Transmission Mechanism of Monetary Policy in Nigeria: Evidence from VAR Approach

Abubakar Hassan

Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Economics

Eastern Mediterranean University
August 2015
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

Prof. Dr. Serhan Çiftçioğlu
Acting Director

I certify that this thesis satisfies the requirements as a thesis for the degree of Master of Science in Economics.

Prof. Dr. Mehmet Balcılar
Chair, Department of Economics

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Economics.

Prof. Dr. Mehmet İvrendi
Supervisor

Examining Committee

1. Prof. Dr. Mehmet İvrendi

2. Assoc. Prof. Dr. Sevin Uğural

3. Asst. Prof. Dr. Kemal Bağzıbağlı.

ABSTRACT

Although the vast majority of the economists and the policy makers alike would agree that monetary policy is relatively effective at least in the short run, there is enormous room for dispute on how it is transmitted through various channels to the economy (Bernanke & Gertler, 1995). Thus, using Vector Autoregressive (VAR) model, this study examines the transmission mechanism of monetary policy in Nigeria. Applying monthly time series data covering the period of 2000M1 to 2014M12, the study shows that there is no long run relationship among monetary policy variables and real economic variables and that monetary policy is relatively effective in Nigeria. In addition, the study reveals three stylized facts about the transmission mechanism of monetary policy: (i) the two primary traditional channels of monetary policy (interest rate & asset price channels) are very weak in Nigeria; (ii) the bank lending channel is not operative in the country; and (iii) the credit and exchange rate channel are the most effective channels through which monetary policy is transmitted in the case of Nigeria. In light of the findings, it is recommended that CBN should re-modify its monetary policy to ensure steady and non-inflationary economic growth in Nigeria.

Keywords: Monetary Policy, Economic Growth, Cointegration, VAR

ÖZ

Ekonomistler ve politika yapıcıların üzerinde hemfikir oldukları konulardan birisi para politikasının kısa dönemde son derece etkin olduğudur. Ancak ekonomiye hangi kanallar yolu ile para politikasının uygulanıp aktarılacağı yönünde muazzam bir tartışma ortamı da mevcuttur (Bernanke & Gertler, 1995). Böylece bu çalışma Vektör Otoregresif (VAR) modelini kullanarak Nijerya örneğinde para politikasının aktarım mekanizmasını ölçmeyi amaçlamaktadır. 2000 yılı birinci aydan 2014 yılı onikinci aya kadar olan süreci kapsayan veri seti kullanılarak yapılan analizde para politikası değişkenleri ile reel ekonomik değişkenler arasında uzun dönem ilişki bulunmadığı ortaya çıkmıştır. Bu sonuçlar aynı zamanda para politikalarının Nijerya'da başarılı bir şekilde uygulanamadığını ortaya koymaktadır. Buna ek olarak çalışma üç farklı stilde para politikasının aktarım mekanizmasının gerçekliklerini ortaya koymaktadır: (i) para politikasının üç temel aracının ikisi Nijerya'da oldukça zayıftır; (ii) Bankaların borçlandırma mekanizması fonksiyonel değildir, ve (iii) döviz kuru mekanizması Nijerya'da en etkin mekanizma olarak para politikasının aktarımında karşımıza çıkmaktadır. Bilgiler ışığında Nijerya Merkez Bankası'nın para politikasını yeniden şekillendirmesi gerektiği düzgün ve enflasyondan arındırılmış ekonomik büyüme için şart olarak karşımıza çıkmaktadır.

Anahtar Kelimeler: Para politikası, Ekonomik Büyüme, Eşbütünleşim, Vektör Otoregresif Model.

DEDICATION

I dedicate this thesis to my beloved mother whose love, caring, moral guidance and support have continued motivating me and kept me succeeding in all aspects of my life.

ACKNOWLEDGMENT

First and foremost, my profound gratitude and appreciations goes to Almighty Allah for making it possible for me to successfully finish my masters program within the minimum duration of two academic semesters.

Secondly, I would like to register my special appreciation to my supervisor, Prof Dr. Mehmet İvrendi for his patience, valuable suggestions, constructive comments, encouragement and intellectual guidance. I would also like to thank all the members of my thesis examining committee, Assoc. Prof. Dr. Sevin Uğural (the program coordinator) and Asst. Prof. Dr. Kemal Bağzıbağlı.for their very useful comments and contributions.

My sincere gratitude also goes to my two extraordinary humble professors: Prof. Dr. Mehmet Balcilar (the chair) and Prof. Dr. Glenn P. Jenkins for their scholarly guidance and tireless contributions. My appreciation also goes to the entire staff of Economics department for their support and encouragements.

Finally, my appreciation also goes to some of my dear friends and colleagues during the program, Saman, Yasaman, Victor, Elham, Seyitan, Pejman, Hasan, Mehmet, Gizem, Firat and Maryam. I would also like to thank my dearest friends back at home who always stand by my side despite the odds, Zaharaddeen and Sadiq.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

1.1 Background to the Study

The investigation into the relationship between monetary policy variables and real macroeconomic variables is one of the oldest areas in the history of macroeconomic theory. This area has attracted the interest of many academicians, economists as well as policy makers even though it is one of those areas where extensive theoretical and empirical researches have been carried out. Quoting some pioneering researchers in this field, Bernanke and Gertler (1995) asserted that "the impact of monetary policy on the real economic variables has been a contentious area of debate in macroeconomics". The main reason for this is that- there is a serious dispute among the vast majority of economists and even among the theoretical thinkers about the actual and magnitude of monetary policy impact on real economic activities and how it is transmitted. Some believe that money does not matter and monetary policy is ineffective of influencing real economic variables such as employment, and real output (economic growth). While others claim that money matters and monetary policy can influence real economic activities at least in the short run and again there are those in between these two opponents who believe that the link between money and output is actually reverse causation not the other way round.

The transmission mechanism of monetary policy is a process whereby the action of central banks in terms of manipulation of money supply and interest rates are

transmitted to the economy via several channels. Various schools of economic thoughts identify a number of different channels of transmission mechanism of monetary policy. The monetarists led by the Milton Friedman posit that money matters and argue that monetary policy is transmitted through either interest rate, exchange rate channel or both. While for early Keynesians oppose the effectiveness of the monetary policy and held the belief that monetary policy works through bank lending and balance sheet channel. And again, for the intermediary school (Real business cycle) see money as neutral- that is they neither belief that money neither matters nor deny the effectiveness of monetary policy on the economy. However, they argue that there is reverse causation running from other important economic variables such as asset price to the supply of money (i.e. asset price channel).

In the same vein, the bulk of the empirical literatures have not reached a resounding conclusion on how monetary policy is propagated to the economy, especially in the developing and low income countries. Although there are various channels of monetary transmissions, bank lending channel seems to command popularity in most advanced countries of the world (Eichenbaum, 1992; Kashyap and Stein, 2000; Morsink and Bayoumi, 2001; and Elbourne, 2008).

However, for the developing and the low income countries the empirical evidences are mixed and full of contradictions (Aleem, 2010; Disyatat & Vongsinsirikul , 2003; Çi, 2007; Mugume et al., 2011; Mengesha & Holmes, 2013; Davoodi et al., 2013; Abradu-otoo et al., 2013; Chileshe et al., 2014; and Ghazanchyan, 2014). Moreover, from Nigeria, there have been a very limited number of well known scholarly researches that investigate the monetary policy transmission mechanism of the Central Bank of Nigeria (CBN). Chuku (2009) was the first to examine the monetary

policy transmission mechanism in Nigeria using SVAR approach. He used quarterly data series from 1986Q1 to 2008Q4 and discovered that money supply (M2) as a quantity anchor has a moderate effect on both output and prices, while the price-based anchor (monetary policy rate and real effective exchange rate) have neutral effect on output.

From the forgoing, one can easily and clearly identify a lots of research voids to be bridged and hence the main thrust of this research work is to critically appraise the Central Bank of Nigeria (CBN) monetary policy actual and potential impact on economic growth in Nigeria, with a view of identifying the particular channel(s) through which the CBN's monetary policy is transmitted in the country.

1.2 Objectives of the Thesis

The overall objective of this research work is to critically appraise the CBN's monetary policy actual and potential impact on economic growth in Nigeria. While the specific objectives of the study include the followings:

i) To check if there is any long run relationship among the various instruments of monetary policy and real economic variables in Nigeria.

ii) To examine the short-run dynamics of the CBN's monetary policy in stimulating the growth process of the Nigerian economy.

iii) To identify the most effective channel(s) through which the CBN's monetary policy is transmitted in the country.

1.3 Motivations

Although, a great number of empirical works on the link between monetary policy and real economic variables were conducted in advanced, middle and low income countries of the world, using different econometric techniques, sample size as well as

different types and sources of data. While the findings of most of these studies were mixed and full of puzzles, this paper observed that studies on empirical investigations on transmission mechanism of monetary policy using the VAR/VECM framework are scarce especially for a developing-open economy like Nigeria, hence the motivation for this study. The main driving force of this research work is to critically appraise the CBN's monetary policy actual and potential impact on economic growth in Nigeria during the periods of banking reforms in Nigeria- that is 2000-2014 using monthly time series data. This will indeed help in assessing the extent to which the CBN's monetary policy has contributed to the macroeconomic development of the country during the aforementioned periods. It will equally help in identifying the medium through which the apex bank's policy is propagated to the real sectors of the country.

1.4 Significance of the Thesis

African countries are in better position of accelerating and sustaining economic growth than their counterparts in advanced countries of the world, because of their huge market potentialities, rising urbanization, growing population and active labour force, high returns on capital and investment, increase in labour productivity and among other growth advantages the continent has been experiencing for many decades. Unfortunately, due to mismanagement coupled with poor formulation, coordination and implementation of major macroeconomic policies including both fiscal and monetary policy, the continent continuous to find its self in its present predicaments. Specifically, the African banking and financial sectors are highly underdeveloped. The informal banking sector is very huge constraining the proper working of the monetary policy, the supervisory and intermediary financial institutions lack independence due to frequent government interventions in their

appears, also despite minimal restriction in the form of free entry and exist into the mainstream conventional modern commercial banking, the banking sectors are not efficient which can be attributed to lack of competition and innovations. It is in this kind of arena, most of the African central banks operate. Against this backdrop, this research work is set up to investigate the link between monetary policy variables and real economic variables in the context of a small developing open economy, like Nigeria. Hence, this research work is significant in a many ways: Firstly, it would serve as an avenue through which the CBN's monetary policy can be critically appraised; secondly, it would help in determining actual and potential impact of the monetary policy on the growth process of the country; thirdly it would equally help in identifying the most effective channel(s) of monetary policy transmission mechanism (MPTM) in the case of Nigeria; and lastly, it would offer relevant policy recommendations that would help in guiding the monetary authorities in formulating and implementing monetary policies as well as the supervision and regulation of the banking sectors.

1.5 Plan of the Thesis

This thesis consists of seven chapters. Chapter one is on the background to the study; chapter two will dwell on the theoretical background and empirical literatures review of the transmission mechanisms of monetary policy. Chapter three will elaborate on the methodology of the study; chapter four will dwell on the econometric specification; chapter five will present the data, sources of the data, measurement issues as well as the descriptive analysis of the study. And chapter six will deliberate on the detailed empirical outcomes of the study and discussions. Finally, chapter seven will round off the study with conclusion, policy recommendations and implications for further research.

Chapter 2

THEORETICAL FRAMEWORK & EMPIRICAL LITERATURE REVIEW

2.1 Theoretical Background

The long standing debate on the relative significant of monetary policy in explaining cyclical upswings and downswings in macroeconomics has been a hot topic since the Great Depression of 1930s. It has now been almost four decades since John Maynard Keynes published the most popular book on 'General Theory of Employment, Interest, and Money' in 1936 which later around early 1960s sparked intensive debate among the then major divergent of economic thinkers. That is the early Keynesians on one side arguing that money is not important at all, and the Monetarists on the other side counter argueing that money really does matter in explaining economic fluctuations, with a new entrant into the debate, Real Business cycles arguing in between the two schools of thoughts. To comprehend this great debate of all times, a strong theoretical underpinning becomes very necessary.

The early Keynesians of the 1950s had the belief that money is insignificant and it does not matter at all to movement in output and prices and hence economic fluctuations (Mishkin, 2009). This notion of the ineffectiveness of money in influencing economic variables is based on three empirical evidences of indirect link between monetary aggregates and real economic activities. First, during the Great Depression of 1930s, interest rate was so low that the monetary policy pursued as at

that time failed to stimulate investment spending. Secondly, Keynesians thought that there is a strong link between changes in interest rate and investment activities, but empirical evidence revealed otherwise that there is in fact weak linkage between the two. Thirdly, business decisions concerning investment in new physical capitals are not necessarily sensitive to low interest rates. In fact, some case studies of businessmen showed that their decision makings on what and how much to invest in physical capital were not related to the prevailing interest rates in the market (Mishkin, 2009). These three reasons led the early Keynesians to the conclusion that money does not matter and that monetary policy is ineffective.

In the early 1960s, a new view of monetary policy, called monetarism**,** led by the Milton Friedman, had emerged and disputes the early Keynesian view of the ineffectiveness of monetary policy based on reduced-form evidence which is back up by three categories of evidences that challenge the earlier held beliefs. These evidences include, timing evidence, statistical evidence and historical evidence.

The timing evidence of the monetarists shows how the growth rate of money supply changes together with economic fluctuations. In their famous paper, 'money and business cycles' Friedman & Schwartz (1963) discovered that in every episode of business cycle over almost a century, the growth rate of money supply always fell down even before the output did (Mishkin, 2009). Also, the growth rate of money supply reaches its peak sixteen months earlier on average before the output level reaches its own maximum point. This revelations led the authors to the conclusion that money growth causes business cycle fluctuations.

The second (statistical) evidence looked at the correlation between money supply and total amount of output through the use of some basic correlation tests. In one of their paper, Friedman & Meiselman (1987) constructed two competing models, a Keynesian model and Monetarist Model. In the Keynesian model, investments plus government spending, representing autonomous spending, A were the main sources of fluctuations- that is by asserting that autonomous spending (A) should be extremely correlated with aggregate output (Y), whereas the money supply (M) should not be correlated with the output. And in the alternative (monetarist) model, the opposite should be the case, that is to say- money supply should be extremely correlated with output, while autonomous spending should not. The correlation tests over several periods of US data by the two authors lend strong empirical supports for the monetarist model.

The monetarist historical evidence was the most successful influential piece that earned them tremendous supports against the Keynesians (Mishkin, 2009). According to the historical evidence, several episodes, such as the Great Depression of 1930s, increase in reserve requirements in 1936-37, Bank panic of 1907 and other major historical events in which movements in the stock of money supply seem to be the main external force. Many of those kinds of historical events provided strong evidence that the growth rate of money is the major element behind most of the economic fluctuations that occurred in history.

Then there were also the new entrants, the Real Business Cycle (RBC) to the great debate on the relative merit of money on the real economic activities. The adherents of the real business cycle held a radical view that emphasizes the reverse causation between monetary aggregates and real shocks in the economy. For instance, they

argue that technological changes and alteration in consumers' taste are the main driving force behind most of the business cycles rather than changes in the stock of money supply. The adherents of this school are skeptical to the monetarists' views that monetary policy is very effective and emphasize on the reverse causation between shocks in the economy (business cycles) and changes in the stock of money (Mishkin, 2009). They backed their arguments by asserting that most of the correlations between output and money do not stem from the shocks in the nominal money supply instead they stem from other sources of money supply movements. For instance, the actions of commercial bank depositors are most likely to be influenced by the economic realities (business cycles) than by manipulations of monetary policy variables by the monetary authorities. The table below summarizes the different views of the three schools of economic thoughts regarding the effectiveness of monetary policy in the economy.

Table 2.1: Views of Different Schools about Effectiveness of Monetary Policy

School of Thought	Views on the Effectiveness of Monetary Policy
Early Keynesians	Money does not matter in explaining Economics economic fluctuations and monetary policy is ineffective.
Monetarists	Money matters to business cycles and monetary policy is effective at least in the short run.
Real Business cycles	Innovation in new technology and changes in consumers' tastes rather than the monetary shocks are the major elements behind most of the economic fluctuations in history.

Source: Compiled by the author.

2.2 Conceptual Framework

A good understanding of the term 'monetary policy' is a necessary ingredient in conducting this research work. Thus, the main focus of this subsection is to highlight and deliberate on how the term has been conceptualized by different institutions, policymakers and researchers; how monetary policy affect aggregate economic

activities (output, employment) and it extended effect on general price level, exchange rate, interest rate and other macroeconomic variables in the economy (that is Monetary policy Transmission Mechanisms)

Generally speaking, a monetary policy is a vital tool under the command of the monetary authorities used in the management of the economy in order to achieve certain macroeconomic objectives. CBN defines Monetary Policy 'as the deliberate actions taken by the central bank of a country in regulating the cost, value, and availability of money in the economy with the aims of attaining certain predetermined macroeconomic goals. Anyanwu (1993) in his book entitled 'Monetary Economics' defined it as a "fundamental economic stabilization tool that involves certain quantitative targets designed to control and regulate the cost, volume, direction and availability of money supply and credit in an economy with the aim of achieving some particular macroeconomic goals and objectives". In the words of Furness (1984), "monetary policy is one which aims at influencing range of economic activities through variation in the availability in money supply, credit and or interest rates in the economy. While according to Folawewo & Osinubi (2006) monetary policy is a combination of various measures by a monetary authority to regulate and control the cost, value and availability of money in a country in line with current level of economic activities prevailing in the country.

2.3 The Transmission Mechanisms of Monetary Policy

For the monetary authorities to be very successful in the conduct and implementation of their monetary policies, they must know the actual impact and timing of their policies as well as the channel(s) through which they are transmitted to the economy

and thus require a proper understanding of the transmission mechanism of monetary policies (Mishkin, 1995).

Transmission mechanism of Monetary policy is a complex process and interesting issue because there are many not only one channel through which monetary policy is propagated (Kuttner & Mosser, 2002). Monetary policy conducted by Central banks is very vital in shaping macroeconomic developments of a country. For instance, changes in bank rate by a central bank have a direct effects on commercial banks loans and advances as well as on how financial assets are valued and their expected returns and also on domestic households and firms decisions concerning consumption, saving and investment spending in the economy. These decisions by the households and firms have in turn significant consequences on Gross Domestic Products (GDP), inflation and employment. Therefore, it is not surprising that the interest rates decisions made by Fed (Federal Reserve System, US), ECB (European Central Bank) and other prominent central banks around the world attracted so much attention, not only by financial press and financial market analysts, but also by the general public (Galí, 2008). A key goal of monetary policy Transmission Mechanisms is to provide us with detailed accounts of how central banks' decisions concerning interest rates and money supply end up affecting various aspects of the economy, both nominal and real sectors through numerous channels.

In simple terms, a monetary policy transmission mechanism (MPTM) refers to the process whereby monetary policy of central bank of a country is transmitted to the various macroeconomic variables and sectors of the economy. CBN (2011) in its first series, Understanding Monetary Policy Series No 1, define monetary policy transmission mechanisms (MPTMs) as, "the various ways whereby deliberate of

actions of monetary authority in forms of changes in the stock of nominal money supply or nominal interest rate affect general price level and domestic output in the economy". The figure below depicts a framework that can help us understand this concept and the forces at play in the conduct and design of monetary policy by central banks around the world.

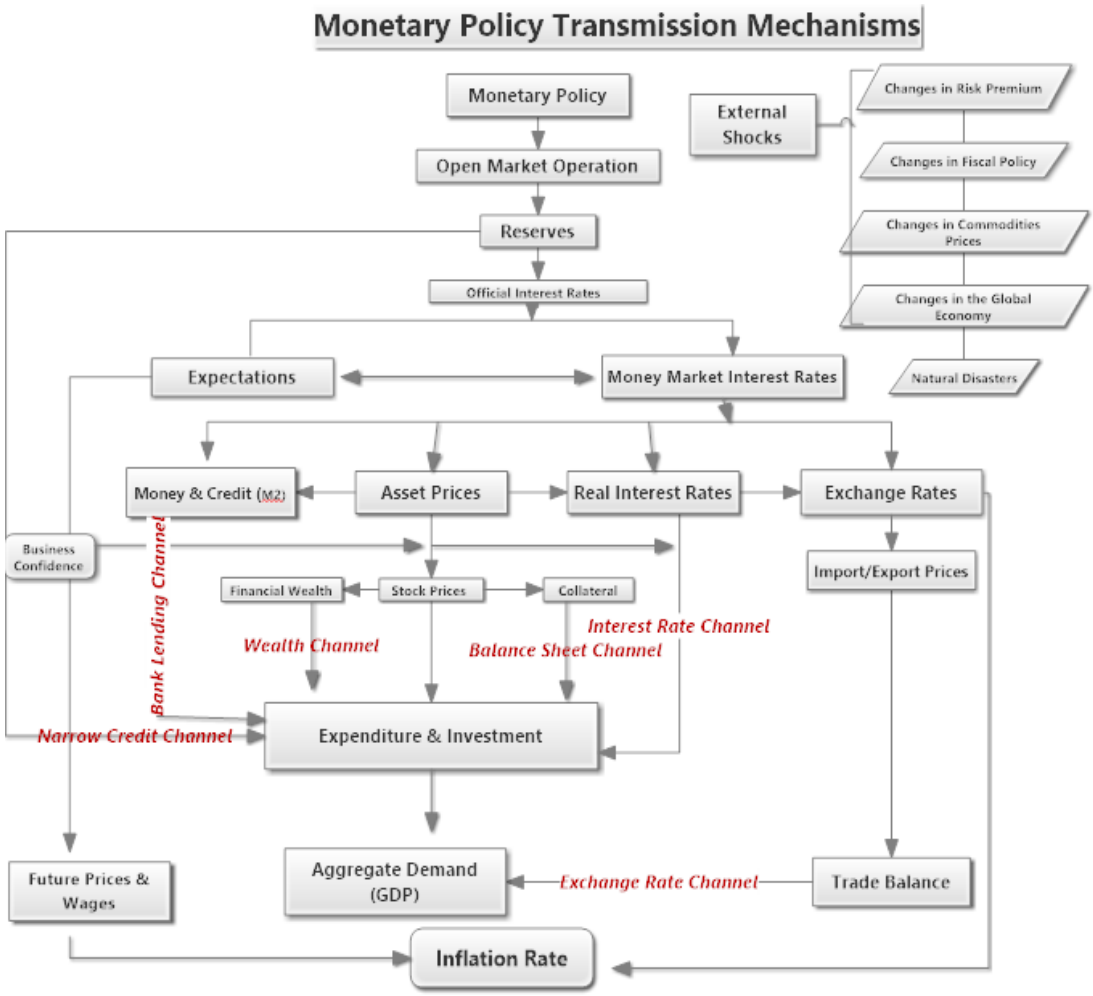


Figure 2.1: The Transmission Mechanism of Monetary Policy
Source: Designed by the author.

2.4 Empirical Literature Review

Through the review of both theoretical and empirical papers on the transmission mechanisms of monetary policy, it is clear that, this area has been extensively studied in both advanced and less developed countries of the world. Although, it appears that

there seems to be at least general consensus about the functioning of the bank lending channel in most of the advanced countries, there is no clear picture of which channel(s) are effective in the developing and low-income countries.

In advanced countries of the world, including the United States (U.S), United Kingdom (UK), Japan, Germany, France, and other fastest growing economies , of the world, there is ample empirical evidences that point to the active role of most of the conventional channels, particularly the bank lending channel as the most effective medium through which monetary policy is communicated to real sectors of the economy (Eichenbaum, 1992; Kashyap & Stein, 2000; Morsink & Bayoumi, 2001; and Elbourne, 2008).

Eichenbaum (1992) examines bivariate VAR using money and output in 5 advanced regions of the world, namely the USA, UK, Japan, France, and Germany. His VAR model includes the industrial production, consumer price index, and official interest rate as the key variables in the baseline VAR model. The results of the VAR model showed that monetary shocks lead to output following a hump-shaped pattern in all the five countries investigated.

Kashyap and Stein (2000) opt for a two step flexible specification procedures and run a cross sectional regression at the first stage and bivariate regression in the second stage, based on quarterly time series data running from 1976Q1 to 1993Q4. They found that bank lending channel is stronger for banks with less liquid assts. Their findings lend empirical support for the presence of the bank lending channel in USA. Also in Japan, Morsink and Bayoumi (2001) found both monetary policy and bank lending playing an important role in transmitting monetary shocks to economic

activities. The two authors made this discovery by estimating a VAR model using seasonally adjusted quarterly time series data from 1993Q1 to 1998Q3 with two lags.

Elbourne (2008) estimate an eight variables SVAR model when investigating the role of housing price in the MPTM in United Kingdom. The results of his paper revealed that housing price do not play a significant role in the transmissions of the bank of England monetary policy. The implication of this finding is that credit and wealth channels do not account for a significant variation of output in response to monetary policy innovations in UK.

However, for developing and middle-income countries, the bulk of the empirical literatures are full of inconsistency and contradictions. For example, Aleem (2010) employs VAR approach in investigating the transmission mechanisms of monetary policy in India. He estimates different number of VAR models that help in examining the effect of contractionary monetary policy on various sectors of the Indian economy. The results of his paper reveal that the bank lending channel is initially increasing in importance in response to monetary squeze and bank lending channel is very important as it plays a very vital role in transmitting the innovations of the monetary policy to the economy. Similarly, in Turkey, Çi (2007) found the same results that were obtained from India by Aleem- that is the interest rate and credit channels are becoming increasingly important in influencing economic activities in Turkey.

On the contrary, Mengesha & Holmes (2013) use VAR methodologies and found both interest rate and exchange rate channels inoperative in Eretria. They however, found reserve requirement ratio to be of significant important and playing a vital role

in transmitting innovations in monetary policy to the various sectors of the Eretrian Economy. While in Thailand, using basic VAR methodology, Disyatat & Vongsinsirikul (2003) examine monetary policy transmission mechanism over the period of 1993Q1-2001Q4. They found bank lending channel playing the important role in the conduct of monetary policy and the way it is propagated to the real sectors of the Thailand economy.

Empirical evidences from African countries suggest that, in most part of this world, the traditional channels which include the interest rate, credit and asset price are generally weak, while the exchange rate and credit channels are more significant even though not very robust (Chileshe et al., 2014). For instance, Mishra et al. (2011) found that the three traditional channels mentioned above are generally weak and statistically insignificant in low income countries. Davoodi et al. (2013) exploring the relative importance of interest rate channel in East-African Countries, using VAR model found that absence of the long run relationship among all the endogenous variables in the model and that the traditional interest rate channel is not strong as it is very insignificant for the region as a whole. Recently, Ghazanchyan (2014) examines three conventional monetary transmission channels in Sri Lanka using VAR model and found some results contrary to the ones obtained from other African countries; that is interest rate has the strongest causal effect on output, followed by bank lending rate which is statistically significant but the optimal lag of 5 in the case of output and a much longer lag for prices; while the exchange rate does not have any significant causal effect on either the price or output.

In contrast, Abradu-otoo et al. (2003) employ the use of structural VECM using a seven variables system in analyzing the transmission mechanisms of monetary policy

in Ghana. They found strong evidence which suggests that there is a long run relationship between the monetary policy and the real economic variables very effective in influencing output and prices in the long run and that exchange rate channel is the most effective conduit through which the Central bank of Ghana transmits its policy to the economy. Similar results were obtained from Egypt by Mashat et al. (2008) who employ the use of VAR approach and discovered the exchange rate as the most effective channel in propagating monetary innovations to output and prices. However, they found other traditional channels, particularly the bank lending and asset price to be less effective and weaker channels just like they were found to be so in other African countries. But the interest rate channel has been getting momentum since 2005 when the interest corridor was introduced.

While in Uganda, Mugume et al. (2011) apply SVAR methodology and found that innovations in monetary policy influence inflation and economic activity but still the influence is limited, as most of the important conventional channels are not functioning fully. In particular, they found interest rate channel to be very weak and the exchange rate as well as the credit channels are also not fully functioning in the case of Uganda economy. Treasury bill rate remains the only effective channel that is partially operative but still indirectly through the lending rates.

To the knowledge of the researcher, there were very limited numbers of available empirical works conducted concerning the transmission mechanism of monetary policy in the case of Nigeria. For example, Chuku (2009) carried out such kind of study in Nigeria. The author uses quarterly data from 1986Q1-2008Q4 and applies SVAR model in measuring the impact of monetary policy innovations in the country. His paper reveal that money supply (M2) as a quantity anchor has a moderate effect

on both output and prices, while the monetary policy rate (MPR) and real effective exchange rate (REER) have neutral effect on output. Also Philip & Muibi (2011) invistigated the transmission mechanism of monetary policy impact on the output of different sectors of the Nigerian economy. They however use VAR metodology and found both the interest rate and excahnge rate as the most effective channels of stimulating output growth of most of the sectors in the country.

Majority of the other empirical studies from Nigeria concentrate on finding the impact of monetary policy on domestic output or inflation and or sometimes on both. They do not really investigate which channel(s) are important in the case of Nigeria. For example, examining the interactions between money and real economic variables (prices and output) in Nigeria, Chimobi & Uche (2010) use cointegration technique and causality test. Their study reveals that no any long run relationship between money and the two real economic variables. However, money supply was found to have a causal effect on both output and prices.

In contrast, Harcourt et al. (2011) adopting the techniques of Vector Error Correction Model (VECM) and cointegration test found that there is long run relationship among money supply, minimum rediscount rate and treasury bill rate in Nigeria. The study also reveals that while minimum rediscount rate impacts on inflation at lag 2, money supply does not. Also, more recently, Ismail (2014) using the same techniques of cointegration and VECM during the period of 1975-2010, also found cointegrating relationship exists between the monetary policy variables and the real economic variable (RGDP) in Nigeria. The core findings of his paper show that inflation, exchange rate and external reserves constitutes the most effective tools of monetary policy in the country.

Chapter 3

METHODOLOGY

3.1 Research Methodology

This current research work adopts the widely used VAR methodology in the literatures of MPTM. Since 1980, after the seminal work of Sims, VARs have become very popular estimation techniques in investigating the relative importance of each and every channel of MPTM. VARs proved to be the most convenient methods of analyzing the dynamic interactions among economic variables Bernanke & Gertler (1995). According to Stock and Watson (2001) VARs are powerful tool for analyzing and describing data as well as for generating multivariate benchmark forecasts.

In this current study, the VAR analysis will commence with a baseline VAR model including real GDP (RGDP) proxied by total market value of monthly crude oil production, consumer price index (CPI) to serve as a yardstick of measuring inflation, the growth rate of broad money (M2) and the official monetary policy rate (MPR) will serve as the two indicators of monetary policy stance in Nigeria. The estimation is carried out using monthly data spanning from January, 2000 to December, 2014 with an optimal lag.

3.2 Model Specification

A recursive VAR model was first introduced by Sims (1980) in macroeconomics for the use in monetary policy analyze to characterize the joint dynamic behaviors of a set of variables without requiring strong assumptions to identify the underlying structural parameters as inherent in structural models. A VAR is a model is a system of dynamic equations where the current year value of each and every variable in the system is depending upon its own past and past values of the other variables in the model.

Following the works of Mishra et al. (2011), Davoodi et al. (2013) and Mishra & Montiel (2013), the economy is assumed to be structured in the form of the following VAR framework:

$$Y_t = C + A(L)Y_{t-1} + B(L)X_t + \varepsilon_t \quad (1)$$

When Y_t is a $(n \times k)$ vector of endogenous variables; C is a $(n \times k)$ vector of constants; X_t is a $(m \times k)$ vector of the exogenous variables; while A & B are the $(n \times n)$ *and* $(n \times m)$ matrices of the estimated coefficients with L as a lag operator of length p; and ε_t is a *n X k* vector of the error terms which are I.I.D (0, 1)

The vector of exogenous variables can be excluded to obtain the following reduced form of VAR model:

$$\mathbf{Y_t = C + A(L)Y_{t-1} + \varepsilon_t} \quad (2)$$

Now, the error term, ε_t is a vector of random components of disturbance terms for all the variables in the model and it captures the influence of the excluded exogenous factors; and A is a $(n \times n)$ matrix which contains the contemporaneous response of the variables to the innovations. Note that the error terms, ε_t comprises of the various

underlying innovations to the variables in the model based on the following specifications:

$$\begin{bmatrix} \boldsymbol{\varepsilon_{1t}} \\ \boldsymbol{\varepsilon_{2t}} \\ \cdots \\ \boldsymbol{\varepsilon_{3t}} \end{bmatrix} = \begin{bmatrix} \mathbf{1} & \mathbf{0} & \boldsymbol{\theta_{12}} \ldots . \boldsymbol{\theta_{1j}} & \boldsymbol{\mu_{1t}} \\ \boldsymbol{\theta_{21}} & \mathbf{1} & \boldsymbol{\theta_{23}} \cdots \boldsymbol{\theta_{2j}} & \boldsymbol{\mu_{2t}} \\ \cdots & \cdots & \cdots \cdots & \cdots \\ \boldsymbol{\theta_{j1}} & \boldsymbol{\theta_{j2}} & \boldsymbol{\theta_{j3}} \cdots \mathbf{1} & \boldsymbol{\mu_{jt}} \end{bmatrix} \quad (3)$$

The reason why the error terms, ε_t are composites is that some variables may affect other variables contemporaneously. For instance, a shock to a monetary policy variable, say ε_{1t} will reflect not only the external shock to that variable, μ_{1t} but also includes alterations in response to the contemporaneous external shocks to the other variables in the model. Therefore, the vector matrix of θ is assumed to be lowered triangular in order to identify the specific initial shocks to the monetary policy.

The baseline VAR model of this study takes the following form:

$$\mathrm{Y'_t} = [\mathrm{RGDP\ CPI\ M2\ MPR}] \quad (4)$$

From the above equation, Y'_t represents the vector of the endogenous domestic variables consisting of RGDP, CPI, M2 and MPR. The baseline VAR model is estimated using monthly time series data from 2000M1 to 2014M12. By Choleski decomposition, the last two monetary policy variables M2 and MPR are placed after the non-policy variables, RGDP and CPI to reflect policy variables likely degree of endogeneity to economic conditions in Nigeria. That is to say the non-policy variables can react to shocks in monetary policy variables but not the other way round.

3.3 Baseline VAR and Channels of MPTM model specifications

In order to analyze the MPTM in Nigeria, the baseline VAR model is augmented to include a new variable (m) that corresponds to the respective monetary policy channel. It is assumed that m responds contemporaneously to shocks to RGDP, CPI,

M2 and MPR. But the four endogenous variables in the baseline model do not responds contemporaneously to a shock to m. thus, the column vector of the endogenous variables can now be reformulated as:

$$Y'_t = [\text{RGDP CPI M2 MPR m}] \quad (5)$$

From the above reformulation, the addition of different variables representing different channels of MPTM can further be specified as follows:

Traditional Interest Rate Channel Model

This channel is one of the primary traditional channels of MPTM that works through the cost of borrowing and lending which in turn affects saving and investment decisions as well as the aggregate demand and supply in the economy (Horvath et al., 2006).The interest rate channel can be represented in the form of the following schematic follow chart:

$$M \uparrow \rightarrow r \downarrow \rightarrow I \uparrow \rightarrow Y \uparrow$$

The schematic chart describes the impact of an expansionary monetary policy and how it is transmitted to the economy. It starts from an increase in money supply (M) which in turn leads to a decrease in interest rate (r) and investment spending rises due to the fall in the interest rate and eventually the aggregate demand (Q) expand in the economy.

In the literatures, the traditional interest rate is commonly found to be strong and relatively effective in most advanced and high income countries as opposed to the low income countries where the interest is generally weak and not fully functioning (Mishra et al., 2011; Mugume et al., 2011; and Davoodi et al., 2013). To capture the so called interest rate channel, equation (6) is reformulated to include interest rate (INTR) to serve as a measure of this particular channel of MPTM. Note that INTR is

the lending rate of commercial banks which moves closely together with official bank rate (i.e. MPR) which is the rate at which the CBN lends to the commercial banks and other financial institutions operating in the country. Thus,

$$Y'_t = [\text{RGDP CPI M2 MPR INTR}] \quad (6)$$

Bank Lending Channel Model

The bank lending channel examines the potential impact of monetary policy of a central bank on the supply of loans and credits by financial institutions, and on firms' balance sheets and their ability to borrow. According to Bernanke & Gertler, (1995) , the bank lending channel arises from market frictions in financial markets due to asymmetric information. Asymmetric information is a situation in which one participant in a market transaction is better informed than the other party. For instance, when a central bank implement a contractionary monetary policy by selling bonds in the open market, bank deposits will contract and this will lead to a decrease in bank loans, then investment will shrink and consequently the aggregate demand will decrease in the economy. Schematically speaking:

$$M \downarrow \rightarrow BDs \downarrow \rightarrow BLsI \downarrow \rightarrow I \downarrow \rightarrow Y \downarrow$$

The empirical evidences from the advanced and some fastest growing economies indicate that the bank lending channel is the most effective medium through which monetary policy is transmitted to the economy (Eichenbaum, 1992; Kashyap and Stein, 2000; Morsink and Bayoumi, 2001; Disyatat & Vongsinsirikul, 2003; and Elbourne, 2008). In this paper, credit to private sector (CPS) will be used to capture the so called Bank lending channel and hence the baseline model becomes:

$$Y'_t = [\text{RGDP CPI M2 MPR CPS}] \quad (6)$$

Asset Price Channel Model

Asset price channel is also one of the traditional channels of MPTM that works through changes in the wealth of households and the market values of firms in the economy. For instance, when there is an expansionary monetary policy, equity prices (Ps) will increase due to the higher demand for equities and this in turn will make equity investments more profitable and attractive and thereby boosting the profit outlooks of the firms (q). And this will result in increase in investment spending (I) which in turn increases the aggregate demand (Y). Thus, the schematic follow chart below shows the transmission channel of asset price to the economy:

$$M \uparrow \rightarrow Ps \uparrow \rightarrow q \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow$$

The q was originated from the Tobin's q theory named after James Tobin who developed the theory to explain how monetary policy affects the economy through the effect of valuation of stocks (equities). He defined q as the market value of firms divided by the cost of replacement investment in capital, new plants and machineries. When q is high, the market price of firms will be high in relation to the cost of replacement investment. And this means firms can issue their stocks and get higher prices, consequently investment spending will rise, because firms can now invest more on new investment goods with little issue of their stocks.The asset price channel is examined in this paper using All share Index (ASI) and hence the following specifications will be used:

$$Y'_t = [\text{RGDP CPI M2 MPR ASI}] \quad (7)$$

Narrow Credit Channel Model

The Narrow credit channel as one of the traditional channels of MPTM also relies on credit market imperfection, just like bank lending channel, but here the banks play

special role by holding assets which have no close substitutes. The basic notion of this channel is that monetary policy can influence the supply of intermediate credit via its impacts on loanable funds (Bernanke & Blinder, 1998). The credit channel emphasizes the influence of quantity of credit on aggregate demand rather than its price. In low income countries where the credit markets are highly underdeveloped and government frequently interfere with the free operations of these markets, monetary policy is more likely to be very effective on aggregate demand through alteration in the availability of credit rather than through changes in the price of credit. The schematic follow chart of this channel takes the following form:

$$M \uparrow \rightarrow Ps \uparrow \rightarrow q \uparrow \rightarrow AS \downarrow \rightarrow MH \downarrow \rightarrow BL \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow$$

With an expansionary monetary policy, the equity prices of firms (Ps) will rise which in turn raises the profit outlook of firms (q) but due to decrease in adverse selection (AS) and moral hazard (MH), bank lending (BL) increases and consequently investment spending (I) rises and aggregate demand follows suit (i.e. Y rises as well). In the literature, this channel as one of the three traditional channel of MPTM is generally found to be very weak in developing and African countries of the world (Chileshe et al., 2014).

In this paper, the narrow money supply (M1) is used here in capturing the narrow credit channel and hence the following vector of the endogenous variables is formulated:

$$Y'_t = [\text{RGDP CPI M2 MPR M1}] \quad (8)$$

Exchange Rate Channel Model

This channel operates through the foreign exchange markets via the effect of interest rate differential on the net exports. Changes in the monetary policy can affect exchange rate via interest rate which in turn alters exchange rate expectations and eventually affects the relative prices of imports and exports as well as the aggregate demand and supply in the economy. For instance, when an expansionary monetary policy is pursued, an increase in money supply (M) will cause the domestic interest rate to fall and this make assets dominated in local currency to be less attractive compared to ones dominated in the foreign currency and consequently the domestic currency will depreciate in value. And due to the depreciation of the domestic currency, domestic goods and services become cheaper relative to the foreign goods and services, thereby leading to raise in net exports (NX) and aggregate demand (Y). Schematically speaking:

$$\mathrm{M} \uparrow \rightarrow \mathrm{r} \downarrow \rightarrow \text{Exchange Rate depreciate} \rightarrow \mathrm{NX} \uparrow \rightarrow \mathrm{Y} \uparrow$$

In the literatures of the MPTM, exchange rate is mostly effective in countries that adopt flexible exchange rate system, and these include even the low income countries (Abradu-otoo et al., 2003; Mashat et al., 2008; and Harcourt et al., 2011). In examining the exchange rate channel, the effect of MPR on RGDP through the exchange rate is focused on. Thus, the following vector of the endogenous variables is specified, with the real effective exchange rate (REER) serving as the yardstick of this particular channel of MPTM:

$$\mathrm{Y'_t} = [\mathrm{RGDP\ CPI\ M2\ MPR\ REER}] \tag{9}$$

Chapter 4

EMPIRICAL SPECIFICATION

4.1 Econometric Methodology

In time series studies, the use of the ordinary least square (OLS) method is not appropriate unless the variables in question are found to be stationary at level. Based on this concern, the present study applies unit root test first so as to uncover the true nature of stationary-properties of all the variables under consideration. This is necessary in order not to run into the problem of spurious regression since unit root problems are common features encountered in most of the time series studies. Johasen Multivariate Cointegration test will be applied if all the variables are integrated of the same order, such as at the first difference [i.e. I (1)]. Following the cointegration test, depending on whether the variables are cointegrated or not, either Vector Autoregressive (VAR) model or Vector Error Correction (VEC) model will be adopted as the estimation technique of the study.

4.2 Unit Root Test

The natural thing to do when testing for stationary properties of each observed time-series ($Y_{t)}$ over a given time periods (T) is to estimate an Augmented Dickey– Fuller regression. First consider a non-stationary time series variable that is generated by first order autoregressive process [i.e. AR (1)] yielding Augmented Dickey Fuller (ADF) test of the following form:

$$\Delta Y_t = \delta y_{t-1} + \sum_{i=1}^{n} \beta_i \Delta Y_{t-1} + \varepsilon_t \qquad (10)$$

Where, the symbol, Δ denotes the first difference operator; δ denotes a parameter which determines stationary of the series under a null hypothesis, H_0: $\delta = 0$ (meaning non-stationary) in contrast to an alternative hypothesis, H_1: $\delta < 0$ (meaning the series is stationary); and n stands for the optimum number of lag length in the dependent variable (Y_t) and it is solely determined by the parameter, β. Note that Y_t stands for a particular time series variable.

However, it is argued that the ADF unit root testing procedure alone is not enough in finite samples, thus the Philips-Perron (1988) unit root test will used as a supplementary test, since this current study uses a finite number of observations. As mentioned earlier on, if all the variables of concern are found to be non-stationary at level but stationary (of the same order) after taking first or second difference then a cointegration test using Johansen Multivariate cointegration would be applied accordingly.

4.3 Cointegration Test

The idea behind testing for cointegration is that, if two or more time series variables move together closely in the long run, although the variables themselves are trending over time (non-stationary), the difference between one variable and another variable is stationary. Thus, in this case, such variables can be regarded as defining a long run equilibrium relationship, as the difference between them is stationary (Hall at. el., 1989). However, if the time series variables do not exhibit long run equilibrium relationship, in principal they will wander randomly from each other without any direction, as the difference between them is not constant (Dickey & Fuller, 1981). To this end, the study employs the Johansen Multivariate cointegration test. Consider, a

vector of stochastic variables, Y_t which has a p-lag vector autoregression (VAR) with the Gaussian error terms of this form:

$$Y_t = \mu + \Delta_1 y_{t-1} + - - - + \Delta p Y_{t-p} + \varepsilon_t \qquad (11)$$

Where Y_t is a vector of endogenous variables which are commonly integrated of order zero denoted as I (0) and ε_t is a vector of innovations. Equation (11) can be further respecified as follows:

$$\Delta Y_t = \mu + \prod Y_{t-1} + \sum_{i=1}^{p-1} \tau_i \Delta Y_{t-1} + \varepsilon_t \qquad (12)$$

Where

And the parameters, $\prod$ and τ can be further be specified as:

$$\Pi = \sum_{i=1}^{p} A_{i-1} \ and \tau_i = -\sum_{j=i+1}^{p} Aj$$

Where Π is the coefficient of the lagged of the dependent variables in its level form and r is the coefficient of the lagged of dependent variable in difference form.

There always two opposing hypotheses that are used in testing for cointegration, these are- the null hypothesis claiming that cointegration does not exist; and the alternative is the null hypothesis claiming otherwise (i.e. conintegration exist). The cointegration test uses the Johansen (1988) maximum likelihood test ratio and often involves two test statistics, namely, the Trace test statistics and the Maximum Eigenvalue test statistics (Johansen & Juselius, 1990). Both tests use the same null and alternative hypotheses that have just been mentioned. The null hypothesis states that the number of different unique cointegrating vector cannot be greater than or equal to q against an alternative unrestricted hypothesis that states that the number of

the vector is exactly equal to q (i.e. q = r). The Trace and Maximum Eigenvalue statistics can be calculated as:

$$\lambda trace(r) = -T \sum_{i=r+1}^{n} Log\left(1-\hat{\lambda}_i\right) \tag{14}$$

$$\lambda \max(r) = -TLog\left(1-\hat{\lambda}_{r+1}\right)$$

Note that the the $\hat{\lambda}$ denotes the estimated Eigenvalue from the matrix and the

T denotes the number of usable observations.

4.4 Estimation Techniques

This study employs VAR/VECM in conjunction with the Granger causality approach as the estimation techniques to investigate the MPTM in a small open-economy like Nigeria. The VAR model and VECM are mutually exclusive and conditional based on the underlying stationary properties of the variables involved and also subject to finding the presence or otherwise of cointegration among the variables under consideration. If all the variables of concern are found to be non-stationary at level but integrated of the same order such as I(1) and in addtition they are cointegrated based on the Johasen Multivariate Cointegration test, then VECM would be used as the most appropriate estimation technique, otherwise the VAR model will be employed.

From the reduced form VAR model in equation (2), the vector of yt can be partition into two components: the vector of monetary policy variables, MPV_t and the vector of the macro-economic (non-policy) variables, NV_t. Thus, the estimated VAR model can now be specified as follows:

$$\begin{bmatrix} \mathbf{NV_t} \\ \mathbf{MPV_t} \end{bmatrix} = \mathbf{C} + \mathbf{A(L)} \begin{bmatrix} \mathbf{NV_{t-1}} \\ \mathbf{MPV_{t-1}} \end{bmatrix} + \begin{bmatrix} \boldsymbol{\varepsilon_t}^{\mathbf{NV}} \\ \boldsymbol{\varepsilon_t}^{\mathbf{MPV}} \end{bmatrix} \tag{16}$$

Where MPV_t denotes the vector of indicators of the Nigerian monetary policy stance, with broad money (M2) serving as the quantity based indicator, and monetary policy rate (MPR) as the price based indicator; and NV_t is the vector of the macroeconomic variables block, which includes real GDP(RGDP), comsumer price index (CPI), interest rate (INTR), credit to private sector (CPS), all share index (ASI), narrow money supply (M1), and real effective exchange rate (REER). As mentioned earlier, C is the vector of constant terms, A(L) is the lag parameters vector, where the number of the optimal lag length is determined empirically by a number of different information criterion including Likelihood Ratio (LR), Final Predict Error (FPE), Akaike Information Criteria (AIC), Schwartz Information Criteria (SIC) and Hannan-Quinn information criteria (HQ). And $\boldsymbol{\varepsilon_t}^{\mathbf{NV}}$ is vector of error terms that are I.I.D; while $\varepsilon_t{}^{MPV}$ represents the monetary policy shocks.

From an estimate of the VAR equation, the interactions among variables can be analyzed further using the technique of Granger causality analysis. Although the Granger causality technique is more appropriate for bivariate models, in practice, it can be extended to a multivariate system of equations by controlling for the other variables in the model. Thus, in this regards, if a VAR methodology is later adopted, the Granger Causality/Block Erogeneity test would be applied in checking the underlying structure of the dynamic relationships between variables.

On the other hand, if however, the variables are integrated of the same order and found to be cointegrated, then VECM should be used instead of the aforementioned VAR model. According to Engle & Granger (1991), cointegration test is a prerequisite condition for running vector error correction model (VECM). The VECM can be specified in terms of error correction term (ECT) which determines

the speed of adjustment of the variables in the model towards their long run equilibrium path, and hence:

$$\Delta Y_t = \alpha + \sum_{i=1}^{p} \beta \Delta Y_{t-1} + \pi ECT_{t-1} + \varepsilon_t \qquad (17)$$

Where α, β and π are the coefficients of the VECM with α representing the intercept, β represents short run coefficients and π denotes the long-run coefficient of one period lag value of the disequilibrium term (ECT_{t-1}). Now, the basic OLS method can be used to estimate equation (17), since all its terms are integrated of order one [i.e I (1)] and as such all the standard hypotheses testing procedures including *t*-test, F-test and other related diagnostic tests can be carried out on the residual term. The theoretical expectation is that the coefficient of lag value of one period of the ECT should be negative i.e. $\pi < 0$ and statistically different from zero for the disequilibrium to disappear in the subsequent periods and the long-run equilibrium to be restored. As mentioned earlier, the coefficient of the ECT represents the speed of adjustment to the long run equilibrium path; that is to say, it measures the time periods it will take for any deviation from the long run relationship to be restored in each period whenever disequilibrium occurs.

Chapter 5

DATA, SOURCES AND DESCRIPTIVE ANALYSIS

5.1 Data

This study used monthly time series data covering the period of January, 2000 to December, 2014. The reason for selecting the aforementioned sample period is that, the Nigerian financial and banking sector has undergone a series of deregulations from a highly unsupervised and less regulated to a more closely supervised, liberated and market-based monetary and financial system during these periods. Also, this sample period is chosen based on the overall aim of this study- that is to empirically investigate how monetary policy affects aggregate economy (RGDP) and it extended effect on general price level, exchange rate, interest rate and other macroeconomic variables in the economy. The findings of this study will help us to validate or invalidate the theoretical underpinning of the early Keynesian Economists who posit that money does not matter and monetary policies are ineffective.

5.2 Measurement Issues

A high frequency data is in most cases more preferable in time series studies, especially one that involve investigating interactions among real economic variables. For this very reason, this study makes use of monthly data in order to properly capture the relative importance of each and every channel of MPTM. However, real GDP is not usually recorded on monthly basis in most countries of the world, Nigeria included. The norm is to use industrial production (which is sometimes recorded on monthly basis) to serve as a proxy for real GDP. Unfortunately, Nigeria does not also

have records of industrial production on monthly basis. In view of this constraint, the study uses total amount of monthly crude oil production which is the most appropriate proxy for real GDP in the case of Nigeria, because as a monocultural economy, oil sector is the mainstay of the Nigerian economy.

No hitches encountered when measuring other chosen variables of interest, because all the data sets for the other variables are available on monthly basis. The variables are measured as follows: (1) real GDP is proxied by total market value of monthly crude oil production; (2) Money supply consisting of broad money (M2) and narrow money (M1) both measured in local currency units; (3) credit to private sector also measured in local currency unit; (4) other variables include interest rates, lending rates, real effective exchange rates, all share index and consumer price index, all measured in percentages with the exception of exchange rate which is measured in US dollars [i.e. the price of one unit of US Dollar expressed in terms of Nigerian local currency unit (Naira)]

5.3 Sources of Data

All the data sets for this study were sourced from very reliable international and local sources of macroeconomic data. These include, (1) IMF's International Financial Statistics; (2) U.S. Energy Information Administration; and (3) CBN' statistical Bulletin and Online statistical database. The majority of the data sets including Consumer price index (CPI), Money Supply (M1 & M2), Interest rates (INTR), Lending rates (LR), and Real Effective Exchange Rates (REER) were obtained from the first source. The total amount of crude oil production, serving as a proxy for real GDP was obtained from the second source. And lastly, credit to private sector (CPS) and all share index (ASI) were obtained from the third source.

5.4 Descriptive Analysis

This section provides a detailed descriptive statistics and comparative analysis of the time series data used in empirical investigation in the next chapter. The table below provides a summary of the descriptive statistics of all the variables of interest.

Table 5.1: Summary of Descriptive Statistics

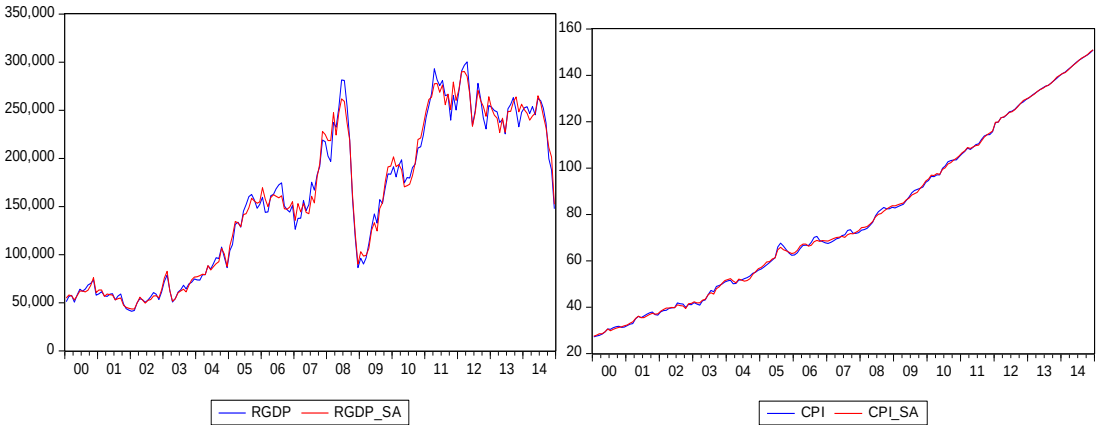
Statistics	RGDP	CPI	M2	MPR	INTR	M1	CPS	ASI	REER
Mean	155854.8	79.07246	6969546.	12.59028	18.57816	3346698.	6315855.	25953.49	92.67001
Median	152678.9	71.03916	4115503.	12.00000	17.55500	2220645.	3638537.	23800.65	90.75924
Maximum	300300.0	150.9295	16833245	20.50000	26.38000	7420946.	18147503	65652.38	135.1489
Minimum	41172.50	27.21806	648506.6	6.000000	10.04000	396991.9	23301.20	5752.900	63.65947
Std. Dev.	79360.53	36.09762	5422454.	3.910018	2.832712	2346599.	5980102.	13198.10	17.09099
Skewness	0.108410	0.407729	0.413619	0.106519	1.007427	0.284448	0.558211	0.747087	0.529548
Kurtosis	1.617792	1.963991	1.618205	2.388909	3.768817	1.468126	1.809849	3.217383	2.471988
Jarque-Bera	14.68133	13.03714	19.45261	3.141128	34.88040	34.88040	19.97144	17.09859	10.50360
Probability	0.000649	0.001476	0.000060	0.207928	0.000000	0.000000	0.000046	0.000194	0.005238
Sample size	180	180	180	180	180	180	180	180	180

Source: Author's Computation using Eview 8.0.

From the table 5.1 above, the monetary policy rate (MPR) has the lowest mean value of 12.59028 while broad money supply (M2) has the highest mean value of 6969546. In addition, the descriptive analysis was also furnished with skewness and kurtosis of all the variables of interest. The Skewness is used to measure the symmetrical property of the histogram while the kurtosis is used to measure the height and the tail shape of the histogram. The yardstick for measuring the skewness is how closer the variable is to the zero (0) and for the kurtosis is how closer the variable is to the three (3). There are basically, three kinds of kurtosis; (i) mesokurtic is when the value of kurtosis is exactly equal to three; (ii) platykurtic when it is lower than three; and (iii) leptokurtic when it is above three. Based on this, RGDP, CPI, M2, MPR and M1 have relatively symmetrical distributions as opposed to INTR, CPS, ASI and REER

which have asymmetrical distributions. For the kurtosis, all the variables can be regarded as platykurtic except for the INTR and ASI which are leptokurtic because only these two have values greater than 3. From the normality test, as can be expected, all the variables that are not in percentages (with the exception of INTR) are not normality distributed. In order to secure normality for these variables, natural log-transformation will be applied to each one of these variables.

To get a clear picture of the general trend of the variables and to find out about their stationary properties, time series plots are necessary. Also, as this study involves the use of monthly time series data, all the variables are seasonally adjusted using X12 approach to avoid seasonality problem which is a common problem encountered when dealing with a high frequency data. The time series plots together with the graphs of the seasonality analysis are presented on figure 3.0 below, where SA denotes that the variable is seasonally adjusted using X12 census approach.



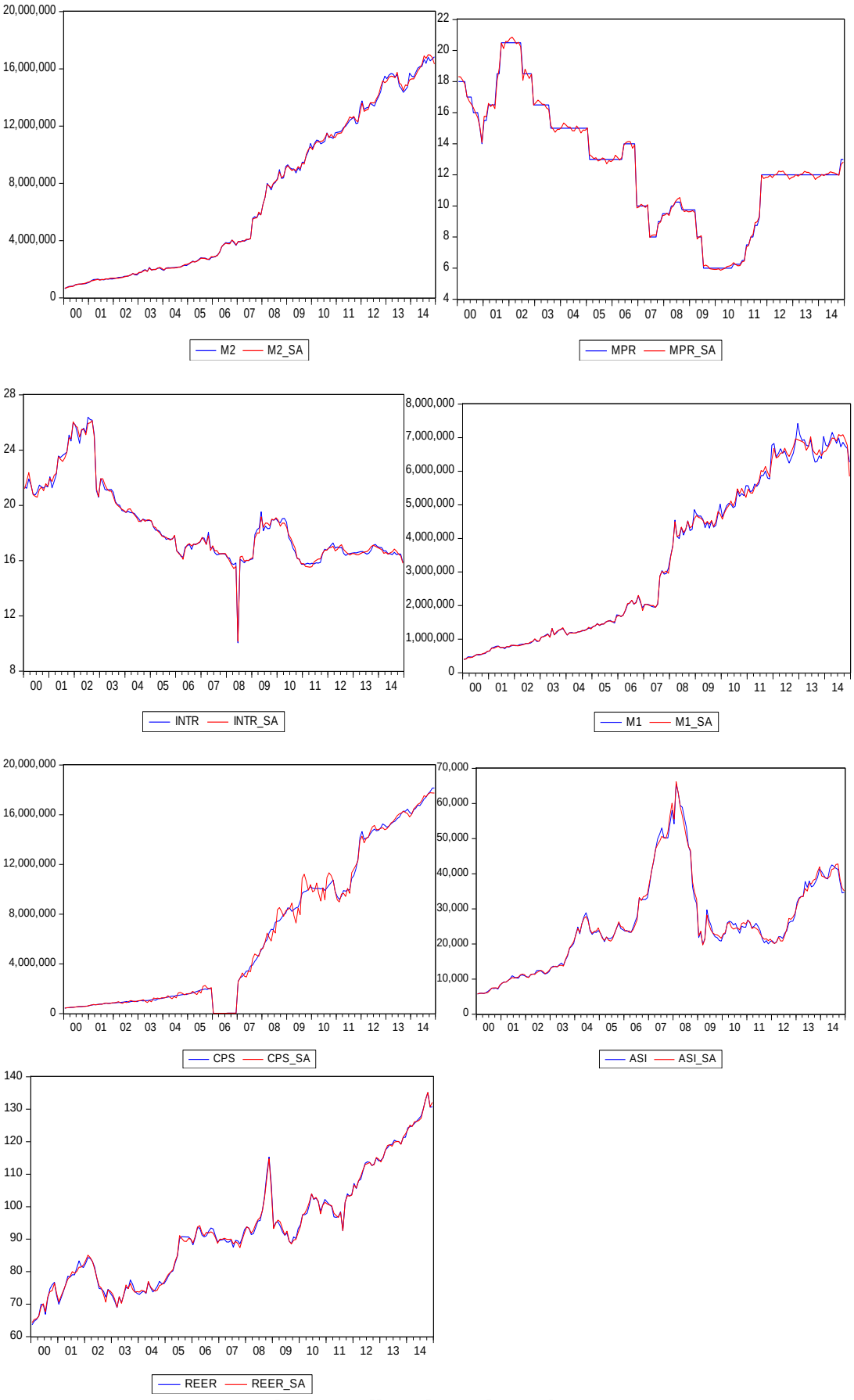


Figure 3.1: Time Series and Seasonally Adjusted Graphs

From the figure 3.1 above, we can observe that, overall, there is no seasonality problem. In fact, only RGDP has some relatively insignificant distinguished seasonal characters. As such, we can use the original seasonally unadjusted variables in our analysis. However, in order to secure normality, especially for those variables that are not reported in percentages, natural log transformation will be applied accordingly.

Chapter 6

EMPIRICAL RESULTS

6.1 Empirical Results and Discussions

In this chapter, the empirical outcomes of the study are presented and discussed. The empirical analysis starts with the conventional unit root testing procedures using both ADF and PP tests in order to uncover the true order of integration in level forms and also at the first difference. After the unit root test, the determination of the lag selection criteria was carried out. Thereafter, the chapter proceeds with Johasen Multivariate Conintegration test after establishing that all the variables of interest are non-stationary at levels but found to be stationary of the same order at first the difference. And after detecting the existence of no cointegrating relationship among the variables, Granger causality test was carried out before the estimation of a series of VAR models and in addition, diagnostic checks and stability test were conducted to ensure the robustness of the whole analysis. The VAR models were executed with the aim of estimating the short run dynamics between the various instruments of monetary policy and real economic variables. The study uses the Impulse Response Functions to justify the rationale behind the adaptation of the VAR methodology as the appropriate estimation technique.

6.2 Unit Root Test Results

The results of the unit root tests, based on ADF and PP tests are presented below in table 6.1 and table 6.2, respectively.

Table 6.1: Augmented Dickey Fuller (ADF) Unit Root Test Results

Variables	ADF Test				Order of I.
	Levels		*First Difference*		
	C	*CT*	*C*	*CT*	
***In*RGDP**	-1.667	-1.979	-10.866*	-10.897*	**I(1)**
***In*CPI**	-1.965	-2.825	-11.562*	-11.695*	**I(1)**
***In*M2**	-2.355	-1.466	-13.508*	-13.739*	**I(1)**
MPR	-1.518	-0.938	-13.128*	-13.202*	**I(1)**
INTR	-1.461	-2.218	-17.789*	-17.739*	**I(1)**
InM1	-2.231	-1,634	-14.699*	-14.989*	**I(1)**
InCPS	-1.828	-2.709	-13.077*	-13.039*	**I(1)**
InASI	-2.468	-1.743	-11.378*	-11.505*	**I(1)**
InREER	-0.929	-3.242	-11.481*	-11.449*	**I(1)**

Source: Author's computation using Eview 8.0

Noted that '*' denotes 1% significant level and I (1) means that the variable is integrated at first difference; C and CT indicate that the test is conducted with drift (constant) and linear trend, respectively; the ADF's lag lengths are automatically selected by SIC; and all variables are computed at 0 lag length.

From the ADF test which is presented in table 6.1 above, it is clear that all the variables are not stationary at levels but stationary at first difference. This is because, at levels, the observed values of the ADF statistics are not greater than their respective critical values in both intercept and linear trend. While at the first difference, the null hypotheses of all the variables are rejected, given that the observed values of ADF statistics are not less than the corresponding critical values, all at 1% significance level.

Table 6.2: Phillips-Perron (PP) Unit Root Test Result

Variables	PP Test				Order of I.
	Levels		*First Difference*		
	C	*CT*	*C*	*CT*	
***In*RGDP**	-1.739	-1.997	-10.866*	-10.897*	**I(1)**
InCPI	-2.352	-2.856	-11.561*	-12.079*	**I(1)**
***In*M2**	-2.453	-1.466	-13.527*	-13.802*	**I(1)**
MPR	-1.603	-1.777	-13.218*	-13.251*	**I(1)**
INTR	-1.572	-2.633	-18.196*	-18.142*	**I(1)**
InM1	-2.472	-1.332	-14.713*	-15.224*	**I(1)**
InCPS	-1.901	-2.917	-13.077*	-13.039*	**I(1)**
InASI	-2.356	-1.899	-11.422*	-11.492*	**I(1)**
InREER	-0.956	-2.982	-11.354*	-11.316*	**I(1)**

Source: Author's computation using Eview 8.0

Noted that '*' denotes 1% significant level and I (1) means that the variable is integrated at first difference; C and CT indicate that the test is conducted with drift (constant) and linear trend, respectively.Tthe Bandwidth is based on Newey-West Bandwidth using Barlett Kernel Estimation Method which automalitcally select 3 lags for all series.

Alternatively, in table 6.2 above, the PP test is presented to reconfirm that all the variables are indeed non stationarity at levels and stationary after differencing them once at the first difference. Following similar procedure as in the ADF test, all the null hypotheses were failed to be rejected in levels but rejected at 1 % level of significant at the first difference for all the 9 variables used in this study.

Evidently, both the two tests reveal the same outcomes implying that all the 9 are integrated of the same order [i.e. I (1)]. Thus, a long run relationship may exist among the variables and consequently the next step is to test if such long relationship actually exists or not among the 9 variables.

6.3 Lag Selection Criteria

Before jumping into the conintegration test, it is of paramount important to select an appropriate optimal lag length. This is because the Johansen Multivariate Cointegration test can be misleading if not carried out using the right optimal lag length. And similarly, the estimation of the VAR or VECM model associated with the cointegrating vector if any exist, is very sensitive to the initial selected optimal lag length. Therefore, the Table 6.3 below reports all the five different information criteria which are mentioned before in chapter three in order to chose the correct optimal lag length for running the cointegration test as well as the estimation of the VAR/VECM model. The criterion for choosing the lag length is based on the lowest value of the test statistics which means that the lower the value of the test statistics the better the model fit the data and vice versa. As can be observed, most of the information criteria have chosen the lag length of 1, with the exception of LR which recommended the optimal lag length of 7. Thus, the optimal number of lag length needed in our forthcoming Johansen Multivariate Cointegration test and the subsequent VAR/VECM model estimations will be based on one lag length (i.e. setting p=1).

Table 6.3: Optimal Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-801.5628	NA	1.69e-06	9.413521	9.559916	9.472918
1	849.7795	3129.870	1.63e-14*	-9.043948*	-7.726392*	-8.509381*
2	894.6837	80.93199	2.05e-14	-8.821904	-6.333187	-7.812167
3	928.4966	57.79642	2.94e-14	-8.470891	-4.811013	-6.985984
4	975.8998	76.61676	3.65e-14	-8.277904	-3.446866	-6.317827
5	1034.684	89.54285	4.02e-14	-8.217252	-2.215053	-5.782004
6	1082.966	69.05501	5.10e-14	-8.034488	-0.861129	-5.124070
7	1152.361	92.79594*	5.18e-14	-8.097224	0.247297	-4.711635
8	1212.042	74.25384	6.06e-14	-8.046999	1.468682	-4.186240

Source: Author's Computation using Eview 8.0
Note: * denotes the lag order chosen by the criterion, all at the 5% significant level.

6.4 Cointegration Test Results

The just concluded unit root tests suggest that long run relationship may exist among the variables of interest, thus it is very appealing to investigate if the variables used in this study can actually converge in the long run or not. To verify this, the study employed Johasen Multivariate Conintegration technique. The estimated results of the Johasen cointegration test for both Trace criterion and the Maximum Eigenvalue criterion are presented below on the table 6.4 and table 6.5, respectively.

Table 6.4: Johasen Multivariate Cointegration Test (Trace)

Hypotheses			(λ_{trace})	0.05	
H0	**H1**	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
r=0	**r>0**	0.226532	173.8859	197.3709	0.3879
r≤1	**r>1**	0.214652	128.1628	159.5297	0.6679
r≤2	**r>2**	0.131351	85.15297	125.6154	0.9401
r≤3	**r>3**	0.103392	60.08763	95.75366	0.9494
r≤4	**r>4**	0.094106	40.66140	69.81889	0.9370
r≤5	**r>5**	0.057714	23.06918	47.85613	0.9599
r≤6	**r>6**	0.033579	12.48763	29.79707	0.9136
r≤7	**r>7**	0.021623	6.407950	15.49471	0.6473
r≤8	**r>8**	0.014040	2.516750	3.841466	0.1126

Source: Author's Computation using Eview 8.0
Max-eigenvalue test indicates no cointegration at the 0.05 level

Table 6.5: Johasen Multivariate Cointegration Test (Maximum Eigenvalue)

Hypotheses			(λ_{max})	0.05	
H0	**H1**	**Eigenvalue**	**Statistics**	**Critical Value**	**Prob.****
r=0	**r>0**	0.226532	45.72311	58.43354	0.4852
r≤1	**r>1**	0.214652	43.00981	52.36261	0.3240
r≤2	**r>2**	0.131351	25.06534	46.23142	0.9652
r≤3	**r>3**	0.103392	19.42624	40.07757	0.9787
r≤4	**r>4**	0.094106	17.59221	33.87687	0.8970
r≤5	**r>5**	0.057714	10.58156	27.58434	0.9750
r≤6	**r>6**	0.033579	6.079678	21.13162	0.9813
r≤7	**r>7**	0.021623	3.891201	14.26460	0.8706
r≤8	**r>8**	0.014040	2.516750	3.841466	0.1126

Source: Author's Computation using Eview 8.0

Max-eigenvalue test indicates no cointegration at the 0.05 level.

From the above two tables, it can be observed that neither the Trace test nor the Maximum Eigenvalue test reject the first null hypothesis of no conintegration (i.e. r =0) at the 5% significant level. This implies that there is no long run relationship among the variables of concern. Categorically speaking, the trace test indicates the existence of zero conintegration vector, and in the same token, the maximum Eigenvalue test also reveals the same outcome, at the 5% level of significance in both cases. These findings lend empirical support to the early Keynesians' view that "Money does not matter in explaining economic activities." This evidence of no cointegration found in this study is also in line with the empirical findings of Davoodi et al. (2013) who found similar evidence in East African countries but it contradicts the findings of Abradu-otoo et al. (2003) who found evidence that suggests that monetary policy is very effective in influencing output and prices in the long run in Ghana Therefore, our next empirical analysis should be based on VAR model as opposed to VECM given the outcomes of the Johasen Multivariate Cointegration test.

6.5 VAR Granger Causality Test Results

The dynamic natures of the causal interactions among the variables of concern will be analyzed first before estimating the VAR models using a technique of Granger causality test. The Granger causality test allows for several causal relationships to be identified in different alternative models. Table 6.7 below shows the summary results of this causality test.

Table 6.8: VAR Granger Causality (Block Exogeneity) Wald Tests

Inferences	Dependent Variables								
	InRGDP	CPI	*InM2*	MPR	INTR	*InM1*	*In*CPS	*In*ASI	*In*REER
*In*RGDP does not cause	____	0.746	0.859	4.434**	8.261*	1.398	1.507	1.562	15.08*
CPI does not cause	0.066	____	6.407**	0.118	3.290***	0.582	2.124	0.557	1.362
*In*M2 does not cause	0.066	0.019	____	3.527***	0.991	2.054	14.50*	0.900	8.375*
MPR does not cause	0.155	0.062	4.006**	____	2.256	1.782	0.908	0.242	8.589*
INTR does not cause	0.563	3.193***	0.002	1.525	____	0.032	0.042	0.100	0.142
*In*M1 does not cause	0.000	0.046	0.274	2.634	0.841	____	12.67*	0.968	8.338*
*In*CPS does not cause	0.118	1.095	0.554	2.492	0.067	0.303	____	2.633	0.091
*In*ASI does not cause	0.043	3.487***	0.071	2.033	4.648**	0.526	1.929	____	0.011
*In*REER does not cause	2.720***	0.663	1.066	2.834***	0.0002	0.045	5.852**	0.494	____
All does not cause	11.29	12.83	20.71*	11.34	26.94*	17.89**	21.25	5.769	34.99*

Source: Author's computation using Eview 8.0 – Extracted from Appendix D2.
Note that the Causality test is based on $\chi 2$ statistic, with 1 degree of freedom, except for "All" which has 4 degree of freedom; and ** & *** signifies statistical significant at 5% and 10%, respectively.

From the above table, there is no evidence of granger causality between money supply (M2) and RGDP. Similarly, there is no granger causality running from MPR to RGDP. At first sight, this may seems to be entirely ridiculous as M2 and MPR constitute the most important instruments of monetary policy globally. However, this is in fact consistent with the Early Keynesians view on the neutral impact of money on economic activities- they posit that money does not matter in explaining economic fluctuations. Note, in this paper, economic growth is proxied by RGDP which should not be taken as a nominal yardstick of the performance of the economy. Therefore, the causality test result is not entirely misleading by asserting that there is no causal relationship between money and RGDP.

However, the test reveals a unidirectional causality running from RGDP to MPR and INTR at 5% and 1% significant level, respectively. In addition, there is also

bidirectional causality between MPR and M2 and also between MPR and REER. This implies that MPR, M2, and REER cause each other. Is this finding in line with any postulations from the point of views of the theoretical thinkers? Yes, it is! From the Monetarists point of view, 'Money is not neutral and monetary policies are effective'. This means that the channel of MPTM follows from MPR to M2 and eventually to REER which in turn affects other major macroeconomic variables in the economy. That is why there is another bidirectional causality running both ways between REER and RGDP. Note also, both M1 and M2 granger causes REER which in turn granger causes CPS, and RGDP. Therefore, based on the outcomes of the Granger causality test, we can expect the exchange rate channel to turn out to be the most effective channel in transmitting monetary shocks to the economy in the case of Nigeria.

In the same token, even though only REER has a causal relationship with the RGDP from the Granger Causality test, but as a group, the variables granger cause M2, INTR, M1 and REER all at 1% significant level, except for the M1 which is rejected at the 5% significant level.

Overall, the block exogeneity outcomes corroborate the endogeneity of M2, INTR, M1 and REER and thereby strengthening the appropriateness of using VAR modeling in carrying out this research work. At this juncture, it is worth noting that the causality test results were only within the specific time span of this study which runs from January, 2000 to December, 2014 and this cannot be used to claim causality beyond this time period.

6.6 Results of the Baseline VAR Model

In this subsection, the estimated results from the VAR models will be presented and discussed using the Impulse Response Functions (IRFs). Because, the just concluded Granger causality test and the earlier cointegration test results suggested that VAR models are more appropriate for examining the dynamic relationships between the monetary policy variables and real macroeconomic variables.

In econometrics, the conventional approach is to estimate VAR models in first difference having established that all the variables of interest are integrated of the same order [i.e. I(1)] and that they are not cointegrated according to the cointegration test. However, this conventional approach is not always followed in the studies of monetary policy transmission mechanisms by some researchers- that is instead, some studies choose to estimate the VAR models in levels, even though the variables in question are non stationary in levels, because as the researchers claim 'monetary transmission mechanism is a short run phenomenon'. In fact, some of the previous studies have even chosen to run VAR models in levels instead of VECM despite the fact that the variables they used have long run relationships (Favero, 2004; Dabla-norris & Floerkemeier, 2006; Tsangarides, 2010; and Thi & Vinh, 2015).

Notwithstanding, in this study, an attempt was made to estimate the VAR models in first difference using the conventional approach. The impulse response functions (IRFs) of the estimated VAR results in first difference were presented in Appendix C. The impulse response graphs appear to be very stable as one time innovations to a broad money supply (M2) or monetary policy rate (MPR) is short lived and dies out

quickly after the 4th month in most of the situations but all the responses of the endogenous variables to the shocks in the monetary policy variables are statistically insignificant. This outcome is perhaps contrary to the theoretical underpinning of the monetary policy relative impact in the economy at least in the short run. Because, the lack of transmission to the real economic variables could only means that money is neutral, even though money neutrality is expected to hold in the long run, while in the short run money would be expected to affect output or some other economic variables in the economy. Thus, this means that the VAR models in first difference have efficient estimators but not consistent with the theoretical expectation. As Sims, et al. (1990) in their paper, titled 'Inference in Linear Time Series Models with some Unit Roots' rightly illustrated that a VAR model in levels incurs some loss in estimators' efficiency but not consistency.

Consequently, this current study adopts the same procedure followed by other previous researchers that do not use the conventional econometrics approach, since the VAR models in first difference are inconsistent with the theoretical expectations of monetary policy transmission mechanism (MPTM). Therefore, the VAR modes are re-estimated in levels rather than in first difference, as monetary policy is a short run phenomenon ((Favero, 2004; Dabla-norris & Floerkemeier, 2006; Aleem, 2010; Tsangarides, 2010; and Thi & Vinh, 2015).

The VAR literature from the Monetary Transmission Mechanism studies is a special case in the sense that some econometricians have argued that the debate on whether VAR models should be estimate based on stationary or non stationary variables is in most cases irrelevant and that one is allowed to run the VAR in levels in any case (Favero, 2001, 2004; and Sims et. al.,1990). In fact, Sims et al.(1990) argue that that

the common practice of transforming VAR models to stationary form by differencing or cointegrated operators form whenever it appears that the data are non stationary is in many cases unnecessary (Sims et al., 1990; p 136/25). They further added that in most cases the statistics of interest might have their distributions unaffected by the nonstationarity and in such circumstances their hypotheses can be tasted without first transformation to stationary process. The objective of estimating a VAR model in levels is to examine the relationship among variables, not to determine efficient estimates" (Aleem, 2010: p5).

We now turn to the analysis of the impulse response functions (IRFs) from the baseline VAR model estimated in levels. IRFs traces out the dynamic paths followed by the endogenous variables in the VAR system resulting from a one-time shock corresponding to one a standard deviation of the innovations. In the impulse response graphs, the solid lines show the responses of the endogenous variables to an innovation, while the dashed lines indicate the boundaries of 95% confidence intervals. If both the upper bound and the lower bound limit include zero, then an innovation to an endogenous variable under consideration has no effect on the that particular variable. Also, the effect of a one-time innovation is regarded as transitory shock if the variable shows a tendency to converge to zero but if it does not, and then it is considered to be a permanent shock. Thus, the results of the baseline VAR model estimated in levels are presented in form of the impulse response graphs in the figure 6.1 and figure 6.2 below:

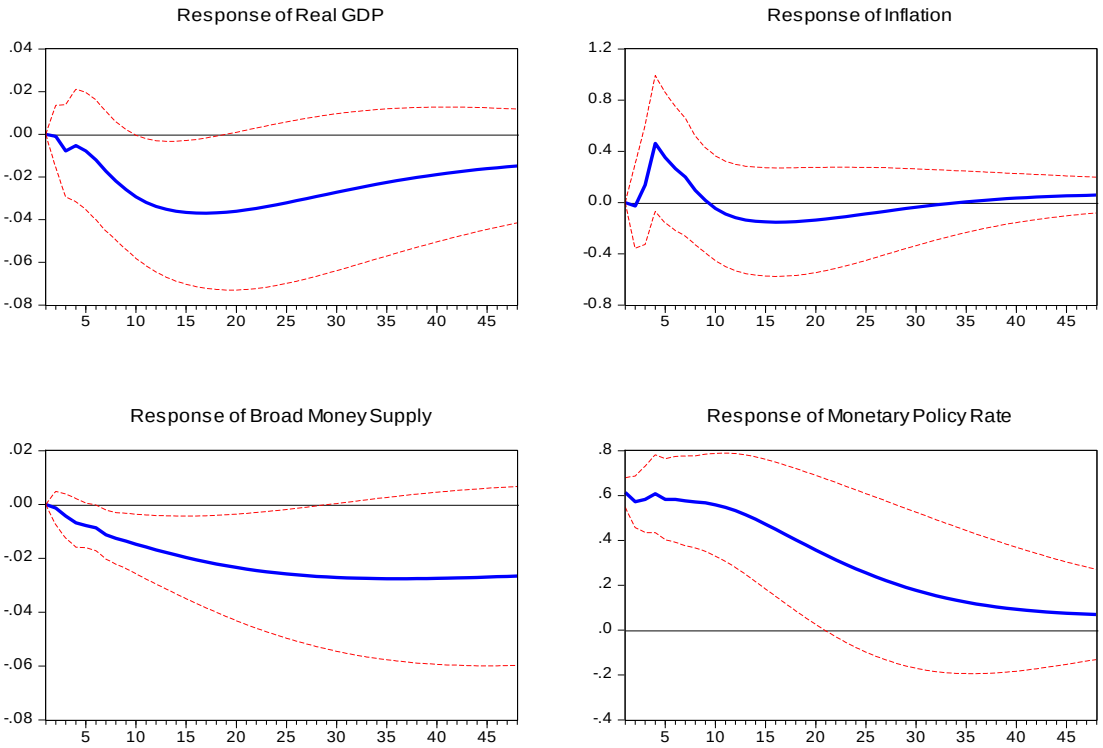


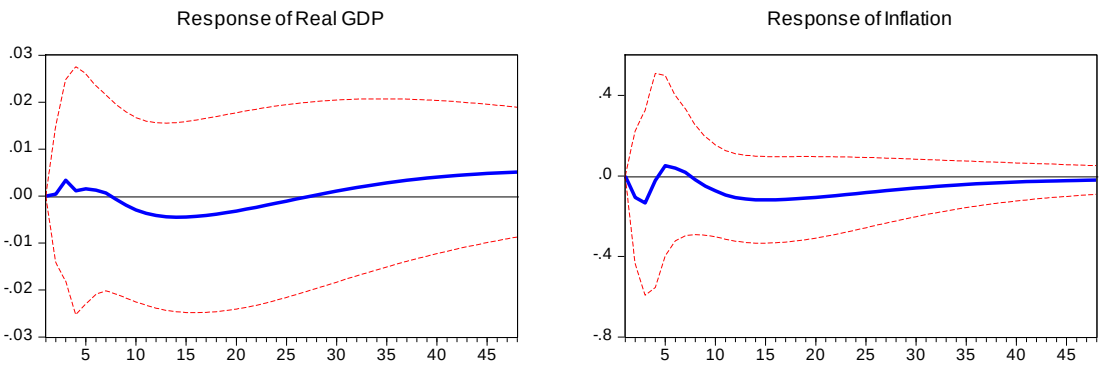
Figure 6.1: Baseline VAR Model- Responses to a Monetary Policy Rate Shocks.

The figure 6.1 above depicts the responses of the real GDP, Inflation (CPI), broad money supply (M2), and monetary policy rate (MPR) to a positive one standard deviation shock in the monetary policy rate (MPR). An unexpected tightening of monetary policy corresponding to a rise of 1.5% in the monetary policy rate (MPR) creates a U-shaped output (real GDP) response which bottoms out after about the 15 – 16 months (at around 4% below the baseline) and continuous to rise persistently without showing any signing of converging to zero even after the end of the 48 month horizon periods. However, the general price level (CPI) do not begins to decline immediately after the initial shocks until about the 5th month, thereafter it starts to fall and converged to the baseline in the 10th month and then becomes negative below the baseline. Although, the fall in the price is smaller compared to that of the output (around 1.9% below the baseline) and later converged again to zero after the 35th month and rise slightly once again above the baseline. The initial

positive response of the general price level to the contractionary monetary policy is commonly found in the literature and is termed 'price puzzle'. This finding is similar to the outcomes of some previous studies (Sims, 1980; Disyatat & Vongsinsirikul, 2003; and Aleem, 2010). Although, only the response of real GDP is statistically significant from the 10th month up to the 20th month, the response of the price level is not statistically different from zero.

As would be expected, the response of the broad money supply (M2) is negative to the shock in the monetary policy rate but statistically significant from the 3rd month up to the 27th month after the initial shock. Similarly, the MPR response to shock in itself is also largely statically significant but positive and persistent.

The results of the IRFs from the figure 6.1 imply that monetary policy is relatively effective at least in the short run in explaining the growth process of Nigeria via the price-based anchor (i.e. MPR). While for the quantity- based anchor (M2) consider the figure 6.2 below.



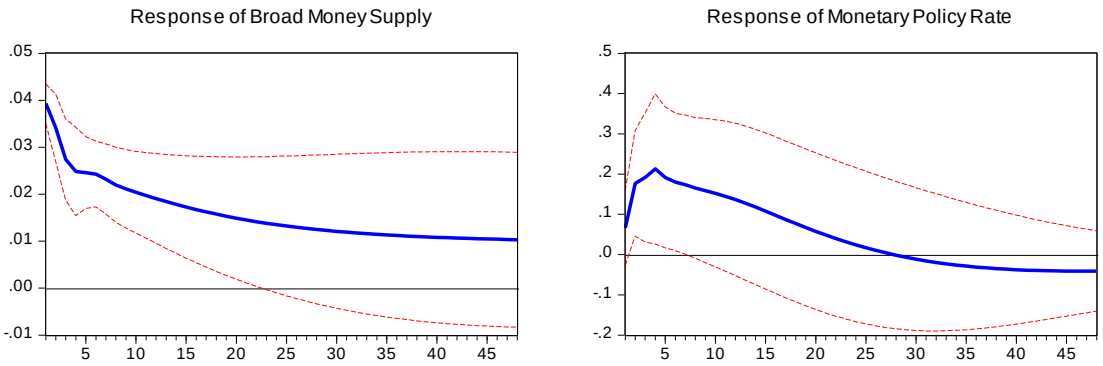


Figure 6.2: Baseline VAR Model- Responses to a Broad Money Supply Shocks.

The figure above shows the responses of the real GDP, Inflation (CPI), broad money supply (M2), and monetary policy rate (MPR) to a positive one standard deviation shock in the broad money supply (M2). An innovation in broad money supply (M2) in the first period leads to a very little and statistically insignificant impact on RGDP. The impact was first positive and suddenly disappeared after the 7th month, becomes negative thereafter and bottoms out in the 13th month (at around 0.5% below the baseline) and converged to zero again after the 25th month and remains positive, slightly above the baseline throughout the remaining horizon periods.

While for the price level, the initial response was negative but statistically significant to a shock in broad money supply (M2) reaching its minimum level at around 0.6% below the baseline and then converged to zero in the 5th month and 6th month and remains below the baseline thereafter until at the end of the horizon periods when the impact disappeared. The initial negative reaction of the general price level (inflation) from a positive shock in M2 is also termed as the 'price puzzle' as mentioned before, because it is contrary to the theoretical expectation. That is to say, an increase in money supply is expected to lead to higher price not the other way round.

The responses of the two monetary policy variables (M2 and MPR) to a positive shock in broad money supply are both positive and statistically significant from the beginning of the horizon periods. For the M2, it becomes statistically insignificant after 23 months and remains permanently positive without showing any tendency of converging to the baseline. But for the MPR, the impact was temporary which becomes statistically insignificant immediately after reaching a peak in the 5^{th} month and converged to zero and thereafter remains negative below the baseline at around roughly 0.3% for the remaining horizon periods.

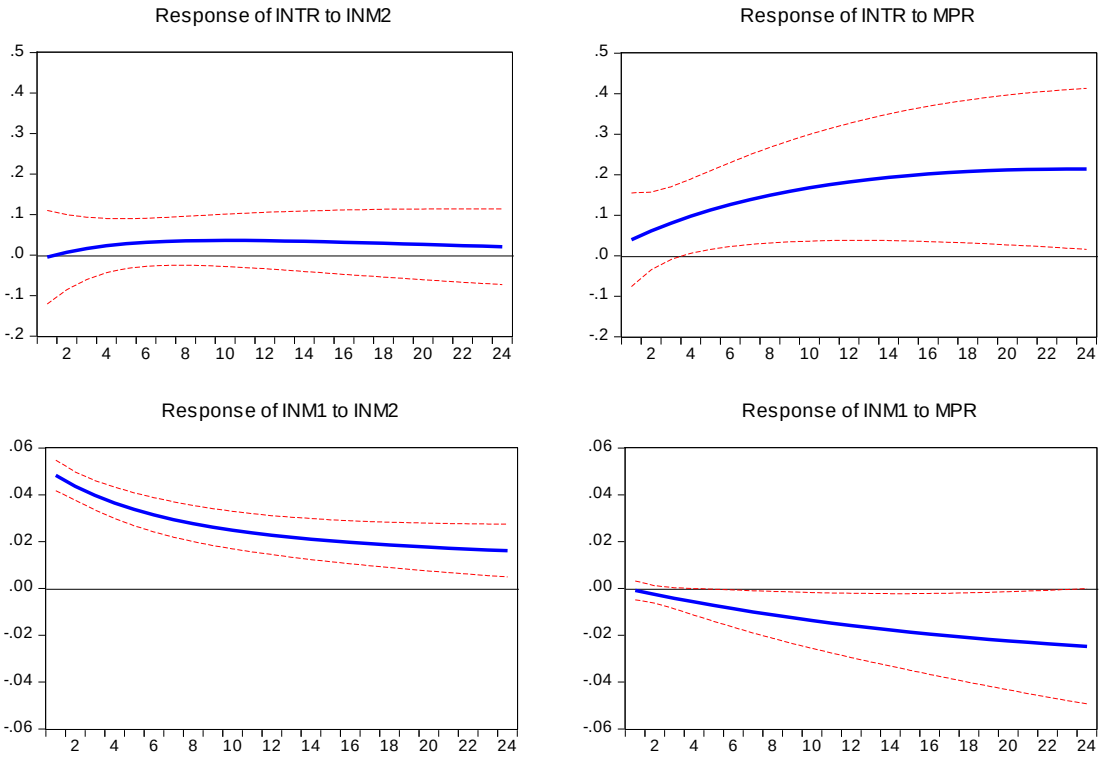
From the forgoing, we can conclude that money is neutral as its impact on both output and prices are statistically insignificant. Perhaps this lends empirical support to the early Keynesians' view of the neutrality of money in affecting real economic variables in the economy. Also the neutrality of money supply is not in contradiction with the findings of Lashkary and Hassannezhad (2011). They discovered that there is no any significant relationship between the volume of money and real macroeconomic variables in Iran and that monetary policy is neutral in the country. However, even though money does not matter in Nigeria, monetary policy is relative effective in the country via the price-based anchor (MPR) as this instrument constitutes one of the most important monetary policy stance for CBN and we found that its impact on output and money supply is at least statically significant in the short run.

Having discovered that monetary policy is at least relatively effective in Nigeria, the next task is to identify which channel(s) are very effective and strong in transmitting the monetary policy in the country. Thus in the next subsection, we will analyze the impulse response functions from the five alternative VAR models formulated in

chapter three of this study in order to uncover the transmission mechanism of monetary policy in Nigeria.

6.7 Results of the VAR Models of Monetary Transmission Channels

To shed more light on the dynamic behavior of the monetary policy variables (M2 and MPR) and the various channels of MPTM and their interactions, the study employed the impulse response functions computed from five alternative VAR models for horizons up to 24 month periods. The impulse response analysis for the horizon of 24 months indicates the response of the various channels of MPTM to a one standard deviation shock in money supply (M2) and monetary policy rate (MPR). The figure 6.3 below shows five pairs of impulse response graphs, each pair indicating how innovations in monetary policy variables (M2 & MPR) affect the various channels of MPTM in Nigeria over a period of 24 month horizons.



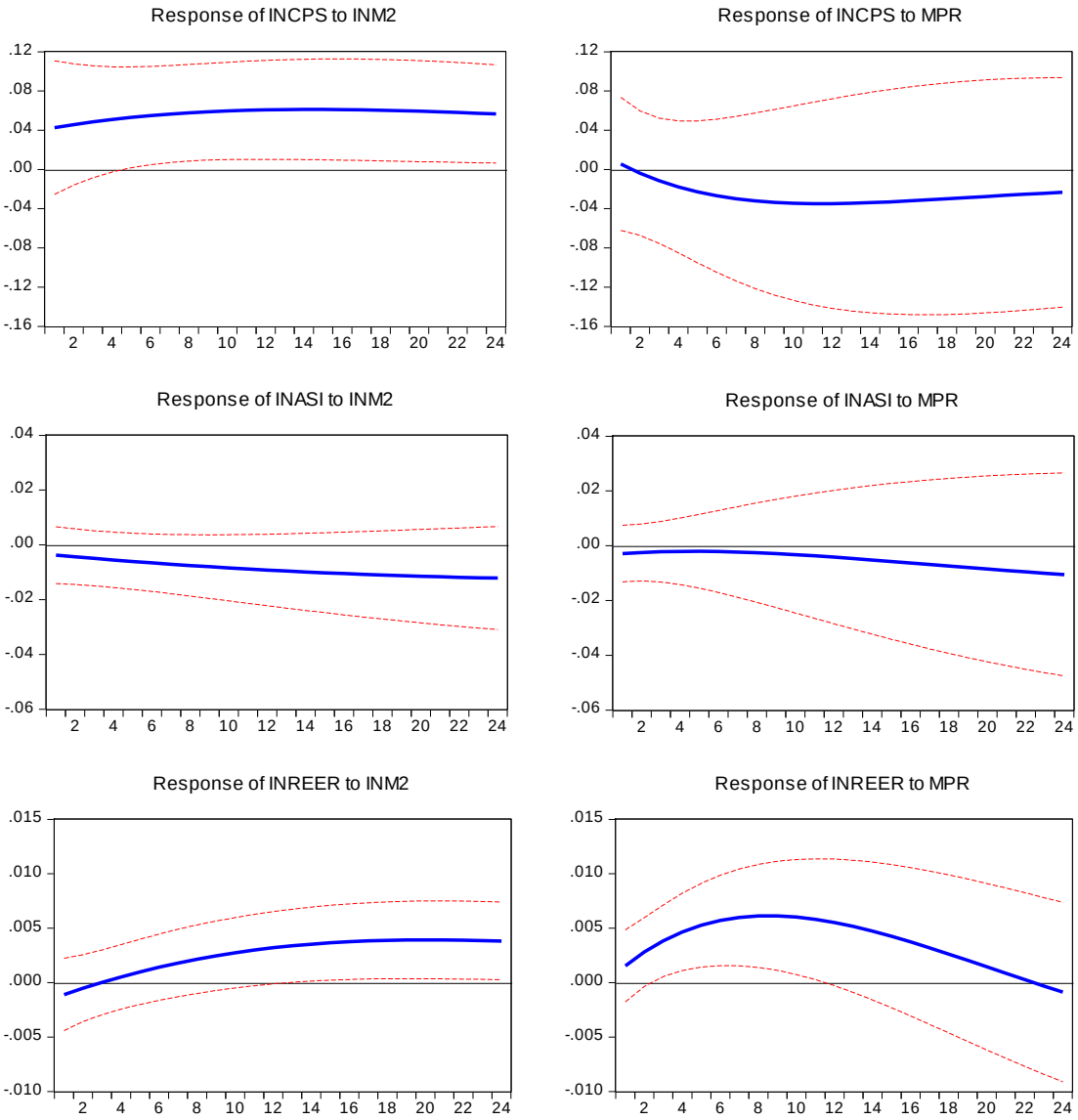


Figure 6.3: Responses of Various Channels of MPTM to Monetary Shocks

The first pair of the IRFs shows the responses of the interest rate (INTR) to innovations in the two monetary policy variables. An innovation in broad money supply yields permanent positive and statistically insignificant impact on INTR, but innovation in MPR on the other hand produces permanent positive statistically significant impact on INTR. The reaction of the interest rate (INTR) which is the commercial interest rate in Nigeria to the policy rate is what would normally be expected to occur, as the two rates are closely related to each other. Because, when the apex bank decide to increase the rate at which it lends to the commercial banks

and other financial institutions in the economy, the lending rate in the money market will go up accordingly and this will in turn constraint the lending power of the commercial banks to their customers. The lack of the statistically significant particularly of the broad money on INTR implies that the interest rate channel is very weak in Nigeria.

In contrast, narrow money supply (M1) responded positively but at a declining rate to innovations in broad money supply (M2) at a very high statistical significant level and responded negatively at a very marginal statistical significant level to innovations in MPR. Here, also the broad money supply (M2) and the narrow money (M1) are closely related to each other, that is why the response of the M1 to the broad money is highly statically significant. Since, this channel is found to be statistically different from zero in case of innovations in the two monetary policy variables; we can conclude that this credit channel is relatively effective in the case of Nigeria.

However, the impact of innovations in monetary policy variables on credit to private sector (CPS) is statistically significant in the case of broad money supply (M2) and insignificant in the case of monetary policy rate (MPR); the CPS received permanent positive shocks from innovations in M2 and permanent negative shocks from innovations in MPR. Similarly, all share index (ASI) have positive permanent statistically significant reactions from innovations in the two monetary policy variables. This two channels, namely bank lending and asset price are also very weak in the case of Nigeria, since their reactions to innovations in monetary policy are mostly statistically insignificant.

In the last pair of the impulse response graphs, the real effective exchange rate (REER) has statistically significant reactions from innovations in the two monetary policy variables. Specifically, an innovation in M2 produces permanent positive impact on REER from the 3rd month and the impact becomes statistically significant after the 14th month and lasted till to the end of the whole horizon periods. Also an innovation in MPR produces statistically significant temporary positive impact on REER. The impact of innovations in MPR on REER reached its peak in the 10th month and then begins to decline continuously from the 11th month, and becomes negative after the 22nd month. The impact remains statistically significant from the 3rd month up to the middle of horizon periods and then becomes insignificant after the 12th month up to the end of the horizon periods. Thus, we can regard the exchange rate channel to be the most effective and strong channel through which monetary policy is transmitted in the case of Nigeria.

Overall, the IRFs reinforce our earlier findings from the causality test results. Thus, the most effective channel of MPTM in Nigeria is through the credit rate channel and exchange rate channel, because only these two channels are found to be statistically significant in response to innovations in the two monetary policy variables. The empirical findings from this study reveal that the CBN's monetary policy is transmitted through credit and exchange rate channel and all the other channels including the two traditional channels (interest rate and asset price channels) as well as the bank lending channel are very weak in Nigeria. These results are in line with theoretical postulations of the monetarists who argue that, "monetary policy is transmitted through either interest rate or exchange rate channel or both". The results are also consistent with empirical findings of the previous researchers from African

countries (Abradu-otoo et al., 2003; Mashat et al., 2008; Mugume et al., 2011; Davoodi et al., 2013; and Chileshe et al., 2014).

6.8 Diagnostic Checks and VAR Stability Test

The big challenge in using VAR methodology is- how robust are the results from estimated VAR models? In order to answer this question, the current study conducted three important diagnostic tests, namely, autocorrelation, hetroskedasticity and normality test as well as the stability test. The table 6.5 below presents the results of the diagnostic checks for all the VAR models estimated in this study.

Table 6.5: Summary of Residual Diagnostic Checks for all the VAR Models

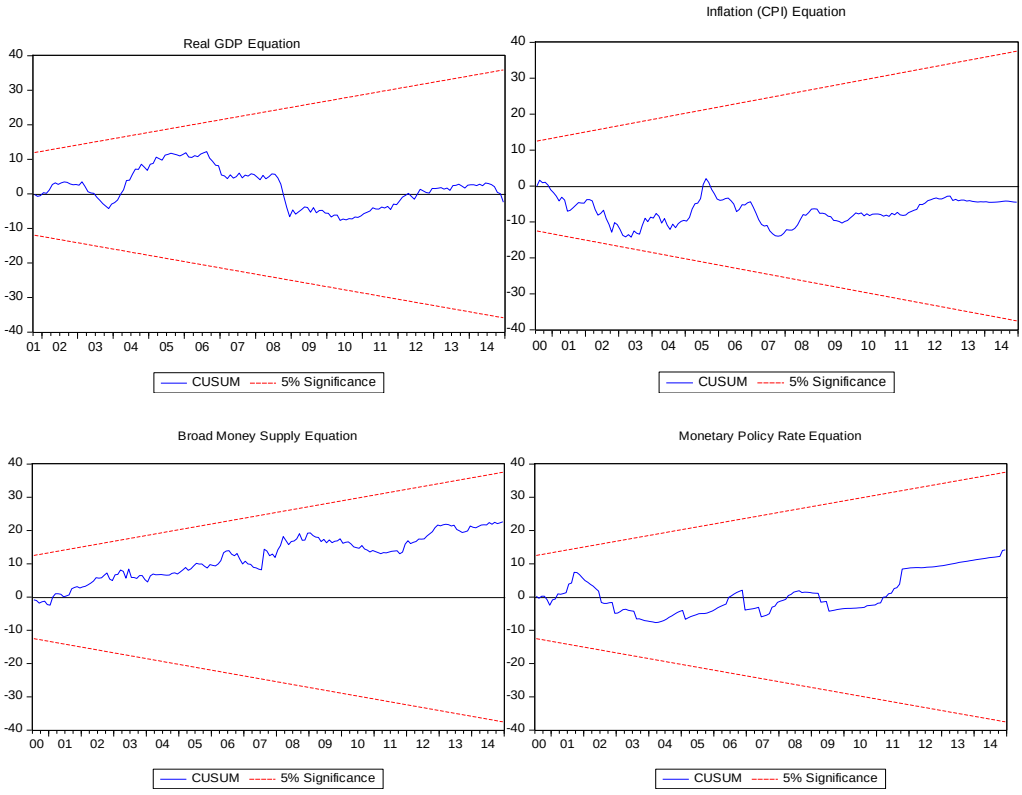
Residual Tests:	**Autocorrelation Test** (H0: No serial corr)	**Hetroskedasticity Test** (H0: No cross terms)	**Normality Test** (H0: Res are normally dist.)
Baseline VAR Model	16.98445 (0.3866)	0.815700 (0.5167)	62.4428*(0.0000)
Interest Rate VAR Model	27.21601(0.3452)	1.471591(0.2015)	74.0337*(0.0000)
Narrow Credit VAR Model	30.92714(0.1914)	0.887394(0.4908)	68.8128*(0.0000)
Bank Lending VAR Model	33.32196(0.1232)	0.646141(0.6648)	62.4183*(0.0000)
Asset Price VAR Model	29.57962(0.2404)	0.972277(0.4363)	63.7718*(0.0000)
Exchange Rate VAR Model	25.65960(0.4259)	1.633764(0.1535)	44.7741*(0.0000)

Source: Author's computation using Eview 8.0

Note: * denotes significance at 1% level; H0 stands for the null hypothesis for no serial correlation (conducted at lag 2), no cross hetroskedasticity terms (at lag 1) and residuals multivariate are normally distributed, for Autocorrelation, Hetrsokedasticity and Normality test, respectively.

The table above shows that both the baseline VAR model and the five alternative VAR models have no autocorrelation or hetroskedasticity problems. However, there is only one minor problem with the normality test that is all the six VAR models are not normally distributed. Alas! This is not a big problem according to Juselius (2006) because the residuals in the VAR/VECs do not need to be normally distributed if it is caused by the excess Kurtosis. This is actually the case of the VAR models in this study; all the VAR systems have excess kurtosis, exceeding the value of 4-5 in all the VAR models. According to Sun et al., (2010) provided that there is no any

autocorrelation or hetroskedasticity problems, the VAR models can be accepted even if the residuals are not normally distributed. Therefore, based on the residual diagnostic tests results in the table above, the VAR systems estimated in this study performed very well, although some fluctuations take place. The little fluctuations appeared in some variables is of course a potential area of great concern, because if the VAR models are unstable, the impulse response functions and their respective standard errors are invalid. In order to address this issue, the study carried out additional stability test on all the equations from the estimated VAR models. The results of the stability test are depicted on the figure 6.4 below.



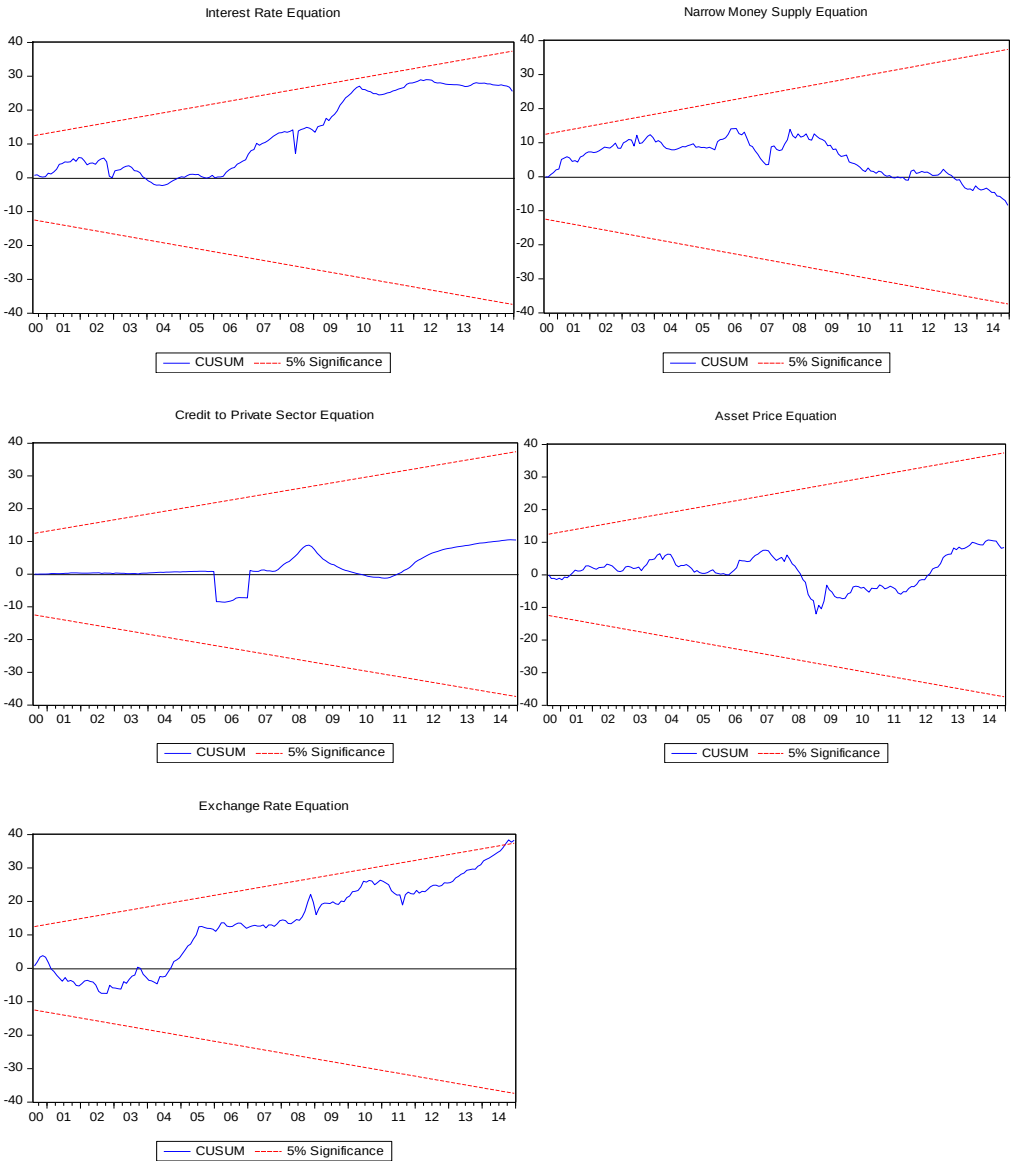


Figure 6.4: VAR Equations Stability Test

The figure above shows the Cumulative Sum of Square (CUSUM) tests for all the main equations in the VAR systems in order to check for their parameters stability. The results indicated that despite some episodes of persistent fluctuations in the VAR systems, the residual variance of each main equation is overall stable, as the entire test statistics lie within the 5% critical band. In addition, this study conducted AR Roots test which is reported in Appendix D. According to the AR Roots tests, all the estimated VAR models are stable, because all their inverse roots of the characteristic polynomial have modulus less than one and lie inside the unit circles.

Chapter 7

CONCLUSION, CONTRIBUTIONS, IMPLICATIONS & POLICY RECOMMENDATIONS

7.1 Conclusion

This study has analyzed the transmission mechanisms of monetary policy in Nigeria using VAR methodology. The empirical analysis began with the conventional unit root tests, and then proceed with the lag selection criteria, and thereafter, the cointegration test followed, and then Granger causality test was carried out before the estimation of a series of VAR models and in addition, diagnostic checks and stability test were conducted to ensure the robustness of the whole analysis.

Applying the VAR methodology to 180 observations of monthly data covering the periods of 2000M1 to 2014M12, the study reveals a number of interesting findings: Firstly, according to the two unit root test results, all the variables are nonstationary at level, but integrated of order one at the first difference (i.e. all the variables are I(1)). This permits the study to continue with the Johasen Multivariate Conintegration test which indicated that there is no long run relationship among the variables used in the study. Given the facts that the variables are not cointegrated, the VAR models were estimated- the baseline VAR model showed that monetary policy is relatively effective in Nigeria. And this outcome lends empirical support to Monetarists' view on the relative effectiveness of monetary policy at least in the short run.

Moreover, estimating additional five competing VAR models, the study uncover three (3) stylized facts about the MPTM in Nigeria: Fact one, the two traditional channels of MPTM namely, interest rate and asset price channels are very weak in Nigeria. Fact two, due to the prevalence of huge informal financial sector servicing large number of unbankable population coupled with exorbitant bank charges, the bank lending channel is also found to be very weak in the country. Fact three, the credit and exchange rate channel are the most effective mediums through which the Nigerian monetary policy is transmitted to the real economic variables in the economy.

The causality test and the impulse response functions (IRFs) further complemented the outcomes of the estimated VAR models. Therefore, in general, the study uncover that monetary policy is relatively effective, especially in affecting economic growth process in Nigeria, at least in the short run and it is transmitted via the credit and exchange rate channel.

7.2 Contributions

At this juncture it is worth mentioning that this study is the first to investigate the transmission mechanisms of monetary policy in Nigeria using monthly time series data and VAR approach. Majority of the previous studies concentrated on investigating the relative importance of monetary policy in the economy, rather than uncovering which channel(s) of monetary policy is more important in the country. So far, there have been a very limited number of well known scholarly researches that investigate the MPTM of the Central Bank of Nigeria (CBN). Chuku (2009) was the first to examine this issue in Nigeria using SVAR approach bases on quarterly data series from 1986Q1 to 2008Q4 and discovered that money supply (M2) as a quantity

anchor has a moderate effect on both output and prices, while the price-based anchor (monetary policy rate and real effective exchange rate) have neutral effect on output. In contrast, Philip & Muibi (2011) invistigate the transmission mechanism of monetary policy impact on the sectoral output growth in Nigeria. They however use VAR metodology and found the interest rate and excahnge rate as the most effective channels of stimulating output growth of various sectors in the country. Moreover, due to data limitations, most of the previous studies made use of annual data and in some few cases quarterly data, because both Nigerian nominal/real GDP and industrial production are recorded only on annual and quarterly basis.

Therefore, this study is unique as it critically investigates the MPTM in Nigeria using VAR approach from a new perspective. In addition, it adds to the existing scanty literatures of MPTM in Africa and Nigeria in particular. The study also uncover three important stylized facts about transmission mechanism in Nigeria- That is the two primary traditional channels of monetary policy are very weak in Nigeria, bank lending channel is not fully operative in the country and credit and exchange rate channel are the most effective transmission channels of propagating monetary policy in the country.

7.3 Implications & Policy Recommendations

Proper understanding of the transmission channels through which monetary policies transmitted to the economy is very crucial in formulating and implementing a broad range of macroeconomic policies. For example, which instrument of monetary policy can better stabilize output and prices? Which monetary policy instrument is more appropriate during different episodes of business cycles? Which instrument of monetary policy is best in curbing the inflationary pressure in the economy? Which

instrument is the best in stimulating economic growth process of a particular economy? Is fixed or flexible exchange rate regime better suited for a particular country or group of countries? How to tackle the tradeoff between maintaining price stability and reducing unemployment via the use of monetary policy? Thus, further future studies should investigate these broad ranges of policy questions in both developed and developing countries of the world. This will go a long way in creating a conducive atmosphere for the smooth execution of monetary policy and thereby ensuring maximum outcomes and reducing uncertainty surrounding the formulations and implementations of monetary policies in both advanced and third world countries.

From the forgoing, some very important relevant policy recommendations can be offer from the empirical findings of this study. First and foremost, the prevalence of weak traditional channels of MPTM in Nigeria can be reverted and make them stronger and functioning very well by making interest rate very attractive for both borrowers and investors in the country through implementation of more business oriented policies that would encourage entrepreneurship and profitable business ventures in the country; there is also the need to develop the stock exchange market so that not only private sector participants, but also the household sector can harness this opportunity and participate in the stock exchange trading activities. Secondly, the bank lending channel is known to be the most important and effective channel of MPTM in most advanced countries of the world, Nigeria can also make its bank channel strong by attracting the huge unserviceable non banking population into the mainstream conventional banking sector and reducing the size its informal sector. Policies such as cashless policies, public awareness and enlighten programs about doing business with banks can help make the bank lending channel operative and

strong. Lastly but not the least, embarrassing more flexible exchange rate regimes and reducing CBN interventions in the foreign exchange markets, as well as making the export sector more vibrant can further strengthen the prevailing effective exchange rate channel in Nigeria.

REFERENCES

Abradu-otoo, P., Amoah, B., & Bawumia, M. (2003). An Investigation of the Transmission Mechanisms of Monetary Policy in Ghana: A Structural Vector Error Correction Analysis. *Bank of Ghana, WorkingPpaper*, 1–37.

Aleem, A. (2010). Transmission mechanism of monetary policy in India. *Journal of Asian Economics*, 21(2), 186–197. http://doi.org/10.1016/j.asieco.2009.10.001

Anyanwu, J. C. (1993). *Monetary Economics: Theory, policy, and Institutions*. Hybrid Publishers.

Ayo, E. J. (1988). *Money and Banking: Analysis and Policy in the Nigeria Context*. Nigeria: George Allen and Union Publishers.

Bernanke, B. S., & Blinder, A. S. (1988). *Credit, money, and aggregate demand* (No. w2534). National Bureau of Economic Research.

Bernanke, B. S., & Gertler, M. (1995). *Inside the black box: the credit channel of monetary policy transmission* (No. w5146). National bureau of economic research.

Central Bank of Nigeria (2011). *Understanding Monetary Policy Series No 2* CBN

Chileshe, P., Mbao, F. Z., Mwanza, B., Mwansa, L., & Zgambo, P. (2014). Monetary Policy Transmission Mechanism in Zambia **, 1–49.

Chimobi, O.P. and U.C. Uche,(2010). Money, price and output.A causality test for nigeria. *American Journal of Scientific Research*, 8: 78-87.

Chuku, C. A. (2009). Measuring the Effects of Monetary Policy Innovations in Nigeria : a Structural Vector Autoregressive (Svar) Approach I . 5(5), 112–129.

Çi, E. B. A. Ş. (2007). The monetary transmission mechanism in Turkey : new developments *Özgür ÖZEL Ça ğ r ı SARIKAYA* June 2007, (07).

Dabla-Norris, E., & Floerkemeier, H. (2006). Transmission mechanisms of monetary policy in Armenia: evidence from VAR analysis.

Davoodi, H. R., Dixit, S. V. S., & Pinter, G. (2013). Monetary Transmission Mechanism in the East African Community: An Empirical Investigation. *IMF Working Papers*, 13(39), 1. http://doi.org/10.5089/9781475530575.001

Dickey, D.A. and Fuller, W.A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, Vol. 49 (, pp. 1057-1072.

Disyatat, P., & Vongsinsirikul, P. (2003). Monetary policy and the transmission mechanism in Thailand. *Journal of Asian Economics*, 14(3), 389–418. http://doi.org/10.1016/S1049-0078(03)00034-4

Eichenbaum, M. (1992). “Interpreting the macroeconomic time series facts: The effects of monetary policy.” *European Economic Review*, 36(5), 1001–1011. http://doi.org/10.1016/0014-2921(92)90042-U

Elbourne, A. (2008). The UK housing market and the monetary policy transmission mechanism: An SVAR approach. *Journal of Housing Economics*, 17(1), 65–87. http://doi.org/10.1016/j.jhe.2007.09.002

FolaIwo, A. O. and Osinubi, T. S. (2006) “Monetary Policy and Macroeconomic Instability in Nigeria: A Rational Expectation Approach”. *Journal of Social Science.* Vol. 12, no. 2, pp. 93-100.

Friedman, M., & Meiselman, D. (1987). The Relative Stability of Monetary Velocity and Investiment Multiplier in The United States, in “Stabilization Policies” *Englewood Cliffs*.

Furness, E. (1975). *Money and credit in Developing Africa.* New York: Macmillian Press Ltd.

Galí, J. (2008). Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework. *Shock* (Vol. 95). Princeton University Press.

Ghazanchyan, M. M. (2014). Unraveling the Monetary Policy Transmission Mechanism in Sri Lanka (No. 14-190). *International Monetary Fund.*

Hall, S. G., Henry, S. G. B., & Wilcox, J. B. (1989). The long-run determination of the UK monetary aggregates. *Bank of England*.

Harcourt, P., State, R., & Harcourt, P. (2011). The Impact of Monetary Policy on Nigeria's Macroeconomic Stability (1970 - 2009) Nenbee, S. G., 2(2), 174–183.

Horváth, C., Krekó, J., & Naszódi, A. (2006). Is there a bank lending channel in Hungary? Evidence from bank panel data (No. 2006/7). *MNB Working Papers.*

Ismail, O. (2014). Does Monetary Policy Influence Economic Growth in Nigeria ?, 12(1), 1–32.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and statistics*, *52*(2), 169-210.

Kashyap, A. K., & Stein, J. C. (2000). What do a million observations on banks say about the transmission of monetary policy? *American Economic Review,* 90(3), 407–428. http://doi.org/10.1257/aer.90.3.407

Kuttner, K. N., & Mosser, P. C. (2002). The Monetary Transmission Mechanism : Some Answers and Further Questions. FRBNY *Economic Policy Review*, (May), 15–26.

Lashkary, M., & Kashani, B. H. (2011). The Impact of Monetary Variables on Economic Growth in Iran: A Monetarists' Approach. *World Applied Sciences Journal*, *15*(3), 449-456.

Mashat, R. Al, Billmeier, A., & Fund, I. M. (2008). The Monetary Transmission Mechanism in Egypt Rania *Al-Mashat and Andreas Billmeier Working Paper* 411 June 2008.

Mengesha, L. G., & Holmes, M. J. (2013). Monetary policy and its transmission mechanisms in Eritrea. *Journal of Policy Modeling*, 35(5), 766–780. http://doi.org/10.1016/j.jpolmod.2013.06.001

Mishkin, F. S. (1995). Symposium on the Monetary Transmission Mechanism. *Journal of Economic Perspectives*, 9(4), 3–10. http://doi.org/10.1257/jep.9.4.3

Mishkin, F. S. (2009). *Is monetary policy effective during financial crises?* (No. w14678). National Bureau of Economic Research.

Mishra, P., Montiel, P. J., & Spilimbergo, A. (2011). How Effective Is Monetary Transmission in Developing Countries? A Survey of the Empirical Evidence.

Montiel, P. J. (1991). The transmission mechanism for monetary policy in developing countries. *Staff Papers-International Monetary Fund*, 83-108.

Mugume, A. (2009). Monetary transmission mechanisms in Uganda. The Bank of Uganda, *4*(1), 3–52.

Pesaran, M.H., Pesaran, B. (1997). *Working with Microfit 4.0.* Camfit Data Ltd, Cambridge.

Phiromswad, P. (2015). Measuring monetary policy with empirically grounded restrictions: An application to Thailand. *Journal of Asian Economics*, 38, 104–113. http://doi.org/10.1016/j.asieco.2015.04.005

Rodriguez, G. H., & Diaz, G.G. (1995). Macroeconomics Fluctuations in Peruvian Economia. Working paper. Lima: Banco Central de Reserva del Perú.

Rogers, J. H., & Wang, P. (1995). Output, inflation, and stabilization in a small open economy: evidence from Mexico. *journal of Development Economics*,*46*(2), 271-293.

Sims, C. A. (1992). Interpreting the macroeconomic time series facts: The effects of monetary policy. *European Economic Review*, 36(5), 975-1000.

Sims C.A. (1980). Macroeconomics and Reality, *Econometrica* 48, 1-48.

Sims, C. A., Stock, J. H., & Watson, M. W. (1990). Inference in linear time series models with some unit roots. *Econometrica: Journal of the Econometric Society*, 113-144.

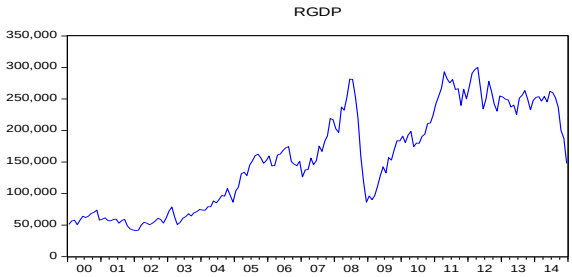
Stock, J. H., & Watson, M. W. (2001). Vector autoregressions. *Journal of Economic perspectives*, 101-115.

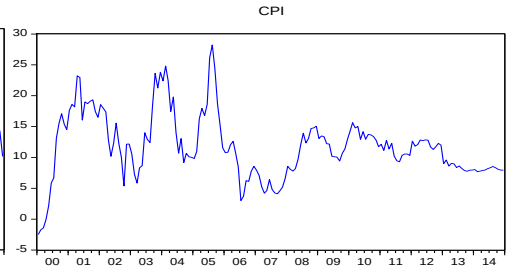
Thi, N., & Vinh, T. (2015). The Role of Different Channels in Transmitting Monetary Policy into Output and Price in Vietnam, *17*(1), 20–40.

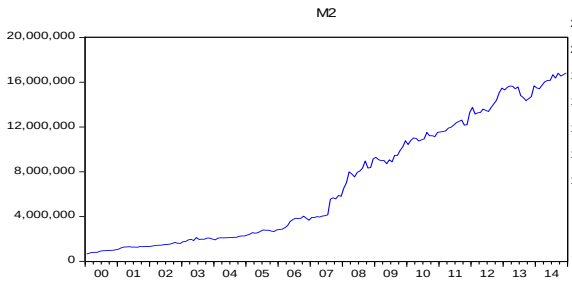
Tsangarides, C. (2010). Monetary Policy Transmission in Mauritius Using a VAR Analysis. http://doi.org/10.5089/9781451962789.001

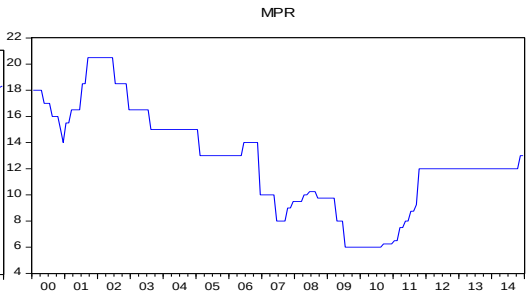
APPENDICES

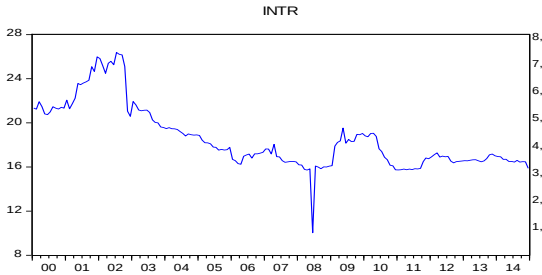
Appendix A: Time series plots of level variables

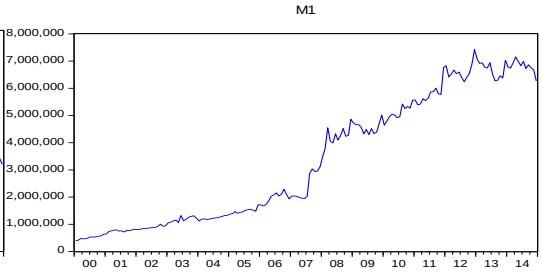


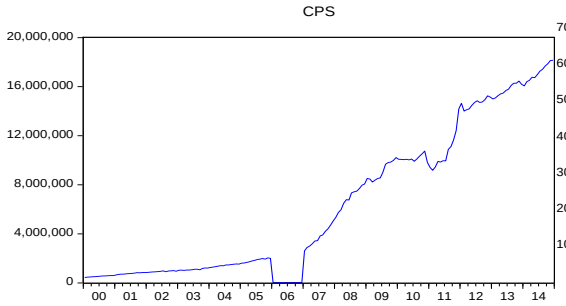


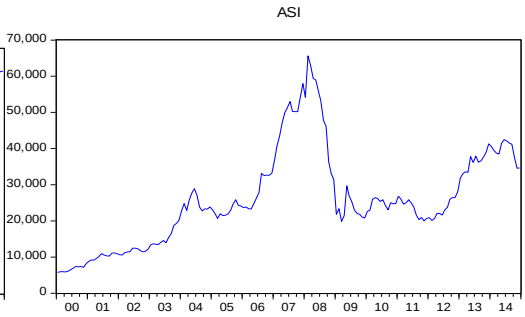


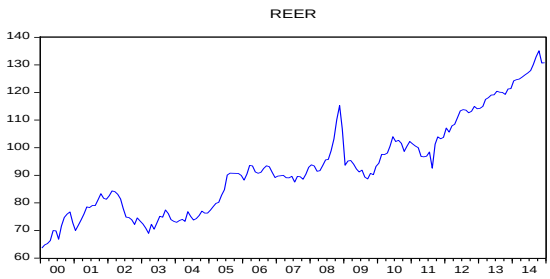












Appendix B: VAR Granger Causality/ Block Exogeneity Wald Tests

Dependent variable: INRGDP

Excluded	Chi-sq	df	Prob.
CPI	0.065911	1	0.7974
INM2	0.065768	1	0.7976
MPR	0.155472	1	0.6934
INTR	0.563358	1	0.4529
INM1	0.000453	1	0.9830
INCPS	0.117706	1	0.7315
INASI	0.042857	1	0.8360
INREER	2.719610	1	0.0991
All	11.29044	8	0.1858

Dependent variable: CPI

Excluded	Chi-sq	df	Prob.
INRGDP	0.746009	1	0.3877
INM2	0.018780	1	0.8910
MPR	0.062252	1	0.8030
INTR	3.193042	1	0.0740
INM1	0.046277	1	0.8297
INCPS	1.094561	1	0.2955
INASI	3.486751	1	0.0619
INREER	0.663326	1	0.4154
All	12.83288	8	0.1177

Dependent variable: INM2

Excluded	Chi-sq	df	Prob.
INRGDP	0.858813	1	0.3541
CPI	6.406776	1	0.0114
MPR	4.005810	1	0.0453
INTR	0.001930	1	0.9650
INM1	0.274095	1	0.6006
INCPS	0.553991	1	0.4567
INASI	0.071324	1	0.7894
INREER	1.066166	1	0.3018
All	20.70835	8	0.0080

Dependent variable: MPR

Excluded	Chi-sq	df	Prob.
INRGDP	4.434222	1	0.0352
CPI	0.118493	1	0.7307
INM2	3.527275	1	0.0604
INTR	1.524559	1	0.2169
INM1	2.633570	1	0.1046
INCPS	2.491815	1	0.1144
INASI	2.032945	1	0.1539
INREER	2.833899	1	0.0923
All	11.33854	8	0.1832

Dependent variable: INTR

Excluded	Chi-sq	df	Prob.
INRGDP	8.260703	1	0.0041
CPI	3.290256	1	0.0697
INM2	0.991436	1	0.3194
MPR	2.256259	1	0.1331
INM1	0.840940	1	0.3591
INCPS	0.067233	1	0.7954
INASI	4.647882	1	0.0311
INREER	0.000187	1	0.9891
All	26.93955	8	0.0007

Dependent variable: INM1

Excluded	Chi-sq	df	Prob.
INRGDP	1.398323	1	0.2370
CPI	0.581582	1	0.4457
INM2	2.053979	1	0.1518
MPR	1.781722	1	0.1819
INTR	0.032364	1	0.8572
INCPS	0.303139	1	0.5819
INASI	0.526285	1	0.4682
INREER	0.045208	1	0.8316
All	17.89132	8	0.0221

Dependent variable: INCPS

Excluded	Chi-sq	df	Prob.
INRGDP	1.507252	1	0.2196
CPI	2.124350	1	0.1450
INM2	14.50102	1	0.0001
MPR	0.908043	1	0.3406
INTR	0.042268	1	0.8371
INM1	12.67161	1	0.0004
INASI	1.928914	1	0.1649
INREER	5.851605	1	0.0156
All	21.25438	8	0.0065

Dependent variable: INASI

Excluded	Chi-sq	df	Prob.
INRGDP	1.562486	1	0.2113
CPI	0.557261	1	0.4554
INM2	0.899801	1	0.3428
MPR	0.242472	1	0.6224
INTR	0.100296	1	0.7515
INM1	0.967854	1	0.3252
INCPS	2.632765	1	0.1047
INREER	0.494293	1	0.4820
All	5.768849	8	0.6731

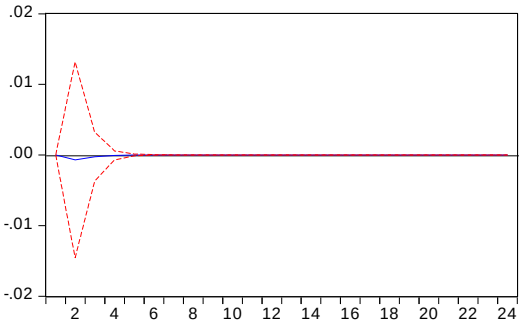
Dependent variable: INREER

Excluded	Chi-sq	df	Prob.
INRGDP	15.07738	1	0.0001
CPI	1.361862	1	0.2432
INM2	8.374850	1	0.0038
MPR	8.588983	1	0.0034
INTR	0.142427	1	0.7059
INM1	8.338031	1	0.0039
INCPS	0.091465	1	0.7623
INASI	0.011308	1	0.9153
All	34.99281	8	0.0000

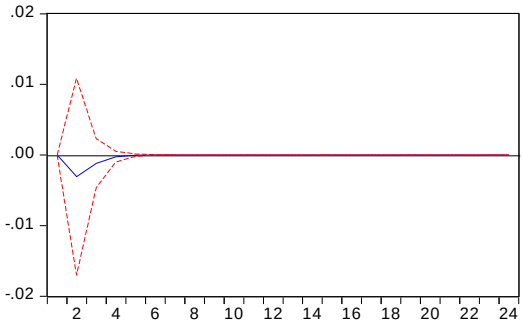
Appendix C: Impulse Response Functions (In First Difference)

Below are the IRFs in first difference. It seems all of them are stable- there is no permanent shocks at all.

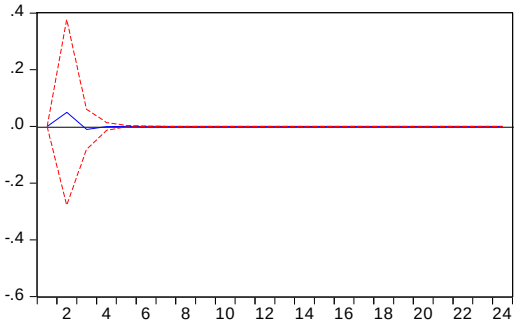
Response of DINRGDP to DINM2



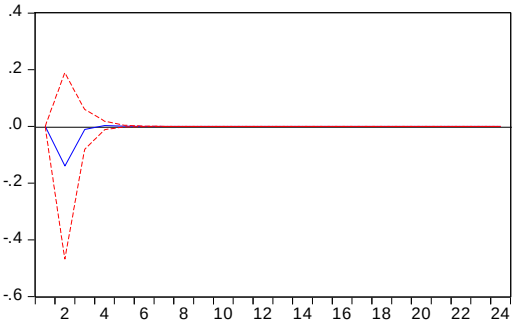
Response of DINRGDP to DMPR



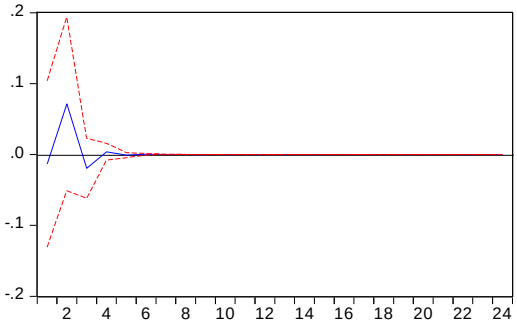
Response of DCPI to DINM2



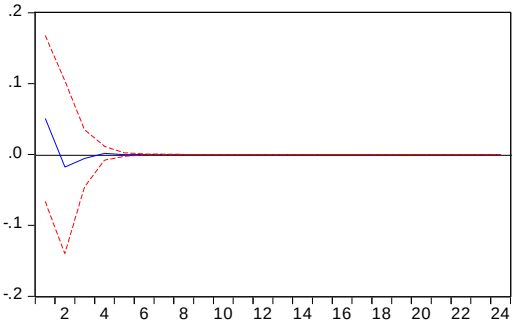
Response of DCPI to DMPR



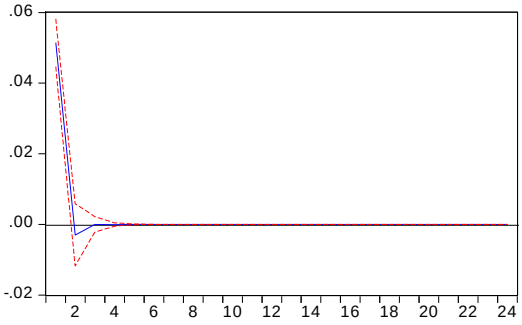
Response of DINTR to DINM2



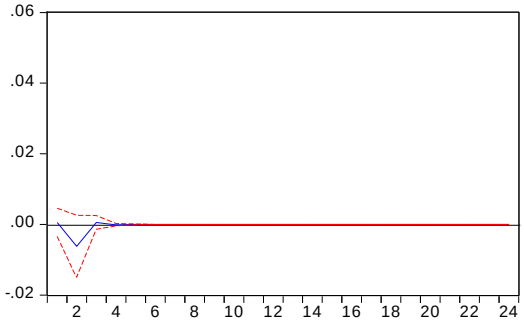
Response of DINTR to DMPR



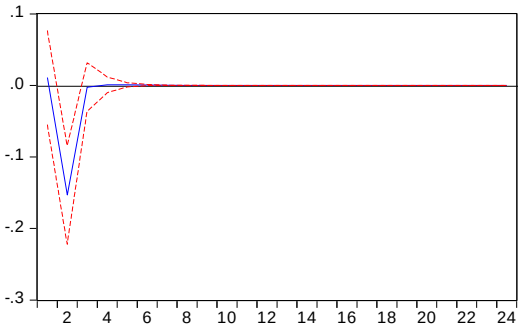
Response of DINM1 to DINM2



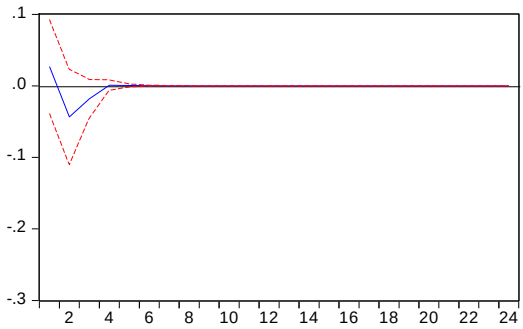
Response of DINM1 to DMPR



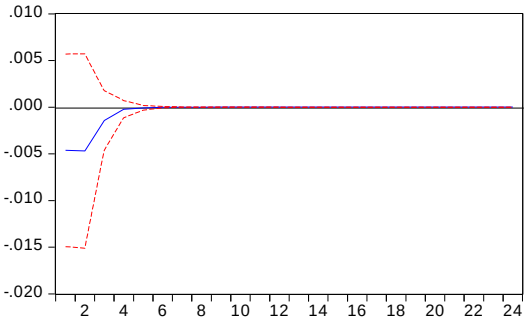
Response of DINCPS to DMPR



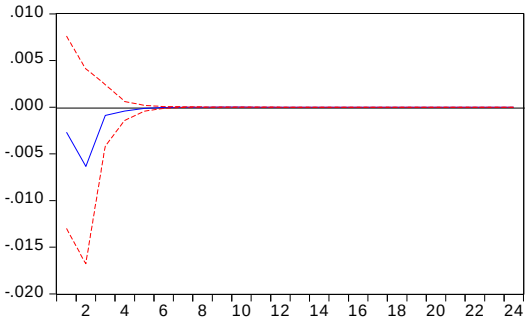
Response of DINCPS to DINM2



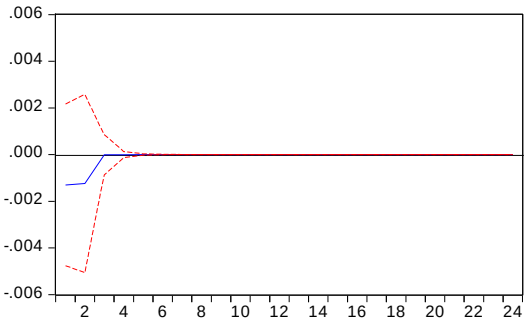
Response of DINASI to DINM2



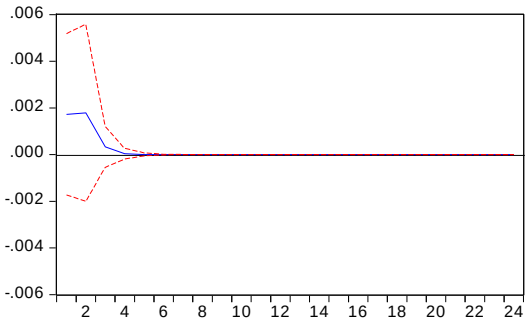
Response of DINASI to DMPR



Response of DINREER to DINM2



Response of DINREER to DMPR



Appendix D: Stability Test- AR Roots Graph