay loans and thereby weaken the banking sector (Gould and Kamin, 1999 and Goldfajn and Gupta, 1999). This debate has remained unresolved and so some studies have made contributions on the impact of monetary policy on exchange rate. Even though this study is not directed at exchange rate volatility during financial or banking crises periods, its focus is generally on exchange rate volatility in Nigeria. However, in this section we attempted to review some of these studies and their findings which have become the relevant literature for this study. Therefore, the table 2.6 in the appendix gives a summary of some empirical studies on the subject matter.

Gould and Kamin (1999) in their study on the impact of monetary policy on exchange rates during financial crises, found that changes in interest rate have no significant impact on exchange rate, that is, monetary policy probably does not have important effect on exchange rate but added that the effect may probably take place more slowly and over longer periods of time

than the episodes examined in their study. Kearns and Manners (2005) however reported that monetary policy changes had impact on exchange rate which occurs virtually instantaneously. They found that about 10-20% of the variation in exchange rate was explained by monetary shocks meaning that monetary policy accounted for only a small part of the observed volatility in the exchange rate.

Zettlemeyer (2000), contributed to the debate on the role of monetary policy in stabilizing exchange rates both during and in the aftermath of a currency crisis and specifically, the extent to which tight money is successful in offsetting, or mitigating the pressure on exchange rate, as conventional open economy models would predict. The study found that on average, a 100 basis point contractionary shock will appreciate the exchange rate by 2-3% on impact and seemingly "perverse" reactions of the exchange rate to monetary policy were mainly attributed to a reverse causality. Only in few instances there were true "perverse" reactions of exchange rate to policy that is, an appreciation following expansionary shocks.

Furman and Stiglitz (1998) did provide a discussion of the various channels whereby high interest rates may affect the exchange rate as a contribution to the debate on whether tighter monetary policy is effective in reversing exchange rate undervaluation or volatility among which include the less availability of credit. Goldfajn and Gupta (1999) provided evidence on the relationship between monetary policy and exchange rate by analyzing large data set of currency crises in 80 countries for the period 1980-1998 to evaluate if monetary policy increase the probability of reversing a post-crisis undervaluation through nominal appreciation rather than higher inflation and found that tight monetary policies facilitates the reversal of currency undervaluation through nominal appreciation but when the economy is also faced with banking

crisis, tight monetary policies may not have the same effect depending on the specification of the model. Even though the result showed a positive correlation between tight policies and nominal appreciations but there is again an argument that is advanced on the endogeneity of interest rate and exchange rates since both are driven by the deterioration in investor's confidence during crisis and may increase the risk premium and interest rate may consequently depress the exchange rate. This would generate a negative correlation and not positive.

Various central banks have model exchange rate behavior differently, in other words, have used different models and methodologies in modeling exchange rate behavior and found several empirical results. The models ranges from the Uncovered Interest Rate Parity (UCIRP), long-term model of Purchasing Power Parity, long-run exchange rate behavior, traditional macroeconomic models, models that explain the role of commodity prices, general equilibrium open-economy macroeconomic models and their recent stochastic variant (Amato *et'al*, 2005).

Alves, Muinhos and Riela (2002), found in line with the UCIRP model by incorporating exchange rate into a small structural model that included an IS equation, a Phillip's Curve, a Taylor rule and an UCIRP condition that was modified to reflect the country's risk premium on external debt, that monetary tightening results in an appreciation, while a rise in the risk premium results in a depreciation of the real exchange rate.

Also, recent studies have used an open-economy Dynamic Stochastic General Equilibrium (DSGE) models. These models allow tracking exchange rate effects and at the same time examining the interactions between different economic sectors, monetary and fiscal policies and key economic indicators. De Walque and Wouters (2004) used the DSGE model with sticky prices and wages by incorporating US and Euro area macroeconomic variables, oil prices and

Euro/Dollar exchange rate and found that both tighter monetary policy and domestic demand shocks causes an appreciation of the domestic currency. Even in more recent years, a new approach to modeling exchange rates, drawing particularly from the market microstructure has increasingly attracted attention in literature (Amato *et'al*, 2005).

Garcia and Moec (2004), found that rather than depreciating the US dollar against other major currencies to correct the US external imbalance which will do little to that effect, a combination of dollar depreciation, fiscal discipline and monetary tightening in the US is more likely to bring about a correction in the current account. A similar conclusion is also reached by the bank of Italy's staff using simulations with their quarterly econometric model. This for us has prompted the question of the impact of the devaluation exercise of the Naira in November 2014, with the additional monetary tightening of the MPR from 12% to 13%, the upper interest rate corridor from 14% to 15%, the lower corridor from 10% to 11% and the CRR from 15% to 20%, if these combine actions had any significant impact for the economy in terms of exchange rate management.

Kapur (2004) has also argued that a monetary tightening can generate a large appreciation of the exchange rate in the short-run, and therefore can be a useful tool in stabilizing the foreign exchange markets. On time horizons, monetary policy in emerging markets might have important short-run effects and Kapur (2004), found that monetary policy in India can have its greatest impact on exchange rate at fairly short horizons. He provided this evidence from a VAR model, which showed that interest rate shocks have their maximal effect on exchange rate after just four months.

Ergun *et'al* (2013) studied and analyze the effect of the additional monetary tightening of the Central Bank of the Republic of Turkey (CBRT) on the Turkish Lira exchange rate using GARCH models and found that AMT is statistically significant in reducing the volatility of Turkish Lira. Also, during the days of AMT, Turkish Lira appreciated against the emerging market currencies.

Black (1984), reported that difference in exchange rate regime has profound impact on the conduct of monetary policy and the choice of exchange rate policy, since credit controls do not mix well with a floating rate. His contribution to literature is that the logic of reserve model leads in the direction of a floating exchange rate, while the logic of credit control model leads in the direction of a pegged rate. This serves as guide to variables which policy makers can target depending on the type of exchange rate regime that is practiced in a country and for the Nigerian case, the cash reserve requirement might be an important variable to consider.

According to Hernandez, Howe, Kwack, Stevens, Berner and Clark (1979), in the long run, exchange rates move by a multiple of the change in interest rate and that exchange rate adjusts with a lag. Theoretical developments also indicates that the effect of an interest rate change on exchange rate movements depends on whether the interest rate change is as a result of a temporary change in the level of the money supply, a permanent change in the level of the money supply, or a change in the rate of growth of the money supply. From the study a temporary change in the money supply leads to a temporary change in interest rates and the effect of this change on the exchange rate will depend on the length of time the temporary interest rate increase is expected to last. Thus, a one percent increase in interest rate which is expected to last for three month will initially lead to a one-quarter percent change in the

exchange rate, however, same one percent change that is expected to last for a full year, will lead initially to a full percentage change in the exchange rate. On the extent to which monetary policy depended on exchange rate intervention, the result indicated that "leaning against the wind" does not necessarily reduce the impact of a monetary tightening on Gross National Product (GNP) and prices. This brings to mind, that we must exercise caution in choosing how to combine the two methods of foreign exchange intervention (direct and indirect intervention) so that there will not be a dampen effect. However, monetary restrictions led to an appreciation of the US dollar and in addition, the increase intervention smooth the paths of the three bilateral exchange rates.

Kearns and Manners (2005) also found that an unanticipated tightening of monetary policy of 25 basis points leads to a rapid appreciation of around 0.35% and added that impact depends on how the surprise affects expectations of future monetary policy. Kearns and Manner (2005) is similar to Goldfajn and Gupta (1999) as they made provision for the endogeneity and external factors that may influence both exchange rate and interest rate. But it is different from Hernandez (1979) as it focus only on small open economies that is why large economies like the U.S was not included in the study.

On monetary tightening cycles and the predictability of economic activity, Adrian and Estrella (2009) found that eleven of the fourteen tightening cycles since 1955 were followed by increase unemployment and three were not. This is in line with the argument by a member of the MPC on the adverse effect of a raising interest rate or tight monetary conditions on general economic activity. However, this study was not concerned about the argument on the effect on the real sector in terms of forgone real GDP growth and rise in unemployment. (Garba, Abdul-Ganiyu as cited in CBN, 2013). In order to tackle the challenge of adjusting exchange rate in line with

fundamentals and at the same time prevent the currency from depreciating or appreciating out of line with fundamentals to a significant extent, the active use of interest rate policy as well as exchange rate management must be observed. This is because there may emerge this kind of trade-off in an economy between the use of interest rate policy for domestic stabilization and its use as a tool for targeting the exchange rate (Egert and Reininger, 2004). A number of studies have investigated the impact of exchange rates movement on the real economy and some papers provided evidence indicating that a depreciating currency did not always bring about an expansion of output (Amato *et'al,* 2005).

Pressure on the domestic currency can as well be caused by speculations and so, whether rising interest rates or generally tightening monetary policy is able to prevent speculative attacks from ending in the devaluation of a currency, Kraay (2001) reports that there is no any systematic association between interest rates and the outcomes of speculative attacks. It is however argued that temporarily high interest rates successfully defended against speculative attacks in several Latin American countries. Yet Korea, Indonesia, the Philippines, and Thailand followed the classic prescription of raising their interest rates to defend their currencies, and all three saw continued depreciations. In both Latin America and East Asia, many other factors were at work, and Furman and Stiglitz (1998) argue that the exchange rate depreciations would have been even larger in the absence of high interest rates, or equivalently, that interest rates were not raised high enough. And so, this reasoning could be reversed to undermine the Latin American example. This kind of discussion is useful, in that it alerts economists to the possibility already suggested by theoretical analysis that there may be circumstances in which higher interest rates work, and others in which they do not. To go beyond theoretical prediction, one needs empirical research

that will confirm or reject the theoretical predictions about the likelihood that such policies can work.

Gould and Kamin (1999) explained the two sides of the argument on the effect of monetary tightening policy, with evidence of the impact of monetary tightening on exchange in the Asian and Latin American crisis. In their view, the importance of monetary tightening are that first, it could serve to convince private sector agents that monetary policy was under control, thereby acting to reduce inflationary expectations and prevent a vicious cycle of inflation and exchange rate depreciation. Second, by raising the attractiveness of domestic currency assets and thereby limiting exchange rate depreciation, it could accordingly limit imported inflation and thus again prevent the development of an inflationary spiral.

Finally, by reducing the level of aggregate demand, monetary tightening not only could reduce inflation, but also could help to cool down the economy, limit imports, improve the balance of payments, and hence improve investors' confidence in the countries' prospects for external viability and debt repayment.

All of these considerations above, however, turned out to be less relevant in the Asian crisis of 1997 and 1998 than were in the Latin American crisis in the 1980s and Mexico in 1995 (Gould and Kamin, 1999). Notwithstanding the differences with Latin America, arguments still were made for the importance of tightening monetary policy in the Asian context. First, even if there was no need to contract aggregate demand, some contended that tightening monetary policy could play a useful role if it restrained the depreciation of exchange rates, since the Asian currencies appeared to have declined by far more than was merited by equilibrium considerations alone, and their collapse had helped to roil financial markets and undermine confidence in the

region. Second, a major factor depressing activity and injuring the banking sector had been the effects of depreciating currencies on the balance-sheets of borrowers in foreign currencies, therefore, supporting the currencies was actually a way of helping to support the economy and the banking sector, even if pursued through tighter monetary policies. Finally, advocates of tighter monetary policy argued that raising domestic interest rates would support local currencies not only by making domestic currency assets more attractive, but also by encouraging agents with external liabilities to attempt to reschedule these debts rather than finance repayments through borrowings in domestic credit markets. This would have the effect not only of reducing exchange rate depreciation, but also of strengthening the balance of payments by reducing runoffs of foreign liabilities.

The IMF's policy recommendations to the crisis Asian economies came under severe criticism as initial increases in interest rates failed to stabilize currencies. The flow of domestic credit became sharply curtailed, and these economies moved into very deep recessions.

Critics of tighter monetary policy, as expressed most notably in Furman and Stiglitz (1998) and Radelet and Sachs (1998), contended among other things that in the midst of a financial crisis, tightening monetary policy might fail to support the currency and might even increase downward pressures on it. First, in the context of a run on the currency, the level of domestic interest rates required to compensate investors for extreme depreciation expectations might be so high as be unsustainable and/or extremely injurious to the economy. Second, in the context of what has been referred to as an "international bank run", with foreign investors determined to pull out of the region, domestic debtors may not have the option of rolling over their external obligations, even if they desire to. Finally, higher interest rates may increase debt-service burdens for firms,

lower loan performance, add to pressures on the banking system, and thereby further raise prospects of financial collapse and external debt default, all of which would have the effect of further undermining investor's confidence and thereby having a depressive effect on currency values. From both side of this argument, both the proponents and critics of monetary tightening to stabilize the exchange rate make plausible arguments, and it is difficult on strictly a priori or theoretical grounds to ascertain which side of the issue carries the greater weight (Gould and Kamin, 1999). Hence, this debate is more likely to be decided on the basis of actual experience and empirical evidence, a subject to which we desire in this research to study the Nigerian case. The difference is that this study is not focus on financial crisis period as it was in the Asian and Latin America rather in Nigeria, the problem at home with us is the declining oil prices and the depleting foreign reserves in the face of a persistently fluctuating and depreciating exchange rate.

To sum up, the empirical studies reviewed showed that monetary policy tightening do affect the exchange rate. However, the direction of the effect is to be empirically determined for every economy and the arguments are still inconclusive, this is because while some studies revealed that monetary tightening exerts positive effects on exchange rate which helps stabilize and appreciate domestic currency, others disagree that it exerts negative effect on exchange rate and the economy. Yet still others disagree that the effects on both direction is not significant.

The methodologies which have been used by the studies to determine the effect of monetary tightening on exchange rate constitutes another empirical issue. While some used a time series approach and estimated with different techniques under it, others used an event study approach. Results from both approaches are mixed. For instance, Furman and Stiglitz (1998), Goldfajn and Gupta (1999) and Ergun *et'al* (2013), used the event study approach but while Goldfajn and

Gupta (1999) considered the long-run effect of monetary tightening and found significance, Ergun *et'al* (2013) and Kapur (2004) studied the short-run and also found significance but Furman and Stiglizt (1998) considered the short-run and found that the episodes were associated with exchange rate depreciation and not appreciation. The event study approach was used in this study because it allows us to look at the various episodes of additional monetary tightening whether the value of Naira appreciated and was relatively stable, than the periods when monetary policy were loose or unchanged. This study replicate Ergun *et'al* (2013) to examine the Nigerian case with modification in the variables of study. Moreso, these studies are foreign and same kind are lacking for Nigeria, especially on the effect of additional monetary tightening on the exchange rate.

To this end, this study contributes to the existing literature in two important ways; first, as empirical evidence, it determines the effect of AMT on the Naira/dollar exchange rate volatility as an extension of studies on exchange rate management and as a potential alternative or complementary tool to the direct intervention. Secondly, the study also shows that AMT moves exchange rate in the intended direction as predicted in theoretical literature by the plotting of the trend between AMT and exchange rate volatility and then the sign and magnitude of the coefficient of the other monetary variables, to also see if they all influence exchange rate in the desired direction or not.

Lastly a key point which has not received much emphasis in literature so far is that the monetary authorities have not one but two ways to influence the exchange rate, which is the direct and the indirect policy. The indirect policy is to influence monetary policy variables to affect exchange

rate, this study therefore emphasized the indirect intervention of monetary policy and an unconventional tool of monetary policy for exchange rate management in Nigeria.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

To achieve the objective of this study, which is to examine the effect of additional monetary tightening on exchange rate volatility in Nigeria, this study build and estimated a variant of the Arch model, the GARCH (2, 2) model. The choice of this model among other competing models was base on some model selection criteria which included the R^2, the Akaike Information Criteria (AIC) and the Schwarz Information Criteria (SIC) among others, which tends to be lower for this model. Hence, volatility modeling using the GARCH (2, 2) enabled us to achieve the objective of this study.

3.2 Conceptual Framework for Analysis

Two theories form the theoretical framework for this study. First is the monetary model approach and second the traditional model approach. The simple monetary theory often assumes that the supply of money is totally independent of interest rates i.e. the supply of money is exogenously determine by the monetary authorities and in the case of Nigeria by the CBN. But more complex models, and especially Keynesian models, assume that higher interest rates will lead to higher level of money supply. The reason is that increase in interest rate expands the demand for credit as a result banks expands their credit, higher interest rate encourages depositors to switch accounts to earn higher interest and high interest rate attracts deposits from overseas, all of these leads to higher levels of money supply. This result to an upward-sloping supply curve with the assumption that interest rates are determined by the market by the interaction of supply and

demand for money. Conversely, if the monetary authority raises interest rate, the supply of money may fall in response to a lower demand for money (Sloman, 2003).

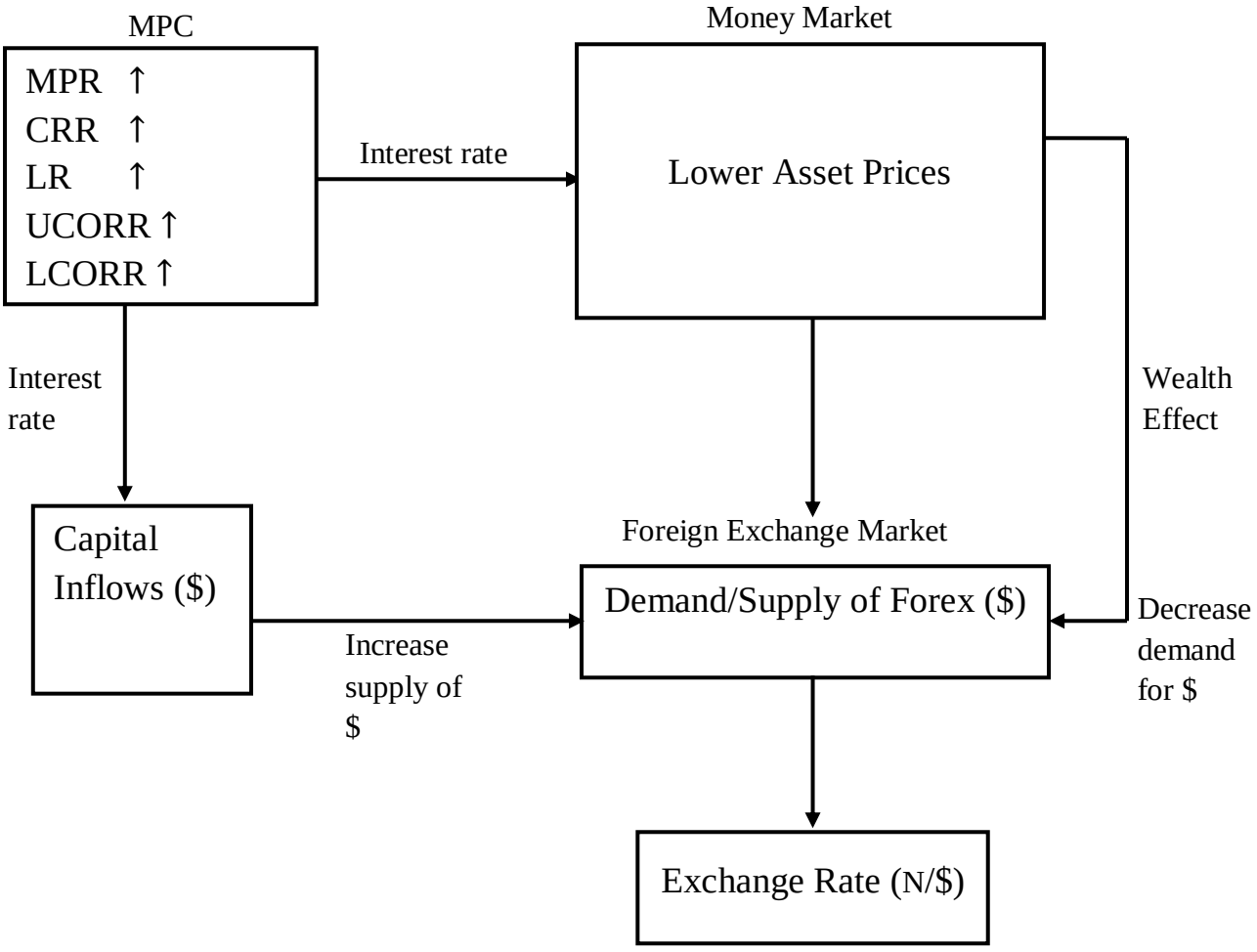
Equilibrium in the money market is attained when the demand for money is equal to the supply of money. This equilibrium is achieved through changes in the rate of interest and with a rate of interest and a quantity of money (i.e. money balance). If the interest rate is above the equilibrium rate, there would be surplus of money balances which will be used to buy shares, bonds, and other assets and part of which will be foreign assets and shares. This will drive up the price of assets and drive down the rate of interest. As the rate of interest falls, there would be a contraction of money supply and an increase in the demand for money balances, especially speculative balances. In a free foreign exchange market, changes in money supply also affect foreign exchange and equilibrium is achieved by changes in the exchange rate. An increase in money supply directly affects the foreign exchange market in the following ways;

i. Part of the excess money balances is used to purchase foreign assets and will therefore lead to an increase in supply of domestic currency coming into the foreign exchange market.

ii. Excess money supply in the domestic money market pushes down the interest rate thereby reduce the return on domestic assets below that of foreign assets and an increase supply of the domestic currency on the foreign exchange market. This will also reduce the demand for the domestic assets by foreigners, and thus reduce the demand for the domestic currency.

iii. Speculators who anticipate a higher supply of domestic currency will cause the exchange rate to depreciate so therefore sell domestic currency and buy foreign currencies now, before the depreciation takes place (Sloman, 2003).

This study is situated within the context of the role of the money market in determining exchange rate. The decision of MPC to tighten the monetary policy by increasing the MPR will follow the interest rate channel to the money market where the demand and supply of domestic currency is determined and real money balance determined. The cost of Naira will usually determine the real money balance with the economic agents. Still, the decision by the MPC to leave the MPR which is already high unchanged but use other additional monetary measures to further tighten such as changing the standing facilities corridor, cash reserve ratio, e.t.c., also follows the interest rate channel to determine the real balance which will be available with the economic agents to make transactions within the foreign exchange market. The higher the real money balance from the transactions in the money market, the higher the demand for foreign exchange in the foreign exchange market. Usually, a high demand that outstrips supply will depreciate the exchange rate and appreciate it when supply of foreign exchange is in excess of demand or when there is a decrease in the demand for foreign exchange. The schematic below illustrate how the decision of the MPC to tighten monetary policy transmits through the money market to the foreign exchange market.



Source: By author

Fig 3.2.1 The Conceptual Framework for Analysis.

The above analysis shows what happens on the demand and supply side of the foreign exchange market. On the supply side, tighter monetary policy through a raise in interest rate induces domestic currency appreciation by increasing foreign capital inflow. The increase in capital inflow means an increase in the supply of foreign currency into the domestic foreign exchange market and thus culminates in the appreciation of the domestic currency. On the other hand (i.e.

demand side), tighter monetary policy raises interest rates, and because the market price of assets varies inversely with the interest rate, this will lower the prices of assets. When the market prices of assets falls the yield or returns on such assets also falls so economic agents experience a decrease in their wealth. Decrease in the wealth of the economic agents also means a decrease in their consumption of both domestic and foreign goods and services thereby reducing the money demand as well as the demand for foreign currency. Put for instance, an asset bought at ₦1000 which is to yield ₦1000 per annum to its holder but due to high interest rate, its market price falls to ₦500 that year. For such individual, there is a loss of wealth of about N500000. Because economic agent feel poorer, his/her consumption especially on luxuries (example, a vacation outside the country) will be reduced, thereby reducing the demand for foreign currency thus help to reduce the pressure on the domestic currency and even appreciate domestic currency. Therefore as both the demand and supply side of the foreign exchange is managed through the tool of additional monetary tightening, exchange rate movements will be orderly and with less rapid swings.

3.3 Empirical Framework

This study follows Ergun *et'al* (2013) in Turkey to model the volatility of exchange rate using a GARCH model Generalized by Bollerslev (1986) and Taylor (1986). This model is suited for volatility clustering often associated with financial data, where large changes are likely to be followed by further large changes. There are three specifications that form the model — one specification is for the conditional mean equation, one for the conditional error distribution and one for the conditional variance. The general representations of these specifications are as follows;

$$Y_t = X_t^{'}\theta + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 3.3.1a$$

$$\mu_t = N(0, \sigma_t^2) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 3.3.1b$$

$$\sigma_t^2 = \tau + \sum_{k=1}^{q} \eta_k \, \sigma_{t-k}^2 + \sum_{n=1}^{p} \psi_t \, \mu_{t-n}^2 + Þ_t^{'}\pi \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .. 3.3.1c$$

Equation (3.3.1a) is the mean equation, it is written as a function of exogenous variables with an error term (μ_t). Equation (3.3.1b) is the conditional error distribution which is estimated either using normal (Gaussian) or students-t or generalized error distribution. Equation (3.3.1c) is the conditional variance equation. σ_t^2 denotes conditional variance which is one-period ahead forecast variance based on past information. It is expressed as a function of (1) a constant term (τ), (2) Last periods' forecast variances (σ^2_{t-k}) known as the GARCH terms (3) news about volatility from the previous periods, measured as the lags of the squared residuals (μ^2_{t-n}) from the mean equation otherwise known as the ARCH terms, and (4) predetermined or exogenous variables (Þ).

The study by Ergun *et al.* (2013), serves as a country specific study that accounted for AMT in the modeling of exchange rates volatility. In the framework, required reserve ratios, weekly repo rate, interest rate corridor, funding strategy and other macro prudential tools were jointly used as complementary tools for the credit, interest rate and liquidity policies to achieve the price and financial stability objectives concurrently. Thus, they modeled exchange rate volatility using the following equations:

Model 1

$$R_t = B_0 + B_1 D_{AMT} + B_2 FXS_t + B_3 RVIX_t + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 3.3.2a$$

$$\varepsilon_t \sim N\ (0, h_t) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .. 3.3.2b$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon^2{}_{t-1} + \alpha_2 h_{t-1} + \alpha_3 D_{AMT} + \alpha_4 FXS_t + \alpha_5 RVIX_t + u_t \dots\dots\dots\dots\dots\dots\dots\dots\dots . 3.3.2c$$

Model 2

$Rem_t = B_0 + B_1 D_{AMT} + B_2 FXS_t + B_3 RVIX_t + \varepsilon_t$ ……..3.3.3a

$\varepsilon_t \sim N\ (0, h_t)$ ……..3.3.3b

$h_t = \alpha_0 + \alpha_1 \varepsilon^2{}_{t-1} + \alpha_2 h_{t-1} + \alpha_3 D_{AMT} + \alpha_4 FXS_t + \alpha_5 RVIX_t + u_t$ ……..3.3.3c

Model variables were defined as follows

R_t = Exchange Rate

Rem_t =Emerging markets Exchange Rate

$B_0, B_1, B_2,$ & B_3 =Intercept and Coefficients

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$= Parameters

D = Dummy variable

AMT = Additional Monetary Tightening

FXS_t= Foreign Exchange sold by CBRT through Auction and Intervention

ε_t = Error Term

$R_t = In(P_t/P_{t-1}) * 100$ $P_t = 0.5 * (Euro/TL) + 0.5 * (USD/TL)$

$Rem_t = In(EM_t/EM_{t-1}) * 100$ $EM_t = Mean\ of\ Emerging\ market\ Currency/TL$

$RVIX_t = In(VIX_t/VIX_{t-1}) * 100$ $VIX_t = Value\ of\ the\ VIX$

VIX = global risk appetite

$$FXS_t = \frac{The\ total\ daily\ amount\ of\ FX\ sold\ by\ CBRT\ through\ auctions\ and\ intervention}{Gross\ FX\ Reserves\ of\ the\ CBRT}$$

D_{AMT} = {0, other days and 1, days of AMT}

To estimate the effect of additional monetary tightening on exchange rate volatility, this study followed the methodological approach in Ergun *et'al* (2013) with modifications in variables of study in order to capture variables peculiar to monetary policy in Nigeria. The objective is to examine whether additional monetary tightening policy has any significant effect in reducing exchange rate volatility in Nigeria. Therefore, if AMT is significant, then exchange rate volatility should be lower compared to episodes of non- additional monetary tightening. We therefore, compared the daily volatility of the exchange rates with the episodes of AMT in Nigeria.

To do this, we use a dummy variable to identify those meetings of the MPC in which the decisions taken was to additionally or further tighten the monetary policy through other monetary measures even when one or more instruments was left unchanged. We matched the dates of the meetings as revealed in the various communiqués and minutes of the MPC and the decisions taken with the dates of the daily exchange rate by putting "1" where there was AMT and other days where there was no AMT, we put "0". The other variables used to capture AMT aside the Monetary Policy Rate (MPR),1 include Cash Reserve Requirement (CRR), Upper Interest Rate Corridor (UCORR), Lower Interest Rate Corridor (LCORR) and the Liquidity Ratio (LR). Thus, the GARCH model estimated for this study is of the following forms;

1 The use of the level of the nominal federal fund rates (and in the case of Nigeria MPR) as a measure of monetary policy stance is proposed by Bernanke and Blinder (1992) and Bernanke and Mikov (1998) while Laubach and Williams (2003) propose the gap between current real interest rate and the natural rate of interest rate as measure of monetary tightness.

$EX_t = c_0 + c_1 D_{AMT} + c_2 MPR_t + c_3 CRR_t + c_4 UCORR_t + c_5 LR_t + c_6 LCORR_t + u_t$ ... ... 3.3.4a.

$u_t = N(0, Z_t)$ ... ... 3.3.4b[2]

$Z_t = \omega_0 + \omega_1 u_{t-1}^2 + \omega_2 Z_{t-1} + \omega_3 D_{AMT} + \omega_4 MPR_t + \omega_5 CRR_t + \omega_6 UCORR_t + \omega_7 LR_t + \omega_8 LCORR_t + u_t$ 3.3.4c

Where,

$t - i$ = lag with one period

EX_t= Exchange Rate

MPR_t= Monetary Policy Rate

CRR_t = Cash Reserve Requirement

$UCORR_t$ = Upper Interest rate Corridor

LR_t = Liquidity Ratio

$LCORR_t$ = Lower Interest rate Corridor

u_t= Error term

$C_0, C_1, C_2, C_3, C_4, C_{5,} C_6$ = Intercept and Coefficients

$\omega_{1,} \omega_2, \omega_3, \omega_4, \omega_5, \omega_6, \omega_7, \omega_8$ =Parameters

D = Dummy Variable (0, for Monetary Easing Policy or where there was no further tightening and 1, for AMT Policy)

AMT = Additional Monetary Tightening

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2 We assume our conditional error distribution to follow the generalized error distribution which is given as

$$l_t = \frac{1}{2}\log\left[\frac{\Gamma(1/r)^3}{\Gamma\left(\frac{3}{r}\right)\left(\frac{r}{2}\right)^2}\right] - \frac{1}{2}log\sigma_t^2 - \left[\frac{\Gamma\left(\frac{3}{r}\right)(y_t - X_t'\theta)^2}{\sigma_t^2\Gamma(\frac{1}{r})}\right]^{r/2}$$

The GARCH model is consist of the conditional mean equation and the conditional variance equation. The mean equation estimated shows exchange rate as a function of AMT, monetary policy instruments and an error term. The variance equation, expresses the conditional variance as a function of own lag (last period forecast variance), one period lag of squared residuals (last period squared residual), AMT, monetary policy instruments and an error term. The presence of AMT in the variance equation enables this study to determine its effect on the conditional variance i.e. volatility. Therefore, the sign has implication for this study, given that AMT is measured to show the direction of the effect of additional tightening policy on exchange rate. Negative sign indicates that AMT reduces Naira depreciation and volatility, as such AMT is effective and significant. The opposite is true with positive sign and the same is for all other variables in the model. In essence, if the coefficient for AMT i.e. $\omega_3 < 0$; AMT is effective and significant. But if $\omega_3 \geq 0$; AMT is not effective and significant. To examine the relationship between AMT and the exchange rate volatility, we obtained the residuals from the OLS estimates and shaded the AMT episodes against the residuals of the series. If AMT has any effect, we expect the fluctuations/movements to be stable compared with the periods when there was no AMT. The level of significance used in the study is the 1% and 5% level of significance.

3.4 Unit Root Test

The time series data used in the estimation of the model was examined for unit root using the Augmented Dickey Fuller (ADF). This becomes important because the use of non-stationary data could lead to spurious results Granger (1969). The use of a line graph to indicate if there is the presence of intercept or trend or both in the data in order to specify the relevant ADF test

suitable for this study was adopted for the unit root (Gujarati, 2007). The standard ADF test is thus specified as:

$$\Delta y_t = \alpha y_{t-1} + \omega_t^{'}\delta + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.4.1$$

Where $\alpha = \rho - 1$. The null and alternative hypothesis may be written as,

H_0: $\alpha = 0$

H_1: $\alpha < 0$

3.5 Data and Sources

The study considered the daily Naira/USD exchange rate from Monday to Friday. This gives a sample with 2322 observations with exception of weekends and public holidays. The monetary policy instruments on which data was collected are, MPR, UCORR, LCORR, CRR, and LR. All these were collected from CBN'S official website, particularly the CBN Communiqués.

For AMT, this study employed the 2- way dummy "1" and "0" to code communiqués and minutes from the MPC meetings which are obtainable from the CBN's official website. The choice of dummy is derived from the need to deduce whether AMT affects the exchange rate volatility in the intended direction. The decisions of the MPC are usually clear to know if the decision is to further tighten, loose or retain their decisions. The use of dummy variable helped us to match the daily exchange rates with the dates of MPC meetings. If in its meeting, (the MPC) the decision taken was to further tighten monetary policy, "1" is written against that date and "0" against the date of MPC meetings in which the decision taken was not additional

monetary tightening. The Econometric View (E-Views) software was applied for the estimation of the coefficients and parameters of the model.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter presents the empirical result of the study based on the methodology developed. The chapter is organized into three sections. Section 4.2 identifies the episodes of additional monetary tightening in Nigeria during the period 2007- 2015; section 4.3 examines the trend relationships between AMT and exchange rate volatility analysis and then, section 4.4 presents the empirical results and discussion.

4.2 Episodes of Additional Monetary Tightening in Nigeria (2007-2015)

Using the various communiqués and minutes of the MPC meetings, we have identified episodes of additional monetary tightening during the period 2007-2015 as shown in the figure 4.2.1.

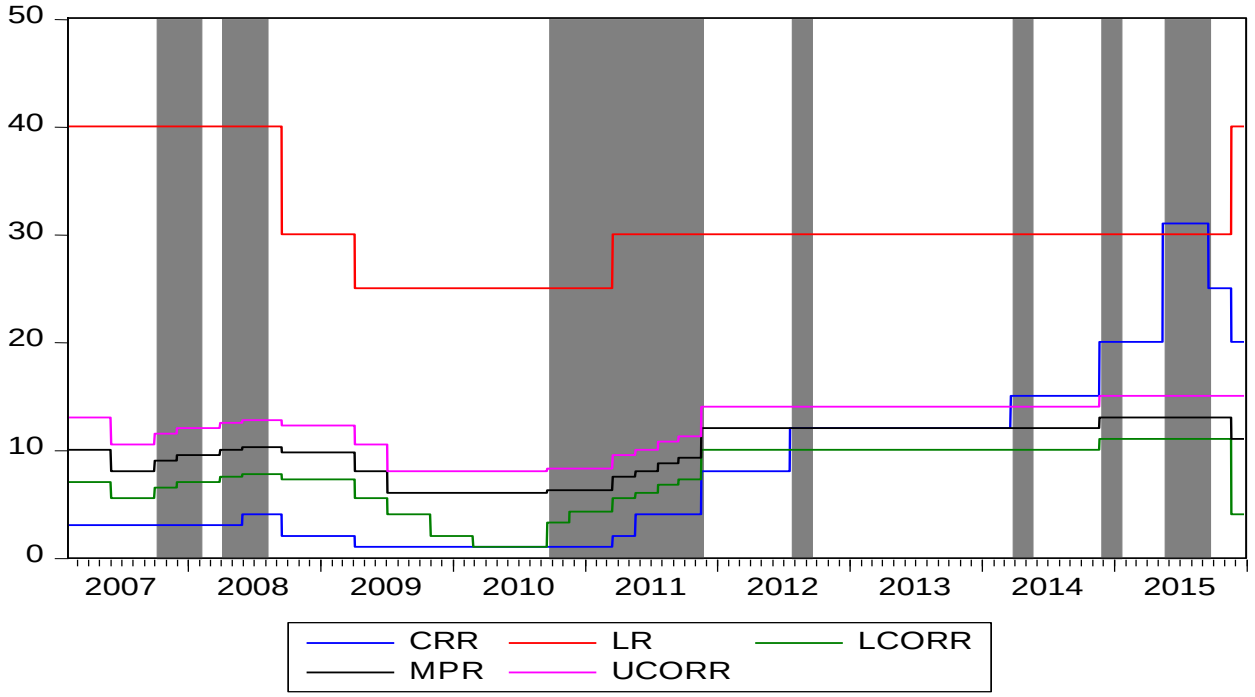


FIG.4.2.1: ADDITIONAL MONETARY TIGTHENING

The first episode observed in this study is from 3/10/2007 to 3/12/2007 where the MPR was increase by 1% to 9% but other instrument left unchanged i.e. corridor was left at +/-250 basis point, CRR and LR at 3% and 40% respectively. With the tight monetary condition, CBN further increased MPR in December (4/12/2007) by 0.5% to 9.5% and other rates remained unchanged until 5/2/2008 when none of the rates was further increased during the MPC meeting. The second episode of AMT was on 1/4/2008 and on 2/6/2008 and ended on 4/8/2008. The MPR was additionally raised by 0.5% to 10% and again by 0.25% to 10.25% on 2/6/2008. Also in this episode, CRR was tempered with in that it was jacked up from 3% to 4% while other rates were held constant. Subsequent meetings were followed by lower rates to mitigate the effect of the global financial crisis on the economy which lasted about eight quarters.

The MPC after a period of about eight quarters resumed tightening on 21/9/2010 with additional monetary tightening on the following periods, 22/11/2010, 24/1/2011, 21/3/2011, 23/5/2011, 25/7/2011, 19/9/2011, 10/10/2011 and 20/11/2011.

It is important to note that from 3/11/2009 to the third episode of additional tightening, the MPC adopted an asymmetric corridor to discourage short term capital flows by creating a managed uncertainty about short term yields where the lower bound was adjusted while the upper bound was left unchanged. On that same 21/9/2010, the MPC adjusted the asymmetric lower bound from +200/-500 to +200/-300, and raised MPR by 0.25% and CRR and LR remained unchanged. After these periods the MPC has not made use of the asymmetric tool but rather the symmetric tool.

The fourth episode of AMT was on 23/7/2012 where the CRR was raised from 8% to 12% while order rates like MPR, LR, and the interest corridors were unchanged. The fifth episode was an

increase in CRR from 12% to 15% on 24/3/2013 and the sixth episode the MPR was raised from 12% to 13% and CRR from 15% to 20% on 24/11/2014. Finally, the seventh episode was marked by an increase in CRR from 20% to 31% on 18/05/2015 but subsequent meetings of the MPC were characterized by either retaining the rates or easing the monetary policy.

4.3 Trend of/and Exchange Rate Volatility in Nigeria (2007-2015)

Trend analysis of exchange rate volatility is employed here to show the interplay between exchange rates at level, its volatility and the episodes of additional monetary tightening. Figure 4.3.1, panel a, graph i-vi shows the trends in the three exchange rates i.e. buying (brate), central (crate), and selling rate (srate) and the OLS residuals of the various rates. There are a number of features observed from the figure below on the behavior of the rates. However, a closer look at the figure indicates that the rates tend to move together, also, their responses seem to be same in respect to AMT.

Panel a

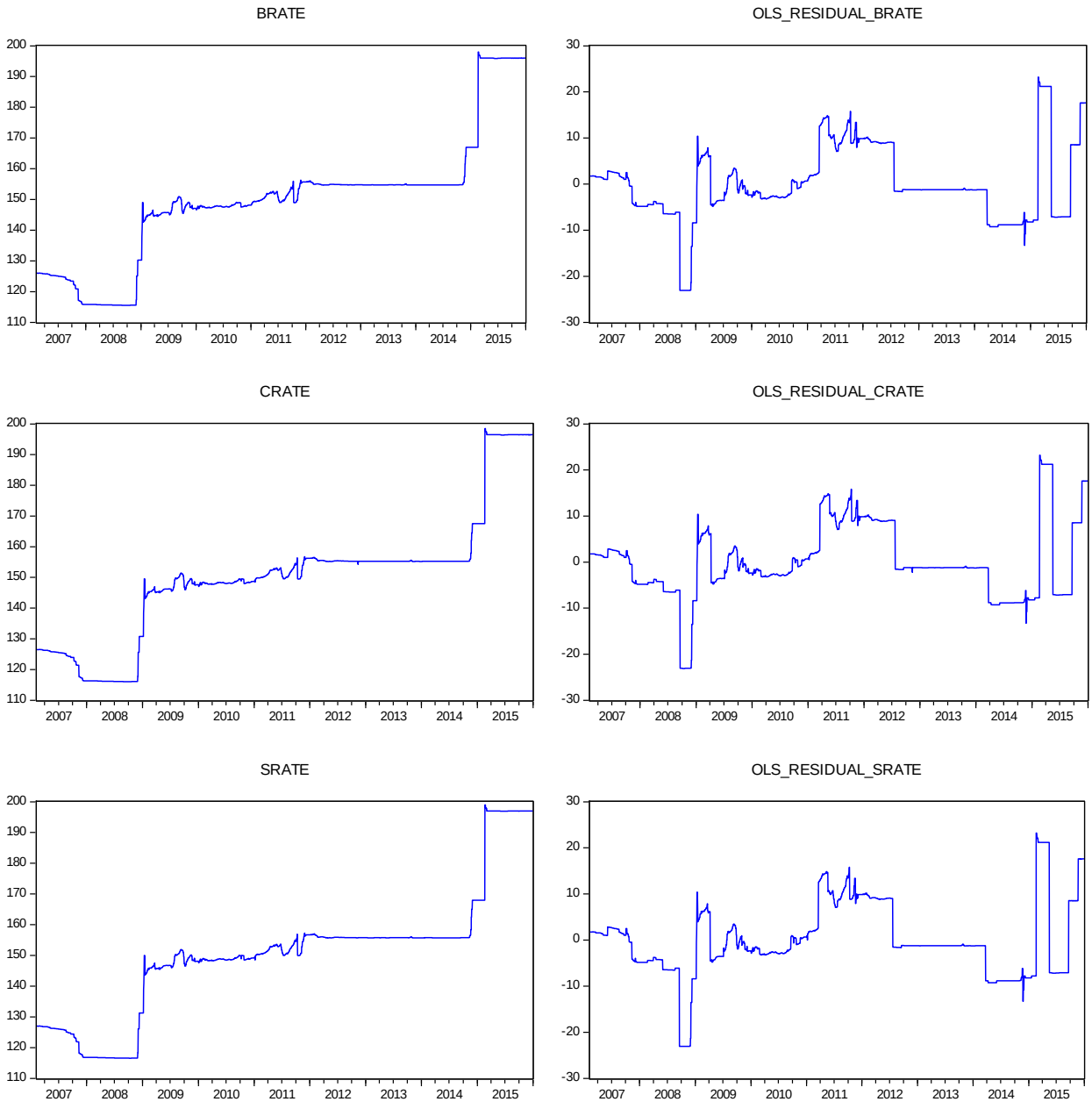


FIG 4.3.1a: Trend of/and Exchange Rates Volatility in Nigeria

First it was observed that before 2008, the rates were stable relative to the period after 2008, the volatile nature in 2009 and 2010 may suggest the effect of the global financial crisis that affected the international economies and Nigeria. Volatility was high again around 2011 and relatively stable by 2012 and even more stable from 2013-2014, but towards the end of 2014 and all

through 2015 there was high volatility again. This indicates that the happenings around the global and domestic economy had significant effect on the Naira exchange rate, for year 2015 we suspected that the uncertainty of the 2015 general elections was partly a cause of the swing. Again, indicating the episodes of additional monetary tightening on the exchange rates we also observed some behavior on the panel b of the figure below;

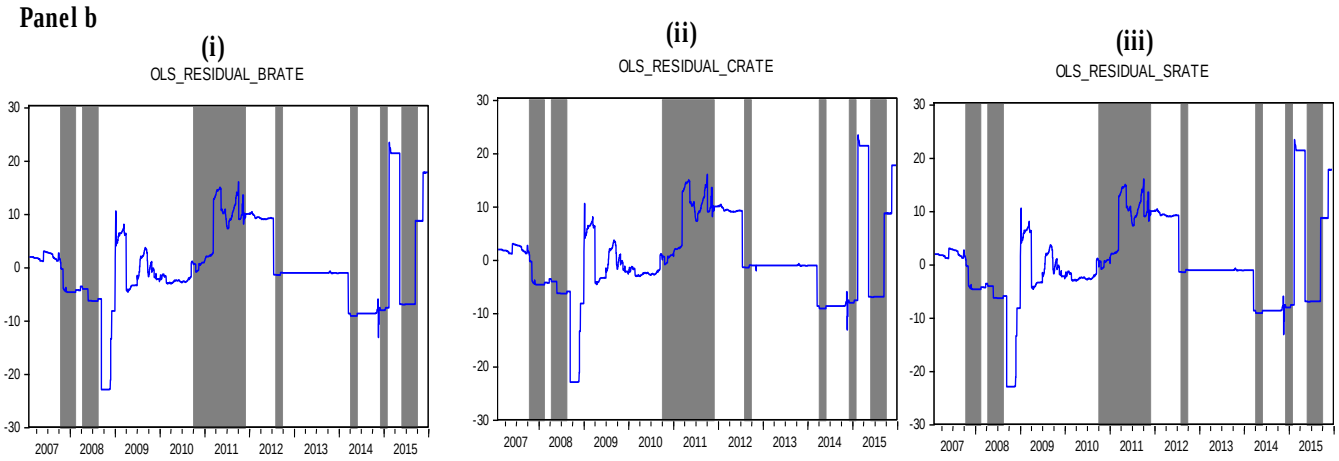


FIG. 4.3.1b: Additional Monetary Tigthening and Exchange Rates Volatility

Fig. 4.3.1b (i.e. Panel b) shows the volatility of the exchange rates and the various episodes of AMT. Since the introduction of MPR which replaced the MRR (Minimum Rediscount Rate), monetary policy has been characterized by sessions of both tightened and ease policies. However, monetary policy were most of the time tightened with the MPR, continually increased until late 2008 when it was lower by 50 basis point from 10.25% to 9.75%, CRR reduced from 4% to 2% and LR from 40% to 30%. Indicating the beginning of ease policy in order to mitigate the effect of the global financial crisis which began late 2008. Observing these period of ease policy couple with the hit of the global financial crisis, the exchange rates fluctuated violently, as seen from the figure 4.3.1b, we see sharp and violent movements when the second episode of AMT was relaxed. Monetary policy remained eased until third quarter 2010, when MPC

resumed tightening again with a rise in MPR from 6% to 6.25% and has since then continued to additionally tighten or maintained the MPR and increase its standing facilities, until 23/11/2015 when the MPR was reduced from 13% to 11% with an asymmetric corridor of +200/-700. For instance during this episode, the standing facilities were narrowed (tightened) from +200/-500 to +200/-300 basis point with LCORR raised from 8% to 8.25% and LCORR from 1% to 3.25%, which has also like the MPR been continuously raised since third quarter 2010 and only either maintained or further tightened. From the graph above, the fluctuation in the rates was not so violent compare to the period before third quarter 2010 as relative stability is observed with the additional tightening of such period. The fourth, fifth, sixth and the seventh episodes were even characterized with more stability in the rates.

Drawing from the above, we can say that the tightening session which began in third quarter 2010 and the additionally tightened policy of the MPC has stabilized the movement of the rates as seen in the figure. We can therefore, infer that the episodes of AMT might have been responsible for the stability in the rates and its value by its influence in encouraging foreign currency inflows and decrease the demand for foreign currency in the foreign exchange market, couple together with direct interventions. To further formalize this finding, this study estimated a GARCH model to further confirm the trend between AMT and exchange rate volatility in Nigeria.

It is also important to note that continuously tightened policy has an adverse effect on the general economy in terms of investment and spending as argued by some literature in chapter two. If this is so, then AMT as a tool must be used only when the conditions in the economy is feasible in other not to hurt the economy.

4.4 GARCH Model Estimation

To estimate the GARCH model specified in chapter three, we started by examining the empirical distributions of the variables of the study. We first tested for normality and then unit root for stationarity.

4.4.1 Normality Test Result

The generalized autoregressive conditional heteroskedastic (GARCH) is found to be a suited technique for modeling financial time series which tend to exhibit non-normal distribution. Therefore, this section examines the distribution of all the variables of study.

Table 4.4.1 Descriptive Statistics of the Variables of Study

	BRATE	CRATE	SRATE	MPR	LR	CRR	UCORR	LCORR
Mean	150.5499	151.0497	151.5495	9.998736	31.04088	8.431100	12.21639	7.406026
Median	151.9700	152.4700	152.9700	10.25000	30.00000	4.000000	13.00000	7.250000
Maximum	198.0000	198.5000	199.0000	13.00000	40.00000	31.00000	15.00000	11.00000
Minimum	115.5500	116.0500	116.5500	6.000000	25.00000	1.000000	8.000000	1.000000
Std. Dev.	21.45784	21.45878	21.45804	2.398201	5.039015	7.921090	2.428435	3.010682
Skewness	0.467856	0.468101	0.467907	-0.487524	0.813203	1.098134	-0.652335	-0.614365
Kurtosis	3.367386	3.367619	3.367331	1.846387	2.555058	3.541957	2.000459	2.274601
Jarque-Bera	99.91604	100.0237	99.93109	225.5875	281.1183	505.9744	267.0856	201.3078
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	357254.9	358440.9	359627.0	23727.00	73660.00	20007.00	28989.50	17574.50
Sum Sq. Dev.	1092161.	1092257.	1092182.	13642.25	60229.03	148828.0	13988.38	21500.29
Observations	2322	2322	2322	2322	2322	2322	2322	2322

H_0; All the rates are normally distributed
H_1; All the rates are not normally distributed

The result in table 4.4.1 reveals the presence of skewness and kurtoses in the data. The variables are all positively skewed except for MPR, UCORR and LCORR which are negatively skewed. However, the empirical estimate of the kurtosis of the various rates shows that the variables exhibit both platykurtic and leptokurtic. This is evident, because their kurtoses are either below or above 3, which is the kurtosis of a normal distribution. Therefore, the presence of skewness and kurtosis in the data indicate that the variables are not normally distributed. The Jarque-Bera test is in accord with this finding, because it also strongly rejects the null hypothesis of normal distribution even at 1%, with probability value of 0.000000 for all the variables and therefore, suited with the GARCH technique.

4.4.2 Unit Root Test Result

The Augmented Dickey Fuller (ADF) test of stationarity was carried out in this study and it is to determine the order of integration of the variables. The test is necessary in order to provide a reliable estimation for policy recommendations. The results in table 4.4.2 indicate that all the variables are not stationary at levels. But when differenced once, the null hypothesis was rejected even at 1%.

Table 4.4.2 Augmented Dickey Fuller Unit Root Test

	Levels			First Difference			
Variables	t-Statistics	1%Critical Value	5%Critical Value	t-Statistics	1%Critical Value	5%Critical Value	Comment
BRATE	-1.6310	*-3.9619*	*-3.4117*	-46.9798*	*-2.5659*	*-1.9410*	I(1)
CRATE	-1.6343	*-3.3019*	*-3.4117*	-47.0682*	*-2.5659*	*-1.9410*	I(1)
SRATE	-1.6342	*-3.9619*	*-3.4117*	-47.0634*	*-2.5659*	*-1.9410*	I(1)
CRR	-2.2820	*-3.9619*	*-3.4117*	-48.6827*	*-2.5659*	*-1.9410*	I(1)
LR	-1.0675	*-3.9619*	*-3.4117*	-48.6827*	*-2.5659*	*-1.9410*	I(1)
UCORR	-1.9108	*-3.9619*	*-3.4117*	-48.6827*	*-2.5659*	*-1.9410*	I(1)
LCORR	-1.0489	*-3.9619*	*-3.4117*	-48.6827*	*-2.5659*	*-1.9410*	I(1)
MPR	-1.6755	*-3.9619*	*-3.4117*	-48.6827*	*-2.5659*	*-1.9410*	I(1)

*Note: Trend and Intercept were included, where their line graphs suggest significance. * indicate the significance of the variables at 1%.*

4.4.3 Effect of Additional Monetary Tightening on Exchange Rate Volatility

Having determined the distribution and the order of integration of the variables of study, this section estimates and reports the GARCH model of equation 3.3.4a and 3.3.4c earlier presented in chapter three. Different specifications of GARCH model were estimated but the GARCH (2,2) was found to be appropriate, this was chosen based on the established model selection criteria. After comparing the AIC, SIC and R^2 which is lower in value compared to GARCH (1,1) model. The ARCH-LM diagnostic Robustness Test among other heteroskedasticity test was carried out as a specification test to further determine the appropriateness of the model and to check for extra ARCH effect. This is important because ignoring ARCH effect may result in loss of efficiency in the results. ARCH-LM therefore, test whether the standardized residuals exhibits additional ARCH. If the variance equation is correctly specified, there should be no ARCH left

in the standardized residuals. From the table 4.4.3b, the result indicates that there are no extra ARCH effects, hence the model was correctly specified. The estimates of the results are therefore presented in table 4.4.3a and 4.4.3b. For brevity, only the GARCH (2, 2) is reported below.

Table 4.4.3a GARCH Estimations

		Mean Equation		
Variable	***Coefficient***	***Std. Error***	***z-Statistic***	***Prob.***
C	180.9379	*0.950882*	*190.2842*	*0.0000*
D_{AMT}	-3.820896	*0.160678*	*-23.77987*	*0.0000*
MPR_{t-1}	-11.90491	*0.612122*	*-19.44860*	*0.0000*
CRR_{t-1}	2.566429	*0.014854*	*172.7756*	*0.0000*
LR_{t-1}	-2.259978	*0.028209*	*-80.11567*	*0.0000*
$UCORR_{t-1}$	12.14441	*0.440924*	*27.54309*	*0.0000*
$LCORR_{t-1}$	-1.582261	*0.208664*	*-7.582810*	*0.0000*
		Variance Equation		
C	50.23474	*7.855942*	*6.394490*	*0.0000*
RESID(-1)^2	0.988381	*0.084224*	*11.73519*	*0.0000*
RESID(-2)^2	0.735832	*0.105556*	*6.971041*	*0.0000*
GARCH(-1)	-0.745438	*0.169430*	*-4.399670*	*0.0000*
GARCH(-2)	-0.013341	*0.005989*	*-2.227775*	*0.0259*
D_{AMT}	-0.800961	*0.467165*	*-1.714512*	*0.0864*
MPR	-1.057926	*8.572968*	*-0.123403*	*0.9018*
CRR	0.154274	*0.018785*	*8.212482*	*0.0000*
LR	-0.482149	*0.106544*	*-4.525346*	*0.0000*
UCORR	-0.936674	*4.272205*	*-0.219248*	*0.8265*
LCORR	-1.116337	*4.226619*	*-0.264121*	*0.7917*

Table 4.4.3b: ARCH-LM Diagnostic Test

F-statistic	0.438425	*Prob. F(1,2070)*	*0.5080*
Obs*R-squared	0.438756	*Prob. Chi-square(1)*	*0.5077*

Table 4.4.3a presents the results. The result of the model shows that AMT is associated with an appreciation of the exchange rate in the mean equation and statistically significant even at 1%. In the variance equation also, AMT reduces the volatility of the exchange rate at 10% significant level. In the mean equation, all the variables were found to be negatively signed and significant, except the CRR and UCORR which are positively signed. However, in the variance equation all variables are negatively signed and only CRR is positive. In terms of significance, only the LR and AMT are statistically significant at 1% and 10% in reducing the volatility of the exchange rate. This suggests that the MPC's decisions of additional tightening policies are associated with a reduction in the volatility in the exchange rate. This further implies that AMT does not only influence the exchange rate, but also influence it in the intended direction. For instance, AMT will help to induce a decline of about 0.80% in the volatility of the exchange rate as seen from the variance equation result. Also, while UCORR is positive in the mean equation, the LCORR is negative and significant, with about 1.58% but was not found significant in the variance equation. In line with this, Aysan, Fendoglu and Kilinc (2014), argues that the corridor policy can be used as a macroprudential policy to contain domestic credit expansion. This is because the wider the upper corridor limit, the higher the cost of funding from the central bank and hence, this discourage the banks to borrow from the central bank to extend credit to the economy. This helps ensures milder fluctuations in the exchange rate. When there is a lesser credit to extend to the economy, it then translates into a lesser demand for foreign exchange by economic agent and thereby ensuring a milder fluctuations/volatility in the exchange rate.

Also, on the impact of the individual variable of monetary policy on the exchange rate, only the LR is statistically significant in the variance equation, suggesting the effectiveness of this instrument in pursuing exchange rate stability in Nigeria. This implies that the MPC can rely

more on the LR to control exchange rate volatility. For example, a 1% increase in LR can induce a decline of about 0.48% in the volatility of the exchange rate as seen from the variance equation. A tightening of monetary policy through the use of liquidity ratio reduces the amount of liquid cash the banks can lend out and thus reduces the amount of money balance with economic agents and then the demand for foreign exchange. A lesser real money balances will result in a lesser demand for foreign exchange at the foreign exchange market, thereby smoothing its volatility. As overall demand for forex falls, exchange rate volatility will be curtailed.

In addition, based on the result of the study, the magnitude of the combined effect of all the instruments of monetary policy is more, than the individual instruments. For example, comparing AMT and LR, results show that D_{AMT} had a better impact on the exchange rate than the LR in the variance equation, as it shows strong evidence that AMT is highly statistically significant than the LR and even other instrument are found not to be statistically significant even though all negatively signed. This seems to suggest that more stability will be attained if all the instruments are used jointly or concurrently in pursuing exchange rate stability.

Although the focus of this study is on the effect of AMT on the exchange rate, effect of other variables is considered important in this study. First, the MPR in the variance equation is negatively signed and not significant, implying the argument that a policy rate that yields price stability may not necessarily provide financial stability of which the exchange rate is a key indicator (Ergun *et'al*, 2013 and Akcelik *et'al*, 2013). Therefore, it is essential for the MPC to seek to utilize more than one policy instrument to ensure financial stability without diluting the price stability objective by using other instruments alongside the MPR.

Therefore, AMT is statistically significant at 10% in reducing exchange rate volatility and can therefore be adopted as an unconventional tool in attaining both price and financial stability in Nigeria.

4.5 Extent to which Additional Monetary Tightening can be a Complementary Tool

To answer the question of to what extent additional monetary tightening can be a tool for exchange rate management in Nigeria is to look at some of the preconditions for the feasibility of AMT. Even though this study found AMT significant in reducing exchange rate volatility, a continuous tight monetary environment has significant effect on the economy's real sector in terms of foregone real GDP growth. Some empirical studies provided some of the perquisite conditions needed for the effectiveness and efficiency of the tool of monetary tightening policy.

First, continuous tightening or additional tightening of monetary conditions may not correct exchange rate depreciations when the banking sector is in crisis. This is so because high interest rate reduces the ability of borrowers to repay loans and thereby weaken the activity of the banking sector the more. Gould and Kamin (1999) and Goldfajn and Gupta (1999), have argued that as it was the case of Asia, when financial crisis occurs simultaneously with banking crisis or balance of payment crisis, a tightening of monetary policy may be counter- productive for any economy.

Also, critics of monetary tightening have argued that tight policy may fail to support the currency and might even increase downward pressures on domestic currency in two ways. One in the context of a run on the currency, the level of domestic interest rate required to compensate investors for extreme depreciation expectations especially when domestic currency is under

pressure to depreciate might be so high as be unsustainable and/or injurious to the economy. Secondly, higher interest rates may increase debt-service burdens for firms, lower loan performance, add to pressure on the banking sector, and thereby further raise the prospects of financial collapse and external debt default, all of which would have the effect of further undermining investor's confidence and thereby having a depressive effect on currency values.

The above suggest that the tool of additional monetary tightening must be used cautiously by ensuring that the conditions in the economy are conducive for further tightening of monetary policy and also its usage should be temporal.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The study aimed at investigating the effect of additional monetary tightening on exchange rate volatility in Nigeria from 2007-2015. To this end, the study began by justifying the increasing need for an alternative/complementary tool for pursuing exchange rate stability as direct intervention hardly works and even constitute a huge cost to the monetary authorities and the nation. Next, was the review of relevant concepts, theories and other related literature. The traditional and monetary model approach of exchange rate determination was used to show the relationship between exchange rate and the variables of study. It was then established that, tight money attracts capital inflow via high interest rate and increases the relative supply of foreign exchange thereby causing the local currency to appreciate (the Traditional Flow Models). On the other hand, tight monetary policy or high interest rate, lowers assets prices through wealth effect, lowers money demand and demand for foreign exchange thereby induce an appreciation in domestic currency (the Monetary Model). Base on this premise, it was established that AMT affect the exchange rate via the interest rate channel in the money market to determine the Naira exchange rate. This explains the view that AMT should work to increase the supply of foreign exchange and decrease its demand in the foreign exchange market thereby reducing exchange rate volatility in Nigeria.

On the other hand, AMT can instead of strengthen and stabilize domestic currency affect the exchange rate in an undesired direction. In order to empirically determine the case of the MPC's

additional tightening, the GARCH technique was adapted. This technique fit the non-normal series and so considered appropriate for this study. The empirical estimates of the GARCH model was used to examined the direction of the effect of AMT on exchange rate volatility in Nigeria. The study also made use of trend analysis and descriptive statistics in addition to the GARCH technique to achieve the objectives of the study which include; (i) First, to identify the various episodes/periods of AMT in Nigeria (ii) To examine the trend between the episodes of AMT and exchange rate volatility in Nigeria (iii) to examine the effect of AMT on exchange rate volatility in Nigeria and (iv) to examine to what extent can AMT be used as a complementary measure for achieving exchange rate stability in Nigeria. This is important for the Nigerian economy as a continuous and heavy dependence on the use of external reserve to combat exchange rate problems is been threatened by the recent happenings in the economy. For instance, the decline in foreign reserve and persistent volatility of the Naira exchange rate. An alternative/complementary measure becomes very needful as the economy seeks to attain both price and financial stability.

5.2 Conclusion

The empirical analysis presented in chapter four allows us to draw some conclusion about each of the research questions raised at the beginning of the study. First, on the question of examining the trend relationship between the periods or episodes of AMT and exchange rate volatility in Nigeria, we can conclude that there were seven episodes of AMT in Nigeria from 2007 to 2015. These are periods where the MPC used additional measures to further tighten the monetary policy stance. These periods were marked with relative stability in the exchange rate movement as shown in fig 4.3.1b. Second, on the trend relationship between AMT and the volatility of

exchange rate, the OLS residuals plots also allows us to conclude that volatility was greatest in the period of global economic and financial crisis and those periods were characterized with eased monetary policy by the MPC in order to mitigate the effect of the crisis on the economy. Thirdly, results from the GARCH model indicate that AMT was statistically significant in reducing exchange rate volatility. Therefore, AMT can constitute an effective tool for reducing exchange rate volatility in Nigeria. This is because it is statistically significant at 10% in the variance equation. This is in accord with theory and empirical literature on AMT. Lastly, the extent to which AMT can be an alternative/ a complementary tool depends on the feasibility of its usage to achieve exchange rate stability because it can also hurt the economy.

Therefore, the major finding of this study is that AMT is effective and statistically significant in reducing the volatility in the exchange rate and so, could be exploit to help achieve exchange rate stability and also serve as a means to prevent reserve loss from direct foreign exchange intervention. Although additional monetary tightening may not also be feasible, especially because of its adverse effect on the output, where it is feasible, it can be an effective complementary/alternative tool of exchange rate management in Nigeria.

5.3 Recommendations

Drawing from the empirical findings, this study recommends that the MPC should begin to exploit the use of unconventional (alternative) tools such as AMT in order to attain its goal of exchange rate stability as an alternative to the usual conventional direct foreign exchange intervention. To achieve effectiveness in the use of AMT, the MPC must note that some of the instrument serves better than others, therefore, attention should be given to such instruments. For

example, from this study, the LR, LCORR and MPR were significant in the variance equation and associated with exchange rate appreciation than the rest.

In addition, the combination of the entire instruments proved even more effective than the individual variables impact on the exchange rate. This is to recommend here that AMT can be achieved by the MPC even when it keeps the policy rate i.e. MPR unchanged and then still tighten through other instruments of monetary policy. This is relevant when the condition in the economy does not allow the MPC to continue to raise the MPR.

However, the finding here that AMT has an effect on the exchange rate volatility suggests that it is capable of being a beneficial tool but also harmful to the economy due to its adverse effect on the general economy. For instance AMT can hurt the economy via investment and spending by reducing investor's confidence through high interest rate and spending due to lower money demand, which in turn raises prices and eventually culminates into exchange rate depreciation or weakening instead of strengthening of the domestic currency. Again, it is true that a high interest rate (tightening policy) will encourage capital inflows and additional tightening will further encourage these inflows, the caution is that such inflows can make the economy vulnerable to a sudden withdrawal of foreign capital especially where such inflows are short-term portfolios and thereby resulting into a higher exchange rate volatility (Amato *et'al*, 2005). The CBN must therefore, tackle this kind of challenge by making sure that currency appreciations are in line with fundamentals to a significant extent. As a result, the active use of interest rate policy as well as exchange rate management must be observed (Egert and Reininger, 2004).

The major recommendation therefore is that, the CBN/MPC should exploit the alternative tool of AMT where feasible in combating the pressure on the Naira exchange rate. This however, must

be done cautiously as strands of literature (e.g. Gould and Kamin, 1999 and Gouldfajn and Gupta, 1999), warns that additional tightening may be counter- productive. They argued that raising interest rates reduces the confidence of investors and lead to weakening and not strengthening of domestic currency by reducing the ability of borrowers to repay loans and thereby weaken the banking sector and even curtail the flow of domestic credit and then lead to depression. It should therefore, be used only temporarily as a tool to defend domestic currency when it is under pressure.

For further research, we recommended that further study should incorporate other markets to investigate the effect of AMT and not just a partial analysis of the effect as suggested by the Mundel-Flemming model of exchange rate determination.

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Appendices

Appendix A

Table A.1 Empirical Studies on Monetary Tightening and Exchange Rate.

S/N	AUTHOR	STUDY	SCOPE	OBJECTIVE	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	ESTIMATION TECHNIQUE.	ESTIMATION RESULT
1	Gould and Kamin (1999).	Impact of monetary policy on exchange rates during financial crisis.	1995-1998 Indonesia, Korea, Malaysia, The Philippines, Thailand and Mexico.	To what extent can a tightening of monetary policy prevent a depreciation of a floating exchange rate in the midst of a financial and balance of payments crisis.	Exchange Rate	International credit spreads, domestic stock prices as proxies for creditworthiness and also domestic interest rates.	Error Correction Model.	Changes in interest rate were not found to have significant impact on the exchange rate for the following countries; Indonesia, Korea, Malaysia, The Philippines, Thailand and Mexico.
2.	Goldfajn & Gupta (1999)	Does Monetary Policy Stabilize the Exchange Rate following a Currency Crisis?	1980-1998	To evaluate the relationship between tight monetary policy and currency stabilization using real rather than nominal variables.	Real Exchange Rate	Real interest Rate	Panel data regression	The result showed a positive correlation between tight monetary policies and nominal appreciations.
3.	Kraay (2001)	Do high Interest Rates Defend Currencies during Speculative Attacks?	Sample of 54 countries over the period 1975-1999.	To determine the effect of high interest rates(tight monetary policy) on currencies during	Speculative attack was proxied by a dummy variable taking on one if the attack fails and zero otherwise	Real discount rate, real domestic credit growth and reserves of deposit banks with the central bank.	Bivariant Probit Regression	The study found no evidence that tighter monetary policy defined as a higher adiscount rate or slower domestic credit growth, played a

S/N	AUTHOR	STUDY	SCOPE	OBJECTIVE	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	ESTIMATION TECHNIQUE.	ESTIMATION RESULT
				speculative attacks				role in defending the exchange rate.
4.	Hernandez,*et'al* (1979)	Monetary policy under alternative regimes: Simulations with a Multi-Country Model.	United State, Japan and West Germany, 1973-1975.	To determine the impact of monetary policy in today's system of managed exchange rate and the extent to which these effects depend on the degree of exchange rate flexibility and intervention.	Exchange Rate	Interest rate, and money supply. Other include reserve requirement, discount rate, Central Bank holdings and real government expenditure.	Multi-Country Model simulation.	The effect of monetary tightening in US caused an appreciation of the dollar with respect to every foreign currency in the study and in addition, the increase intervention has smooth the path of the three bilateral exchange rates.
5.	Kearns and Manners (2005)	The Impact of Monetary Policy on the Exchange Rate: A study using Intraday Data.	The four countries for the study are, Australia, Canada, New Zealand and United Kingdom.	To investigate the impact of monetary policy shocks on exchange rate	Exchange rate	Monetary policy decisions of changes in Interest rate	Event study using intraday data.	An unanticipated tightening of monetary policy of 25 basis points leads to a rapid appreciation of around 0.35%.
6.	Zettlemeyer, (2000)	The Impact Monetary Policy on the Exchange Rate: Evidence from three small open	Australia, Canada and New Zealand during the 1990s.	To what extent is tight money successful in offsetting, or mitigating pressure on the exchange rate and the impact	Exchange rate	Three month market interest rates(T-Bill rates).	Regression analysis and immediate response of the exchange rate associated with policy actions using a standard	On average, a 100 basis point contractionary shock appreciates the exchange rate by 2-3% on impact.

S/N	AUTHOR	STUDY	SCOPE	OBJECTIVE	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	ESTIMATION TECHNIQUE.	ESTIMATION RESULT
		Economies.		of policy shocks on the exchange rate.			recursive identification scheme.	
7.	Adrian and Estrella (2009)	Monetary Tightening Cycles and the Predictability of Economic Activities.	1955-2005	To Investigate the ability of financial indicators to discriminate between monetary tightening cycles that are followed by decline in real economy activity and those that are not.	Unemployment	Nominal and real interest rate, as well as other interest rate spreads	Discriminant analysis and logistic regression.	Of the fourteen cycles covered in the study, only 3 did not lead to an increase in unemployment. The other ten were followed by an increase in unemployment and, with one exception caused by a dated recession.
8.	Ndungu, (1999)	Monetary and Exchange Rate policy in Kenya.	Kenya	To assess whether the exchange rate is affected by monetary policy and whether these effects are permanent and transitory.	Real Exchange rate.	Excess money supply, real income growth, rate of inflation	Cointegration	The result showed that excess money supply predict each other with cyclical movements of the real exchange rate and that the nominal exchange rate over the period is determined by real income growth, the rate of inflation, money supply, the cycles in the real exchange rate movement, the

S/N	AUTHOR	STUDY	SCOPE	OBJECTIVE	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	ESTIMATION TECHNIQUE.	ESTIMATION RESULT
								cointegrating vectors and shocks.
9.	Aysan,*et'al* (2014)	Managing short-term capital flows in New Central Banking: Unconventio nal monetary policy Framework in Turkey.	Turkey, 2010-2013.	To curtail the adverse effects of volatile short-term capital flows on the exchange rate.	Exchange Rate, demand and supply of foreign exchange.	The asymmetric interest rate corridor and the reserve requirement in the form of Reserve Option Mechanism (ROM).	A new policy framework of the Central Bank of the Republic of Turkey (CBRT).	From a capital flows perspective, the interest rate corridor helped smooth fluctuations in supply of foreign funds, whereas the reserve option mechanism helped contained movements in demand for foreign funds. Both policies have been actively used by the CBRT and appeared to be effective in containing financial stability risks stemming from excessively volatile capital flows.
10.	Ergun *et'al* (2013)	The Effects of Additional Monetary Tightening on Exchange Rates.	Turkey, 2011- 2012 .	To examine the effect of Additional Monetary Tightening on exchange rate volatility.	Exchange rate.	Interest rate corridor, required reserve, weekly repo rates, funding strategy and other macro prudential tools as well as liquidity policy.	GARCH model	Additional Monetary Tightening is statistically significant in reducing the volatility of Turkish lira and even appreciated

S/N	AUTHOR	STUDY	SCOPE	OBJECTIVE	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	ESTIMATION TECHNIQUE.	ESTIMATION RESULT
								it in value against other emerging market currencies.
11.	De Walque and Wouters (2004)	An open economy DSGE model linking the Euro Area and the US Economy.	National Bank of Belgium.		Euro/Dollar exchange rate	Oil prices, prices and wages	DSGE model using Bayesian Technique.	Both tighter monetary policy and domestic demand shocks causes an appreciation of the domestic currency.
12.	Alves *et'al* (2002)		Central Bank of Brazil		Real exchange rate	Risk premium on external debt	A small structural model that include an IS equation, a Philip's curve, a Taylor rule and a UCIRP condition.	Monetary Tightening results in an appreciation while a rise in the risk premium results in a depreciation of real exchange rate.
13.	Kapur (2004)	Exchange rates and monetary policy: The Indian Experience.	Reserve Bank of India.				VAR with short-run restrictions.	Monetary Tightening can generate a large appreciation of the exchange rate in the short-run, and therefore can be a useful tool in stabilizing foreign exchange markets.
14.	Garcia and Moec (2004)	US Current Account Adjustment: A Tentative Econometric Assessment with					NIGEM, a standard Multi-Country Macroeconomic Model.	A depreciation of the US dollar against other major currencies alone will do little to correct the US external

S/N	AUTHOR	STUDY	SCOPE	OBJECTIVE	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	ESTIMATION TECHNIQUE.	ESTIMATION RESULT
		NIGEM.						imbalance. Rather, a combination of dollar depreciation, fiscal discipline, and monetary tightening in the US is more likely to bring about a correction in the current account.
15.	Olanipekun (2013)	Exchange Rate Volatility and Economic Activities in Nigeria.	1990- 2012.	To examine the impact of exchange rate volatility on economic activities of listed firms in Nigeria. Specifically focusing on the effect on output, export and investment.	Nominal, real and real effective exchange rate.	Oil prices, interest rate, output, export, import, investment of selected firms.	GARCH (1, 1) model with system GMM and the panel data approach.	A 10% decline in exchange rate volatility could increase export by 0.2% on the average in all sectors, increase aggregate output by 0.02% and 10% increase in exchange rate would result in 0.2% increase in investment.

Source: Author's Compilation from Empirical Studies.

Appendix B

Glossary of Selected Terms	
Internal Balance	This refers to the aim of monetary authority to achieve the following objectives: price stability (Low inflation), Low unemployment, High and stable Economic growth
External Balance	This refers to the attainment of Balance of payment equilibrium and Exchange rate stability
Monetary Policy Rate (MPR)	It is the short term policy rate of the CBN which represents the change of cost of funds to money deposit banks that the apex bank uses to anchor interbank rates
Monetary Policy Committee (MPC)	The highest body of Central Bank which is responsible for making monetary policy.
Wealth Effect	Wealth effect is the shift in the consumption function when household wealth changes. A higher interest rate reduces household wealth and makes borrowing dearer.
CRATE	Central Rate
BRATE	Buying Rate
SRATE	Selling Rate
AMT	Additional Monetary Tightening