MONETARY POLICY, INFLATION STABILISATION AND OUTPUT GROWTH IN GHANA, 1980-2017

By

IBRAHIM ABDULAI

(Matric No: 211225)

B.A.(Hons), M.Phil. Econs. (Legon)

A Thesis in the Department of Economics,

Submitted to the Faculty of Economics and Management Sciences

in partial fulfilment of the requirements for the award of the Degree of

DOCTOR OF PHILOSOPHY

of the

UNIVERSITY OF IBADAN

JULY 2021

CERTIFICATION

We certify that this thesis was carried out by Ibrahim Abdulai, in the Department of Economics, Faculty of Economic and Management Sciences, University of Ibadan, Nigeria.

……..
Supervisor

Professor Festus O. Egwaikhide
B.Sc. (Econs), M.Sc. (Econs), Ph.D(Ibadan)
Department of Economics
University of Ibadan, Nigeria.

……..
Co-supervisor

Dr. Mutiu Abimbola Oyinlola
B.Sc. (Econs), M.Sc. (Econs), Ph.D (Ibadan)
Reader,
Department of Economics,
University of Ibadan, Nigeria.

……..
Co-supervisor

Dr. Oluwatosin A. Adeniyi
B.Sc. (Agric. Econs), M.Sc. (Econs), Ph.D (Ibadan)
Senior Lecturer,
Department of Economics,
University of Ibadan, Nigeria.

DEDICATION

This thesis isdedicated to my parents, Alhaji Abdulai Adam and Madam Memunatu Narpo

ACKNOWLEDGEMENTS

Pursuing a Ph.D. course in Economics has been the most challenging experience in my academic life. I am extremely grateful to the almighty Allah for giving me the physical and mental strength to successfully complete the programme.

To begin with, this thesis would not have been successfully completed without the help of my supervisor, Professor Festus O. Egwaikhide. I am extremely grateful to him for agreeing to be my supervisor and all the support, guidance and pieces of advice he gave to me. In fact, he has impacted positively on my development as a researcher and as a person for the period that he supervised me. I am also grateful to the members of my thesis committee for reading my work and providing useful comments. However, I am solely responsible for any error, omission and misinterpretation in the work.

Staying away from home to undertake a challenging task of this nature requires good friends around. I am extremely grateful to Dr. Abel Fumey who received me when I first reported in Ibadan and continued to offer his support during the course of the programme. I also wish to thank Dr. Taofeek Ayinde for his unflinching support from data collection to technical assistance. I am thankful to my academic and professional colleague, Mr Victor Osei. Thanks to my colleagues in the CPP programme, Sakinat Olaide Opeloyeru and Oyeteju Odufuwa for sharing useful pieces of information during the course work and the thesis stage.

I am really thankful to my wife, Samira and my children, Iman, Abdul-Shakoor and Abdallah for their patience, prayers and understanding while I embarked on the academic journey. Their support and love gave me strength and determination to get through difficult times. Special thanks go to my parents, Alhaji Abdulai Adam and Madam Memunatu Narpo, and siblings fortheir constant prayers. I wish to express my gratitude to colleagues at the Bank of Ghana including, Miss Mary Mensah, Mr. Emmanuel Kinful, Dr. Zakari Mumuni, Dr. Frank Prah, Mrs. Agnes Ossuan as well as Ms. Kentrone Mercy Ayilo (AERC librarian) for helping me in diverse ways.

Finally, I am sincerely grateful to the African Economic Research Consortium (AERC) for offering me full scholarship to study a Ph.D. programme.

ABSTRACT

Monetary policy is central to the attainment of low and stable inflation, and long-term growth. Ghana's inflation has been relatively high and volatile since 1980 with modest economic growth. Inflation averaged 37.3% and 15.4% annually in 1980-2000 and 2001-2017, respectively. Real Gross Domestic Product (RGDP) grew at 3.2% and 6.2% in the same periods. While various monetary policy strategies had been implemented to stabilise inflation and stimulate growth, the extent to which monetary policy had affected inflation and output has been under-studied. The study, therefore, examined the role of monetary policy in inflation stabilisation and output growth in Ghana from 1980 to 2017.

The New Neoclassical Synthesis which emphasises interest rate as a major tool for controlling inflation and output growth was adopted. Three econometric models, namely Fractional Cointegration Vector Autoregression (FCVAR), Nonlinear Autoregressive Distributed Lag (NARDL) and Structural Vector Autoregression (SVAR) were estimated. The FCVAR was used to determine the stabilisation role of monetary policy by examining the short and long-memory properties of inflation and RGDP growth; and the NARDL model was used to examine the long-run (a)symmetry impact of monetary policy on RGDP growth. The SVAR model was employed to determine the impulse response functions taking into consideration the structural monetary transmission mechanisms. The period consideredincluded 1980-2001 when monetary policy targeted monetary aggregates and inflation-targeting (IT) regime (2002-2017) which used Monetary Policy Rate (MPR) as a stabilising instrument. The variables employed were exchange rate, inflation, MPR, money growth and RGDP growth. Quarterly data were collected from Bank of Ghana's *Annual Reports* and Ghana Statistical Service's *Bulletins*. The estimates were evaluated at $\alpha \leq 0.05$.

The magnitude of the fractional parameters for MPR was 1.24 and 0.79 for money growth. This implies that it took a shorter period for monetary policy to contain inflation and ensure RGDP growth under IT, compared to targeting monetary aggregates. There was a significant negative relationship between MPR and inflation (-0.61), suggesting that an increase in MPR dampened inflation. The impact of MPR on RGDP growth was symmetric (t = -0.0294), as a percentage change in MPR exerted a proportionate effect on RGDP growth. However, the relationship between money growth and RGDP growth was asymmetric (t = -2.3053). A one-standard-deviation shock from MPR increased inflation up to the fourth quarter, while RGDP growth declined in response to the same shock. Shocks from growth in RGDP, money and MPR contributed 9.31%, 3.25% and 7.36%, respectively to the variation in inflation. Inflation was persistent because it retained 43% of self-shock, indicative of a relatively high inflation inertia. A significant variation in MPR (33.37%) is attributable to inflation shock, implying that the monetary authority responded quickly to deviation of inflation from target.

Monetary policy rate had a better stabilisation effect on inflation and a greater impact on output growth than monetary aggregates in Ghana from 1980 to 2017. The use of monetary policy rate should be sustained, while improving its effectiveness through continuous financial sector reforms.

Keywords: Inflation stabilisation in Ghana, Output growth, Inflation-targeting, Monetary policy rate, Monetary aggregates.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 Statement of the problem

The principal objective of central banks all over the world is the achievement of low and stable inflation (Svensson, 2002). Attaining low inflation has become central because of the idea that price stability is fundamental to the achievement of other economic objectives including high and stable RealGross Domestic product(RGDP) growth, sound and stable financial sector and exchange rate stability. In view of this, the ability to choose and implement the right Monetary Policy (MP) strategy that is capable of delivering the key objective of the central bank is crucial in macroeconomic management.Essentially, the choice of MP strategy hasbecome an important subject in theoretical and practical macroeconomic research and policy on monetary economics. Monetary management is quite complicated as it entails a deeper understanding of the structural dynamics of the domestic macroeconomy. Consequently, in choosing a policy strategy just like most macroeconomic policies, the monetary authority mustbe guided by the characteristics of the country. The challenge for the central bankerincludes the identification of objectives andthe choice of specific targets, policy instruments and information setsneeded to facilitate policy formulation and implementation. These factors have to be consistent with the broader macroeconomic objectives. A specific policy framework or strategy guides the central banker in adopting policy instruments forpolicy formulation and implementation (Houben, 1999; and Walsh, 2004).

Several MPframeworks can be identified in the macroeconomic literature(Mishkin, 1999; and Stone and Bhundia, 2004). There are regimes with explicit target. These are: (i) inflation-targeting (IT); (ii) monetary-targeting (MT); and (iii) exchange rate targeting (ERT).For IT,a medium-termtarget is set for inflation and the central bank commits itself to achieving the target. Regarding MT, the key plank is the setting up of medium-term targets for money growth. For ERT, the exchange rate is fixed to that of an anchor country. In some countries, MP is conducted using more than one target. A typical example is the multiple indicators approach practiced in India (Patra and Kapur, 2012). In other countries, MP is conducted without an explicit nominal anchor. Examples are the Two Perspectives Approach in Japan, the European Central Bank'sTwo-Pillar Framework and the Federal Reserve System'sEclectic Approach (Cuaresma and Gnan, 2008).

Practically,the implication of MP on the economy of Ghana has and continued to be subjected to intense policy debate. While there is little or no disagreement over policyobjectives, theexisting debateshinges on the effectiveness of different monetary frameworks in attaininglow inflationwhile ensuring long-term RGDP growth and employment generation. The argumentscentres largely on the extent to which existing regime is able to produce low and stable prices in order to propel the country to meet its growth aspiration. Since the Bank of Ghana (BoG) informally adopted IT in 2002 andformally in 2007, the arguments among various economists have focused on the question of whether the country could have achieved better macroeconomic outcomes under a different policy framework.There are those who remain unconvinced about the prospects of IT in Ghana, as the country continues to face challenges in the financial system, and struggles to deal with fiscal dominance that hinders IT (Gemayel et al., 2011).

Globally, IT continues to gain popularity following the example of New Zealand that pioneered it in 1990. Even though the literature cites various benefits of IT, three key benefits are discernible. These are: (i) the lowering of inflation; (ii) reducing the costs of disinflation; and (iii) the ability to better anchor inflation expectations of economic agents (Bernanke et al., 1999; Johnson, 2002; Levin et al., 2004; Vega and Winkelried, 2005; Mishkin and Schmidt-Hebbel, 2007; and Goncalves and Salles, 2008). In particular, Gonçalvez and Salles (2008) argued that developing economies pursuing IT have

gainedfrom significant drop in the variability of inflation and growth compared to non-IT countries. Also, a survey by Walsh (2009) concluded that IT is important for developing countries because it gives them the opportunity to adopt an effective nominal anchor that is explicit, the hallmark of IT, in order to introduce the neededcredibility to the monetary authority.

In May 2007, the BoG completely abandoned MT and fully embraced IT as its policy framework, becoming the second central bank in Sub-Saharan Africa to do so.[1] The decision by Ghana, a developing country,was not inconsistent with the global thinking which encouraged the adoption of IT by a country which is at lower levels of economic and financial development.[2] Even though several factors motivated the decision of BoG to shift to IT, three key factors are discernible. These are: (i) the consistent failure of the central to bring inflation down to the single digits; (ii) the inability of the BoG to use an efficientpolicy instrument as the dependence on money supply(MS) over the years became ineffective as an intermediate target; and (iii) theinstability of the money demand function due to increased financial innovation and structuralchanges in the economy.Consequently, targeting money growth became problematic (Bawumia et al., 2008).

Historically, Ghana has experienced several episodes of erratic economic growth as well as high inflation, especially during the decades of the 1970s through 1980s. For instance, average inflation in 1971 was 9.6% but rose consistently to 116.4% in 1977 and to 122.9% by 1983. It averaged 47% between 1980 and 1990, and 23% in 1991-2006. The annual average inflation however, dropped to about 13% in 2007-2016, the period following the adoption of a full-fledged IT regime. While inflation exhibited high volatility in the decades of 1970s through early 2000s, it became relatively stable following the adoption of IT in 2007. Inflation averaged 10.7% in 2007 but increased sharply to 19.7% in 2009, largely due to global commodity price shocks and the global financial crisis. This posed a major challenge to the monetary authority as it attempted to steer inflation to the target rate. In 2017, prudent macroeconomic policies together with fiscal consolidation

[1]The Reserve Bank of South Africa is the first central bank to implement IT in Sub-Saharan Africa.BoG pursued IT-lite in the 2002 to May 2007.

[2] key prerequires for IT is for the country to a have a strong macroeconomic fundamental as well as a robust and stable financial system.

contributed to the lowering of inflation to an average of 12.4%. On growth performance, it registered low to negative growth rates between 1970s and early 1980s. Annual average growth rate was 3.6% between 1980 and 2006 and almost doubled thereafter to 6.8% between 2007 and 2016.

The growth of money is next. The growth in broad MS[3] oscillated widely from 51.3% in 1981 to 46.3% in 1988 and further to 52.3% in 1992. It declined sharply to 25.4% in 1999 but increased to 56.5% in 2001. As at 2002, the growth of broad MS stood at 39.2%. During the same period, inflation increased from 15.5% in 1981 to 26.0% in 1988 but declined to 19.4% in 1992. It however, increased to 29.5% in 1999. As at 2001, inflation rate stood at 44.2% and reduced to 24.7% in 2002.

Clearly, trends in inflation did not follow that of MS as the theoretical literature on monetary theory suggests. Thus, the monetary authority in Ghana had to decide on other regimes that could better anchor inflation expectation. Another important development was the significant improvement in the financial system that led to increase in MS as a percent of gross domestic product (GDP) in nominal terms. It rose from 16.9% in 1988 to 24.5% in 1999 and further to 34.1% in 2002. This was followed by increased financial innovation that saw the emergence of new financial products and services. Accordingly, both the money multiplier and velocity became unstable, thus violating a key assumption of stable money demand function underpinning MT (Bawumia et al., 2008).

Having conducted IT for a decade and half, the fundamental question has to do with the extent to whichIT regime has enabled the BoG to control inflation without compromising other macroeconomic objectives such as high and stable output growth. Linked to this is the growing desire to studywhetherMP has heightened or eased booms and recessions in the business cycle. In view of this and together with the fact that empirical studies that seek to answer these questions are nascent in Ghana, there is the need to study the dynamics of MP, inflation stabilization and output growth in Ghana before and during the IT eras.

[3]Defined as (M1) + (M2) + foreign currency deposits. (M1)=currency + demand deposits; (M2)=(M1) + Time and saving deposits.

1.2 Objectives of the thesis

The main objective of this thesis is to analyse the implication of MP on inflation and output in Ghana. The specific objectives of the study are:

i. to analyse theimplications of monetary policyon the stabilisation of inflation in Ghana,
ii. to investigate the asymmetric effect of monetary policy for inflation and output growth in Ghana, and
iii. to examine the structural transmission of monetary policy and other macroeconomic shocks in Ghana.

1.3 Justification for the research

This study is justified on theoretical, empirical and methodological planks. Theoretically, the thesis is anchored on the New Neoclassical Synthesis, extended to account for a more prominent role for money. In the New Keynesian Model,MPaffects inflation through the nominal interest rate (IR) and reference to monetary aggregates is relaxed. However, it has been posited that monetary aggregates, even though may not necessarily play a direct role, facilitate inferences and convey reliable information aboutthe macroeconomy (Arestis, Chortareas and Tsoukalas, 2009; Beck and Wieland, 2007; and Andres, Lopex-Salido and Nelson, 2009). The information content of MP about the macroeconomy is the major fulcrum of IT framework as it has been approached in three major ways in the empirical literature. The first is to influence the equilibrium IR or potential output. The second approach is to obtain the long-memory properties of inflation and growth, while the third approach focuses on the role of money in the midst of data revisions (Arestis, Chortareas and Tsoukalas, 2009). While this study agrees on an explicit role for money as highlighted above, it does not agree on the information channel for money due to the following reasons. First, the debate about the preference between rational expectation hypothesis and adaptive expectation hypothesis determines the information content captured by money. Secondly, information content of money will leave much to subjectivity and it is for this reason that the Bayesian Dynamic Stochastic General Equilibrium (DSGE)has been criticised in empirical investigation. This is because the prior and posterior information

requirements of the Bayesian framework are exogenously obtained. Therefore, this study adopts a more tractable approach where an explicit role for money is introduced through the money market equilibrium into the system of equations.

Empirically, the literature on MP, inflation and output are broadly categorised into various strands. The first relates to how MP has been used to control inflation and promote output growth.It evaluates an optimumpolicy within the fulcrum of the inflation-output trade-off (Apergis, 2002; Narayan, Narayan and Smyth, 2009; and Briec, Gabillon, Laselle and Ratsimbanierana, 2012). The second strand considers the stabilization role of MP in controlling for inflation and output volatility. The third strand is preoccupied with the implication of long-term growth uncertaintiesin the context of optimum and efficient policy framework (Drew and Hunt, 2000; Athanasios, Porter, Reifschneider, Tetlow and Finan, 2000; and Yetman, 2003). Others consider the issue of long-memory properties of inflation and its persistence on the effects of policyshocks (Lovcha and Perez-Laborda, 2018). While extensive research efforts have been dissipated towards the first three strands of the empirical literature, very little enquiry into the fourth strand has beenundertaken. The present study is partly to fill this lacuna using Ghana as a case study.

While various methodologies have been employed to investigate monetary policy, inflation and output, Taylor (1993) technique, extended by Moura and Carvalho (2010); Nojkovic Petrovic (2015); Tillman (2012); and Bleich, Fendel and Rulke (2012), has been largely used. The methodology employed is largely influenced by the objectives pursued. A host of studies interested in shock transmission of MP have estimated the Generalised AutoregressiveConditional Heteroscedasticity (GARCH), Structural Vector Autoregression (SVAR) and recently the Structural Fractionally Integrated Vector Autoregression (SFIVAR) techniques (Haslag and Hein, 1995; Berument and Yuksel, 2006; Miles, 2008; and Lovcha and Perez-Laborda, 2018). Added to these are game-theoretic and experimental studies that compared IT countries with non-IT countries (Ardakani et al., 2018). Researchers who are only interested in impact analyses coupled with short-run and long-run dynamics have employed panel estimation techniques and cointegration methods (Brito and Bysteadt, 2010; and Hayat et al., 2016).

The principal objective of this researchis however, to analyse the stabilisation role of MP in stemming inflation and enhancing growth in Ghana. This study adopts the Fractionally Integrated Vector Autoregression (FIVAR) technique to investigate the short and long-memory properties of inflation and output in the context of policy shocks before and during IT era. This is related to the study of Lovcha and Perez-Laborda (2018) that adopted a Structural FIVAR to investigate MP shocks on inflation. While the study of Lovcha and Perez-Laborda (2018) is an ex-post study, this study is ex-ante as its objective is to investigate stabilisation role for monetary policy. In addition, a Structural Vector Autoregression (SVAR) and a Non-LinearAutoregression Distributed Lag (NARDL) modelare estimated to establish the structural transmissions as well as the symmetric (or asymmetric) effect of MP on inflation and output respectively.

1.4 Scope of the study

The focus of the thesis is to examine the effect of MP on inflation and output in Ghana. The research employed quarterly data from the first quarter of 1980 to the fourth quarter of 2017. The data point is chosen to reflect periods when BoG conducted MP in the context of IT and the period when money was targeted. As highlighted above, BoG officially announced the adoption of IT in 2007, even though, unofficially the process began in 2002. Thus, the period iscarefully chosen in such a way that it helpedto capture different policy regimes implemented by BoG over the last three decades. The period also reflects the phase of the economy when MP moved away from strictly controlled regime in early 1980s to the current period, wherepolicy is largely guided by market fundamentals.

1.5 Organisation of the research

The remaining sections are organised into four chapters. In chapter two,macroeconomic developments andthe evolution of MP in Ghanaare discussed in detail. In particular, monetary developments within the traditional MT and IT regimes are examined. Trends in economic growth and inflationdiscussed under different MP regimes are reported. The chapter also contains a review of the theoretical and empirical literature on MP. A detailed discussion of relevant theoretical and empirical literature on MP, inflation and output

growth is presented. Chapter three contains discussion on the theoretical framework and empirical model upon which the study is predicated. It also captures the methodologyused to estimate the empirical model. This is followed by chapter four where the empirical estimation and analyses are undertaken. Chapter five contains the summary and conclusions from the research andsome policy recommendations.

CHAPTER TWO

BACKGROUND AND LITERATURE REVIEW

This chapter presents discussions on macroeconomic developments and the evolution ofmonetary policy (MP) in Ghana from post-independence till date. Anexamination of developments in key macroeconomics variables including inflation, exchange rate, gross domestic product (GDP) growth,money supply (MS) and exchange rate was carried out. The analyses of these economic indicators were pursued in the context of how macroeconomic policies have evolved over the years and covered the period immediately after the attainment of political independence in 1957 through2017. This helped in understanding the role of various factors in shaping the conduct and outcome of economicpolicies over the years. The chapter also contains a narrative detailing the evolution of monetary regimesincluding the period of direct controls to theIT regime.

The chapter also contains a comprehensive review of the existing theoretical and empirical literature on MP. The macroeconomic literature on monetary economics has identified different MP regimes shaped by competing theoretical frameworks and methodologies. There are studies on how MP has been used to reduce inflation and promote Real Gross Domestic Product (RGDP) within the fulcrum of inflation-output trade-off. Other studies have investigated the stabilisation role of MP in controlling inflation and output volatility using traditional MP framework such as monetary-targeting (MT) and inflation-targeting (IT). There is also an emerging strand that considers the issue of long-memory property of inflation and its persistence following MP shocks. The review of the literature has been carried out to capture the various perspectives.

2.1 Macroeconomic developments

Ghana has a chequered history of macroeconomic developments since the attainment of political independence in 1957. After recordingimpressive GDP growth performance during the immediate post-independence years, the economy began to register poor and volatile growth rates from mid-1960s. With a relativelystrong growth performance in 1950s and early 1960s, growthstarted to slowdown, recording -4.3% in 1966 down from 4.4% achieved in 1963. Growthremained unstable during much of 1960s and 1970s and only began to stabilise from early1980s.Apart from years of very lowgrowth rates, the economy recorded negative growth rates in 1966, 1972, 1975-1976, 1979, and 1981-1983. As indicated in Table 2.1 below, growth averaged 3.1% in the period 1961-1965 but declined sharply to 0% and -0.3% in 1981-1985 and 1986-1985 respectively. The growth rate however, picked up strongly to 4.8% in 1986-1990 and further to 7.1% in 2011-2015 driven largely by the recovery and production of crude oil in 2011 which placed Ghana among oil exporting countries. Headline inflation also increased from an average of 4.6% in 1966-1970 to 70% in 1976-1980. It however, declined steadily to 14.6% in 2016-2017.

An important observation in the growth narrative is that periods of negativegrowth rateswere largely characterised by military interventions in the administration of the country, resulting incomplete policy reversals. There wasa rampant shift in policy stance from relatively market-oriented position to that which was focused on inward-looking, populist and protectionist regimes.Apart from the role of the political economy in macroeconomic performance, periods of negative growth outcomescoincided with global oilsupply shocks that impacted negatively on the balance of payments position.Notwithstanding the generally poor growth performance, some positive growth episodes were registered during the review period. For instance, the economy witnessed growth rate of 10% in 1970. The year was characterised by a relatively liberal economic environment, instituted by the government to promote private investment.

Table 2. 1. Selected macroeconomic indicators (period averages)

	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016-2017
GDP Growth (%)	3.1	3.0	0.0	1.0	-0.3	4.8	4.3	4.3	5.0	6.5	7.1	5.8
Inflation		4.6	17.1	70.0	62.3	31.6	27.5	25.3	20.4	13.6	12.4	14.6
GDP Per Capita (US$)	207	236	271	347	357	392	390	378	376	1127	1876	1998
Per Capita Growth Rate	0.1	0.8	-2.6	-0.8	-3.5	1.9	1.5	1.8	2.4	3.8	4.6	3.5
Exchange Rate	0.0001	0.0001	0.0001	0.0002	0.0021	0.0208	0.0722	0.3316	0.8559	1.2000	2.5349	4.3101
REER (2010 = 100)					1631.2	185.3	129.2	128.0	95.6	102.0	81.7	78.4
Budget Deficits					-0.03	-0.02	-0.1	0.6	-5.9	-5.7	-8.7	-7.0
Current Account Balance (%GDP)				-0.5	-4.1	-2.1	-5.2	-7.5	-5.1	-8.5	-8.5	-4.3
Interest Rates (Annual Average)	5	6	7	11	16	25	32	38	23	15	17	24
Credit (% of GDP)	7.0	8.4	7.9	3.9	2.1	4.1	4.8	10.0	13.0	14.5	14.8	15
Broad Money (Annual %)	14.1	7.4	27.0	43.1	42.9	43.1	44.1	36.1	33.1	34.4	28.3	19.3

Source: Bank of Ghana'sannual reports (various years).

The post-independent years also witnesseda huge public spending. This, together with negative terms of trade shocks experienced in 1962, resulted in large fiscal deficits.To close the resulting huge financing gap, the fiscal authorities relied heavily on the domestic banks and Bank of Ghana (BoG) in particular, to finance fiscal deficits. This, however, created high inflation environment, general macroeconomic instability, low growth and high unemployment. In a bid to deal with the lingering social and economic crises, the military regime[4] that overthrew the Kwame Nkrumah's government in 1966initiatedastabilisation programme immediately after assuming office. The objectives of the programme were to rein in the high inflationary pressures and produceasound economic condition for private investment, growth and employment. The key plank of the stabilisation programme was thecontrol of public expenditureand reduction of public debt to sustainable levels.This was to be supported by significant reduction in direct government involvement in private economic activities while an enabling environment was created for private sector savings and investment. While some successes were made in reducing inflation and growth in money, GDP growth remained negative. Between 1966 and 1967, growth in MS reduced to an average of 0.2%, compared to 12% over 1961-965 period. Inflation declined from 26.4% in 1961to 13.3% in 1966. During the same period, GDP growth recorded a negative growth of 3%. Efforts aimed at achieving a sustainably highgrowth ratemeant that a newtwo-year development plan had to be introduced in 1968 to stimulate economic growth, reduce unemployment (which had risen to about 10.5%), liberalise trade and the foreign exchange market.

The rulingmilitary juntathat overthrew the Kwame Nkrumah's government handed over power to a civilian government which ruled from 1969 to 1971.Favourable global economic conditions, together with improved domestic economic fundamentals during the period created a conducive environment for the government to increase spending on social infrastructure. Earliertrade liberalisation policies led to increased supply of raw materials and enhanced growth in manufacturing. For instance, industrial output increased from 7.0% in 1968 to 10.7% in 1969. Inflation declined to 3.9% in 1970 from 7.1% in 1969. However, negative terms of trade shocks resulting from lower cocoa prices (Ghana's

[4]In 1966, the National Liberation Council (NLC) overthrew the ruling government through a coup d'etat.

major export commodity and contributor to government revenue during that period) led to 28% fall in export earnings. This introduced significant pressures on the balance of payments, leading to substantialerosion of gains made from earlier stabilisation programme. To correct the balance of payment imbalances, the government introduced a number ofinterventionist and inward-oriented policies including restrictions on import, limits on foreign exchange transfers, and a devaluation of the domestic currency by about 44%. While the policies aimed at restoring macroeconomic stability, the major unintended consequences of the policies were shortages of critical imports. This led to price increases during the latter part of 1971. Furthermore, challenges in the industrial sector such as shortage in industrial raw materials (due to import restrictions) and equipmentnegatively affected domestic production. Thus, after recording growth rate of 9.7% in 1970 from 6% in 1969,growth declined to 5.2% in 1971, reflecting weak macroeconomic fundamentals. Inflationary pressures picked up strongly in 1971 as inflation increased significantly from 3% in 1970 to 9.6%(Table 2.2).

Table 2. 2. Selected annual macroeconomic indicators

	GDP growth (%)	Inflation	GDP per capita growth (%)	Current account balance (% of GDP)	Exchange rate depreciation	Broad money growth (annual %)	Credit % of GDP	Interest rates
1961	3.4		0.2			8.8	5.8	4.5
1962	4.1		0.9		0.0	15.2	6.2	4.5
1963	4.4		1.3		0.0	7.3	7.6	4.5
1964	2.2		-0.6		0.0	37.1	7.0	4.5
1965	1.4	26.4	-1.2		0.0	1.9	8.5	4.5
1966	-4.3	13.2	-6.4		0.0	4.9	8.5	7.0
1967	3.1	-8.4	0.9		20.6	1.2	7.6	6.0
1968	0.4	7.9	-1.6		18.5	10.2	8.7	5.5
1969	6.0	7.3	3.8		0.0	10.4	9.2	5.5
1970	9.7	3.0	7.2		0.0	10.0	8.3	5.5
1971	5.2	9.6	2.5		1.4	11.1	12.6	8.0
1972	-2.5	10.1	-5.2		28.8	40.7	10.1	8.0
1973	2.9	17.7	0.0		-12.6	18.8	5.3	6.0
1974	6.9	18.1	4.0		-1.3	26.7	5.7	6.0
1975	-12.4	29.8	-14.5	0.6	0.0	37.9	5.8	6.0
1976	-3.5	56.1	-5.4	-2.7	0.0	37.1	5.9	8.0
1977	2.3	116.5	0.6	-2.5	0.0	60.3	5.0	8.0
1978	8.5	73.1	6.8	-1.3	53.4	68.5	3.5	13.5
1979	-2.5	54.4	-4.3	3.1	55.9	15.8	2.8	13.5
1980	0.5	50.1	-1.9	0.7	0.0	33.8	2.2	13.5
1981	-3.5	116.5	-6.2	-9.9	0.0	51.3	1.8	19.5
1982	-6.9	22.3	-9.9	-2.7	0.0	23.3	1.8	10.5
1983	-4.6	122.9	-7.8	-4.2	221.1	40.2	1.5	14.5
1984	8.6	39.7	5.0	-0.9	307.5	53.6	2.2	18.0
1985	5.1	10.3	1.7	-3.0	51.1	46.2	3.1	18.5
1986	5.2	24.6	2.1	-1.5	64.1	47.9	3.6	20.5
1987	4.8	39.8	1.9	-1.9	72.3	53.3	3.2	23.5
1988	5.6	31.4	2.8	-1.3	31.6	46.3	3.1	26.0
1989	5.1	25.2	2.3	-1.8	33.4	54.7	5.8	26.0
1990	3.3	37.3	0.5	-3.8	20.9	13.3	4.9	27.3
1991	5.3	18.0	2.4	-3.8	12.7	39.1	3.7	31.8
1992	3.9	10.1	1.0	-5.9	18.8	52.3	4.9	22.6
1993	4.9	25.0	2.0	-9.4	48.5	33.5	4.8	34.2
1994	3.3	24.9	0.6	-4.7	47.3	52.6	5.3	30.8
1995	4.1	59.5	1.4	-2.2	25.5	43.2	5.1	41.0
1996	4.6	46.6	2.0	-4.4	36.4	39.2	6.0	45.0
1997	4.2	27.9	1.7	-5.9	25.2	44.1	8.2	45.0
1998	4.7	14.6	2.2	-7.0	12.9	17.5	9.4	43.2
1999	4.4	12.4	1.9	-12.5	52.9	25.4	12.6	28.3
2000	3.7	25.2	1.2	-7.8	99.4	54.2	14.0	27.0
2001	4.0	32.9	1.4	-8.0	3.9	56.5	11.9	27.0
2002	4.5	14.8	1.9	-1.7	15.3	39.2	12.1	24.9
2003	5.2	26.7	2.5	1.3	4.9	23.2	12.5	25.7
2004	5.6	12.6	2.9	-6.6	2.2	27.3	13.2	19.1
2005	5.9	15.1	3.2	-10.3	0.9	19.5	15.5	16.8
2006	6.4	10.9	3.7	-5.2	-1.4	39.3	11.1	14.3
2007	4.3	10.7	1.6	-9.6	11.1	36.8	14.5	12.7
2008	9.1	16.5	6.3	-11.7	20.0	39.2	15.9	15.8
2009	4.8	19.3	2.2	-7.3	16.7	24.7	15.7	18.3
2010	7.9	10.7	5.2	-8.5	7.1	31.9	15.3	14.7
2011	14.0	8.7	11.3	-9.0	6.7	34.0	15.1	12.9
2012	9.3	9.2	6.7	-11.7	17.5	25.1	15.6	14.5
2013	7.3	11.6	4.8	-9.0	17.0	19.5	12.9	15.8
2014	2.9	15.5	0.5	-6.9	45.5	37.3	14.5	18.5
2015	2.2	17.1	-0.1	-5.7	18.6	25.6	15.7	23.0
2016	3.4	17.5	1.2	-5.1	10.7	22.5	15.4	25.9
2017	8.1	11.8	5.8	-3.4	5.2	16.1	13.9	22.5

Source: Bank of Ghana annual reports and statistical bulletins (various years)

The decade, 1972-82, was characterised by widespread political instability as a result of rampant military interventions and domestic social upheavals. Fiscal policy was highly expansive. The central government increased expenditure led tohuge fiscal deficits,largely financed byBoG. In an attempt to deal with high inflation and consistent with what had been done in the preceding years, the authorities decided to impose restrictions on imports, foreign exchange transactions and ceiling on lending rates of commercial banks. Unfortunately, the policies exacerbated the existing economic problems and led to marked distortions in domestic price setting as well as shortages in goods and services. In a bid to address the foreign exchange crisis, the authorities reinforced the pegand devalued the domestic currency by 26% in 1972. However, these interventions further exacerbated the crisis and introduced other unintended consequences. In particular, it resulted in the emergence of parallel markets in the economy. The economic decay was compounded by the 1973 global oil crisis, which aggravated the already precarious balance of payments position. Excessive borrowing by the government from BoG to finance budget fiscal deficits led to increased MS. Indeed, money growth rose from 60% in 1977 to 69% in 1978 (Figure 2.1). The budget deficits had increased from 4.0% of GDP in 1974 to 8.0% in 1975 and further to 11% in 1976. Inflation rose to 116.5% in 1977, compared to 56.4% in 1976. Another stabilisation programme was launched in 1979 but was jettisoned immediately after a military intervention that same year. Even though inflation declined from 73% in 1978 to 54.2% in 1979, the period between 1979-1982 witnessed further deterioration in the macroeconomy reflecting persistently high inflation, poorgrowth performance and structural balance of payments deficits. By 1982, the economy was in crisis, and requiring a pragmatic approach to economic policy management (Alagidede, Baah-Boateng and Nketiah-Amponsah, 2013).

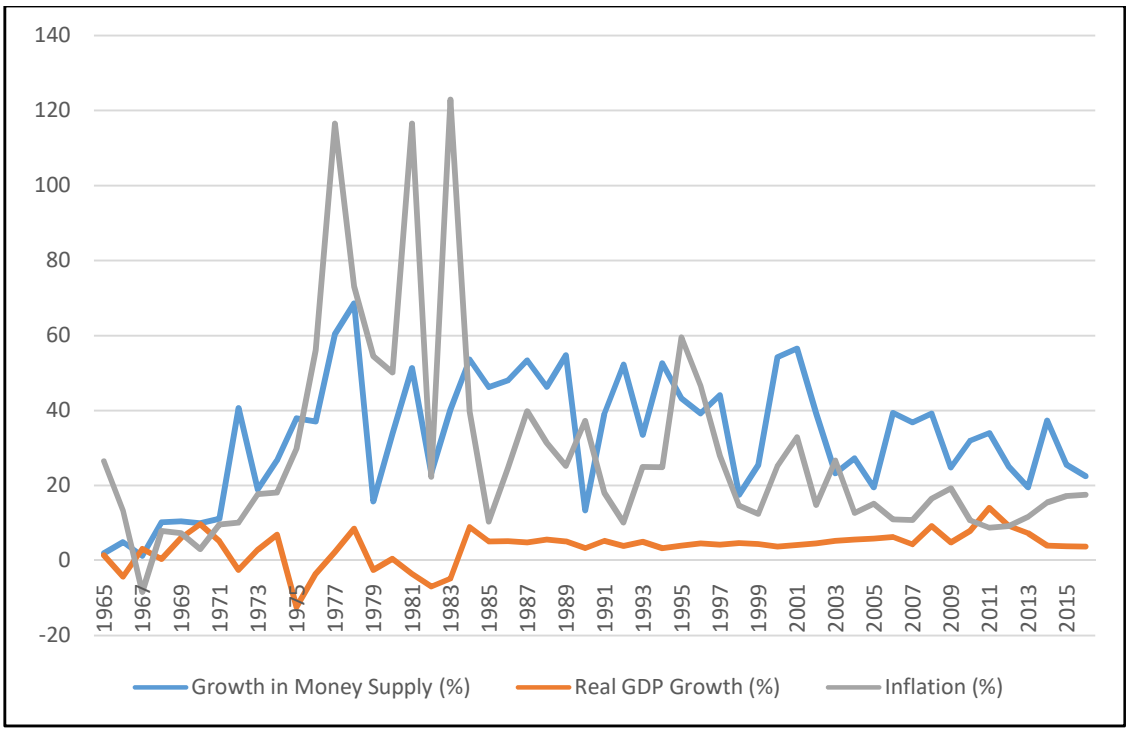

Figure 2. 1. Money supply, real GDP growth and inflation

Source: By the author using data from the Bank of Ghana's annual report (various years)

Against the backdrop of severe macroeconomic decay and structural rigidity during the decade of 1960s and 1970s, the authorities, in 1983,subscribed to package ofreform programmesunder the auspices of the World Bank and the International Monetary Fund (IMF). The programme had two broad components. These are: (i) the Economic Recovery Programme (ERP) introduced in 1983 and (ii) the Structural Adjustment Programme (SAP)launched in 1986. The core objectives ofthe programmes were:(i) to correct the persistent macroeconomic imbalances; (ii)to remove the lingering structural bottlenecks in the country;(iii) to build a formidable social infrastructural network needed to facilitate economic activities; and (iv)to rebalance the economy by opening up sectors that had hitherto been subjected to state monopoly and controls to private sector participation. Among the policies were: (i) the liberalisation of interest rates; (ii) exchange rate reform; (iii) reducing the growth in MS to levels consistent with economic growth and inflation target; (iv) reducing budget deficits; and (v) introducing market administered prices in economic transactions. Reforms in the financial sector, underpinned by the financial repression hypothesis of McKinnon (1973) and Shaw (1973), represented a key element of the SAP. Ghana was confronted with huge and unsustainable amounts of public debt by the end of 1980s and, thus, crowding out the private sector from the market for loanable funds. Domestic investment was severely affected and negatively impacted economic activity.Consequently, and in the quest to raise capital to finance business activity, there was the need to pursue a comprehensive financial sector reform.

At the initial stages of the ERP, the authorities were preoccupied withthe need to achieve macroeconomic stability.Issues relatingto structural macroeconomic adjustment and growth were to be dealt with once macroeconomic stability was achieved. The Ghanaian economy responded positively to the paradigm shift in macroeconomic management during the early period of the ERP. As presented in Table 2.2, asharp increase in growth rate of 8.6% was achieved in 1984 compared with a negative 4.6% recorded in 1983. Average annual inflation dropped significantly from 123% in 1983 to 39.7% in 1984 and further down to 10.3% in 1985. Considering the first decade of the stabilisation programme, inflation averaged 26.1%. It increased to 28.5% during the second decade, though lower than the decade prior to the reforms. Subdued inflation and improvedGDP growth recorded during the reform period was largely a reflection of improved domestic

macroeconomic policies, supported byhuge foreign directinvestments and foreign aid that enabled the government to increasepublic expenditure on socialinfrastructure (Aryeetey and Tarp, 2000).

Generally speaking, the economy respondedpositivelyto the new policy measures notwithstanding intermittent shocks that highlighted the structural vulnerability of the country. As strongly echoed in earlier discussions,real GDP growth and its per capital exhibited significant volatility and sometimes negative during the 1970s.Specifically, headline inflation was not only high but volatile.Gross investment had declined to an average of 7% of GDP during the period. An interesting observation during the pre-reform period was that government austerity measures did not result in a decline in the fiscal deficit because revenue mobilization effort was extremely poor.

The hitherto negative growth narrative began to change as the authorities started to implement the various aspects of the reform package albeit sequentially. Real GDP growth averaged 6.3 from 1984 to 1986 while GDP per capita recorded a growth rate of 2.8% during the same period. A characteristic feature of the period following the economic and financial sector reforms is the relative stability of GDP growth albeit intermittent periods of less than expected outcomes. As a share of GDP, total gross investment increased sharply from about an average of 7%in the period prior to the reforms to about 22%during the latter part of 1990s, and to 26% from 2000 to 2005. Contrary to theoretical expectations on the effects of exchange rate reforms, budget deficits of the central government and headline inflation dropped in the immediate post-reform period. While significant achievement was made at reducing fiscal deficits up to the latter part of the 1980s, the phenomenon of high deficits re-emerged around 2000 due to high election induced expenditures. As can be seen in Figures 2.2 and 2.3, headline inflation recorded low and relatively stable rates compared to its pre-reform levels. Foreign aid increased from an average of 3.5% of GDP in the period before reform to about 11% in 1987-1993 andto 12% in 2000-2006.

Significant volatility in inflation and output is clearly discernible during the periods before the formal adoption ofIT (Figures 2.2 and 2.3). This observation is consistent with various episodes of inflation discussed above. Some stability was achieved during the latter stages of SAP and the years following the adoption of formal IT. In 2011, GDP growth increased by 14%, the highest in the history of the country. The increase was mainly due to

theproduction and exports of crude oil[5]. In 2007 when the BoG officially moved into full-fledged IT, a medium-term inflation target of 5% within ±1% range was announced but later revised to 8% with a symmetric band of ±2%. Significant debt reduction following the heavily indebted poor country (HIPC) initiative led to significant decline in public debt thathelped stabilise the exchange rate. However, external factors such as fuel price shock which began during the latter part of 2007, together with expansionary fiscal policy in 2008, introduced new inflationary pressures and complicated monetary policy. Consequently, inflation consistently diverged from the announced target.

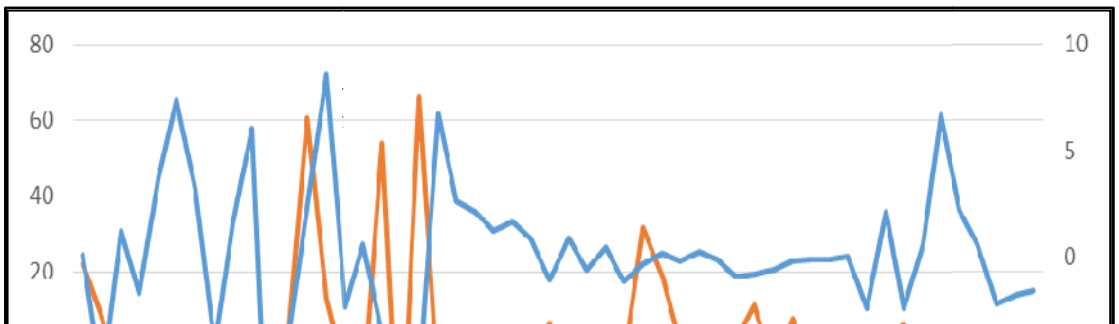

Figure 2. 1: Output and inflation variability in Ghana

Source: Author

Figure 2. 2. Inflation and output volatility

Source: By the author using data from the Bank of Ghana's annual reports (various years)

Figure 2. 3. CPI inflation and inflation target

Source: By the author using data from the Bank of Ghana's annual report (various years)

2.2 Monetary policyand macroeconomic management

The choice of MPregimehas evolved over several decades in tandem with changing dynamics and characteristics of structural and political economic environment in Ghana. While the policy approach and the type of instruments used have changed considerably from a predominantly control system to market based framework, the broad objective continues to be the attainment of price stability; albeit, growth objectives featured stronglyduring the early 1980s when macroeconomic stability and growth objectives became central to economic policy management. During the period preceding ERP, one of the key challengesthat impacted policy formulation and implementationwasexcessive liquidity overhung arising from persistent monetisation of budget deficits.

During the latter part of the 1960s, MP was largely restrictive. In 1967, for instance, the central bank imposed a 10% ceiling on banks' lending to households and private companies while credit was strictly rationed towards selected areas including manufacturing, exports and agriculture. The main instruments used by BoG to control MS from the 1960s to the mid-1980s were nominal Interest Rates (IR), credit controls and cash reserve requirements. For instance, the IR was administratively adjusted upwards from 5.5% in 1970 to 8% in 1971 by the central bank. To stimulate the so-called priority areas of the economy, the central bank reduced the ceiling on total credit to these sectors from 20% to 33.3% in 1971. These policies led to increase inMS to 41% in 1972, while inflation increased marginally from 9.6% to 10.1%.

Monetary policy approach can be classified as being largely expansionary during the greater part of the 1970s.The quest to undertake large scale investment in social infrastructure in the midst of weak domestic revenue mobilisation efforts, and the lack of external inflows meant that the government had to resort to huge budget deficits financed from domestic sources which were eventuallymonetised by the central bank. In 1973, the authorities reduced the IR to 6.0% and maintained it till 1975 andadvanced more credit to selected sectors.The implication of the above policy stance was that itresultedinsubstantialgrowth inMS from 23% in 1974 to 72.4% in 1978. Consequently, inflation increased to 117% in 1977. In a bid to stem the rising inflation and correct the macroeconomic imbalances at the time, the government introduced another stabilisation

programme in 1979. Fiscal and monetary policies werepursued with the aim of achieving the necessary adjustments in total domestic demand needed to stem inflation and achieve higher economic growth. The central bank's policystance became tighter as the policy rate was increased from 6.0% to 13.5% in 1979. In addition to the IR hike, a limit was imposed on the net domestic assets of commercial banks, thereby limiting their ability to extend additional loan to economic agents. To control excessive lending to the central government, a limit was placed on net claim on the central government.

The government also pursued some unorthodox policies to address the lingering macroeconomic challenges facing the country. In line with this, the government embarked upon an ambitious currency reform programme in 1979[6]to mobilise excess cash that was thought to be idlingin the non-banking sector. While currency outside the banking system was exchanged at 30% discount, bank deposits were exchanged at full value. The immediate effects of the policy were drops in money growth and inflation. Growth in money declined sharply to 13% in 1979, down from 72% in 1978while inflation dropped from 73.1% to 54% in the same period. However, positive outcomes for inflation did not reflect in output growth.Understandably, real sector activities suffered due to the austere measures pursued by the government. Real GDP growth dropped significantly from 8.5% in 1978 to -2.5% in 1979 before recovering marginally to 0.5% in 1980.

There was no definite policy stance of the BoG during the early 1980s. The policy rate which had been increased to 13.5% in 1979 was maintained at that level in 1980. During the period, an important MP action pursued was the change in the policy on reserve requirements. Cash reserve ratio was lowered to 40% from 48%, while other reserve ratios went down to about 20%. However, the above policy was quickly reversed in 1981 following the significant growth in MS from 13% in 1979 to 34% in 1980. Consequently, BoG hiked the IR from 13.5% to 19.5%, while cash ratio and other reserve ratios went up to 42.0% and 27.0% respectively. In addition, credit ceilings for priority sectors were set within 20% to 100% margin, indicating more credit being allotted to those sectors. However, these policy measures were not strong enough to stem the high growth in

[6] The BoG replaced the existing notes and coins in circulation with newly designed ones.

money and inflation. Money supply growth increased to 55% in 1981. The economy witnessed inflation rate of 116% and GDP recorded a -3.5% growth.

With the economy recording negative RGDP growth, the authorities had to lower interest rate to stimulate domestic investment. The BoG reduced interest rate from 19.5% to 10.5% in 1981 and the minimum reserve cash ratio was reduced to 30% while other reserve ratios went down to 25%. In 1982, BoG introduced another unorthodox MP to control liquidity by withdrawing selected currency notes in circulation. All fiftycedi notes in circulation worth about 1.3 billion cedis were withdrawn from the economy. All bank deposits of fifty thousand cedis or more were frozen and subjected to vetting for any fraudulent gains. Both MS and inflation recorded reduction in their respective growth rates to 23% and 22% in 1982. Economic growth, however, remained sluggish with yet another growth of -6.9%. Not surprisingly, the policy led to widespread hoarding of currency as itbattered public confidence in commercial banks and created serious credibility gap between the citizens and the government. As a result, savings in the banking sector were severely affected. On the whole, monetary polies implemented prior to ERP were not successful in correcting macroeconomic imbalance in Ghana.

As stated earlier,ERP was introduced in 1983 to correct the persistentmacroeconomic imbalances and structural economic issues in the country that had existed since independence. Importantpolicy tools that came under rationalisation were interest rates, credit ceilings, cash reserve ratios and the exchange rate. The economy recorded impressive GDP and inflation outcomes during the period immediately after the ERP was launched. During the first phase of the ERP[7], the stabilisation phase, inflation declined from 123% in 1983 to 10.3% in 1985 while RGDP growth jumped from -4.8% to 5.1% during the same period. The dynamics of the political economy had some effects on the domestic economic fundamentals. Particularly, elections years were associated with huge government expenditure, which tended to be inflationary. The average annual inflation

[7]The ERP was structured in three main phases. The first phase, covering the period 1983-1986, focused on rationalising government expenditures while creating a conducive environment for investment. The second phase (1987-1989) was preoccupied with the divestiture of state own enterprise and foreign exchange reforms. In thethird phase, monetary reforms were pursued vigorously intensified and corporate taxes were reduced to boost investment and production.

rate within the stabilisation phase was 24.8%, excluding the 1983's figure but averaged 33.1% during the period 1983-2001. It is worth noting that there were periods when inflation was brought down to as low as 10% (in 1985 and 1992), but was not sustained. Inflationary pressures significantly moderated from 2003 with a single digit inflation of 8.7% in 2011 and 9.2% in 2012. Inflation generally trended downward and averaged 14.5% in the period 2002-2017 (Figure 2.4). The major factor that contributed to this downward trend included the significant inflow of resources into the economy from debt relief under HIPCas well as the Multilateral Debt Relief Initiative (MDRI). The IT regime in place also helped BoG to better anchor inflation expectations. Even though inflation started to trend downwards from 2003, factorssuch as external shocks following the global financial crisis, and fiscal slippages created an upsurge in inflation that increased to 19.3% in 2009. Real GDP growth was relatively strong, averaging 6.5% during the period 2002-2017. It grew strongly from 4.5% in 2002 to 14% in 2011, mainly driven by crude oil exports. However, growth rate subsequently slowed to 3.6% in 2016. The low growth was due to the fall in global cocoa and oil prices. Also, inadequate electricity supply negatively affected activities in the industrial sector.

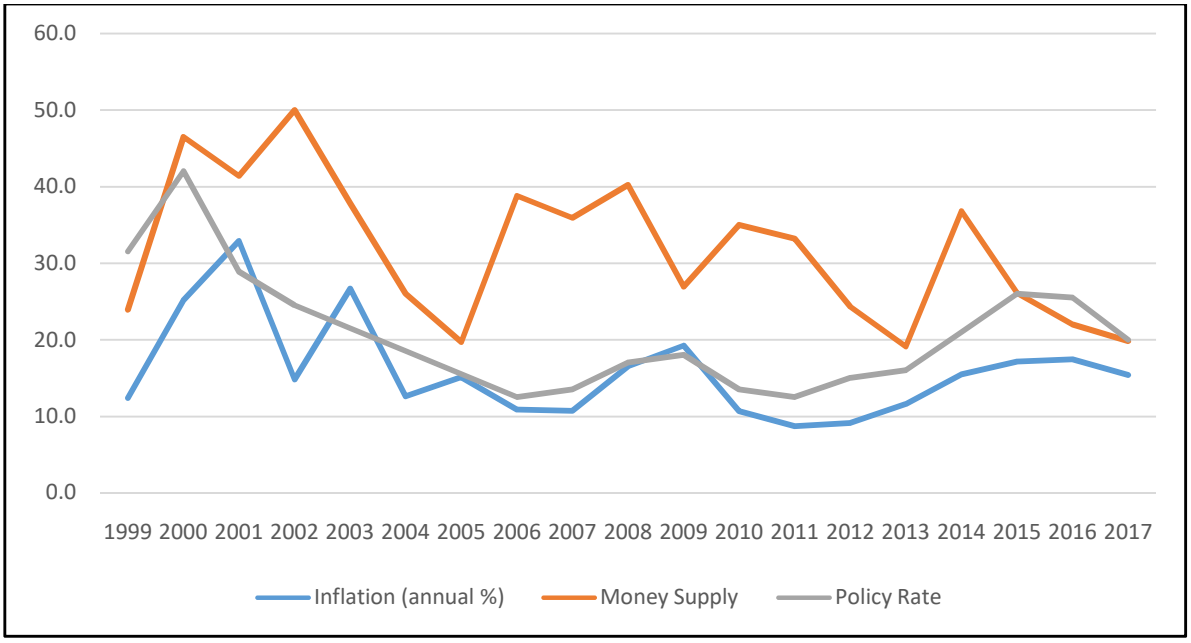

Figure 2. 4. Inflation, money growth and policy rate

Source: By the author using data from the Bank of Ghana's annual reports (various years)

2.2.1 Interest rates and domestic credit

The country recorded negative real interest rate during the 1960s and 1970s due to the excessive controls in the economy. This created a disincentive to private savings and, therefore, constrained the ability of banks to mobilise surplus funds in the economy for investments. In view of this, therefore,identifying and correcting the factors that led to the distortion of the yield curve underpinned interest rate policy of the BoG during the early phase of ERP. The BoG acknowledged the need to allow the IR to be market determined and so adopted a gradualist approach in moving towards a liberalised system. The IRwas increased to 14.5% in 1983 whilst savings and lending rates were maintained at 11.5% and 19.5%, respectively. However, it did little to rein in inflation as it increased to 123% in 1983 due to domestic and external factors.[8]Notwithstanding these challenges,the BoG continued to implement tight policies and limited the amount of credit to the government. To control government expenditure and curtail the monetisation of the budget deficit, public sector borrowing from the banking sector was discontinued. Instead, the government focused on external sources of financing to meet revenue gaps. The IR was increased further to 18.0% in 1984 and reviewed regularly to ensure that positive Real Interest Rate (RIR) existed at all times. On top of that, the minimum savings deposit rate rose to 15.0% while the maximum lending rate went up to 21%.

The BoG also undertook reforms aimed at removing distortions in the financial market that prevented opportunity cost of capital to be reflected in the market IR. For instance, BoG changed the IR policy from that which was subjected toadministrative control to a market determined system in 1988. It was also meant to pave the way for the introduction of Open Market Operation (OMO). Essentially, high inflationary expectations at the time meant thatthe prevailing yield curve did not provide enough incentive for savings mobilisation. For instance, the average interest rate on 12-month deposits recorded between June and December 1990 was 17% per annum and inflation averaged 35%. The policy rate was adjusted upwards from 26% to 30% and finally, to 33% in December 1990. Subsequent adjustments were undertaken in order to mobilise excess cash in the economy. Excessive liquidity beyond what was optimal for the market was considered as

[8]See for example, Sowa and Kwakye (1993) or Chibber and Shafik (1991)

the major source of inflationary pressures in Ghana. Thus, credit policies of the BoGcontinued to focus onmaking domestic credit available to areas deemed critical for economic development such as agriculture. In 1988, the BoG introduced reforms to credit ceilings. For the first time, the central bank imposed quantitative credit ceilings on commercial banks in order to control and monitor domestic credit and abolished sectoral credit ceilings. The understanding was that, the sectoral credit ceilings did not allow for proper distribution of fundsto the various sectors. Again, the sectoral credit ceilings did not encourage commercial banks to beinnovative and adopt competitive banking practices. Consequently, sectoral credit allocation was terminated whilst global ceilings remained. This implied that commercial banks could use their discretion in grantingloans. Private sector credit to households and firms has witnessed significant growth over the past years. On annual basis, it constituted 13.8% in the 2002-2017 period compared to 7.7% of GDP in 1990-2001 (Table 2.3 and Figure 2.5).

Table 2.3. Sectoral distribution DMBs' credit (millions of Ghana cedis)

	Dec-13	Dec-14	Dec-15	Dec-16	Dec-17	Dec-18
Public Sector	2,205.80	3,059.20	3,896.00	5,425.50	3,842.50	5,131.20
Private Sector	14,757.20	21,042.70	26,203.10	29,983.50	33,987.00	37,593.20
Agric, For. &Fish	535.90	890.10	1,020.70	1,130.00	1,343.70	1,428.20
Export Trade	130.60	226.80	145.00	162.30	311.90	319.10
Manufacturing	1,466.50	1,963.90	2,363.80	2,576.00	2,930.20	3,975.10
Trans., Stor., & Comm.	674.00	1,255.00	1,170.10	1,262.20	2,272.80	2,831.50
Mining & Quarrying	448.20	655.10	570.90	694.80	1,098.40	1,375.70
Import Trade	1,521.30	1,831.60	2,140.90	2,048.40	1,877.10	1,358.70
Construction	1,480.00	2,205.10	2,759.90	3,133.60	3,763.30	3,719.90
Commerce & Finance	2,424.20	3,070.70	4,309.00	6,803.30	7,072.30	7,684.90
Elect., Gas & Water	1,196.90	2,039.90	3,307.50	3,445.60	2,897.60	2,863.10
Services	3,730.00	4,719.60	5,866.50	5,591.10	6,238.20	7,978.90
Miscellaneous	1,149.60	2,184.70	2,548.90	3,135.60	4,181.60	4,058.10
Total Outstanding Credit	16,963.00	24,101.90	30,099.10	35,409.00	37,829.50	42,724.40

Source: Computed by author using data from Bank of Ghana's annual reports

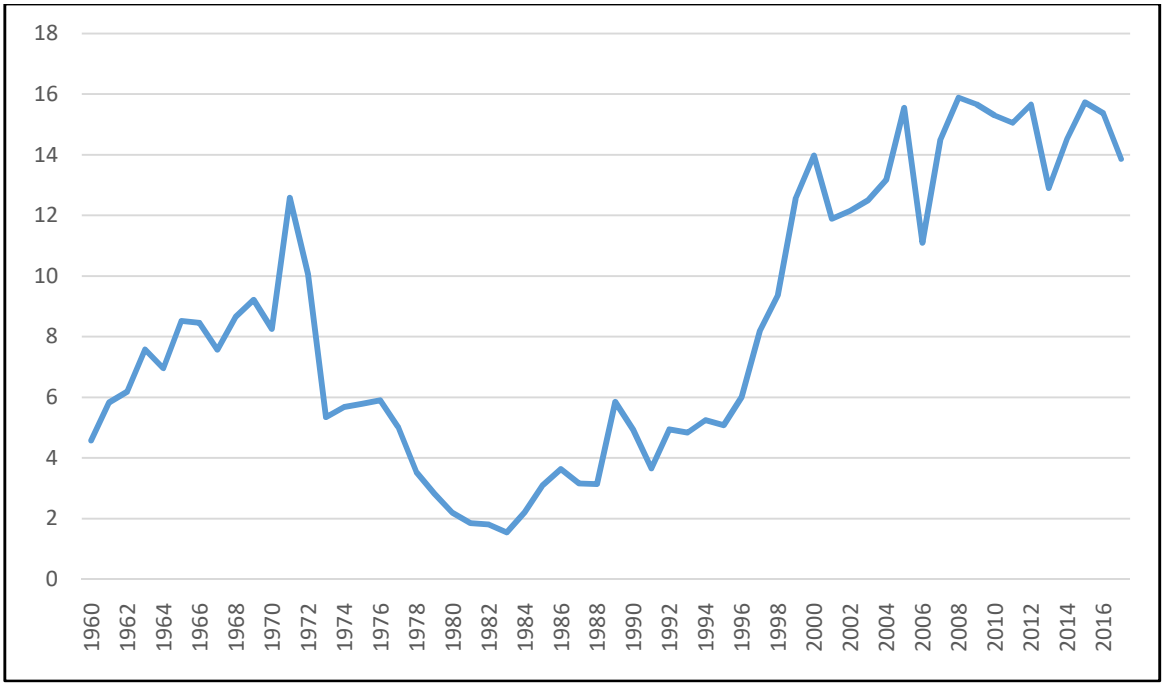

Figure 2. 5. Credit to the private sector (% of GDP)

Source: Author, using data from Bank of Ghana'sannual reports (various years)

2.2.2 Open market operations and reserve requirements

Initially, the purpose of cash reserve requirement was to serve as a guaranteed source of funds to finance the central government's budget deficit. Thus, the levels did not signal MP stance. Instead, it introducedimpediments to effective and efficient treasury management of commercial banks. Consequently, and in line with the reform agenda, the BoG restructured the policy on reserve requirements to ease the liquidity situation of commercial banks and make available sufficientfunds for private sector investment.[9] In 1988, there was a switch so that cash reserve requirements became tighter than secondary reserves. The cash ratio was raised from an average of 23% to 25%, while other ratios went up to 12.5% from 10.2%.[10] Generally, reserve requirements did not appear to be an effective MP tool. During the period for which it was used as quasi-MP tool, it was not seen as an effective tool for liquidity management as commercial banks heldsignificant excess reserves beyond the prudential limits. In March 1990, the reserve requirements of banks were revised upwards to further mobilise excess cash to meet government borrowing requirements. The cash reserve ratio was set at 27% of total deposits as compared to cash ratio of 30% on demand deposits and 10% on savings and time deposits during the preceding year. During the transition to formal IT, secondary reserve requirement was abolished. This was to make liquidity available to the banks to enhance the transmission mechanism of MP.

In an attempt to improve and introduce market dynamics to monetary management, the BoG introduced Open Market Operations (OMO)in 1988. Various money-market toolsincluding government of Ghana bills (treasury bills) and other securities were introduced to the banking and non-banking sectors. These were aimed at: (i) providing investment opportunities for excess liquidity in the financial sector;(ii) creating an environment for a market determined IR; and (iii) developing an active money market where liquidity could be traded at the inter–bank level. For most part of the period, the

[9] Ghana of Ghana Annual Report (1985) p. 7

[10] Primary reserves are the proportion of deposits of banks held with BoG. Secondary reserves are another proportion of deposits that were supposed to invested in government of Ghana securities. Primary reserves with the central bank were, however, not remunerated.

BoG used OMO to mobilise excess liquidity and to encourage private savings in areas less exploited by the commercial banks.

2.2.3 Exchange rate policy and redenomination of the cedi

As with key macroeconomic indicators discussed above, the exchange rate policy has evolved over the years, moving from the era of fixed regimes to the current regime where the rate is allowed to be determined by market fundamentals albeit with intermittent interventions by the BoG to fine-tune the market.Between 1957 and 1982, the system can be described as largely fixed regime.From 1957 when the country gained independence to mid-1966, the domestic currency was pegged to the British Pounds.The peg was then shifted to the US dollar from 1966 to 1982,largely motivated by political rather than economic factors (see Harrigan and Oduro, 2000). The policy to systematically move away from a controlled regime to a relatively market-determined system began in 1983 to coincide with the advent of the ERP. Because of the overvalued nature of the domestic currency arising from the historical fixed regime, a policy to gradually devalue the domestic currency began in 1984. This replaced the adjustments that were made on quarterly (BoG, 2010). The auction system was instituted in 1986 to improve the way the rate was adjusted during the transition totrade liberalisation. Accordingly, the exchange rate waspartly market determined with some interventions by the BoG. In addition to the auction system, a dualsystem was put in place through the auction market approach. The first window maintained a fixed but changeable exchange rate and applied to government related transactions, cocoa, petroleum and non-traditional exports.In the second window, a weekly auction system was employed where the exchange rate covered other transactions not captured in the first window and was market determined. In 1987, the two exchange rates were merged and completely liberalised in 1988. To deepen the exchange rate market, the government enacted a law that allowed forindividuals to be licensed to operate forex bureaux (Bhasin, 2004). The period 1990-1992 witnessed the replacement of the weekly retail auction with the inter-bank wholesale market. Consequently, the system of wholesale auctioning was abolished and replaced with the inter-bank marketwhere the BoG is a participant.On exchange rate developments, the trend clearly shows an erratic path. Historically, the domestic currency has depreciated consistently with isolated cases of appreciation (Figure 2.6).

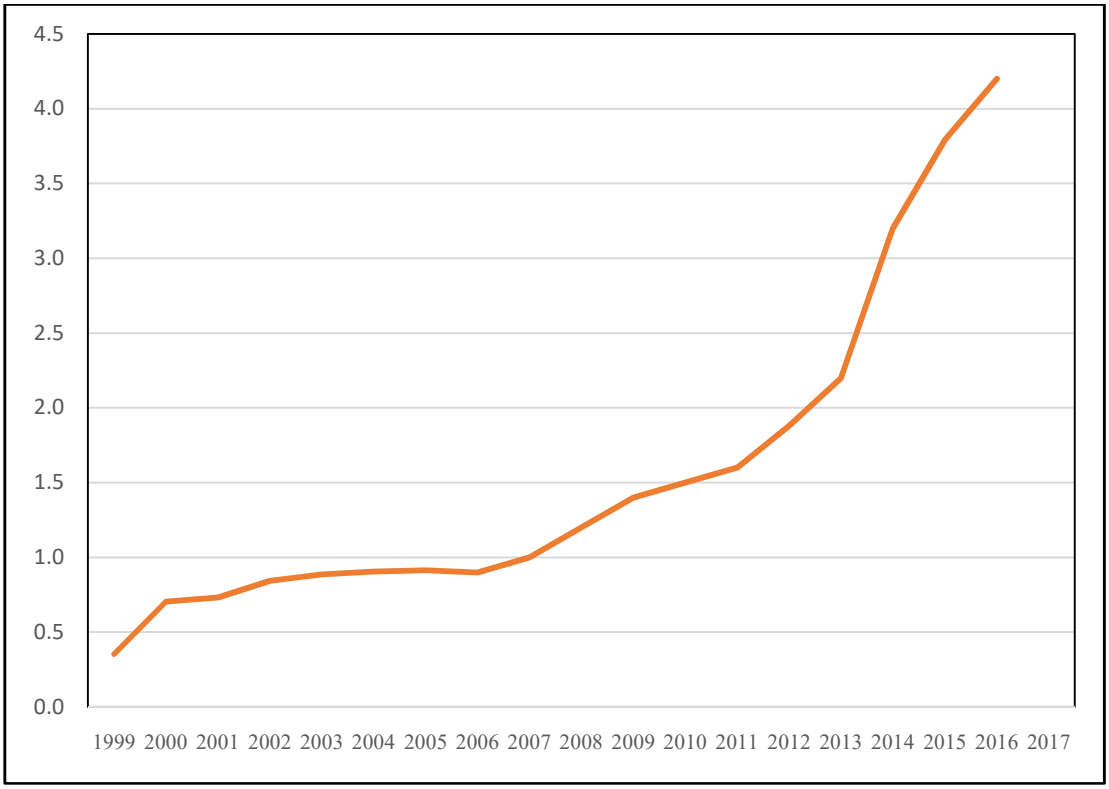

Figure 2. 6. Exchange rate (GHS/USD)

Source: Author, using Bank of Ghana'sannual reports (various years)

Having achieved relative macroeconomic stability, the central bank embarked on a currency redenomination exercise that led to the change in the currency note and coins in circulation in June 2007. Ten thousand Cedis (the existing currency at the time of the re-denomination) was replaced with 1 New Ghana Cedi. Unlike similar exercise in the past, the value of the currency remained unchanged and there was no time limit within which the old currency could be exchanged for the new Ghana cedi. The need to address the issue of high numerical values of prices (the consequence of past episodes of macroeconomic instability including high inflation and excessive depreciation of the domestic currency)underpinned the idea behind the exercise. It was perceived that the policy would: (i) enhance efficiency in economic transactions; (ii)eliminate the challenge of carrying large sums of cash to transact basic economictransactionswith its attendant risks; and (iii) improvethe book and record keeping system of institution. Prior to the redenomination exercise, the Cedi was traded between¢9,300 to ¢10,000 against the US Dollar. It became ¢0.93–¢1 to 1USD after the redenomination. However, this did not imply that the underlying purchasing power of the domestic currency has changed. Thus, the purchasing power of the old currency remained the same as the new one.

2.3 Evolution of monetary policy frameworks in Ghana

2.3.1 Controlled regime

In Ghana, MP management has undergonesignificantmodifications over the past decades. From early 1960s throughthe mid-1980s, the system of monetary management can be described as that of a controlled regime. During this period, the BoG imposed limits on loans to individuals and institutions, regulated interest rates, and set reserve requirements on banks deposits[11] in order to achieve money growth targets.The authorities preferred this approach to controlling money growth because of the relative ease of implementation and monitoring. At the beginning of each year, theBoG set target for money growth based onRGDP growth projections and inflation. The next step was to establish the credit growth

[11] The deposits were kept with the Bank of Ghana and not remunerated.

that was consistent with the target and then, allocate the credit among banks based on the criterion set by BoG. However, the major challenge with the controlled regime was that it resulted in a situation where the banks were left with excess cash with no avenue to invest. Because of the lack of productive areas to invest the excess liquidity, it created a disincentive for banks to go for additional savings mobilisation. Another major problem associated with the system was that real interest rates were generally negative since the lending rates was lower than the rate of inflation (Addison, 2001).

2.3.2 Monetary targeting

To improve the efficiency of monetary management, the BoG introduced an indirect approach to MP management in 1987. This implied the adoptionof indirect market base instruments such ascash reserve requirements, OMO and repurchase agreements.[12] As was the case in all monetary-targeting (MT) central banks globally, the motivation for moving to MT regime in Ghana was anchored on the understanding thathigh inflation wasdue to growth in money. Several authors concluded that changes in prices weredue to growth in money supply in Ghana (Ewusi, 1997; Kwakye, Addison, and Wampah, 1996; and Lawson, 1996). Thus, inflationary pressures in the country were largely driven by dynamics in money growth. As a consequence, and consistent with the global trend at the time, controlling growth in money was considered the best approach to controlling inflation.

The BoG and theFinance Ministry set the targets for inflation and real GDP growth using a financial programming framework. The link between money (the intermediate target) and inflation was based on the quantity theory identity and evolved over the years. Initially, narrow money supply (M1), representing demand deposits and currency in circulation,was used as an intermediate target. Over time, as quasi money[13] grew and became important, theBoGmoved to M2 (adding time deposits and short-term savings to M1). Finally, in 1997, the authoritiescame up with a broader definition of money supply, M2+, that includes foreign currency deposits. This was because, foreign currency grewand became significant in the balance sheet of the banks. With MP oriented towards an

[12] Including repo, foreign exchange reserve, and forex swaps.
[13]It comprises time plus savings deposits held with banks.

indirect approach, BoG was able to rein in money growth (intermediate target) through an operating target for which it had greater control.[14]

Net Domestic Assets (NDA) and reserve money were the two operating targets employed by the BoG.[15]Initially, a floor was set for the Net Foreign Assets (NFA) while NDA was used as the sole operating target. This was because NFA was not viewed as contributing largeliquidity in the economy. This was especiallyduring the early stages of the ERP as export earnings were relatively low. The leadingcauses of excess money was basically the claims of BoG on the central government and private institutions. In this regard, targeting NDA was considered an appropriate toolforcontrolling credit to the central government, households and institutions. When exports revenue started to increase and external inflows became huge, it meant that relying on NDAalone was not adequate in controlling liquidity. Consequently, the argument in favour of adopting reserve money as the operating target became pronounced.

2.3.3 Inflation targeting

Before the discussion on IT in Ghana is pursued, it is necessary to shed some light on the rudiments of IT. Over the past twenty years, pursuingMP in the context of IT has and continues to gain popularity across the world. New Zealand started to implement IT in 1989 and was subsequently embraced by several advanced countries. IT is a monetary framework that embodies the following key features: (i) aclearly specified inflation target announced for the medium-term; (ii) core mandate of the central bank being the achievement of stable prices in the economy; (iii) relying on several information to inform decision making on theIR; and (iv) transparency and accountability in monetary management(Mishkin, 2001). The key plankofIT is a clear decision on what price stability means in practice. Pricestability is said to prevail when inflation is very low and stable.In such an environment, economic agentshardly consider the prospects of high future inflation in economic decision making (Miskin, 2001). Thus, economic agents (including

[14]A necessary condition is that there must be link between intermediate target and the operating target.Hence, achieving the operating target implies attaining the intermediate target and subsequently, the ultimately goal, inflation.

[15]Relationship between RM andMS is via money multiplier. Thus MS = m*(Reserve money), where m=money multiplier.

producers and buyers of goods and services) rarelyconsider the possibility of higher prices in the future.

For IT to be successful, certain prerequisites and initial conditions have to be satisfied. The prerequisites are largely related to elements of IT mentioned above. The key prerequisites include: (i) the existence of an independent central bank covering operational and instrument independence; (ii) an efficient and developed infrastructure for policy making and implementation; (iii) a sound domestic economic fundamental; (iv) a strong and stable financial system; (v) absence of fiscal dominance; and (vi) the absence of external dominance (Batini and Laxton, 2006). Among the various factors mentioned above, the importance of fiscal solvency under IT framework has been highlighted in the literature. Growing fiscal deficits and high debt burden adversely impacted the ability of the monetary authority to carry out policies that adequately control inflation. Initially, IT was seen as a framework meant for developed countries. As time went on and given the success of the framework in most countries, it became acceptable that developing countries could adopt IT without necessarily having to meet all the preconditions(Batini and Laxton, 2006).

Even though Ghana's economy showed signs of recovery in the mid-1980s to the early 1990s, macroeconomic challenges emerged during the latter part of 1990s through early 2000s due to poor domestic economic management and external shocks. Inflation increased to 32.9% in 2001 while real GDP growth stood at 4.2%. The fiscal balance was -9% of GDP and the current account balance recorded a deficit of -8% as percentage of GDP. This presented a major challenge to the BoG in MP management. Against the backdrop of weak macroeconomic fundamentals and the inability of the BoG to achieve its core objective of low inflation, it officially switched from MT to IT in May 2007. As noted earlier, this positioned the BoG as the second central bank in Sub-Saharan Africa to implement a full-fledged IT.[16] Though it was an unpopular decision at the time, the BoG was largely motivated by the global consensus that developing countries could adopt IT even at lower levels of economic and financial development (Stone, 2003). The BoG was

[16] Reserve Bank of South Africa is the first Sub-Saharan African central bank to adopt IT.BoG operated an IT lite regime from 2002 to 2007.

convinced that once it was able to put in place a clear transitional arrangement, it could adopt an IT lite, while the institutional frameworks were put in place for a full-fledged IT.In 2002, a new BoG law was passed that provided the legal framework for the transition to IT. The law explicitly provided for the operational and instrument independence forBoG and clearly states that the core objective of the BoGis to attain low inflation while pursuing other secondary objectives such as high growth, exchange rate and financial sector stability. The law also mandated that a Monetary PolicyCommittee (MPC) be established to deliberate and take decisions on MP (BoG Act 612, 2002).

While several factors motivated the BoG to shift to IT regime, three main factors are discernible: (i) the failure to control inflation (ii) loss of an effective nominal anchor as monetary aggregates became ineffective as an intermediate target; and (iii) increased financial innovation, together with significant changes in the structure of the economy weakened the stability of moneydemand function. Consequently, targeting money growth became problematic (Bawumia et al., 2008). Apart from its effects on demand for money, transformation in the economyandfinancial sector reforms also affected the income velocity of money. Consequently, high growth rates in money became insignificant in explaining price fluctuations (Figure 2.7). The BoG, therefore, had to look for an alternative framework that wascredible enoughto provide an anchor to steer inflation expectations to that of the monetary authority. IT was thus, seen as the best framework to offer that. Also, IT was also considered as a means to reinforce policy consistency and coordination between the BoG and the fiscal authority. This is because IT improves the credibility of policy actions,since it entails a joint commitment to macroeconomic stability by the political and monetary authority. It also helps to establish a legal and institutional framework to increase the transparency and accountability and thus, better anchor inflation expectations.

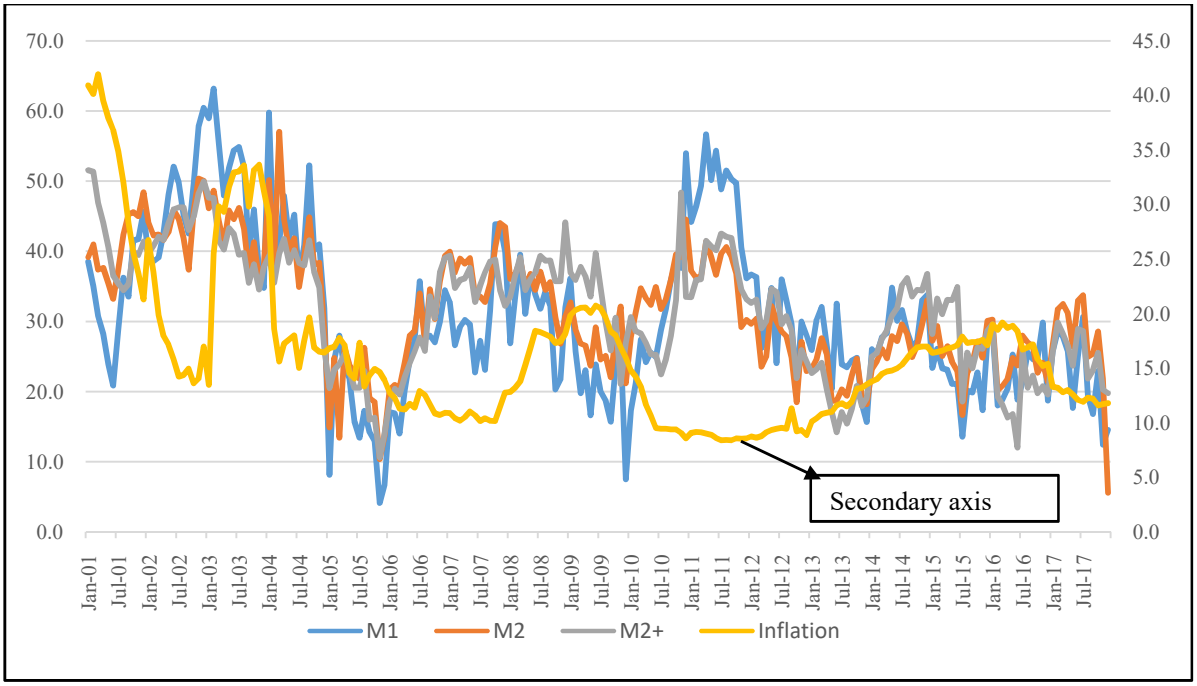

Figure 2. 7. Money supply and inflation (year-on-year growth)

Source: Author, using data from Bank of Ghanaannual reports (various years)

2.3.4 Transition to inflation targeting in Ghana

When BoG announced the decision to adopt IT, the country had not met all the preconditions as documented in the literature. Consequently, the authorities took advantage of a five-year transitional period to gradually develop some of the capacity needed for a formal IT framework. During the transitional period, covering 2002–2007, the BoG continued to monitor monetary aggregates while it developed macroeconomic and financial indicators needed for policy formulation and implementation. Other activities werethe opening up of the foreign exchange market as well as capital account liberalisationthat allowed external investors to participate in government bonds. The BoG recognised the need to address issues that all central banks had to deal with before adopting formal IT. These included the appropriate price to target, the type of datato employfor analysis and formulation of policy. Also important was the need to build a solid macroeconomic model to offer an understanding of the dynamics of the economy.

Another important consideration was the choice of an appropriate indicator of real sector activities. In the absence of quarterly GDP data, a Composite Index of Economic Activity (CIEA) was developed and used to assess developments in the real economy. The BoG collected information on job vacancies by government and the private sector, port activity and new vehicle registrations, and used themto construct the CIEA. Surveys of businesses and consumers were developed to gauge private sector expectations of inflation. Also, steps were taken to develop the analytical tools of the staff of the central bank.Several empirical and policy papers on monetary policy and inflation were undertaken by staff of the BoG. For instance, an empirical study on monetary growth, exchange rate and inflation in Ghana was conductedto understand the role of money and the transmission of monetary policy (Bawumia and Abradu-Otoo, 2003). To enable the financial system toefficientlydeploy fundsto households and firms, the35% secondary reserve requirements on bank deposits, which hitherto served as instrument of monetary policy, was abolished. (BoG, 2015).

An essential part of Ghana's story on inflation dynamics is the effect of monetisation of fiscal deficits on inflation. Over the years, the government succeeded in influencing the work of the central bank because it lacked the necessary institutional and operational

independence in pursuance of its mandate. To overcome this challenge, the BoG Act 612 (2002) explicitly gave the BoG institutional and operational independence. The Act stipulatesthat: (i) thecentral aim of BoG is to control inflation. This should be pursued without recourse to directives from the executive arm of government; (ii) MPC task withthe formulating of MP; and(iii) government borrowing from BoGrestricted to 10% of previous tax revenue. To further safeguard the fiscal operations of the government and ensure fiscal solvency, a Fiscal Responsibility Act was enacted in 2018. The law set a limiton fiscal deficit not exceeding 5% of GDP in any particular year. A Fiscal Council was created to advice government on economic management. Key areas that needed attention include ensuring sustainable fiscal balance and public debt management.

2.3.5 The Monetary policy committee

The mandate for the MPC is derived from Section 27 of the BoG Act 612 (2002). As stated earlier, it mandates the establishment of an MPC to carry out the responsibility of formulating and taking decisions on policy stance. The MPC changes the short-termIR (the monetary policy rate) in order to control inflation while taking cognizance of growth and other macroeconomic goals of the government. The MPC is chaired by the governor of the BoG who holds a casting vote. Other members include two deputy governors, the heads of Financial Market and Research departments.Two external members, to complement the work of the MPC are appointed by the government.During each year, the Committee meets six times to deliberate on key macroeconomic developments as presented by staff of the central bank. On the basis of available information and the risk to growth and inflation outlook, a decision is accordingly made on the policy rate.Historical decisions and trends in the policy rate are presented in Table 2.4 and Figure 2.8.

Table 2.4. Summary of Bank of Ghana's monetary policy committee's decisions

Date	Action	Policy Rate	Key factors informing the decision
February 18, 2015	No change in the policy rate	21%	1. The global economy was characterised by uncertainty and volatilities in the financial markets. 2. Low international prices export commodities. 3. The third quarter of the year witnessed growth in economic activity and improved business and consumer sentiments. 4. Energy sector challenges continue to persist. 5. Potential IMF deal expected to boost investor confidence. 6. Increased food and core inflation[17]
May 13, 2015	The policy rate increased by 1%	22%	1.Increased headline and core inflation as well as inflationexpectations observed. 2. Substantial exchange rate pass-through. 3. Increased energy

[17]Core inflation in CPI inflation excluding energy and utility prices

			and utility prices. 4. Unresolved energy sector challenges, fiscal consolidation and depreciation of the domesticcurrency impacted negatively on economic activity. 5. Business sentiments remained weakwhile consumer confidence rose.
July 15, 2015	A further hike in the policy rate by 2%	24%	1. Headline and core inflation maintained an upward trend andinflation expectations remain elevated. 2. The Ghana cedi recovered strongly against the major currencies during the month. 3. The central government sustained the fiscal consolidation effort. 4. Domestic growth remained vulnerable due to the impact of the domestic energy challenges. 5. Higher volatility in international prices of commoditiesthat affected global growth prospects negatively.

September 14, 2015	The policy rate increased by 1%	25%	1. Inflation pressures remained strong and rising core inflation. 2. Inflation expectation of consumers elevated due to uncertainty in the domestic forex market. 3. Weak domestic economic activity. 4. Ongoing fiscal consolidation. 5. Negative effect of high volatility in domestic and global financial markets and declining commodity prices on the balance of payments.
November 16, 2015	Another increase in the policy rate by one percentage point.	26%	1. Core and headline inflation increasing albeit at a moderate rate. 2. Inflation expectation significantly higher than the target set in the medium-term framework. 3. External financial conditions remain weak. 4. Anticipated upward adjustment in utility tariffs. 5. Some stability in the domestic forex market which had to

			be consolidated. 6. Positive expectation on economic activity conditioned onimprovement in energy situation. 7. Government fiscal stance within the programme benchmarks. 8. A continuous drop in commodity prices. 9. High upside risk to inflation and the probability of itmoving away from the target.
January 25, 2016	The policy rate left unchanged.	26%	1.Rising core inflation and slower pace of economic activity. There was,however, the expectation of a turnarounddue to improvement in energy challenges together with effective and well-coordinated fiscal and monetary policy. 2. Weak consumer confidence, low commodity prices, low global growth and relatively stable domestic currency expected to have a dampening effect on inflation.

March 21, 2016	The policy rate left unchanged.	26%	1. Noticeable improvements in the pace of economic activity. 2. Positive consumer and business confidence. 3. Some improvement in energy situation due to increased oil and gas production. 4. Strong fiscal consolidation. 5. Uncertaintiesrelating to crude oil prices significant risk to the inflation outlook. 6. High volatility in commodity prices and tight external financing conditions introduced some risk. 7.The above factors combined with relative stability in the domestic forex market meant that risk to inflation and growth outlook wasbalanced.
May 16, 2016	No change in the policy rate	26%	1.Growth outlook remained positive while the pace of fiscal consolidation continues to hold firm. 2. Weak global growth outlook and

			tight financing conditions. 3. Exchange rate stability. 4. Risk to inflation and growth was balanced.
July 18, 2016	No change in the policy rate	26%	1. Low commodity prices. 2. Relative stability of the local currency. 3. Expected improvement in liquidity on the foreign exchange market. 4. Balanced risk to inflation and growth
September 19, 2016	No change in the policy rate	26%	1. Some decline in headline inflation but high relative to the target. 2. Stabilityin exchange rate market. 3.Tight fiscal stance expected to affect growth momentum.
November 21, 2016	Policy rate decreased by 0.5%	25.5%	1. Global growth prospects remained weak. 2. Declining headline and core inflation partly due to stability in exchange rate. 3. Declining commodity prices and disruption in oil

			and gas production;
January 23, 2017	No change in the policy rate	25.5%	1. Continues decline in inflation expectations, headline inflation and core inflation. 2. The likely impact of sharp depreciation of the exchange rate. 3. Persistent increases in food inflation. 4. fiscal slippages due to election related expenditures in 2016. 5. Modest growth condition but with positive prospects. 6. Uncertainties in the global environment
March 27, 2017	A two-percentage point drop in the policy rate	23.5%	1. A significant drop in the underlying inflation pressures. 2. The forecast suggest growth to trend below potential.
May 22, 2017	Policy rate decreased further by 1%	22.5%	1. Though economic activity picked up, it trended below potential. 2. Some improvement in business sentiments as credit condition eased. 3. Increased

			production of crude oil. 4.Expected fiscal consolidation. 5. Both headline inflation and inflation expectation trending downwards together with stability in exchange rate.
July 18, 2017	Another decrease in the policy rate by 1.5%	21%	1. Largely informed by improvement in domestic economic activity while fiscal policy expected to provide strongpushfor growth. 2. Continue to witness exchange rate stability and a decline in headline inflation.
September 2017	No change in the policy rate	21%	1. Positive global growth prospects. 2. prices of Ghana's key export commodities had shown recovery, driven by market dynamics, policy uncertainties and increasing global trade. 3. Foreign exchange market conditions remained relatively stable, supported by improved liquidity conditions, despite some marginal demand pressures.4.

			Both cconsumer and business confidence surveys showed improved sentiments in the economy. 4. There was an increase in core inflation, an indication of emerging pressures that required further monitoring.
November 2017	Policy rate dropped by 1%	20%	1. Further strengthening of global growth. The recovery process had also expanded beyond those of the advanced economies to include large emerging market economies. 2. Indicators of economic activity and business and consumer confidence remained strong. 3. The cedi had remained relatively stable in the foreign exchange market despite movements which were not a reflection of the underlying fundamentals. 4.Signs of dampening inflation expectations, with core inflation on course to achieving

			the medium-term inflation target.
January 2018	No change in the policy rate	20%	1. Global economy continued to rebound although near-term growth risks were on the upside. 2. The global outlook was still subjected to substantial downside risks, including protectionism and geopolitical tensions. 3.Favourable commodity prices, with strong trade surplus impacting positively on the current account outturn, and a higher-than-programmed reserve build-up. 4. The relative stability of the exchange rate and fiscal consolidation efforts had all acted to support a trend decline in headline and core inflation. The forecast also showed that inflation was likely to stay within the target band for the year. 5. Provisional estimates for overall

			real GDP growth for the third quarter of 2017 turned in strong on the back of oil exports and evidence from all leading indicators of growth.
March 2018	A 2% decrease in the policy rate	18%	1. The global economy strengthened in the first two months of the year together with a favourable financing conditions. 2. Monetary policy was accommodative and improved business confidence boostedinvestment and consumer spending. 3. Global inflation was gradually firming up in advanced economies, and was envisaged to result in a faster than anticipated monetary policy normalization. 4. Core and headline inflation trended downwards and this was consistent with the Bank of Ghana'smedium-term forecasts.
May 2018	A further 1% reduction in the	17%	1. Global economic growth expected to

	policy rate		strengthen in the near-term, supported by positive business and consumer confidence. 2. Although global financing conditions remained favourable, the strengthening of the US dollar, rising oil prices and US long-term yields were beginning to exert pressures on emerging market currencies. 3. Inflation picked up in major advanced economies and in most commodity importing emerging markets due to higher oil prices and narrowing output gaps. 4. The risks to the inflation outlook were subdued over the forecast horizon, but changes in global financing conditions and its impact on emerging market asset classes required some vigilance.
July 2018	No change in the policy rate	17%	1. Global economic growth was strengthened, albeit risks were mounting

			in the medium-term. 2. But headline inflation in most advanced and emerging market economies went up, driven mainly by wage dynamics and increase in crude oil price. 3. The domestic currency experienced some pressures with the strengthening of the US dollar and reverse capital inflows weighing down on emerging market assets. 4. uptick in headline inflation, following increases in administered prices. 5. Uunderlying inflationary pressures were subdued, as inflation expectations remained well-anchored with declining core inflation. 6. Real GDP growth was strong in the first quarter and projected to remain high, although private sector credit growth was below expectations.
September 2018	No change in the	17%	1.

	policy rate		Favourableexternal sector, with a strong trade surplus outturn driven by higher oil exports. 2. A fairly robust economic activity, though below 2017 levels. 3. Growth outlook was masked by uncertainty surrounding the impact of higher petrol prices, exchange rate depreciation and tightened credit stance of banks on economic activity. 4. The forecast affirmed a slowdown in the pace of disinflation, due to the second round effects of increases in petroleum prices, exchange rate depreciation, taxes, global inflation, and tight global financing conditions.

Source: MPC press releases (various editions)

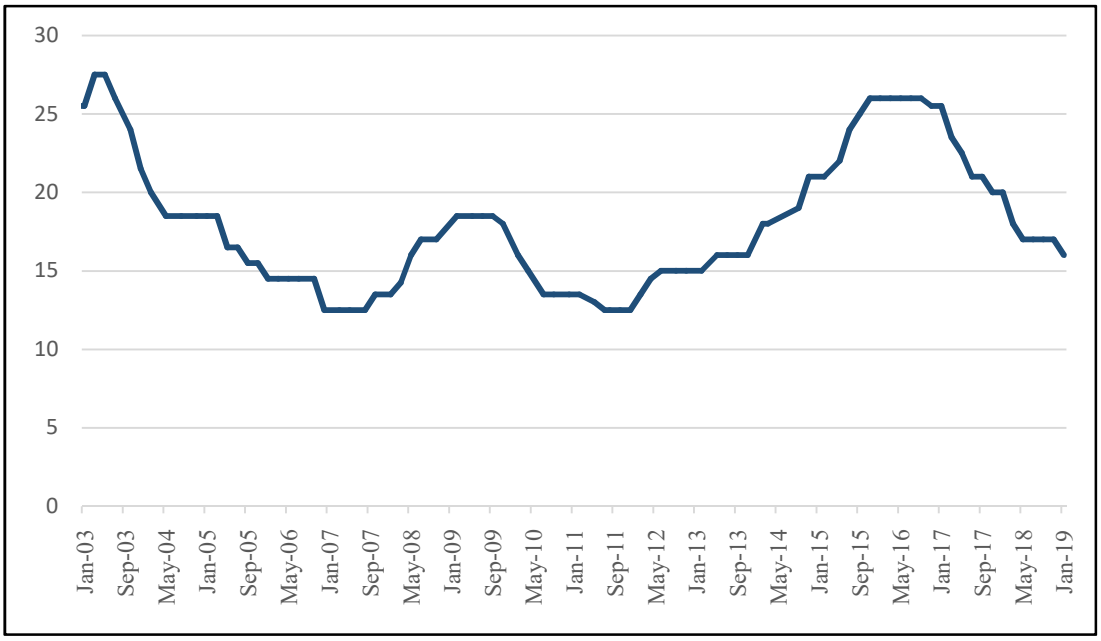

Figure 2.8. Trends in the monetary policy rate

Source: Bank of Ghana statistical bulletins (various editions)

2.4 The financial system

An efficient, sound and robust financial sector is critical for efficient MP formulation and implementation. Ghana's financial system continues to evolve, reflecting changing macroeconomic fundamentals of the country and increased integration with the global financial architecture. The country's financial sector comprises the banking, insurance and capital markets. Commercial banks dominated the financial system landscape before the financial sector reforms. During the mid-1980s, commercial banks were largely weak and undercapitalised (Antwi-Asare and Addison, 2000). The situation was largely caused by the repressive financial policies of the government that prevented the banks from engaging in effective intermediation and high inflation (BoG, 2015). The situation was exacerbated by high non-performing loans held by state institutions and politically connected individuals. Also, the sharp devaluations of the domestic currency during the period 1983-1986 rendered huge amount of many US Dollar denominated loans impaired and became unserviceable (Antwi-Asare and Addison, 2000). It was for this reason that the Financial Sector Adjustment Programme (FINSAP) was seen as a key element of SAP. An important outcome from the reforms was the introduction of new banks. Before the FSR, the sector was made up of only two foreign and five state-owned banks.

At the beginning of the ERP, the government's main preoccupation was the attainment of macroeconomic stability with specific focus on monetary and fiscal stability. Financial sector reforms was earmarked to follow once macroeconomic stability started to gain root.The banking industry was characterised by weak balance sheet as the non-performing loans of the sector stood at 41%as at 1989 (Leith and Söderling, 2000).

The agenda to overhaul the financial sector began in 1987 with the implementation structured in fourstages. From 1987 through 1988, the government embarked on the policy of systematic liberalisation of interest rates and credit to the various sectors of the economy. This was followed by the introduction of the Financial SectorAdjustment Programme (FINSAP) in 1989, also implemented in stages. From 1989 to1991, efforts were gearedtowardsestablishing an effective and efficient prudential regulationsystem and the restructuring of weak banks to make them viable and profitable. To enhance the capacity of the central bank in the area of banking supervision, a new Bank of Ghana law

was passed in1989. Members of staff of the central bank were also trained to build their capacity to effectively supervise the commercial banks. During the second and third phases of the programme, 1992-1995,the government intensified the restructuring efforts including limiting the role of government in the financial sector and creating new institutions. The Ghana Stock Exchange (GSE) was established in 1990 with 11 listed companies.The number of companies on the GSE increased to 33 in 2007. Non-Banking Financial Institutions such as savings and loans companies and brokerage firms were also established to address the financial needs of the large informal sector of the Ghanaian society. All these efforts, together with liberalation of the exchange rate market in 1992, largely contributed to the removal of rigidities in the financialsector. (Sheng and Tannor, 1996). Confidence was restored in the system as reflected in the money supply and the expansion of the financial system (Figures 2.9 and 2.10). These developments are necessary conditions for the conduct of an effective and efficientmonetary policy.

The sector grew with 28 banking institutions, 126 rural banks and 41 NBFIs 2018. The growth in the number of banks has been accompanied by the emergence of new products and branch expansion. The growth in the financial sector is reflected in both credit to households and individuals and growth in money to GDP ratio. After dropping significantly from late 1970s to early 1980s, both variables picked up sharply and maintained increasing trend, albeit with some brief episodes of volatility reflecting periods of general macroeconomic downturn. The ratios declined in 2017, reflecting base effect as GDP was rebased in 2017[18] that led to a significant increase in nominal GDP (BoG, 2007).

To maintain and safeguard the integrity of the financial sector, the BoG undertook a comprehensive review of the asset of the entire commercial banks in 2016. Upon the completion of the exercise, some banks were identified as weak and highly vulnerable with poor capital base. Their balance sheets were also full of high non-performing loans while the corporate governance structure was identified to be extremely poor.

[18] The GDP of Ghana was rebased in 2017 with 2013 becoming the new base year. The exercise resulted in nominal GDP increasing significantly from GH¢205.9 billion to GH¢256.6 billion. It implied a respective increase of 24.6% and 8.1% in nominal and real terms.

Consequently, some banks had to be liquidated and to prevent a contagion and unintended negative consequence for the entire economy, the government had to intervene to protect about 1.5 million depositors. These included individuals, institutional depositors and pension funds amounting to over GH¢7. 6 billion (BoG 2016).

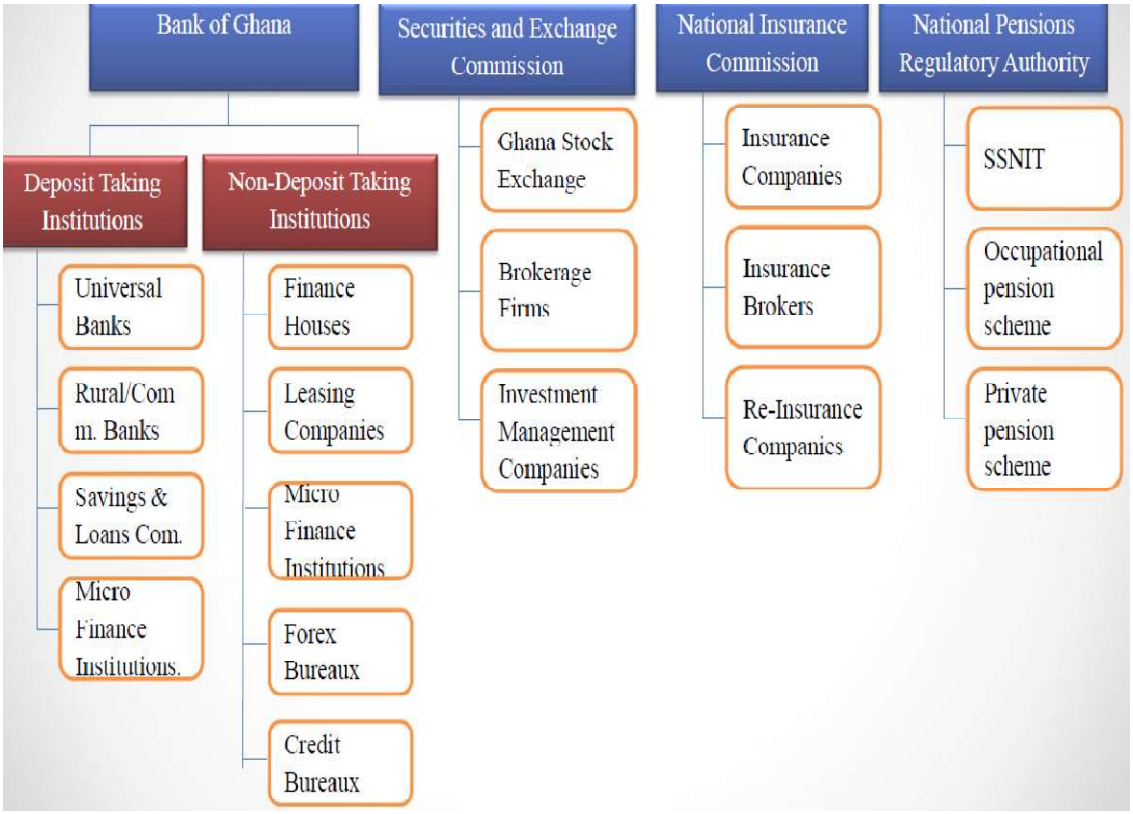

Figure 2. 9. Structure of the financial service industry in Ghana

Source: By author

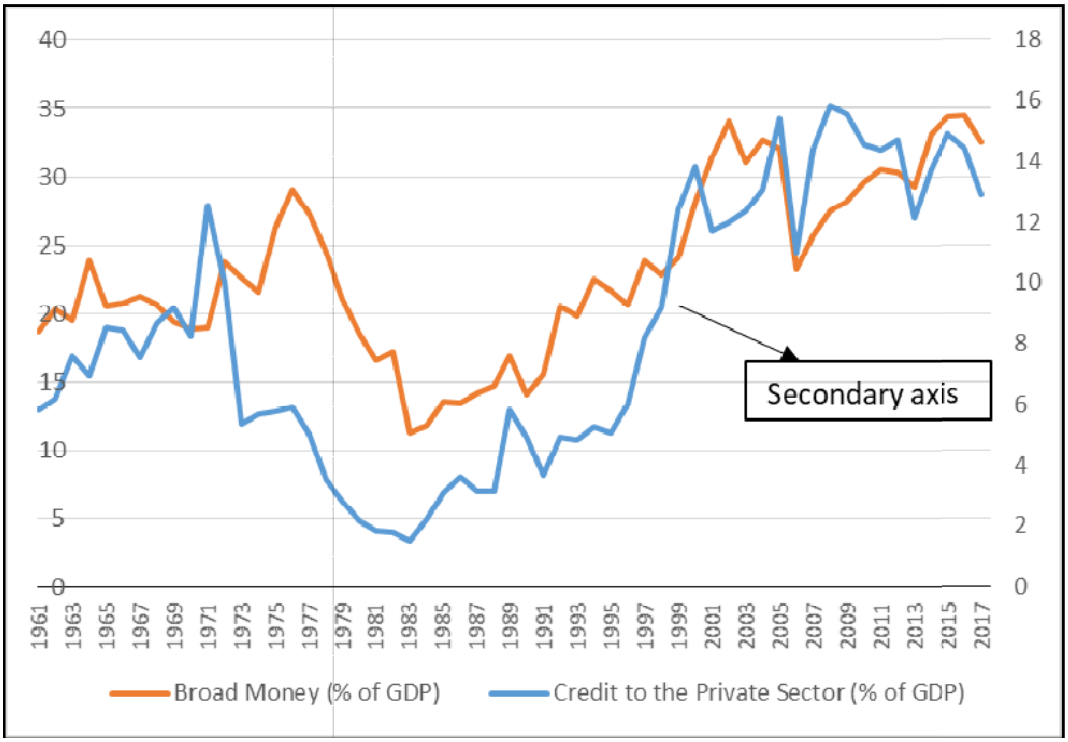

Figure 2. 10. Growth in money and private sector credit

Source: Author, using data from Bank of Ghana's annual reports (various years)

2.5 Conceptualissues and monetary policy

In both theoretical and empirical macroeconomic literature, monetary economics is well studied. As a concept, monetary policy is the process by which the monetary authorityundertakesmeasures, such as the control of short-term nominal interest rate (IR) or the growth in money in order to control inflation. Other goals of monetary policy include high and stable real GDP growth, low unemployment and stability of the domestic currency. Bernanke and Blinder (1992) noted that the extent to which the monetary authorityis able to effectively predict economy activity is critical to the efficacy ofMP. Generally, MP can be regime-based, rule-based or instrument-based.

Monetary policy regimes refer to various approaches by which MP is implemented by the central bank. A particular regime outlines the nominal anchor, tools and instruments to shape decision-making. It also specifies how MP decisions are communicated to the public.Essentially, MP regimes include Monetary Targeting (MT), Exchange Rate Targeting (ERT) and Inflation-Targeting (IT). As a concept, targeting is interpreted to mean a variable for which the MP rule responds to and seeks to minimize the loss function of themonetary authority. The task of deciding on an appropriate MP regime is systematic and endogenously determined as it largely depends on the structure of the economy (Wong and Chong, 2014). Gavin (2018) argued that what constitutes MP regime is still largely misconceived. Monetary policy regime is not entirely a new concept as it relates to the idea of monetary standard that was evident during the classical gold era, and also well practiced during the Bretton Woods era where paper money standard was prevalently adopted.

Haslag and Hein (1995) opined that instrument-based MP can occur through balance-sheet and non-balance sheet actions. Balance sheet actions are the adjustments that occur through money market activities such as borrowing through discount windows and open market operations. Non-balance sheet actions include reserve requirement ratios. Choi and Ratti (2000) submitted that non-balance sheets actions are broadly categorised into aggregates and non-aggregate measures. The aggregate measures include MS, reserve requirements among others. The non-aggregate measures include the IR.

2.5.1 Monetarytargeting

Monetary targeting (MT) refers to a system of monetary management by which the central bank seeks to control inflation by controlling growth in money. Under MT, there is no explicit inflation target and MP instrument is limited to the monetary aggregates. The prevailing interest rate (IR) is the result of open market operations that are undertaken to regulate liquidity and control money growth. Essentially, MT is based on Monetarist theory that consider money as the only way through whichMP can affect prices and output.Two main conditions are critical for the success of MT. Firstly, the central bankshould be able to influence the stock of money in circulation. Secondly, and most importantly, is the fact that a constant link between money and nominal income must exist (Fontana and Palacio-Vera, 2004).

The quantity theory of money is the theoretical basis upon which MT is founded.It states that $M_t V_t = P_t Y_t$ where M_t is MS; V_t is velocity money; P_t is price level; and Y_t isoutput. The theory states that prices and money supply are related according to the equation $P_t = V_t M_t / Y_t$. The fundamental assumption is the constancy of velocity of money and that growth in money has no short-run effect on GDP growth. A stable multiplier is also important for the effectiveness of the framework. It is important to note that the assumption of stable multiplier is the major drawback of MT. This is basically due to the endogeneity of money supply. Thekey point is that, it is the lending activities of commercial banks that determines the expansion of money supply. The extent that individuals and firms adjust their behaviour with regards to credit, determines the extent to which money supply will change.

2.5.2 Inflation targeting

As discussed earlier, IT is a MP regime where a medium-term inflation target is established and made known to the general public(Ftiti and Hichri, 2014). Essentially, there is aclearunderstanding by all stakeholders that MPis focused on achieving low inflation. Once the target is established, the responsibility of the central banker is to adjust the policy rate in order to keep actual inflation close to or at the target. The fact that the central bank makes use of an array of information in taking decisions means that it

offerstractabilityin the conduct of MP(Bernanke and Mishkin, 1997; Dueker and Fisher, 2006; and Lee, 1999). In terms of the key elements of IT, Ayres et al. (2014) highlight the following: (i) an explicit target for inflation; (ii) the commitment by the monetary authority toachieving low inflation is the central objective of MP; (iii) the central bank makes use of an array of information to inform policy formulation; and (iv) transparency and accountability in the conduct of MP. Theseare achieved through effective communication on the policies, goals and evaluation of the economy.In an IT regime, there is some form of conditional discretion to the policy maker. The central banker is given the room to formulate policies to deal with short-term shocks to the economy while the inflation target is given (Lucotte, 2012).Bernanke and Mishkin (1997) offered another dimension to the discussion of IT along the line rules versus discretion debate. They argued that conducting MP in the context of IT should beseen as the interplay between rules and discretion. In other words, the central banker is free to pursue whatever policy is needed to deal with shocks without compromising the core mandate of price stability.

In macroeconomic literature on MP, issues of prerequisites (preconditions) for adopting IT are well discussed. Several preconditions have been highlighted but the key ones are: (i) the existence of a central bank that enjoys significant operational and instrument independence (ii)monetary authority that operates with a clearly stated mandate of price stability; (iii) lack of fiscal dominance in the country; (iv)sound, efficient and stable financial system to aid policy transmission; (v) flexible exchange rate policy; and(vi) adequate logistics and strong human resource base (Lucotte, 2012). Clearly, and consistent with the thinking of the proponents of IT, the above precondition suggest that IT is solely meant for developed and emerging market economies. However, recent debates on IT suggest a global consensus in favour of the adoption of IT by developing countries. These countries could implement IT in phases. The first phase (the transitional phase) could be used to develop the necessary infrastructure while MP is pursued within the framework of an informal IT. The second phase is when all the preconditions are fully met and MP could then move into a full-fledged IT. This point is reinforced by Mishkin (2000) who argued that IT offers better outcomes for MP compared to regimes such as MT and ERT. It offers the central banker the leverage in dealing with both external and internal structural macroeconomic shocks.Also, the existence of a medium-term inflation target

that is publicly known by economic agents allows MP toeffectively anchor inflation expectation in a credible manner.

While the literature has and continues to highlight benefits associated with IT, some disadvantages have been outlined. Ayres et al. (2014) noted that the reduced discretion of the monetary authority can introduce negative growth effect, especially when there is inflation bias in policy settings. Because of the requirement of flexible exchange rate, the fear is that IT can lead to increased volatility in exchange rate when the economy is confronted with external shocks. This particularly applies to developing countries as they might not have met key requirements including strong external reserves, strong fiscal position, strong financial system and low inflation. In particular, Bernanke and Woodford (2005)emphasised that weak institutional arrangements and poor macroeconomic conditions could weaken credibility and as such, compromise the efficacy of MP. Unfortunately, developing countries are characterised by these constraints.In a counter argument, Bernake et al., (1999) averred that the fact that IT introduces credibility through commitment and transparency in monetary management is good for developing countries. This has been re-echoed by Gonçalves and Salles (2008) in their submission that IT contributesto better macroeconomic outcomes for developing countries because of the enhanced credibility in MP that comes with it.

2.5.3 Price-level targeting

Even though Price-Level Targeting (PLT) is similarto IT, the processes through which the central bank controls inflation are different. Under PLT, deviation of growth in Consumer Price Index (CPI) from the medium-term target is compensated for in the next period in a manner that the desired target is systematically achieved withina given time horizon. Monetary policy is preoccupied with keeping the level of prices close to a predefined path (Røisland, 2017). Worth highlighting is the fact that unlike IT, PLT does not necessary mean zero inflation because the medium-term path may include increase in prices over a period of time. Monetary policy response to shocks is different under PLT compared to IT. Under IT, policy response is quick in response to a shock that introduces upside risk to inflation. However, under PLT, MP is pursued in away that inflation is allowed to

temporarily move above the implied target so that the price level gradually reverts to the pre-defined target path.

Røisland (2017) noted that there has been little practical experience of PLT. The only historical example is Sweden between 1931-1937, when the Riksdag tasked Sveriges Riksbank with stabilising the price level. Though current debates on PLT is theoretically based, some arguments have been outlined in the literature in favour of PLT. These includes: (i) enhances confidence in the purchasing power of the domestic currency; and (ii) enhances effectiveness of expectation channel of MP. This may be particularly important if policy is inhibited by the IR being stuck atthe lower bound (Meh et al., 2010; Vestin, 2006; Coibion et al., 2012; and Svensson, 1999). The necessary condition for PLT to be effective is the existence of forward-looking rational agents and a credible price level target in the economy as a whole. If these conditions are not fully in place, PLT could result in less stability in inflation and the real economy. Essentially, if inflation expectations are not fully rational and forward looking, the benefit from a promise to overshoot the inflation target if it deviates from the target will be smaller. PLT could then result in less stability in inflation and output (Steinsson, 2003). Another downside of PLT, as articulated by Andersson and Claussen (2017), is that it compels the policy maker to respond to temporary shock to inflation that would otherwise be appropriate to ignore. Another issue is that getting the economic agent to understand the dynamics of IT can be challenging. Generally, people relate to inflation more easily than the price level.

2.5.4 Nominal GDP targeting

Though practically unpopular, nominal Gross Domestic Product Targeting (GDPT) has received relatively wide attention in monetary literature in recent years. The idea that MP should be oriented towards stabilising nominal GDP was brought into focus as most countries experienced lower bound for the policy rate (Meade, 1978; Von Weizsacker, 1978; and Tobin, 1980). The argument in favour of GDPT focuses on both the time inconsistency problem and accountability, and provides a good balance between the consideration of nominal stability and output stability. Thus, policy is carefully oriented such that it gives equal wait to GDP deflator and real GDP. The issue with GDPT is that the numerical target value must be based on an uncertain estimate of trend real GDP. It

may not also anchor inflation expectations as usefully as IT (Williams, 2016; Bean, 2013; and Andersson and Claussen, 2017).

2.5.5 Monetary policy transmission

This describes the process through which MP decisions affect the economy through its impact on prices and RGDP growth (De Angelis etal.,2005).In modern financial architecture, most countries have an inter-bank market that serves as the window for commercial banks to trade excess/surplus liquidity among themselves. The inter-bank rate[19] is the key rate through which the transmission process works (De Angelis et al., 2005).The key players in the market include commercial banks and the central bank. Surplus banks lend to deficit banks. In the event that a surplus or deficit bank is unable to lend or borrow from the market, the central bank steps in with liquidity to ensure that the market continue to operate without any interruption. Economic agents would revise their expectation of future economic prospects as a reaction to decisions on the policy rate that signals policy stance and the direction of other interest rates such as inter-bank lending and treasury-bill rates (Mollentze, 2009). In an efficient macroeconomic environment for instance, an upward adjustment in IR by the central bank would initially lead to increase in the inter-bank IR. The next phase entails upwards revision of IR in the inter-bank wholesale money market. Commercial banks will consequently increase IR on credit to households and institutions to reflect the increased borrowing cost at the inter-bank money market. This would affect the demand for credit,as well as domestic aggregate demandonce economic agents adjust their expenditures. Other variables including domestic aggregate supply, wages and unemployment would also adjust. Eventually, prices change to reflect the dynamics of the economy.

[19] The rate that is applied when commercial banks borrow among themselves.

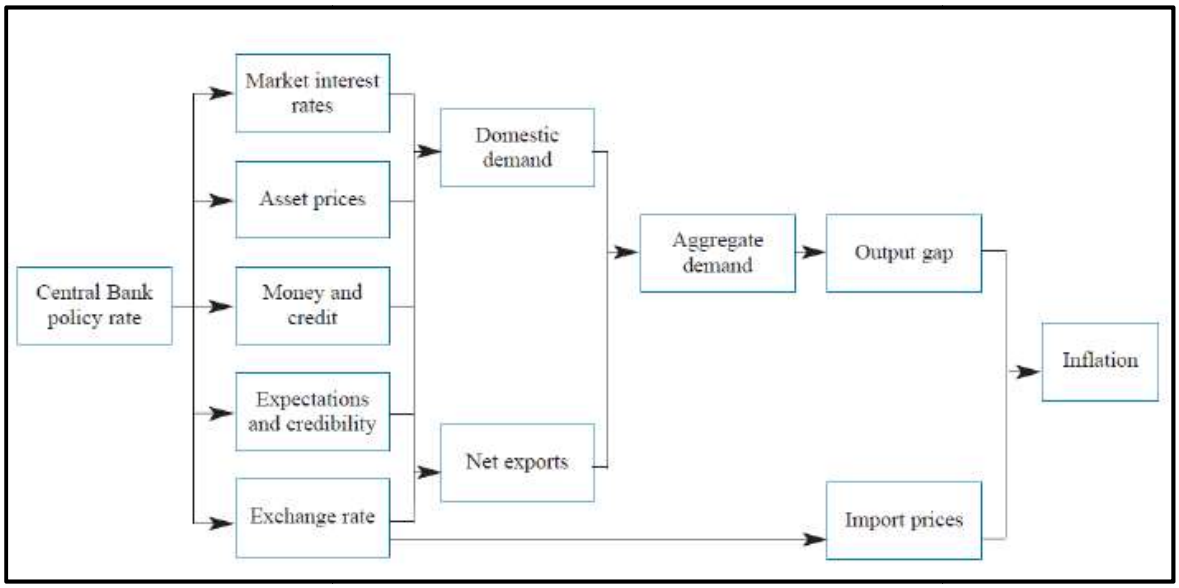

Figure 2. 11: Monetary policy transmission mechanism

Source: By the author

2.6 The theoretical literature

The subject of MP in macroeconomics has been subjected to intense theoretical debate. While there is a general agreement on its role in macroeconomic stability, disagreement abound on how it should be conducted. Behind this lies difference in theoretical underpinnings. In the early 1970s, debates in the macroeconomic literature on monetary managementprincipally focused on the choice of instrument and whether to target IR or monetary aggregates.The issues were examined within the conceptual preposition of different macroeconomic schools of thought. One of such, isPoole (1970),who studied the issue-based Neo-Keynesian macroeconomics. Also, New-Classical rational expectation model was employed by Sargent and Wallace (1975)to analysethe same issue. Post-Keynesians oriented the debate on the endogeneity of money supply and argued that targeting money was considered not effective in controlling inflation. Since money supply was determined by credit to private economic agents (including households and institutions), the only leverage at the disposal of the monetary authority is to target the short-term interest rate (Moore, 1988).

The debate on optimal MP formulation changedbetweenmid-1970s to early 1980s. Lucas (1973) analysedMP and inflation in the context of classical macroeconomicsand rational expectations. He noted that reducing inflationand increasing output can be achieved by fooling workers.This led to structural shift in macroeconomic thinking and MP formulation from Keynesian to Classical Economics. Also, issues about rational expectationsmoved towardsseeking knowledge about prices and how the publicresponds to anticipated and unanticipated policy decisions, givev their past knowledge about the economy (Lucas, 1976). This behaviour of economic agents has important repercussion on macroeconomic policy outcomes.These considerations shaped the thoughts that led todiscussionsontime-consistency and game theoretic approach to MP (Kydland and Prescott, 1977; and Barro and Gordon, 1983). Subsequently, a new interest emerged on policy credibility, and “rules vs. discretion” policy(Taylor, 1993).

Essentially, early macroeconomic theories on MP andinflation have been discussed within theoretical prism of classical view and monetarism. The classical position has been expressed by the Quantity Theory of Money (QTM), as championed by Hume (1955),

Ricardo (1945) and Fisher (1997) while the monetarist view was proposed by Friedman (1968). The quantity theory doctrine stressesthe role of money in the dynamics of prices. Hume (1955) observed a sectorial spread effect of money growth while Ricardo (1945) suggested that money supply growth beyond some optimal level is the main cause of inflation. Fisher (1997) formally provided an equation of exchange that presupposes that growth in money is the singular element responsible for movement in prices. In the light of this, Pigou (1917) also demonstrated that an exogenously determined money supply can and do exert some influence on the dynamics of inflation. The classical theory shows that excessive money growth is the main cause of inflation. In order to reduce inflation, therefore, controlling money growth became a necessary and sufficient condition. Friedman (1968) provided the monetarist view and popularised the saying - "only money matters''. In fact, he posited that "inflation is always and everywhere a monetary phenomenon'' (Friedman 1968).

2.6.1 The New Classical economics

During 1970s, New Classical (NC) economics dominated macroeconomics debateon monetary economics. The core principle underlying the NC theory isunderpinned by the concept of rational expectations. The economy is also assumed to be characterised by flexible prices and nominal wages. Rational Expectations Hypothesis (REH) was introduced by Muth (1961) and later popularized by Lucas (1972). Flexibility in prices and nominal wages suggested that there would be equilibrium in all marketsand full-employment would prevail in the economy.The implication of REH is that the public haveadequate information about policies of the government. As a result, future expectations of the economy are formed in the right way. Also, policy decision of the government will be expected and known to everyone, and economic agents would have taken it into consideration in forming decision on prices.

In this regard, the effective way for the monetary authority to influence the economy is by pulling a surprise elementon economic agents (Birol, 2015). An unanticipated policy action can only have short-termramification on prices since MP decisions are fully anticipated by economic agents. Its effect will eventually be restricted to inflation with no impact on output and unemployment. For instance, given an unanticipated permanent

expansionary MP,the short-run Phillips curve will move up, implying higher inflation and increase in employment (or less unemployment). A fall in unemployment happens because workers initially understand increasedwages to mean a corresponding increase in their real wages and so, receive more employment offers. Overtime, they get to know that the increase in wages was an illusion as real wages falls. Hence, less employment is accepted, unemployment increases, output falls and the economy fall back to initial equilibrium position. To the NC therefore, inflation is inimical to every country. MP should therefore,be preoccupied with the achievement of lowinflation. If the economy is suffering from deflation, MP should aim at positive inflation target to avoid undesirable growth outcomes (Palley, 2007).

2.6.2 The Keynesian loanable theory

Generally speaking, the whole of Keynesian Economics focuses on how aggregate spending in the economy affects output and inflation (Blinder, 2018). Specifically, however, the loanable funds theory explains how MP is used to control inflation and eventually, impact other economic indicators. It is an indirect theory of MP and predicated on three main concepts, namely: marginal efficiency of capital, investment multiplier and IR.The Keynesian loanable theory explains short-run dynamics of the economy and suggests that growth in money would result in expansion of funds at the disposal of financial institution. Interest rate would fall due to increased liquidity because the demand for loanable funds would be less than the supply. The theoryis also predicated on the notion thataggregate demand shocks have noeffect on real output and employment in the short-run. Prices are expected to be rigid before this impact can be effective as changing prices will counter-balance the effect of a rise in moneyon the economy. Consequently, MPaffects the economy indirectly via nominal IR by moving the economy to a new steady state path characterized by low inflation and high RGDP growth(Dickens, 2011).

2.6.3 The post Keynesianmodel

The key plank ofpost-Keynesian Economics (PK) is the concept of effective aggregate demand. It asserts that effective demand is importantacross all time horizons. In a competitive market economy, the tendency for the economy to automatically move to full

employment is not feasible (Aretis, 2009). The hallmark of the NC theory discussed above is that MP decisionshas nolong-run effect on RGDP growth but only leads to an increase in inflation. This contrasts sharply with the neo-Keynesian model that assigns real effect for MP, irrespective of the time dimension.

The PK model employs fundamentally different microeconomic foundation. Though it shares certain fundamental underpinnings with the neo-Keynesians, their arguments and explanations with regards to the role ofMPin reducing inflation and stabilising outputare different.The conclusions of the PK models have several important implications for the economy. These are: (i) the existence of unemployment at every point in time; (ii) procyclicality of real wages; and (iii) RGDP growth can be induced by either wages or profit of firms (Bhaduri and Marglin, 1990). When the economy is characterised by a high rate of unemployment, growth does not suffer, when wages are increased in order to reduce unemployment. Trends in wages is critical in shaping the path of GDP growth and firms' profit. If wagesincreasequickly and steeply, then growth rate and profit of firmsreach its maximum at a higherrate of unemployment. This implies that controlling wage growth beyond some level could yield a positive growth and employment benefits. Thus, policy should aim at achieving high wage that is stable and not exposed to abnormally large increase. The outcomes of PK havesignificant implication for monetary management. Essentially, MP is critical with significant implication for the economy including inflation, output, real wage and unemployment. The only cost associated with expansionary monetary policy is higher inflation. A fall in unemployment rate triggers a policy dilemma. That is whether to go for increased wages and reduced employment or to settle for lowerunemploymentat the expense of low inflation.

2.6.4 New Neo-Classical synthesis

New neoclassical synthesis (NNS) embodies basicelements of Monetarist, Real Business Cycle, REH and KeynesianEconomics into a single macroeconomic framework. In terms of the practical policy implication, the monetary authority should concentrate on the task of controlling inflation and stabilising it.This is because, focusing on reducing inflationimproves the ability and efficacy of MPin stabilising the business cycle and

reducing unemployment (Goodfriend and King, 1997). The NNS hugely capitalised on the rational expectation proposition but consider price as sticky as firms do not engage in downward adjustment of their prices in order to maintain a profit maximising mark-up. Aggregate demand and productivity serve as the driving factor for product mark-up. According to this theory, the credibility of the monetary authority in stabili-ing price contributesto keeping actual and potential outputs at their natural rate level. The baseline theory of the NNS model presupposes an effective stabilization role of policy if predicated on the welfare of households. Historically, itsefficacyinmacroeconomic stabilisation including low inflation and long-term RGDP growth have been shaped by series of historical collections evidenced in USA. Issues such as the Volcker disinflation reform, the Great Moderation and a host of other reforms taken to stabilise inflation and output have remained prominent in this regard. Goodfriend (2004) posited that this theoretical development is informed by the historically high rate of inflation witnessed since 1979.

2.6.5 New-Keynesian theory

The New Keynesian (NK) theoryemergedasan effort to address the limitations of monetarist and RBC. It is also an attempt to address the issue raised by the Lucas' critique and offerdifferentperspectivesto the flexible-price setting model proposed by previous authors. However, in recent theoretical discussions in the literature and practical policy modelling, NKis largely considered as an attempt to provide some microeconomic foundation by combining major elements of the RBC theory with those of Keynesian Economics. It has, thus, become the conventional approach to current theoretical and practical monetary policy analysis (Goodfriend and King, 1997; Rotemberg and Woodford, 1997; and Woodford, 2003).

Thecentral element of the NK model is that it does not consider money as acritical variable in MPtransmission to prices and output. Since themonetary authority considers IRas MP instrument in the context of the NK model, monetary decision affects nominal variables through the NK Phillips curve. The implementation of MP may be pursued without recourse to money and irrespective of whether the policy is optimal or not. Money supply is only determined on the bases ofagents optimising behaviour. Themodel is centered onkeybuilding blocks, namely, the aggregate supply equation that captures the

relationship between output gap, actual inflation, expectedinflation and IR. The MP rule is denoted by the interest rate and represents MP instrument that is changed depending on the path of inflation compared to the target.

The model also introduced three importantadjustments to the standard RBCmodel. First is the explicit introduction of IR, wages and prices. Second, the model relaxes the assumption of perfectly competitive market for goods and labour. Thus, some firms can earn positive price mark-up in the goods market.The third innovation is the introduction of nominal rigidities in the market modelled in line with the proposal by Calvo (1983). Here, a fraction of firms in the market are able to change prices. Also important is the introduction of wage rigidities and financial frictions (Gertler and Gilchrist, 2018). Some authors have attempted to undertake a robustness check on the role of money in the NK model. For instance, Balfoussia et al. (2011) theoretically studied the implication of moneyin the context NK model. Based on a static long-run equilibrium, they noted thatthe model with only aggregate demand, the Phillips curve and the Taylor rule could exhibit internal disequilibrium.Thus, introducing money into the system of equations to replace the Taylor rule would avoid a situation whereby the model exhibits internal inconsistency.

2.6.6 Monetary policy and the monetary neutrality hypothesis

The theoretical proposition on the neutrality of money has generated a continued debate that has been broadly categorised into various strands (Issaoui, Boufateh and Guesmi, 2015). These categorisations leaned on the radical posture and the conservative approaches of the thinkers behind this neutrality proposition. The radical position is the absolute neutrality of money that was guided by the classical and neoclassical thoughts of supply creates its own demand. To the thinkers of this school of thought, the neutrality of money is time invariant as they posited that the theory holds at all time horizons; short, intermediate and long-run situations. Money is considered a veil that conceals the reality of economic activities. Money exchange is only seen as a substitute to barter exchange. From this exposition, Walras (1874) employed money as a scaling factor in the theoretical development of his market-clearing condition.

On the other hand, Friedman and Schwartz (1963) admitted that the effects of money on the real sector only happens in the short-run. Nominal variables are only affected by expansionary MP expansions in the long-run. Lucas (1996) introduced the role of expectation into how money affects prices and real activities. He admitted that only an unexpected or unanticipated monetary shock exerts short-run impacts on prices, output and unemployment. The assumption is that economic agents are rational and the market is always in equilibrium. An anticipated increase in money would have been incorporated into decisions of economic agents. As such, anticipated monetary growth would only translate to higher prices and wages bargain will make wages to be constant. Keynes (1936) submitted that money affects the real sector only if the economy is still operating below full employment capacity since money can only positively influence underemployment; a short-term phenomenon.

2.6.7 Transparency and policy credibility

Credibility of MP is importantforpolicy effectiveness and the abilityto achieve medium-term inflation and output objectives.The quest to bring enhanced policy credibility motivated most countries to adopt IT regime. In order to effectively steerthe expectations of economic agents on inflation into the medium-term, economic agents must have strong confidence in MP. In the realm of rational expectation models, private agents act rationally as theytake into consideration current economic conditions in predicting the future. In view of this, building a MP environment that is shaped by credibility is a necessary condition in managing aggregate demand shocks to the economy that would be seen to be temporal(Aron and Muellbauer, 2006). Ifthe publichasconfidence in the authorities in terms of theirwillingness to achieve low inflation objective, they will form their expectations in line with that of the monetary authority. This will then make the monetary authority's disinflation policy much easier to achieve. It would also shield the economyfrom reacting to short-term aggregate supply shocks that would not require aggressive response from the central bank by way of interest rate adjustments. Building credibility is contingent on several factors including the role of technology and the political environment. This has implication on instrument and operational independence of

MP. There are also issues of structural constraints that serve as impediments to the transmission mechanism (Aron and Muellbauer, 2006).

2.6.8 Rules-versus-discretion

The debate on rule-versus-discretion assumed a new direction in 1970s that led to the concepts of time consistency and inflation bias. Kydland and Prescott (1977) observed that there might be the tendency for the policy maker to take advantage of potential gains from the trade-off betweeninflation and output, as suggested by the short-run Phillips curve. This is because monetary authoritywould attempt to raise output above its potential level by engineering unexpected inflation. However, this will not affect output but lead to higher inflationsince it would be fully anticipated by economic agents.Essentially, the concept of rules and discretion is based on the notion of the authority to commit the central banker to a stated course of MP.

Earlier models of MP that attempted to analyse the problem employedboth game theoretic and principal-agent settings because of time-inconsistency problem that results in mistrust between monetary authorities and economic agents (households and firms), leading to the inability to establish cooperative Nash equilibrium inpolicy outcome (Walsh, 2010; and Woodford, 2003). In other words, both the central bank and economic agents have distinct objective functions which they seek to minimise, subject to certain constraints such as supply constraint, typically the short-run Phillip curve. In linewith the formulation by Barro and Gordon (1983); and Kydland and Prescott (1977),the optimisation problem is specified below:

$$L^C = \lambda\left(y_t - y^p\right) - 1/2\left(\pi_t - \pi^T\right)^2 \quad (2.1)$$

Where y_t, y^p, π_t and π^T represents output, potential output, inflation and inflation target respectively. The economic agents' problem involves the minimisation of a loss function as specified below:

$$L^A = E\left(\pi_t - \pi^e\right)^2 \quad (2.2)$$

In this case, π^e represents private agents' future inflation expectations. The presence of time-inconsistence problems is reflected in the fact that there exist two distinct objective functions. One representing the monetary authority and another one for economic agents. As household and firms form their expectations, the monetary authority is tempted to cheat with a 'surprise element' once they believe that expectations have been well anchored. Thus, expansionary policy will be pursued only if thepolicy maker believe that doing so will engenderRGDP growth without compromising inflation objective.

Following the introduction of IT in the 1990s, empirical works on MP leaned heavily on the above formulation. For instance, in Svensson (1997), three main equations - inflation, output and an exogenous variable - form the building block of the model. Interest rate decisions are taken periodically to control inflation and promote output growth. The authorspecified a particular period's loss function as:

$$L(\pi_t) = 1/2\left(\pi_t - \pi^T\right)^2. \qquad (2.3)$$

The above equation implies that the aim of the central banker is to, as much as possible, reduce the gap between actual inflation and the target level. Consequently, the overriding aim of MP is to steer inflation expectations such that $\pi_{t+1/t} = \pi^T$, by adjusting short-term IR. Practically, steering inflation to the desired path is achieved over a given time horizon specified by the authorities. How quick inflation get to the target rate is a function ofstructural macroeconomic features and the speed of transmission mechanism. This shows the objective function of an IT central bank having a single goal. If the objective is to reduce inflation and achieve high and stable RGDP growth, the model is adjusted to include output gap (Svensson, 1997).

$$L(\pi_t, y_t) = 1/2\left[\left(\pi_t - \pi^T\right)^2 + \lambda\left(y_t - y^p\right)^2\right] \quad (2.4)$$

The above equation says that MP aims atminimising the divergences of inflation and output growth from the target and potential path, respectively. The monetary authority controls inflation by influencing private agents'expectations about the economy based on the available information. However, in taking policy decisions, the central bank make use

of several pieces of information in the economy instead of relying solely on divergence of inflation and GDP growth from their desired paths.

The global economy witnessed a period ofstable prices in 1990s after experiencing high inflation in the 1980s. Major reforms to monetary management played critical role in achieving this favourable outcome. There was a dramatic shift in policy towards announcing the expecteddirection of the economy based on current information available. It was noted across the spectrum of policy making that announcing intermediate targets was key to improving the work of central banks. Announcing the intermediate target in advance is very important as it prevents shocks (domestic and external) from causing aperpetually higher inflation. It alsoensures thatpolicy is committed to low inflation which the public believesis strong and credible. Above all, it commits the monetary authority to undertakeprudent policies as well as provide a benchmark against which economic agents can use to measure the efficacy of policy (Croce and Khan, 2000).

2.6.9 Rule-based monetary policy

Rule-based MP is rooted in the writings of Henry and Simons (1936). A rule-based MP can be active or passive, general or specific and sometimes, quantitative or qualitative. It is, usually, anchored on a defined relationship between some identified variables, and public pronouncements by the monetary authority on the course of policy action.

This theory nullifies the 'black-box' viewpoint championed by the monetarists that MPinfluences thebehaviour of economic agents and economic phenomenon without specifically identified intervening variables. As a systematic approach, rational expectations can be introduced into MP framework by adhering to rule or through credibility. The Taylor's (1979) IR rule or McCallum (1999) monetary base rule are the frameworks for rule adherence while credibility can be obtained through maximization of a welfare function. The rational expectation theory is hinged on the Taylor's principle. This principle presupposes that monetary authority can only stabilize inflation and curb inflationary pressures provided it can raise the short-term interest rate above its higher past or expected inflation rate (Moura and Carvalho, 2010).

2.6.10 Monetary policy and aggregate volatility

As stated earlier, the key objective of MP is to steer inflation to the level consistent with macroeconomic fundamentals of the economy, including output growth and low unemployment, stable exchange rate among others. Importantly, central banks seek to avoid a situation characterised by wide short-run movements in inflation and output that tend to have negative welfare implication. Severalprocesses have been identified through which enhanced efficiency in policy could contribute to the lowering of inflation and RGDP growth volatility.[20]Existing macroeconomic fundamentals together with economics agents' perception about the economy have important implicationfor the dynamic trade-off between inflation and RGDP growth. For instance, Orphanides and Williams (2006) notedthat as economic agent continue to learn and gather more information about the economy, the trade-off between inflation and RGDP growthtend to diminish. In essence,once the authority successfully and credibly anchors private agent's inflationary expectations, it automatically reduces the medium to long-term aggregates volatility in prices and output.

In the context of the models of rational expectations, Clarida et al. (2000) viewed the 1970s as the era where policy rules permittedintermittent volatility in macroeconomic variables. The situation began to change in the 1980s when it became obvious that widespread fluctuations in economic variables had negative implication on long-term growth and social welfare. Benati and Surico (2008) investigated the effects of this phenomenon for the Great Moderation. Thus, improvements in policy making can contribute positively to reducing volatility in inflation and output and consequently speed up any stabilisation process the central bank might be undertaking.

Boivin and Giannoni (2006) allowed for a strong and quick policy reaction to aggregate demand shock that impacts inflation and output growth. They observed that systematic changes in MP in an environment characterised by multiplicities ofsupply and demand shocks were responsible for the great moderation. On the contrary, Stock and Watson (2003) noted that witha more detailed and comprehensive model that assumes sticky

[20]For a detail survey, see Stock and Watson (2003).

price[21], it would be theoretically challenging to assume that lower inflation and RGDP growth volatility in USA was due to MP.

2.6.11 Monetary policy and inflation-output variability

The trade-off between output and inflation variability as largely articulated in theoretical literature has and continue to generate differentoutcomes. Conceptually and in line with several theoretical orientations, the argument is that the quest for a higherstability of inflation can only be achieved at the cost of high variability of output. There is, however, an important caveat about the inflation-output variability issues that is worth highlighting. Specifically, high variability does not necessarily imply a high trade-off in the levels of inflation and output. For instance, Fuhrer (1997) noted that the presence of a long-run variability trade-off does not necessarilysignify a long-run trade-off in the levels of inflation and output. Importantly, the output-inflation trade-off does not apply in the long-run situation and so exploited in the short-run. In a similar line of reasoning,Walsh (1998, 2009) and Hutchison and Walsh (1998) observed that when an economy comes under constant shocks, the presence of short-run trade-off between the level of inflation and output would introducesignificant variability in the long-run and attempts to achieve lowerinflation variability would result in highoutput variability. To overcome the apparent policy dilemma, the central bankerought to accepta higher level of variability in output in order to achieve lower inflation variability when the economy is confronted with supply and demandshocks. However, if the policy maker's objective is preoccupied with achieving low output variability, then shock to inflation must be allowed to persist in order to keep output around the potential path. However, the conclusions reached by Fuhrer (1997) and Walsh (1998) have been challenged by studies such as Dotsey and Sarte (2000) as theynoted that higher variability in inflation results in higher growth in output, due mainly to the precautionary savings motive.

Any type of shock to the economy comes from either aggregate demand, aggregate supply or a combination of the two. Thus, the kind of policy intervention depends on the nature of the shock and whether it is temporary or permanent (Ceccheti and Ehrmann, 2002). An

[21]For example, in Smets-Wouters (2007)

important consideration is that while aggregate demand shock affects inflation and outputin the same direction, supply shock exerts the influence asymmetrically.For the monetary authority, the concern is more on supply shocks since it compels the policy maker to settle on a trade-off between output and inflation (Chatterjee, 2002; Cecchetti and Ehrmann, 2002). The Taylor curve offers the analytical framework or efficient policy frontier within which this trade-off has been analysed in the context of policy choices faced by the central banker (Friedman, 2006). The Taylor curve has gained and continue to gain popularity in monetary theory. Chatterjee (2002) and Taylor (2008) noted that it clearly portrays the dilemma faced by the policymaker in trying to choose between inflation-output variability trade-offs.

Figure 2.11 demonstrates how the central bank can play between inflation and output objectives to achieve an optimal and efficient monetary policy decision.Different points along the Taylor curve show choices with different dynamics of inflation-output variability trade-offsavailable to the monetary authority (Taylor, 1999). To attain a low level of inflation variability implies settling for higher variability of output. Given an aggregate supply shock, an optimum point is for example **A** but entails a higher variability of output. However, the central bank would be deemed to have improved the conduct of policy it was able to move from **C** to **B.**The key issue is that, any point on the curve depends on the type of shock and the central bank's desire to achieve the inflation target at the expense of higher output variability. For small supply shocks, the likelihood is for the central bank to place a greater focus on output since the Taylor curve will be relatively closer to the origin such as **T1T1**. An improvement inthe conduct ofMPcould push the efficient position from **B** to **D.** The Taylor curve can also shift due to changes in the variability of shocks. Thus, it is imperative for the central bank to build credibility and improvement in the way policy is designed and implemented. This would ensure that the economy always operates on the efficiency frontier such as**T2T2**.

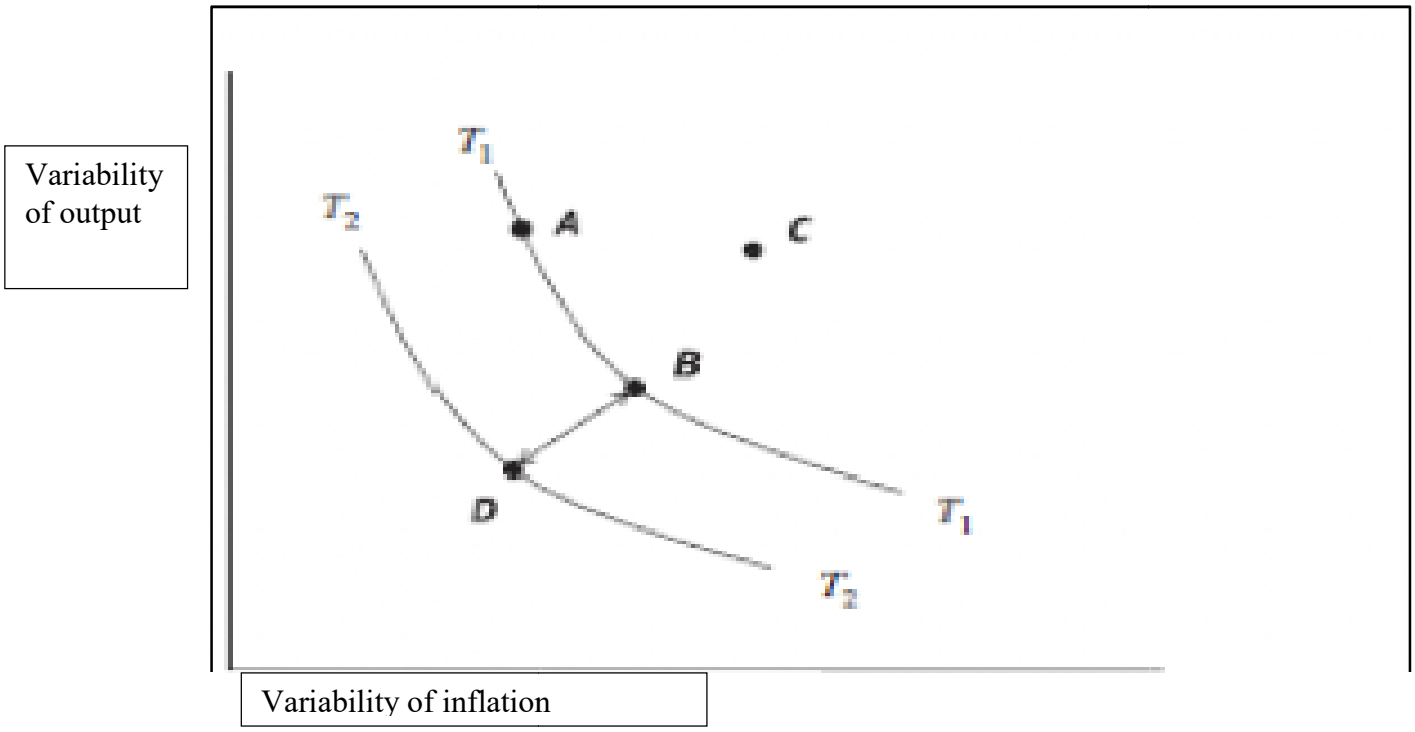

Figure 2.12. Inflation-output variability trade-off

Source: Adapted from Olson, E. and Enders, W. (2012)

2.7 The empirical literature

Studies relating to macroeconomic literature on MP, inflation and output are broadly categorised into various strands. The first strand relates to how MP regimes have been used to control inflation and achieve long-term growth while maintaining general macroeconomic stability. By extension, this strand of the literature evaluates optimum policy within the fulcrum of inflation-output variability trade-offs (Apergis, 2002; Narayan, Narayan and Smyth, 2009; Briec, Gabillon, Laselle and Ratsimbanierana, 2012). The second strand considers the stabilisation roleof MP in reducing inflation persistence and its volatility. The third strand is preoccupied with the implications of output uncertainty for optimum and/or efficient MP framework (Drew and Hunt, 2000; Athanasios, Porter, Reifschneider, Tetlow and Finan, 2000; Yetman, 2003). An emerging work attempted to analyse the issue of long-memory of inflation and its persistence on the effects of MP shocks (Lovcha and Perez-Laborda, 2018). These strands are presented in the context of composite role of MP and regime versus rule-based approaches to MP. The central theme underpinning recent literature on policy regimes suggests a greater attention being given to studies on IT as opposed to other MP frameworks. Clearly, this is due to the fact that IT has globally dominated the policy space for close to three decades and continue to gain popularity in emerging and developing countries. This explains why the empirical literature discussed in this study is dominated by IT. However, conscious effort was made to ensure that other forms of MP regimes are discussed within the framework of the objectives of the study.

2.7.1 Composite monetary policy

Recent empirical studies have sought to examinestructural macroeconomic implications of MP. These studies have mostly been done for developed countries, ostensibly due to the superior data available to those countries. Notable is the study by Carnova and Gambetti (2009), who examined the structural macroeconomic implications of MP in the USA economy. Specifically, theyattempted to investigate how policies by the Federal Reserve have impacted inflation and output dynamics, using quarterly data from 1959 to2006. They employed time-varying Covariance Vector AutoregressionModel with Bayesian methods. Based on the posterior median, their results showed thatthe USAwitnessed a fall

in inflation persistence during the early 1980s. This was partly attributed to changes in the way shocks propagated across sectors in the economy. Also, a large posterior uncertainty renders the upward trend in the output growth persistence up to the early 1980s, insignificant. The authors concluded that MP policies of the USA Federal Reserves contributed less to inflation dynamics in the USA.

Keen (2009) approached the issue in a purely methodological perspective with the construction and estimation of general equilibrium models to compare the fit of sticky price models and limited participation to models without friction. Keen's study was supported by an extensive review of business cycle models and a sufficient build up on Keen (2004). The parameters of the model were obtained using maximum likelihood and vector autoregression with a disaggregated quarterly data point that covered 1959Q2-2003Q4 and 1979Q4-2003Q4. When a vector autoregression model with three or four lags were estimated for the two periods, sticky price models performed better and fits the data fairly well. However, using pseudo-odds measure, the vector autoregression model with one or two lags performed better than all the general equilibrium models. In conclusion, a combined sticky price modelproduced a superior result than any separate model. Thus, MP produces data consistent responses to RGDP growth, IR and inflation.

Kimura and Kurozimi (2010) obtained theoretical evidence for the hypothesis of great moderation, suggested by Bernanke (2004), as strong policy action was found to have robust stabilisation effect through firm-level price setting. Theauthors suggested that when the policy maker exhibits the tendency to react quickly to risk to inflation, firm would not change prices frequently. This will result in the New Keynesian Phillips curve with a relatively flat curvature. Also, Kandil (2014) conducted cross-sectional and time-series analysisto examine the relative impact of MP shocks on output and inflation and whether or not the relative effects are symmetric or asymmetric in nature. The author focused on developing countries for the period of 1968-2008. Together with a demand-side analysis, they found that MP shocks were stabilising as the volatility of RGDP growth declines in the midst of variations in policy responses to shocks in different countries. However, changes in policy responses were found to be procyclical to price inflation as adjustments in MPincreased persistence in inflation and volatility in all the countries studied. In a

follow-up study, Kandil (2015) included developed countries in the sample but covered a shorterperiod, 1977-2008. They also employed cross-sectional and time-series analysis and the results showed marked disparities in adjustments of monetary shifts in developing countries compared to advanced economies. Overall, it was found that evidence supports the classical neutrality of money.

2.7.2 Stabilisation role of regime-based monetary policy

Recent studies on the stabilisation role of MP have largely centered on analysing the macroeconomic effect of IT,compared to other MP regimes. Among the early empirical studies, Bernanke and Mihov (1996) attempted to provide an empirical understanding of the kind of instrument that the Bundesbank target.This was against the backdrop that Germany practiced monetary targeting. Theyemployed an econometric technique based on structural vector autoregression and settled on IR (theLombard rate) as instrument ofMP.They reported that the Bundesbank effectively uses the Lombard rate to control inflation. The rate is increased in response to upside risk to inflation based on inflation forecast. The increase in the forecast for inflation also meant downward revision of growth forecast and growth in money. Even though Germany is not an IT country, the conduct of the monetary authoritymimics IT regime.

A central theme that shapes most studies on MP is the extent to which low inflation objective could be attained without comprising other key macroeconomics objectives such as RGDP growth and sound, stable and robust financial system. For instance, Cecchetti and Ehrman (1999) attempted to analysethe relative importance that a sample of 23 central banks (advanced and developing) attach to inflation-output stability. They argued that all the countries in the sample cared more about inflation volatility than output growth. This implies that achieving medium-term inflation objective is more important to central banks than achieving higher growth.

Cross-sectionalanalyses have been undertaken to compare the performance of IT versus non-IT regimes in controlling inflation and achieving long-term output growth. Abo-Zaid and Tuzemen (2012) conducted a study for a group of developing and developed countries that employeddifferent MP frameworksto establish the policy regime that is able to better

control inflation. The data for their study covered the period between 1980-2007. They indicated that countries that conducted MP in the context of IT were better able to reduce inflation than non-IT central banks. Before their study, Gonçalves and Salles (2008) had conducted a similar study but the coverage was for 36 mainly developing countries that covered the period of 1980-2005. Their finding indicated that IT regime was associated with a decline in inflation.Two major studies, namely, Brito and Bystedt (2006) andBatini and Laxdton (2006) also arrived at similar conclusions but employed a common technique (difference-in-difference estimation technique). The results are consistent with Mishkin and Schmidt-Hebbel (2007). Unlike other studies, their study covered 21 IT and 13 non-IT countries and employed instrumental variable estimation and ordinary least squares while the data covered the period of 1989-2004. In the case of Neumann and von Hagen (2002),they concluded that IT had dampening effect on inflation and reduced its variability. Thus, central banks that adopted IT witnessed a significant decline in the variability of inflation. However, they limited the scope of their study to cover only6 IT and 3 non-IT countries and employed various techniques including double differences and unrestricted vector autoregression.Relatedly, Levin et al. (2004) came up with a similar conclusion based on similar sample of IT and non-IT countries.

Propensity Score Matching (PSM) technique has been employed by some authors to compare different policy frameworks using cross-sectional data.A treatment sample was used by Vega and Winkelried (2005) to analyse the implication of MP on inflation for 23 ITand86non-IT economies. In the case of countries that practice IT, adrop in mean inflation and its variability was observed during the study period. However, their findings were later contradicted byDe Mendonça and De Guimarães e Souza (2012) who used the same estimation techniques but with a larger sample of 183 countries grouped along the IT non-IT dichotomy and a larger data set covering the period 1990-2007. Unlike the conclusion of Vega and Winkelried (2005), their findings indicated that less-developedeconomies that pursued IT regime witnessed a significant decrease in inflation and its variability. However, the same conclusion could not be made for developing countries.

Other empirical works find no substantialgain in inflation outcomeimmediately after adopting IT regime in developed countries compared to developing ones. This conclusion is striking but not surprising becausedeveloping countries could have benefited from the increased credibility which was lacking prior to adopting IT. Also, most developing countries adopted IT while inflation was still in the double digits compared to developed economies. While some studies were reporting positive outcomes for inflation and its variability, others sought to empiricallyfind out the sustainability of the gains made in reducing inflation. In this regard, Ball and Sheridan (2005) noted that most of the gains made by IT countries in lowering inflation waneonce mean reversion is accounted for. Theconclusion is interesting and in line with earlier findings that developed countries did not experience a significant drop in inflation immediately after adopting IT. In the case of developing countries, the huge decline in inflation was largely due to the initially higher level of inflation. Statistically therefore, the propensityis for inflation, after experiencing a huge drop, to drift towards its mean. The mean could however, be lower than what it would have been in the absence of IT. It is important to note that the technique employed failed toprovide solution tothe issue of endogeneity and self-selection bias.

In an effort to deal with self-selection bias, Lin and Ye (2007) applied PSM method for 22 developed IT economies, covering the period of 1985-1999. Again, they concluded, in agreement with previous studies, that IT did not exert expectedeffects on inflation for developed countries.In contrast, Vega and Winkelried (2005) reported a decrease in inflation and its variability for all the IT countries in their sample. However, both studies have been criticised on various grounds. The failure to account for time trend and latent features of individual nations in the sample has been considered a major flaw. All the countries were considered as homogenous without considering individual country and regional characteristics. What has been done in the literature is to employ a dynamic panel estimator to control for omitted variable bias and simultaneity in the system. Brito and Bystedt (2010) applied this framework on a group of 46 emerging economies between 1980-2006 and concluded that there was no statistically significant evidence that IT exerts a dampening effect on inflation and its variability. The same issue was investigated based on a different methodological perspective by Angeriz and Arestis (2006) using

SeeminglyUnrelatedRegression (SURE) for ten IT countries, covering the period of 1980-2004.They concluded that IT regime did not lead to a reduction in inflation.

However, attempts have been made to re-examine conclusions of previous studies using larger samples size, tractable models and techniques.A notable study in this regard is Batini and Laxton (2006). Using an extended sample of 42 developing, emerging market and developed economies, theyanalysed inflation outcomes after the countries employed IT. Following an approach based on Ball and Sheridan (2005), they highlighted that IT adopters were able to anchor inflation expectation and consequently, achieved a reduction in inflation. This suggested that pursuing MP in the context of IT regime is superior to other policy frameworks.Apart from Batini and Laxton (2006), Goncalves and Salles (2008) also employeda similar approach as in Ball and Sheridan (2005) to study macroeconomic implication ofMP for 36 EMEs (both IT and non-IT)and used annual data covering 1980-2005. Their findings were largely consistent with those from previous studies. An important factor that couldaffect the results of such cross-sectional study is the number of countries that are used for the study. Thus, unlike previous studies, De Mendonça and De Guimarães e Souza (2012) conducted their analysis based on an extended sampleof 180 countriesbut covered the period of 1990-2007. With the countries grouped into developing and developed countries, using PSM technique, the findings suggest a positive outcome on inflation for developing countries.

Stemming from this, Thornton (2016) revisited IT in developing countries after the generalisation made by Goncalvez and Salles (2008) that IT countriesachievedlargerdeclines in inflation and real GDP growth volatility. This revision was consequent upon the criticism of Ball (2010) that identified some countries as outliers coupled with the differences in currency regimes. The countries combined by Goncalvez and Salles (2008) included high income countries and those with fixed and crawling peg exchange rate regimes. With a panel of 72countries at various levels of development, they obtained results that suggested that countries with IT regime experienced low inflation. For developing countries, however, implementing IT did not result in low inflation and output variability. This is after controlling for different MP regimes and mean reversion.

The same result was obtained when compared to countries that implemented fixed exchange rate regime. This implied that Ball (2010) concerns were genuineas incorporating them yielded different results.

With a theoretical proposition and empirical plausibility that inflation uncertainty lower real output, Miles (2008) analysed the implication of IT on the variability and persistence of inflation in Canada. The study employed the method of Generalized Autoregressive Conditional Heteroscedasticity (GARCH) as the technique of analysis, and quarterly data that spanned1970-2006. His result showed that while IT reduced the persistence of inflation, itintroduced uncertainty. By implication, the real output reduced. This motivated Sanchez (2010) to analyse the actual and target inflationwithin the framework of South Korean IT regime usingSeemingly Unrelated Regression (SUR) and data scope spanned monthly periods of 1999M-2006M12.With an optimal macro-model predicated on an infinite horizon quadratic loss functions that was designed primarily for the Bank of Korea and in tandem with the characterisation of ITframework in Korea, the study found evidence that the central bank is preoccupied with stabilising prices with negligible importance on the stabilisation of output. The study favoured a gradual approach to the implementation of IT and preferred IR smoothing to output stabilisation goal.

Bleich, Fendel and Rulke (2012) predicated their study on a theoretical anchor provided by Svensson (1997) to analyse the consistency of IT regime in stabilising inflation. A forward-looking MP rule for IT central banks was estimated and comparisons were made before and afterIT periods. The period of investigation spanned 1990-2007. The estimated Taylor rule showed a coefficient of inflation thatis significantly larger than unity for eleven central banks. This indicated that the ability of central banks to stabilise inflation increased with IT regime. However, a caveat on the inflation stabilisation capacity of the monetary authority was raised. More so, the submission that IT central banks were more anti-inflationary had not been resolved and was still subjected to empirical interrogation.

Abo-Zaid and Tuzemen (2012) studied almost three decades of MPindeveloping economiescovering 1980-2007. On the strength of theoretical proposition that lowinflation is achievable under IT regime, they employed difference-in-difference technique to

investigate a panel of twenty-seven countries practicing IT. The implication of ITframework was found to be mix for the two categorisations of countries and also mix in terms of its effects. An explicit IT regime for developing countries resulted in significant drop in inflation of about 3.2 percentage points higher than non-IT central banks. For developed countries, however, there was no relationship between the period when IT was adopted and changes in average inflation. The reason adduced to this difference in results was that inflation was generally stable in developed economies as compared to their developing counterpart at the time of adopting IT. However, IT had a positive and significant effect onRGDP growth in both developing and developed countries. Before then, Brito and Bysteadt (2010) obtained a panel evidence of IT for some emerging economies. For a data scope that ranged 1980-2006, a battery of panel estimation techniques was employed; including a robust Generalized Method of Moment (GMM), simple pooled cross-section ordinary least square and the pooled ordinary least square estimation with time variable effects. They argued that the effect of IT on inflation has been overstated and that it could best be described as conservative window-dressing because the reduced inflation rate experienced by developinginflation-targeters was counter-balanced by reduced output growth. They suggested an output growth cost of reduced inflation rates along the inflation-outputtrade-off framework.Nojkovic and Petrovic (2015) studied MP in six emerging European countries[22] using a three-way discrete choice model within a Taylor-typed modelling framework. They noted thatoutput gap and real exchange rate weresignificant in MP rules. In terms of operational behaviour of the monetary authority, they reported that central banksadjustedinterest rate discretely to close the gap between the actual inflation and the target.

Lovcha and Perez-Laborda (2018) used a model based onStructural Fractionally Integrated VAR (SFIVAR) to study the implication of MP shocks on long-memory property of inflation. They considered quarterly model of the economy of USA comprising inflation, interest and capacity utilisation, as a measure of real activity. To obtain robust long-run estimation results of the SFIVAR model, different sub-sample periods that coincided with the era of great moderation (1980Q1-2007Q4) and the pre-

[22] These include Albania, Czech Republic, Hungary, Poland, Serbia and Romania.

Volcker period of 1954Q3-1979Q2 were investigated. The fractional (order) of integration for inflation rate, as depicted by these sub-samples became imperative. They showed that long-memory of inflation data was robust and could not be attributed to data breakpoints and that capacity utilisation, inflation and Fed funds rate were mean reverting though non-stationary. The first two variables were found to be statistically significant with fractional parameters of 0.612 and 0.683, respectively, while the last variable, the Fed funds rate, was statistically insignificant with 0.143 coefficient. It was also found that no regime switching behaviour was observed, as the estimated orders of fractional integration did not change considerablyacross periods.

Pearce and Sobue (1997) calibrated a static game-theoretic methodology and showed that inflation bias of the monetary authority would be reduced if MP was conducted with surprises and uncertainty. Also, Ardakani, Kishor and Song (2018) estimated treatment effect of MP, anchored on Svensson (1997) theoretical framework of inflation forecast targeting of a loss minimisation function with a panel of 98 countries for the period 1990-2013. For its merits over joint modelling approach, the study used multivariate imputation by chained equationmethod and the data samples were divided into developed and developing countries. With a propensity scores coupled with sensitivity analyses, the study found no majordisparity in the level of inflation for the countries. However, the sacrifice ratio and interest rate variability declined for developed countries, compared to developing countries.

Issaoui, Boufateh and Guesmi (2015) revisited the money neutrality proposition and conducted an empirical study that spanned 1960-2011 for USA and Morocco and 1962-2011 for Gabon. Techniques based on of SVAR and SVECM were employed. The authors established that the short-term effect of MP on RGDP growth was positive and decreasing while the long-run effect was not systematically zero. The study could not provide empirical evidence for the proposition of neutrality of money through broad money supply as a better measure of monetary aggregate. It was suggested, however, that growth in money created inflationary pressures in the countries considered.

2.7.3 Monetary policy and real GDP

Several studies have investigated the implication of MP on RGDP growth in both advanced and developing economies as the central bank pursues the mandate of price stability. The literature is divided between those who strongly believed in the efficacy of MP on growth and those with a contrary opinion, all using different methodologies and estimating techniques.

Some studies affirmed a positive RGDP growth effect when the policy regime was conducted using IT. A pulse dummy technique was employed by De Guimarães e Souza et al. (2016) to study a group of countries between1990-2007. Developing countries experienced positive and sustained growth effect of IT. This is consistent with Amira et al. (2013) that established similar conclusion for a sample of 36 emerging market economies (EMEs); albeit, they used the two-step system of generalised method of moment panel estimator. Disparities in growth effects among developing countries in different regions have also been reported in the literature. Using fixed effects and ordinary least squares estimation for a sample of 51 countries, Ayres et al. (2014) concluded that the effect of IT on output, though insignificant, differ among developing countries in different regions.Before this study, Abo-Zaid and Tuzemen (2012) employed difference-in-difference techniquefor data covering 1980-2007 to analyse growth effects of MP for 50 countries. They highlighted that developing countries that practice IT experiencedenhanced growth. In the same vein, Brito and Bystedt (2006) anlysed Latin American countries using the same difference-in-differences approach. They, however, found that IT has a neutral effect on output and its variability.In an attempt to proffer an explanation for the reasonemerging market economies experienced lower output variability, Mishkin and Schmidt-Hebbel (2007)averred that these countries usually face fewer domestic supply shocks coupled withrelatively effective monetary and fiscal policies.Mollick et al., (2011) approached the issue from a different perspective. He attempted to investigate the implication of IT on per capita GDP for a sample of 55 developed countries and Emerging Market Economies (EMEs). The novelty in the study is the modification of the neoclassical growth model to controlfor elements of globalisation in the countries. The study concluded that IT is associated with increased output and GDP per capita in the countries studied. However, for emerging economies, the result of

thelong-run effect depends on the model dynamics. Positive growth effect is smaller when the static model is used compared to the dynamic framework.

2.7.4 Rule-based monetary policy

The study of Taylor (1993), as extended, has been largely used to investigate the welfare outcome of a rule-based MPregime and its impact on inflation and output volatility. Tillman (2012) specified a Keynesian-typed Taylor's rule that incorporates information into the conventional rule-based Taylor's (1993) framework, to investigate how credibility as well as the dynamic consistence of the monetary authority led to improved welfare of private agents. The study showed that the stabilisation bias of discretionary policy can be mitigated if the central bank aimed at minimising deviation of the policy instrument from IR level suggested by the Taylor's rule.

Westelius (2005) examined persistency puzzle of staggered price wage contracts on employment and inflation when the economy is on the path of disinflation. He predicted his work on Barro and Gordon's (1983) neoclassical model of discretionary policy with some modifications, using data for the period 1970-2001. Four different sub-samples that ranged between 1970Q1-1997Q2, 1970Q1-2001Q1, 1970Q1-1979Q4 and 1980Q1-2001Q1 were employed with the use of the Phillips-Ouilaris and Johansen cointegration tests. His argument based on his result is that lack of transparency and credibilityeven in the absence ofnominal rigidities, introduced persistence in unemployment and inflation following a disinflationary policy. Also, in a theoretical paper, Adam (2009) formulated a basic model in which the policy maker places significant weight on inflation objectives within the framework of rule-based policy. He argued that doing so actually contributes to loweringinflation and output variability. In contrast, the presented model suggested that overly ambitious efforts aimed at stabilizing output through policies based on discretion rather than rules could lead to increased variability in economic variables. Anchored on a Vector Autoregression (VAR) framework and with series of scenarios analyses backed by a collection of propositions and lemma, the study established that macroeconomic stabilization became counter-productive if the attainment of the objectivesaffects negatively, the hitherto economic agents'decision-making process.

The study of Berument and Yuksel (2006) investigated how IT regime altersinflation pattern and its volatility for five developed and four emerging countries that practiced IT predicated on the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model. They concluded thatITregime in the countries studied did not produce uniform outcomes. This suggests that countries might have implemented monetary policies based on different policy rules. Specifically, empirical evidence conformed to the expectation that ITresulted in decreased conditional inflation for New Zealand, United Kingdom, Australia, Chile, Canada, Columbia, South Africa and Sweden; albeit, it was only found significant for Sweden and Chile. Also, this result was found consistent with various model specifications for all these countries except Australia, Chile and Sweden. However, this consistency of theoretical expectation to empirical findings was absent for Brazil as positive relationship was obtained for ITregime and inflation.

Hayat, Balli, Obben and Shakur (2016) examined the role of policy discretion as opposed to rulein inducinghigh inflation without compromising on growth. The technique of Autoregressive Distributed Lag (ARDL) model was employed, between 196-2010. The results showed that monetary discretion was found tohave significant long-run bias against inflation without imputed RGDP growth benefits. However, in the short-run, only an occasional but perceptible real growth gain of monetary discretion was found. An indirect result suggested no inflation-output trade-off effect ofdiscretionary MP, both for short and long-run situations. For instance, by using active monetary discretion, the monetary authority in Pakistan distorted the economy from its natural path through the creation of inflation and growth cycles. This led to destabilising, rather than stabilising effects. Divino (2009) assessed MP for small open economy with a focus on low and stable inflation, along the exchange rate channel. The building block of a system of equationincluding household sector, aggregate supply and aggregate demandwas specified. The author concluded that real exchange rate movement plays a major role in the dynamics ofoutput and inflation gap stabilisation trade-off. Thus, the policy maker's optimization problem impliestargeting inflation within a policy framework characterised bya managed-float exchange rate.

Using a sample of seven Latin American countries, Moura and Carvalho (2010) estimated sixteen alternative Taylor's rule specifications separately foreach of the countries to obtain a robust Taylor rule specification that adequately captures the structural formation of these economies in terms of their MP strategies. The authors employed the use of monthly data that ranged between January 1999 and January 2008. Three mainMPstance including tough, mild and lax policies were identified across the countries. They highlighted that the appropriate model varies across countries in terms of their predictive power. Brazil and Mexico werelargely preoccupied with the attainmentof inflation objectives as they favoured strong and prompt policy response to counter potential risk to inflation.On the other hand, Chile and Peru followedless aggressive policy while Venezuela, Argentinaand Columbia did not show strong commitment to fighting inflation even if it trends above the optimal path.

2.7.5 Instrument-based monetary policy

Haslag and Hein (1995) investigated a comparative short-run policy effect of reserve requirements and high-powered money in the USA. They examined the manner in which MP was implemented for price stability and economic expansion. Three different SVAR models were estimated using data scope that spanned 1959-1990 to establish contemporaneous effect ofMPinstrumenton selected macroeconomic indicators. They suggested that caution should be taken in imposing the equality restriction onhigh-powered money and reserve requirement when the dynamic reaction of targeted variables to innovations inMPwas examined. There was evidence that suggested that economic agent's responses to policy actions were different. As such, a notion of a single holistic statistic to summarise all MP actions was faulted.

Some studies sought to compare different policy indicators in terms of their predictive power. For instance, the predictive power of different MP instruments on real economic activity has been studied by Choi and Ratti (2000). The comparison was mainly between IR and monetary aggregates. The study analysed two sub-samples that spanned 1959-1966 and 1966-1972 periods with VAR framework. They showed that non-borrowed reserve mix outperformed the federal funds rates based on its predictive power over different forecasting horizons. Also, the study of Nelson (2003) focused on the relationship

between money, aggregate demand and inflation in his investigation of the role of money. The author suggested a range of variables in household's money-holding decision within a New Keynesian framework. His results indicated that both the dynamics of inflation are still governed by money growth. Interestingly, it was found that the importance of money for aggregate demand came not through real balance but on money serving as a proxy for the various substitution effects of MP that existed when asset prices matter for aggregate demand. Dwyer and Fisher (2009) evaluated the relationship betweenmoney growth and inflation. With a dataset of 166 countries and an unbalanced panel structure that ranged between 12 to 21 years, the study found 0.41 correlation for countries that had money supply growth of up to 10%. They showed that correlations between money growth and RGDP growth and inflation are higher when all countries (including countries experiencing high and low inflation) were put together.

Defina, Stark and Taylor (1995) investigated the trade-off betweeninflation and output volatility within the framework of different policy rules by the Federal Reserve, and employed USA data for the period 1959Q1-1993Q2. They showed that IR smoothing produced a more efficient outcome for inflation-output variability trade-off, relative to the case under money target. However, the decision between nominal GDP target andIR smoothing; and RGDP growth and money supply targetsdepends on the policy maker's preference forRGDP growth versus stability in inflation.They further suggested that the monetary authoritycould engineer an inflation output trade-off of 3.5 to 4.5 for output volatility, and 2.5 to 3.75 for that of inflation. Attempt to achieve trade-off outside this optimal range led to higher volatility inmacroeconomic variable. Other policy rulesshowed that RGDP growth targets or interest rate smoothing produce results not significantly different from other optimal policy rule. Essentially, the decisionon which rule to adopt dependson the weight placed on inflation, relative to output stability. Compared to interest rate smoothing, targeting monetary aggregates produced inferior outcomes. Again, the decision between achieving high nominal GDP growth or hitting money growth targetsis contingent on policy maker's inclinations for high GDP growth and low unemployment as opposed to low inflation objectives.

Also, Chadha and Tsiddon (1998) examined the distribution of RGDP growth around potential when IR is a non-linear function of demand for money using several Monte Carlo simulations. The central argument is that the variance of output displayed positive relationship with inflation when fluctuations in output were explained by disturbances from the money market. However, variance of output showed negative relationship with inflation when the fluctuations from output occurred due to disturbances from the goods market. When both disturbances were found significant, a critical non-zero trend inflation rate minimized the standard deviation of RGDP growth.

2.7.6 Monetary policy, inflation and output variability trade-off

As the inflation targeting framework continue to evolve, so is the dilemma faced by central bankers when it comes to the achievement of low inflation versus high output growth.Several empiricalworks have attempted to investigate the inflation-output variability trade-off in the context of inflation targeting MP framework in recent times.There seems to be a convergence in the conclusions of most of the studies which suggest that the quest by the central banker to achieve low and stable inflation can only be achieved at the expense of higher variability of output growth.For instance,Olson and Enders (2012) employed vector autoregression model to analsze MPefficiencyin the United States from 1875 to 2000.Their model captured the time-series properties of output and inflation but did not control for other sourcesof shocks. They concluded that that an efficient MP that ensures that the Taylor curve is close to the origin is associated with a low inflation-output variability trade-off. This suggest that central banks that have been able to build high credibility are able to achieve theirinflation objectives without compromising output and other macroeconomic objectives. Essentially, they demonstrated that the period after the 1950s was characterised by lower opportunity cost of low inflation in terms of output losses. Cecchetti and Ehrmann (2002) followed the techniques of Olson and Enders (2012) to investigate the evolution of preferences of the central banker during1980s and 1990s. They analysed the inflation-output variability trade-off ofa cross-section of 23 countries. The sample is made up of ninefull-fledged inflation-targeterss. Theyfound that all the countries in the sample placed high preference for low variability of inflation during the 1990s, compared to 1980s. This particularly applies to inflation

targeting countries relative to non-inflation targeting countries. The implication of the aversion to high inflation variability is that it led to low output and high volatility. In a similar study but with different outcomes, Levin, Natalucci, and Piger (2004) noted that inflation targeting countries do not necessarily experience higher volatility in output compared to non-inflation targeting countries. Generally, findings from earlier studies such as Cecchetti and Ehrmann (2002) have been corroborated by studies such as Cecchetti, Alfonso, and Stefan (2006) where it isestablished thatenhanced monetary policy efficiencyis highlyreinforced by structural changes in the economy and low supply shocks.

Different types of shocks have different implication on the dynamics of inflation-output variability trade-off. Efforts have been made to empirically ascertain how the link reacts to those shocks. For instance, Ndou et al. (2013) explored how the nature of the trade-off is affected by demand and supply shocks in the case of South Africa.They arguedthat the Taylor curve stayed close to the origin during the period when the country pursued inflation targeting compared to the period before in the midst of different types of shocks. Before Ndou et al. (2013), Lee (2002) undertook a similar enquiry for the United States with data spanning 1960 to1999. To adequately account for majorstructural breaks, the author adopteda two sub-sample analyses and utilised a Bivariate Generalised Autoregressive Conditional Heteroskedasticity approach. The author noted that there is always a long-term inflation-output variability trade-off in the United States but the magnitude varies across the periods. Stephanos and Vangelis (2015) employed a similar approach to study monetary policy effectiveness in the context ofchanging levels of transparency from 1982 to2011. Using vector autoregressive model and introducing conditional variances of inflation and output, they established that a positive shock to the central bank's transparency is associated withlowinflation and output variability.

In an attempt to study how the inflation output trade-off behaves under different regimes, Onyukwu, Nwosu, and Ito (2011) employed a bivariate GARCH approachto investigate the issue using datafor Nigeria. Theyconcluded that the extent of monetary policy's effect on output and inflation depends on the type of policy regime in place, even though the effect on the dynamics of the trade-off is not obvious. They further demonstrated that

monetary policy had a relatively strongereffect onoutput when MP is characterised by direct controls.However, the impact is larger for inflation when a market-based regime is in place. Meanwhile, using the GARCH model, Conrad and Karanasos (2015) showed that output variability adversely affected the variability of inflation in the US. In particular, the study presented strong evidence supporting the theory proposed by Logue and Sweeney (1981);a study that affirmed the positive impact of inflation uncertainty on the variability of output.

Fuhrer (1997) investigatedthe behaviour of inflation-output trade-off in the United States from 1966 to 1993 and established that the variability trade-off tends torise when the standard deviation of output or inflation islessthan two percent. The author further argued that whenan economy is impacted by shocks, policy decision is complicated by the choice between controlling inflation or ensuring output growth. Generally, conclusions from most empirical studies suggest that central bankers during the 1990sreacted strongly to deviation of actualoutput from the potential path.

Some authors also looked at the trade-off issue in the context of inflation forecast targeting. For instance, employing a moving average representation of a vector autoregressive model, Fackler and McMillin (2011) approached the issue usingdata split into two sample periods including 1962 to 1983 and 1980 to2000. The authors concluded that there was a favourable trade-off between inflation and output variability for the United States during the study period. Again, as far as the efficacy and credibility of MP is concerned, there was higher policy credibility during the second sample period than the first period as less efforts were required by the policy makers to effectively anchor inflation expectations and steer it to the desired target.They also demonstrated that thelow inflation variability was associated with lower levels of output and interest rate variability and this was evident during the first sample period compared to the second period.

An important empirical question is whether the extent of the trade-off differ under different policy regimes. To investigate the efficiency of inflation targeting and non-inflation targeting regimes and their implication for inflation-output variability trade-offs,Amarasekara and Bratsiotis (2015) employeda micro-founded framework and

developed an inflation-unemployment variability frontier using data from 1980 to 2007.According to the authors, there was strong trade-off between inflation and unemployment variability for 14 countries. Theauthors argued that post1993 was characterised bya higher inflation-unemployment variability trade-off in the countries studied. They further argued that inflation targeting countriesexperienced lower variability trade-off compared to non-inflation targeting central banks.

Clearly, conducting MP within the framework of inflation targeting offerslucidity and transparency to the core objective of MP.Fraga, Goldfajn, and Minella (2004), had earlier on articulated this line of argumentby comparing the performance of inflation targeting in emerging and advanced economies and concluded thatthe trade-off was higher for emerging market economies compared to advanced economies. Before their study, Arestis, Caporale, and Cipollini (2002), utilised stochastic volatility models to investigate whether or not the move to inflation targeting by some countries affected the trade-off during the 1980s and 1990s. The basic conclusion from their study is that the move to inflation-targeting largely improved monetary policy trade-offs due to enhanced transparency and credibility that is associated with inflation targeting.

2.8 Synthesis of research gap

From the empirical evidence,majority of the studies focused more on IT as opposed to other MP frameworks. This ostensibly is due to the fact that IT has globally dominated the MP policy space for close to three decades and continue to gain popularity in emerging and developing countries.The estimation approach is broad based ranging from general equilibrium models to simple statistical techniques. Also, country specific studies are limited as most of the studies are based on cross-sectional analysis and highly focused on developed and emerging market economies.

The literature can be broadly categorised into three strands. The first relates to how MP has been used to control inflation and promote output growth. It evaluates an optimum policy within the fulcrum of the inflation-output trade-off. The second strand considers the stabilisation role of MP in controlling for inflation and output volatility. The third strand is preoccupied with the implication of long-term growth uncertainties in the context of

optimum and efficient policy framework. However, very little enquiry into the issue of long-memory properties of inflation and its persistence on the effects of policy shocks has been undertaken.The major attempt in this regard is the study by Lovcha and Perez-Laborda, 2018who investigated the long-memory property of inflation in the context of monetary policy shock but did not introduce the information content of money in their model. The present study is partly to fill this lacuna using Ghana as a case study.

Theoretically, most of the studies in the literatureemployed traditional Keynesian framework which exclusively assign IR as the tool for controlling inflation and ensuring output growth.The New-Neoclassical synthesis which also emphasis the stabilisation role of IR but embodies key element of Monetarist, Real Business Cycle, Rational Expectations and Keynesian economics is employed as the theoretical framework for this study while the role of money is explicitly introduced into the model.

CHAPTER THREE

THEORETICAL FRAMEWORK AND METHODOLOGY

This chapter presents the theoretical framework and methodology for the study. Generally, conducting an empirical investigation requires a three–prong methodological approach which entails pre-estimation test, empirical estimations and post–estimation tests. It is along this thread that the framework for empirical investigation is provided for this study. From the framework employed, the functional models for the study are identified and the empirical models for investigation is specified. Also, the framework for the techniques of analyses is stipulated and the sources and description of data is discussed.

3.1 Theoretical framework

Monetary policy has been subjected to significant debate and widespread disagreement in the literature over appropriate models that best describe the transmission of MP to key economic variables. Following insights gleaned from the theoretical literature and the fact that Ghana is an inflation-targeting (IT) country, this thesis is anchored on the New Neoclassical Synthesis (NNS), drawing from the works of Goodfriend and King (1997), Rotemberg and Woodford (1997), Yun (1996), McCallum and Nelson (1999) and Barradas (2014). Essentially, the model adopts the key elements of both Keynesian and Classical economics into a modern framework of macroeconomics. It is defined by two key elements: (i) it is built on new classicaland real business cycle theories as it combinesrationalexpectations and inter-temporal optimisation into a dynamic macroeconomic model; and (ii) erected on New Keynesian model by incorporating nominal rigidities and imperfect competition into macroeconomic analysis. In addition to these key theoretical elements, it embodies practical aspects of MP implementation in general (Goodfriend and King, 1997).

By implication, it is a welfare maximising theory of MPanchored on the mark-up effects of interest rate (IR) movement on price stability. An IR policy action initiated by a credible

monetary authority first stabilises production mark-up and subsequently to prices. With strong policy credibility, private agents will anticipate lower their inflation expectations and the IR policy will eventually exert an impact on inflation and other macroeconomic variables. The core of the model is underpinned by various equations. These includes: (i) the Phillips curve; (ii) aggregate demand; and (iii)a MP rule. Themain economic actors are households, institutions and the monetary authority.

3.1.1 The aggregate demand

The building block of the model begins with the aggregate demand. This is derived from the amalgamation of individual consumption in the economy after optimising each household consumption behaviour. Subject to a budget constraint, the typical household optimises a consumption function as follows:

$$\underset{C_t,N_t,M_t}{Max}\ E_0\sum_{t=0}^{\infty}\beta^t\left(\frac{C_t^{1-\sigma}}{1-\sigma}-\varphi\frac{N_t^{1+n}}{1+n}+\theta In\left(\frac{M_t}{P_t}\right)\right) \tag{3.1}$$

Where C_t is private consumption, $1-N_t$ is leisure, P_t is price level and M_t is money stock.

The optimisation problem is subject to a flow budget constraint given as:

$$P_tC_t+B_{t+1}+M_t-M_{t-1}\le W_tN_t+\prod_t+(1+i_{t-1})B_{t-1} \tag{3.2}$$

Where W_t is wealth, Π_t is profit from production, and B_{t-1} is stock of nominal bonds held by the household. The price paid for the bond is the nominal interest rate, i_{t-1}.Household begins the period with a given money stock defined as M_{t-1}. The maximisation of the individual's utility function requires setting up of the Lagragian:

$$L=E_0\sum_{t=0}^{\infty}\beta^t\left(\frac{C_t^{1-\sigma}}{1-\sigma}-\varphi\frac{N_t^{1+n}}{1+n}+\theta In\left(\frac{M_t}{P_t}\right)-\lambda_t\left(P_tC_t+B_{t+1}+M_t-M_{t-1}-W_tN_t-\prod_t-(1+i_{t-1})B_{t-1}\right)\right) \tag{3.3}$$

The first order conditions of equation (3.3) are the following:

$$\frac{\delta L}{\delta C_t}=C_t^{-\sigma}-\lambda_tP_t=0; \tag{3.4}$$

$$\frac{\delta L}{\delta N_t}=\varphi N_t^n-\lambda_tW_t=0; \tag{3.5}$$

$$\frac{\delta L}{\delta B_{t+1}}=\lambda_t-\beta E_t\lambda_{t+1}(1+i_t)=0; \tag{3.6}$$

$$\frac{\delta L}{\delta M_t} = \theta \frac{1}{M_t} - \lambda_t + \beta E_t \lambda_{t+1} = 0 \tag{3.7}$$

From equation (3.4), the marginal utility of money, $\lambda_t = \frac{C_t^{-\sigma}}{P_t}$ (3.4')

By substitution, the results become:

$$\theta \frac{1}{M_t} = \frac{C_t^{-\sigma}}{P_t} - \beta E_t \frac{C_{t+1}^{-\sigma}}{P_{t+1}} \tag{3.8}$$

Re-arranging equations (3.7) – (3.8) yield;

$$\varphi N_t^n = C_t^{-\sigma} w_t \tag{3.9'}$$

$$C_t^{-\sigma} = \beta E_t C_{t+1}^{-\sigma} (1 + i_t) \frac{P_t}{P_{t+1}} \tag{3.8'}$$

$$\theta \left(\frac{M_t}{P_t} \right)^{-1} = \frac{i_t}{1 + i_t} C_t^{-\sigma} \tag{3.9}$$

Equation (3.8') is the Euler equation for the optimal consumption that is a function of the marginal utility of consumption, C_t returns on bond, $(1 + i_t)$ and the rate of discounting future value of consumption to its present value (the discount rate given as σ). The discount rate allows the household to smooth out consumption and embark on inter-temporal consumption choices. The rational expectation and forward-looking components are $E_t, C_{1+t}^{-\sigma}$, and P_{t+1}. In line with the generalisation by Woodford (2003), the Euler equation is aggregated to obtain the aggregate demand function. Accordingly, current output would relate positively to its past value and negativelyto real interest rate (RIR) so that:

$$y_t = -\tau (i_t - E_t \pi_{t+1}) + \varepsilon E_t (y_{t+1}) + \varepsilon \tag{3.10}$$

This generalisation, consistent with the life-cycle hypothesis, *ala* Friedman (1957), suggests that current consumption is a function of income flow throughout life. It further reflects how the consumer would prefer to smooth out consumption level throughout his or her lifetime. The implication is that the individual would prefer saving to consumption only when current interest increases and prefer consumption to saving when interest rate falls. Barradas (2014), in line with Duesenberyy (1949), argued that the persistent feature

of most macroeconomic variables suggests that not only forward-looking rational expectation components are important but also backward-looking adaptive expectations. Duesenberry (1949) advanced a cross-sectional paradigm to the relative income hypothesis where it was established that current consumption level depends on the individual's historical consumption pattern. The intuition is that current aggregate demand is influenced by its past level. As such, the generalization in equation 3.10 is re-specified as:

$$y_t = -\tau(i_t - E_t\pi_{t+1}) + \varepsilon E_t(y_{t+1}) + \rho y_{t-1} + \varepsilon \quad (3.11)$$

Equation 3.11 includes both the future level of output expected in the current period, $E_t(y_{t-1})$, and the lagged components, y_{t-1}, as important variable in determining current the level of output. As noted earlier, i_t represents short–term IR while $E_t\pi_{t+1}$ is future inflation expected in current period. The following parameters: τ, ε and ρ,represent the impact of variations in the real interest rate, current expectation of future output and the effect of lagged output on the current output, respectively. Most of the previous works in this area (for example Barradas, 2014)support the argument that output should be measured in terms of gaps, g_t(deviation between the actual and potential levels). Consequently, equation 3.11becomes:

$$g_t = -\tau(i_t - E_t\pi_{t+1}) + \varepsilon E_t(g_{t+1}) + \rho g_{t-1} + \varepsilon_t \quad (3.12)$$

3.1.2 The Philipscurve

Next is the Phillips curve that ascribes role of rational expectation of economic agents to the dynamics of price movement (Friedman, 1968; and Phelps, 1967).The refinement to the standard Phillips curve defines current rate of inflation as a function of current output gap and expectation of future inflation formed in the current period. This is represented as:

$$\pi_t = \vartheta g_t + \upsilon E_t \Delta P_{t+1} + \psi_t \quad (3.13)$$

Where ϑ, $\upsilon$and υcapture the effects of output gap, expected price changes and lagged price changes respectively, and $\psi_t$is white-noise disturbance term that is identically, independently and normally distributed. The introduction of expected future price changes is justified by the assumption of nominal price rigidity. Considering the persistentnature of

inflation, the lagged inflation rate is included to capture the backward-looking adaptive expectation component of the model so that:

$$\pi_t = \vartheta g_t + \upsilon E_t \Delta P_{t+1} + \gamma \Delta P_{t-1} + \psi_t \quad (3.14)$$

The inclusion of the lagged inflation rate aligns with the contemporaneous effect of past inflation rate on price setting and contract considerations.

3.1.3 The monetary policy rule

The third equation is the MP rule. This is based on Taylor's (1993) rule of MP that specifies that MP policy decisions are guided by a particularinterest rate rule. The benchmark framework is specified as:

$$i_t = r^* + \Delta P_t + \kappa(\Delta P_t - \Delta P_t^*) + \upsilon g_t \quad (3.15)$$

By simple expansion and factoring out $(\Delta P_t = \pi_t)$ gives:

$$i_t = r^* - \kappa \Delta P_t^* + (1+\kappa)\Delta P_t + \upsilon g_t \quad (3.16)$$

Substituting for $\nu = r^* - \kappa \Delta P_t^*$; $\eta = (1+\kappa)$; equation (3.16) becomes:

$$i_t = \nu + \eta \Delta P_t + \upsilon g_t \quad (3.17)$$

Equation 3.17 is the Taylor (1993) rule and it says that interest rate depends on the deviation of inflation and RGDP growth from their respective optimal paths. Since the monetary authority, in taking MP decisions, considers the balance of risk between inflation and output, sudden adjustment in IR in a bid to reduce inflation would not be undertaken. Another important consideration is that inflation target is achieved over a specified time horizon. Hence, theauthorities would prefer a gradual approach in reacting to inflationary pressures. Consequently, the Taylor rule is adjusted to allow for interest rate smoothing where a lagged IR is included as an additional explanatory variable. Thus, a partial adjustment framework, as specified below aptly describes this behaviour. A framework of incomplete adjustment in IR is presented below:

$$i_t = \varpi i_{t-1} + (1-\varpi) i_t + \varepsilon_t \quad (3.18)$$

Incorporating equation 3.18 into equation 3.17 gives:

$$i_t = \varpi i_{t-1} + (1-\varpi)\left(\nu + \eta \Delta P_t + \upsilon g_t\right) + \varepsilon_t, \quad (3.19)$$

where ϖ measures the partial adjustment of monetary policy rate.

Considering the rational expectations hypothesis, equation 3.19 becomes:

$$i_t = \varpi i_{t-1} + (1-\varpi)\left(\nu + \eta E_t \Delta P_{t+1} + \upsilon g_t\right) + \varepsilon_t \qquad (3.20)$$

The model has several important implications for the implementation of monetary policy in stabilising prices and output. In view of the gradual adjustment of interest rates, changes in the policy rate can exert persistent effect on the economy. Even in an environment characterised by costly price adjustment, there would be less inflation-output trade off. The model impliesmajorbenefits from low inflation, arising from relatively less distortions in prices and better efficiency in economic transactions. In this model, credibility is essential as it facilitates the understanding of the implication MP on the macroeconomy.

3.2 The empirical model

The empirical model is derived from the theoretical framework. Based on equations 3.12, 3.14 and 3.20, a system of equations is specified as follows:

$$\left.\begin{aligned} g_t &= \alpha_0 + \alpha_1(i_t - \pi_{t+1}) + \alpha_2 g_{t+1} + \alpha_3 g_{t-1} + \varepsilon_t \\ \pi_t &= \beta_0 + \beta_1 g_t + \beta_2 \pi_{t+1} + \beta_3 \pi_{t-1} + \psi_t \\ i_t &= d_1 i_{t-1} + (1-d_1)(d_0 + d_2 \pi_{t+1} + d_3 g_t + \varepsilon_t \end{aligned}\right\} \qquad (3.21)$$

The expectation operator, E_t, has been eliminated because of the assumption that all unobserved components of the models are neutralized. An important innovation to the model worth highlighting is the role of money. Central to this model is interest rate. Adjustments in IR affect aggregate demand, through the output gap and then to inflation. For an IT central bank such as BoG, its interest rate policy is pursed without direct recourse to money supply. Money market equilibriumis achieved from the aggregate interaction of supply and demand formoney. Nominal interestrate plays the role of an equilibrating factor.

Even though money is subdued in an IT setting, it neverthelessfacilitates inferences and conveys reliable pieces of information about the fundamental of themacroeconomy (Arestis, Chortareas and Tsoukalas, 2010; Beck and Wieland, 2007; and Andres, Lopex-Salido and Nelson, 2009). This is relevant to Ghana being a developing economy and

relatively cash-based. Notwithstanding the fact that policy actions are conducted in the context of IT framework in Ghana, monetary aggregates continue to feature somehowas part of the information used to shape the policy making process of the BoG. Thus, the money market equation is introduced as follows:

$$\frac{M}{P} = L(\bar{i}, \overset{+}{Y}) \tag{3.22}$$

Since the output gap is considered to have appropriately captured the performance of the economy, then, equation 3.22 becomes:

$$m_t = f_1 + f_2 i_t + f_3 \mathrm{g}_t + \varepsilon_{mt} \tag{3.23}$$

Substituting equation (3.23) into equation (3.21) and factoring out the money market equation yields the following as the empirical model:

$$\mathrm{g}_t = \alpha_0 + \alpha_1 \mathrm{i}_t - \alpha_2 \pi_{t+1} + \alpha_3 \mathrm{g}_{t+1} + \alpha_4 \mathrm{g}_{t-1} + \varepsilon_{\mathrm{gt}} \tag{3.24}$$

$$\pi_t = \beta_0 + \beta_1 \mathrm{g}_t + f_m^* m_t \alpha_2^* \mathrm{g}_{t+1} + \alpha_3^* \mathrm{g}_{t-1} + \beta_2 \pi_{t-1} + \mu Z_t + \psi_t \tag{3.25}$$

$$i_t + d_1 i_{t-1} + (1 - d_1)(d_0 + d_2 \pi_{t+1} + d_3 \mathrm{g}_t) + \varepsilon_{it} \tag{3.26}$$

In terms of future expectations of the variables, their expected values are determined by current values based on the assumption of perfect foresight implied in the theoretical framework. Together with examining the stabilization role of MP (the indirect role through which IR stabilizes inflation and RGDP growth), the implication of money on inflation in the domestic economy is also investigated.

3.3 Methodology

To address the specific objectives of the research, three main econometric modelsare employed. These are Fractional CointegratedVector Autoregression (FCVAR), Structural Vector Autoregressive (SVAR) and Non-Linear Autoregressive Distributed lag (NLARDL) models.

3.3.1 The fractional cointegratedvector autoregression model

The nominal rigidity assumption underlying the model suggests that MP shocks to inflation and RGDP growth might die out gradually over time. To investigate the short and long-run dynamics, the FCVAR technique is employed. As a baseline, the FCVAR

models are taken as the multivariate specification of the autoregressive fractionally integrated moving average (ARFIMA) models. However, while the former requires different order of integration, the latter requires the same order of integration. As the latter has been well developed and applied to empirical investigation, the former has been latent in empirical studies generally, and for the study of MP in particular (Lovcha and Perez-Laborda, 2018). By simple specification, the FCVAR model is specified of the form:

$$M(L)Y_t\left[I-M(S)\right]^{-1}\xi_t \tag{3.27}$$

Where the short-memory property is captured by $M(S)$ and is a polynomial matrix of order p, ξ_t is the vector of identically independent and normally distributed error terms while the $M(L)$ is the long-memory polynomial matrix with a diagonal element of the form $(1-M)^{p_m}$. p_m is the order of fractional integration of the mth variable. It is the measure of how persistentthe variables in the model are. A more persistent variable commands a larger parameter and vice versa.

For a vector of jointly determined independent variables such that $Y_t=(Y_{1t},Y_{2t},...,Y_{kt})'$ is of the K-dimensional $FIVAR(d,p)$ framework given as; $B(L)D(L)Y_t=\varepsilon_{t,}where;t=1,2,...,T$. Where L is the lag operator, $\varepsilon_{t,}$ is a $K*1$ vector of error term. The operator $B(L)=I_k-\sum_{i=1}^{p}BL^i$, Where B is the $K*K$ matrix of coefficients. The operator $D(L)$ is a diagonal $K*K$ matrix characterized by the K-dimensional vector of degrees of fractional integration $d=(d_1,d_2,...,d_k)'$ as follows:

$$D(L)=\begin{bmatrix}(1-L)^{d_i} & 0 & . & . & . & 0\\ 0 & (1-L)^{d_i} & . & . & . & 0\\ . & . & . & . & . & .\\ . & . & . & . & . & .\\ . & . & . & . & . & .\\ 0 & 0 & . & . & . & (1-L)^{d_i}\end{bmatrix} \tag{3.28}$$

The term $(1-L)^{d_i}$ can be generated from the binomial expansion given as;

$$(1-L)^{d_i} = \sum \frac{\Phi(i+d_j)}{\Phi(d_j)\Phi(i+1)} L^i = \sum_{i=0}^{\infty} \omega^{(d_j)} L^i \qquad (3.29)$$

Where $\Phi(.)$ is the gamma function; $\omega_0^{(0)} = 1,$ and $\omega_i^{(0)} = 0,$ for all $i \neq 1$. The error term is positive definite matrix; the roots of matrix of coefficients fall outside the unit circle and the matrix of dependent variables are not perfectly collinear (Do, Brooks and Treepongkaruna, 2016).

Following from the baseline, the FCVAR model is specified in an error correction form as:

$$\Delta^d Y_t = \alpha\beta^{'}\Delta^{d-b} L_b Y_t + \sum_{i=1}^{k} \Phi_i \Delta^d L_b^i Y_t + \varepsilon_t \qquad (3.30)$$

Where Δ^d is the fractional difference operator, and $L_b = 1 - \Delta^d$ is the fractional lag operator. It should be noted that the standard Cointegrated Vector Autoregression (CVAR) model is only a specialised case where the two restrictions imposed in the FCVAR are normalised to 1. These two restrictions are $(d \geq b)$ and $(d - b < 1/2)$. This suggests that, unlike the CVAR model, the FCVAR model has two fractional parameters of d and b .The former relates to the fractional order of the time series variable and the latter determines the degree of fractional cointegration. Also, the FCVAR model is more general as it accommodates fractional integration and cointegration but with the same main structure with the CVAR model (Nielsen and Popiel, 2018).

Based on the symptoms for short or long-memory property of the series obtained through the contradicting unit-root, the use of FCVAR is to demonstrate the possibility of long-run equilibrium condition amidst fractional (hybrid) level of integration. The standard cointegrating vector autoregression (CVAR) is predicated on the fact that the series are integrated of order 1 while the autoregressive distributed lag (ARDL) model is employed when the series are made up of I(1) and I(0). Also, the Toda-Yamamoto (1995) technique is considered appropriate when the series are mix of I(0), I(1) and I(2). The benefit of the

Toda-Yamamoto (1995) technique is to avoid differencing of differencing in the series. However, FCVAR is most appropriate when there is possibility of fractional integration of the series between the I(0) and I(1) dimensions. This would suggest that the variables in the cointegration system have long-memory property. The economic intuition is explained by lags in the effectiveness of MP to stabilize inflation and output.

The decision criterionis that the fractional parameter should range between 0 and 0.5 but when numerically greater than 0.5, the statistical significance is measured. If numerically greater than 0.5 but not statistically greater, then the FCVAR technique is justified and the long-memory property of the variables within the system can be validated. Also, when the fractional parameter tends towards 1, the statistical significance is to ascertain that this is not statistically different from 1. If validated to be statistically insignificant from 1, the standard cointegration technique is supported.

To establish the robustness of the FCVAR technique, a null hypothesis that the CVAR is the appropriate modelling framework is tested for. This is to further validate the fractional parameter of the unrestricted FCVAR model. The basic idea is to simply ascertain whether or not the FCVAR model is robust to alternative model such as the standard CVAR model.

3.3.2 Structural vector autoregression (SVAR) model

The SVAR model is used to assess the structural transmission of shock among the variables in the system of equations. The basic framework of the SVAR is as follows:[23]

Let z_t be a T-dimensional time series $(T\times 1)$ vector of endogenous variables, $z_t=(z_{1t},...,z_{nt})$, and ε_t be an $(T\times 1)$ vector of structural innovation with zero mean. The kth$-$order SVAR model is presentedbelow:

$$Cz_t = C_1^* z_{t-1} + C_2^* z_{t-2} + ... + C_k^* z_{t-k} + A\varepsilon_t \tag{3.31}$$

Compactly, equation (6) can be rewritten as:

[23] See Nakahira (2009).

$$Cz_t = \sum_{i=1}^{p} C_1^* z_{t-1} + A\varepsilon_t \tag{3.32}$$

Matrix $C(t \times t)$ is invertible, and it summarises the contemporaneous relationship among the variables while $C_i^{*}{}'s (i = 1, ..., p)$ are $(n \times n)$ coefficient matrices. Structural shocks are properly identified from the error terms of the estimated reduced form with the appropriate identifying restrictions. Positive off diagonal elements of matrix A $(t \times t)$ permit shocks to directlyimpactseveral endogenous variables at the same time. The vector of structural error terms, ε_t , follows a white-noise process.

Pre-multiplying with B^{-1}provided that A is non-singular yields the reduced form equation as follows:

$$z_t = C_1 z_{t-1} + C_2 z_{t-2} + ... + C_p z_{t-p} + V_t \tag{3.33}$$

Where $C_j = C^{-1} C_j^* (j = 1, ..., p)$. $V_t = C^{-1} \mathrm{A}\, \varepsilon_t$ describes the relation between the reduced form disturbances (V_t) and the underlying structural shocks (ε_t). Thus, we obtain:

$$E(V_t V_t^{'}) = C^{-1} A E(\varepsilon_t \varepsilon_t^{'}) A^{'} C^{-1} \tag{3.34}$$

Moreover, assuming that the variance of each disturbance is standardised, and substituting population moments with the sample moments, we have:

$\hat{\sum}_u$ contains $\frac{t(t+1)}{2}$ different element, so $\frac{t(t+1)}{2}$. This represents the parameters that are identifiable in A and B in matrices. For the identification to be achieved, the highest number of parameters in matrices A and B sum up to $\frac{t(t+1)}{2}$. The number of unknowns equals the number of equations as in 8 above. Thus:

$$2t^2 - \frac{t(t+1)}{2} = t^2 + \frac{t(t+1)}{2} \tag{3.35}$$

Restrictions should be imposed for identification. If one of the matrices C and A is an identity matrix, then, $\frac{t(t+1)}{2}$ restrictions are left to be imposed. Practically, various ways of identifying restrictions include:(a) $A = I_k$, (b) $C = I_k$, (c) $Cv_t = A\varepsilon_t$ (Amisano and Giannini, 1997) and (d) the pattern with prior information on the long-run effects of some shocks, like that of Blanchard and Quah (1989).In tandem with the empirical model, the transmission of MPto real GDPgrowth and inflation in Ghana can be investigated. Thus:

$$INF_t = (GR\_M2_t, EXCHR_t, INT_t, RGDP_t) \tag{3.36}$$

INF_t refers to inflation, which is an indicator for the price level in the economy, GR_M2 is monetary growth, $EXCHR_t$ the rate of exchange rate, INT_t is the rate of interest while RGDP is the RGDP. The matrix form of the transmission mechanism is represented as:

$$\begin{vmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{vmatrix} \begin{vmatrix} RGDP \\ INT \\ EXCHR \\ M2\_GDP \\ INF \end{vmatrix} = U(D) \begin{vmatrix} RGDP \\ INT \\ EXCHR \\ M2\_GDP \\ INF \end{vmatrix} + \begin{vmatrix} \varepsilon RGDP \\ \varepsilon INT \\ \varepsilon EXCHR \\ \varepsilon M2\_GDP \\ \varepsilon INF \end{vmatrix} \tag{3.37}$$

3.3.3 Non-Linear autoregressive distributed lag (NARDL) model

To derive the general form of the asymmetric model, we strictly follow the earlier derivations of Pesaran and Shin (1998) and Pesaran, Shin and Smith (2001). The equation below is a multiple asymmetric long-run equation form:

$$y_t = \delta^{+\prime} x_t^+ + \delta^{-\prime} x_t^- + \varepsilon_t \tag{3.38}$$

$$\triangle x_t = \omega_t \tag{3.39}$$

where x_t is a k × 1 vector of independent variables with $x_t = x_0 + x_t^+ + x_t^-$ and δ^+ and δ^- represent long-run asymmetric long-run coefficient. Assume that the expression $\boldsymbol{z_t} = (\varepsilon_t, \boldsymbol{\omega_t'})$ is data generating process that follows a general n^{th} order Vector Autoregressive model (VAR) such that:

$$z_t = \sum_{i=1}^{n} \beta_i z_{t-i} + \mu_t \quad (3.40)$$

Where t = 1,2,3,4, 5,……..,T, $\boldsymbol{\beta_i}$, I = 1,2,3,…….n are (k +1) x (k + 1) matrices of unknown parameters, μ_t is independent and identically distributed (i.i.d.) with mean zero(0) and a constant variance given by **Π** which is a (k + 1) x (k + 1) positive definite matrix and $\boldsymbol{z_0 \equiv (z_{t-n}, \ldots\ldots, z_0)}$. The error term, μ_t is further partitioned conformably with

$\boldsymbol{z_t}$ = ($\boldsymbol{\mu_{1t}, \mu'_{2t}}$)′ and its variance matrix as $\Pi = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma'_{12} & \sigma_{22} \end{bmatrix}$ (3.41)

Therefore, expressing μ_{1t} conditionally in term of μ_{2t} leads to the following expression:

$$\mu_{1t} = \lambda \mu_{2t} + v_t \quad (3.42)$$

where $\lambda = \sigma'_{12}\Pi_{22}^{-}\sigma_{12}$, $v_t \sim iid(0, \sigma_v^2) \equiv \sigma_{11} - \sigma'_{12}\Pi_{22}^{-}\sigma_{12}$, and v_t is uncorrelated with$\mu_{2t.}$Substituting equation 3.42 into equation 3.40 and partitioning $\beta_i = (\beta'_{1i}, \beta'_{2i})'$, i = 1,2,…..n leads to the following condtional equation for μ_t as:

$$\mu_t = \lambda \omega_t + \sum_{i=1}^{n} \phi_i z_{t-i} + v_t \quad (3.43)$$

Where $\boldsymbol{\phi_i} = \beta_{1i} - \lambda \beta'_{2t}$, I = 1,2,3…n and marginal equation for the vector autoregression ω_t is given as follows:

$$\boldsymbol{\omega_t} = \sum_{i=1}^{n} \boldsymbol{\beta_{2i} z_{t-i}} + \mu_{2t} \quad (3.44)$$

Defining $\phi_i = (\phi_{1i}, \phi_{2i})$ equation 3.43 can be re-expressed as follows:

$$\begin{aligned} &\boldsymbol{\varepsilon_t} \\ &= \sum_{i=1}^{n-1} \boldsymbol{\phi_{1i} \varepsilon_{t-i}} + \lambda \Delta x_t \\ &+ \sum_{i=1}^{n} \boldsymbol{\phi_{2i} \Delta x_{t-j}} \\ &+ v_t \end{aligned} \quad (3.45)$$

Equation 4.45 can further be expressed as:

$$\Delta\varepsilon_t = \alpha\varepsilon_{t-1} + \sum_{i=1}^{n-1} \pi_i \Delta\varepsilon_{t-i} + \lambda\Delta x_t + \sum_{i=1}^{n} \phi_{2i}\Delta x_{t-j} + v_t \quad (3.46)$$

Where $\alpha = (\sum_{i=1}^{n-1} \boldsymbol{\phi_{1i}\varepsilon_{t-i}}) - \mathbf{1}$ and $\boldsymbol{\pi_i} = -\sum_{j=i}^{n-1} \boldsymbol{\phi_{1j}}$.

Taking the first difference of equation 3.40 and combining it with equation 3.46 gives the following cointegrated asymmetric error-correction model expressed as follows:

$$\Delta\boldsymbol{y_t} = \alpha\varepsilon_{t-1} + \sum_{i=1}^{n-1} \boldsymbol{\pi_i}\Delta\boldsymbol{y_{t-i}} + \sum_{i=0}^{n} \psi_i^{+}\Delta x_{t-i}^{+} + \sum_{i=0}^{n} \psi_i^{-}\Delta x_{t-i}^{-} + v_t \quad (3.47)$$

Alternatively, making the error-term in equation 3.38 the subject and lagging by one-period backward and combine with equation 3.47, we can then obtain the following NLARDL in asymmetric cointegration form highlighting the short-run and long-run dynamics of the model.

$$\Delta\boldsymbol{y_t} = \alpha y_{t-1} + \eta^{+}x_{t-1}^{+} + \eta^{-}x_{t-1}^{-} + \sum_{i=1}^{n-1} \boldsymbol{\pi_i}\Delta\boldsymbol{y_{t-i}} + \sum_{i=0}^{n} \psi_i^{+}\Delta x_{t-i}^{+} + \sum_{i=0}^{n} \psi_i^{-}\Delta x_{t-i}^{-} + v_t \quad (3.48)$$

Where $\eta^{+} = -\alpha\delta^{+}$, $\eta^{-} = -\alpha\delta^{-}$, $\psi_0^{+} = \delta^{+} + \lambda$, $\psi_j^{+} = -\pi_i\delta^{+} + \phi_{2j}$ for j=1,2,3,4…….n and $\psi_0^{-} = \delta^{-} + \lambda$, $\psi_j^{-} = -\pi_i\delta^{-} + \phi_{2j}$ for j=1,2,3,4…….n

Equation 3.48 is a formal transformation of an autoregressive distributed lag model or ARDL(p, q, q) model for dependent variable, y_t and the independent regressors, x_t^{+} and $x_t^{+}$with q = p + 1, respectively. The model satisfies the following assumptions: (i) the error-term is assumed to be independent and identically distributed (i.i.d); (ii) the error-term is uncorrelated with other innovations and finally; and (iii) the condition that $\alpha < 0$ ensures the stability of the model to be estimated.

3.4 Data issues and sources

The data for this study is high frequency data of the quarterly form. These are exchange rate, interest rate, inflation, output gap and money supply. The data spanned the quarterly period of 1981-2017. The interest rate is the policy rate of the BoG while inflation rate is the change in the consumer price index. The consumer price index is preferred to other measures of inflation, such as the producer price index and the GDP deflator for obvious reasons. First, it captures the rate of inflation at the level of individual and households and this constitutes a broader and wide-ranging price transmission channel of price changes in Ghana. The output gap measures the divergence of RGDP growth from the potential or trend path. The sources for these data are Bank of Ghana (BoG), Ghana Statistical Service (GSS) and the International Monetary Fund (IMF).

To evaluate the impact of monetary-targeting and IT on inflation and output dynamics in Ghana, the data scope was further disaggregated into two sub-samples. The twosub-sample periods are 1980-2001 and 2002-2017. This was done to compare the dynamics of inflation and output before and during inflation targeting periods. The BoG began IT informally in 2002 and formally in 2007. Interrogating the dataprovides better insights as to whether IT has been a better MP strategy for Ghana.

The variables used in the study are defined as follows: (i) inflation – or headline inflation –is the year-on-year changes in the consumer price index; (ii)exchange rate is the price of the domestic currency (the cedi) against the US Dollar; (iii)interest rate is the monetary policy rate (MPR); (iv) output gap defined as the deviation of RGDP growth from the potential path; and (v)money supply is the quarterly year-on-year changes in the broad money supply.[24]

Prior to empirical estimations of the various econometric models, pre-estimation test such as unit-root and stationary tests are conducted to evaluate the time series properties of the data. Also, structural break test and a lag selection criterion are undertaken, which

[24]Broad money (M2+) is defined as: (M2) + foreign currency deposits in the banking system.M2 is defined as: current in circulation + demand deposits + time and saving deposits.

together with the unit-root test results forms the foundation for the estimation of the fractional cointegration vector autoregrassion model.

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSION

Estimates of the various models and the interpretation of relevant results are presented in this chapter. The results of thepre-estimation tests such as the unit-root and stationarity tests are given. Also, test statistics for structural break tests are discussed and the short-memory and long-memory characteristics of the data, conditionalon the outcomes of the unit-root and stationarity tests, are obtained. These preliminary tests provide the arrowhead for appropriate model estimations. Thechapter concludes with the estimations of robustness checks and some diagnostic tests.

4.1 Unit-root and stationarity tests

The pre-estimation diagnostic tests begin with the unit-root and stationarity tests. It is necessary to establish whether the series are stationarity or not. This information is needed to justify the appropriateness of the estimation technique. The results of the Augmented Dickey-Fuller (ADF) testare shown in Table 4.1.The test statistics indicate that Real Gross Domestic Product (RGDP) growth and inflation (INF) are stationary in levels at 1% level of significance.Variables that had unit-root as well as non-stationary were the exchange rate (EXCHR), Money Supply (MS) and Nominal Interest Rate(IR). Results based on the ADF tests indicate that exchange rate is stationary at order one and at 5% level of significance. Both MS and MPR were also significant at order one but at 1% level of significance. The test result of the Phillips-Perron (PP), KPSS and Ng-Perron are reported side by side with that of the ADF tests. The reason are two folds. First, to have a solid judgment regarding the stationarity status of each of the variables. Second, the additional test helps to gauge the suitability of FCVAR as modelling technique. Test results of PP confirm the stationarityof MS, and INF in levels at 1% level of significance. The KPSS test

shows that only one of the variables, IR, is stationary at levels and at 10% significant level. This contrasts sharplywith the modified unit-root test of Ng-Perron. At 5% level of significance for EXCHR and 1% for RGDP growth and IR, these variables were significant at order one. The null hypothesis for the Ng-Perron test is that all the series are stationary at levels. For KPSS test, only IR is significant and at 1% level of significance. Exchange rate is insignificant both in levels and first difference. However, inflation, output and real GDP growth were significant of order one at 1% level of significance.

Table 4. 1. Unit-root and stationarity test

At Levels				
Variables	**ADF**	**PP**	**KPSS**	**Ng-Perron**
EXCHR	2.320	5.374	1.131	0.844
RGDP	-4.719***	-2.607	0.636	0.318
MS	-2.294	-3.616*	0.851	0.545
INF	-6.434***	-3.591*	0.996	0.949
IR	-2.697	-2.178	0.289***	0.248
At Order 1				
Variables	**ADF**	**PP**	**KPSS**	**Ng-Perron**
EXCHR	-1.058**	-3.938**	0.905	-
RGDP	-	-5.721***	0.034***	-
MS	-4.910***	-	0.030***	-
INF	-	-	0.207***	-
IR	-6.747***	-7.789***	-	-

Notes:-Critical Values for Ng-Perron: 1% = 0.174; 5%=0.233; 10%=0.275.
-KPSS: 1% = 0.739; 5% = 0.463; 10% = 0.347. PP & ADF: 1% = -3.446; 5% = -2.881; 10% = -2.577
-Dlog(EXCHR) = 0.408 for KPSS; log(EXCHR) = -4.050. - *** (1%), **(5%), *(10%)

4.2 Structural breaks test

Results of the structural break test, as shown in Table 4.2 suggest that there is a single break point across the data but each variable has a different break date. Inflation and RGDP growth rate have similar break point around the second quarter and first quarter of 1987,respectively. However, IR and EXCHR have their break points a decade apart and at different quarters. The former has it in the first quarter of 2010 while the latter has it at the third quarter of 2001. In the case of IR, the structural break that occurred in 2001 could be due to the shock to the economy that led to high inflation and exchange in 1999 through 2001. However, the structural break for the exchange rate is negligible because the value of the test statistics is insignificant. The break-point in the data suggests that during the period under investigation, there have been series of structural changes in the Ghanaian economy. While it is anticipated that the EXCHRwould respond to changes in the rate of interest, the 2001 break point for the former is a strong indication that the domestic exchange rate is not completely driven by market-determined interest rate. In fact, most of the factors influencing the dynamics of the exchange rate are external in nature since Ghana is a small open and commodity exporting country[25].

The redenomination of the domestic currency occurred in 2007 about the same period that the BoG embarked on a full-fledgedIT regime but the break point in EXCHR only occurred three years after in 2010; albeit, insignificantly. The growth rate of MS, broadly defined, had its break point at the second quarter of 1989.

[25]Until 2011 when Ghana starting producing and exporting crude oil, cocoa and gold exports were the major sources of external inflows into the economy.

Table 4. 2. Estimates of structural break test

Variables	Break Points	Statistics Value
EXCHR	2010:01	-3.597
GDPR	1987:01	-5.427*
MS	1989:02	-6.855**
INF	1987:02	-8.667**
INT	2001:03	-5.328*

Note: Critical Values at 1%: -5.57; 5% = -5.080. Note: ** 1% significance; *5% significance.

4.3 FCVAR model

To establish the implications of MP for inflation and real GDP growth relationships across different time horizons, a Fractionally Cointegrated Vector Autoregression (FCVAR)model is estimated. Prior to the analysis of the results, it is imperative to provide some relevant benchmark for accepting the results from the estimation of the FCVAR (Lovcha and Perez-Laborda, 2018). The estimation technique is done systematically and under two modelling frameworks. The first model estimation was undertaken by introducing money as the MP policy instrument, while the second model uses IR as the instrument of MP. At each stage, the policy instruments serve as an exogenous variable and it is suppressed within the system of equations. This is done to reflect the two major MP frameworks that BoG has undertaken over the past three decades. These are monetary targeting that was practiced from 1981 to coincide with the ERP and IT that started informally in 2002 and formally in 2007.

Prior to the estimations, two tests were conducted, in addition to the unit-test discussed above. These are the lag selection test and the cointegrating rank test. Apart from the fact that the lag selection helps with the judgment on the FCVAR, it is also a signal on the speed with which the respective policy instrument affects the desired target, such as inflation and RGDP growth. Table 4.3 indicates that the optimal lag length for model 1(MS equation) is 7 and for model 2 (IR equation) is 4. The Akaike Information Criterion (AIC) was used for the decision rule. The implication of this is that it takes more time for convergence to be reached when MS, as compared to interest rate, is used in the model. It also provides the optimal lag length to be included in the FCVAR modelling framework as far as the MS and the IR equations are concerned.

Having settled on the optimal lag length, the next step under the FCVAR modelling framework is to conduct an examination of the model to determine the number of cointegrating equation (rank). It is this that determines if the variables co-move in the long-run situation. In addition to the information gleaned from the test statistics and structural break taste conducted earlier, at least, one cointegration equation exists before the modelling could be advanced and the implications deduced. Results of the two models presented in Table 4.4 indicate the existence of at least one cointegrating equation in the

models. In otherwords, while the variables are individually non-stationary in the short, they collectively exhibit a long-run relationship that make them collectively stationary.There is the tendency for any short-term deviation from equilibrium to converge towards a long-run equilibrium, all things being equal. Thus, the null hypothesis of rank zero (0) is rejected at 1% level of significance.

Table 4.3. Optimal lag length

Mode1 1: Money Supply Model					
K	**R**	**LR**	**AIC**	**BIC**	**PmvQ**
10	1	-29.52	1389.0	1685.7	1.00
9	1	18.72	1341.5	1611.2	1.00
8	1	3.99	1342.2	1585.0	1.00
7	1	33.44	1328.2*	1544.0	1.00
6	1	67.3	1343.6	1532.4	0.99
5	1	32.53	1392.9	1554.8	0.00
4	1	13.65	1407.5	1542.4	0.04
3	1	91.82	1403.1	1511.0	0.01
2	1	29.78	1476.9	1557.9	0.00
1	1	3.64	1488.7	1542.7	0.00
0	1	0.00	1474.3	1501.3*	0.00
Model 2: Interest Rate Model					
K	**R**	**LR**	**AIC**	**BIC**	**PmvQ**
5	1	-14.5	2275.9	2437.8	0.89
4	1	98.5	2243.4*	2378.3*	0.16
3	1	100.9	2324.0	2431.9	0.43
2	1	26.2	2406.9	2487.8	0.24
1	1	43.1	2418.1	2496.0	0.28
0	1	0.00	2440.2	2467.1	0.28

*Note:*AIC = Akaike Information Criterion;BIC = Bayesian Information Criteria; LR is the Likelihood Ratio. PmvQ = the probability value for the Multivariate Q-test which is used as the white noise tests on residuals.

Table 4. 4. Cointegration rank results

Model 1: Money Supply			**Model 2: Monetary Policy Rate**	
Rank	**LR Stat.**	**P-values**	**LR Stat.**	**P-values**
0	45.843	0.009*	63.536	0.000***
1	9.148	0.847	19.487	0.097
2	3.815	0.458	0.078	1.000
3	-	-	-	-

Note: *** 1% significance; **5% significance, and *10% significant

The results obtained from this study are striking in that when MS is taken as the MP instrument – the case when MP is conducted with the framework of monetary targeting – the variables in the system of equation were found to be collectively fractionally cointegrated with 0.793 fractional parameter which is said not to be statistically different from 0.5. Statistically, this shows that the cointegrating vector is non-stationary but mean-reverting. Even though non-stationary, the fractional parameter is found to be statistically different from 0 and 1. That is, the extreme position of either I(0) for stationary series or I(1) for non-stationary series is rejected at 5% level of significance. This indicates that there is a hybrid position that suggests the existence of a long-memory property of the cointegrating vector when money is the nominal anchor for MP. Essentially, the value of the fractional parameter, together with the lags of seven quarters obtained from the lag selection results, presuppose that it takes time for MP to affectkey macroeconomic variables such as inflation and RGDP growth. However, when IR enters the system as the policy variable, the fractional parameter obtained is 1.236 which is not statistically significant from 1. This indicates that the use of interest rate makes inflation and RGDP growth to exhibit short-memory property. This implies that it takes a shorter period for MP to stabilise inflation and RGDP around the respective optimal paths. This is also consistent with the optimal lag of four quarters, lower than that obtained for the MS equation.

The results obtained in this study do not align with those obtained in Lovacha and Perez-Laborda (2018) who used a Structural Fractionally Integrated Vector Autoregressive model to study the implication of MP on long-memory property of inflation in USA. They showed that long-memory of inflation data was robust and could not be attributed to breakpoints in the data. They found fractional parameters of 0.612 and 0.683 for capacity utilisation and inflation. Allowing for long-memory has strong implications for the analysis of the response of the variables to asymmetric policy actions. The presence of long-memory in the data is robust to the use of difference estimation periods. Thus, long-memory seems not to be a direct consequence of underlying breaks, but rather an intrinsic characteristic, likely brought by aggregation in the construction of the indices as stressed in Gadea and Mayoral (2006). Again, the results are different from the ones reported by Tule, et al. (2019) who found a long-memory for inflation and its major components for

Nigeria, suggestion high inflation persistence across the various data point. The reasons for the differences in results could beexplained.In the case of Lovacha and Perez-Laborda (2018), their study was based on USA with long history of low and stable inflation. They also employed capacity utilisation as compared with RGDP growth used in this study as proxy for output gap. Both Nigeria and USA are not explicit IT countries. However, Ghana, having transitioned from a high inflation environment implies that the current path of inflation, though high, is low compared to historical averages.

The implication for the long-memoryproperty of the MS variable is that the stabilisation effect of MP in the context of monetary-targeting on inflation and output would take a relatively longer time horizon to actualise. On the other hand, IR takes shorter time because the short-memory property of the variables within the system is invalidated (Table 4.5). It suggests that the cointegrating vector is mean reverting and becomes stationary. This indicates that an explicit role for MS as a policy instrument would stabilise inflation and output but over a longer time horizon, compared to an explicit role for IR that occurs within a short time. In simple terms, the concern is not which policy variable of the monetary authority would stabilise inflation and output but the one that will speed up the stabilisation process. The use of MS will elongate this stabilisation effect for MP in Ghana than it would for IR. Thus, to target inflation, the role of money must be explicitly specified in the model but preference should be given to the use of IR as the policy variable. It is also an indication of how persistent inflation is during the period of monetary-targeting compared to IT era.

This result, in a way, corroborate the findings in Bawumia et al. (2008)suggesting that the role of money in inflation control has diminished over time. It also confirms the result in Issaoui, Boufateh and Guesmi (2015) who revisited the money neutrality proposition and suggested that growth in money created inflationary pressures. It became difficult to establish a discernible relationship between MS and inflation. It was thus, part of the reason why the central bank decided to shift the MP framework from targeting money to IT.

The parameter, $\hat{\delta}$,is the standard deviation of the results obtained from the fractional cointegrating model, corroborating the fractional parameters. The standard deviation of

0.238 for IR model and -6.037 for the IR model indicates that the transition to equilibrium in the event of inflation overshooting its target is slow when MS is the policy instrument compared to the IR model. This is instructive enough to support an explicit role for IR within an IT regime. The negative sign of the standard deviation of MS shows that the variable is counter-cyclical. This is unlike the IR that is pro-cyclical, suggesting that IR is adjusted upwards in response to increase in inflation.

Table 4. 5. FCVAR results for the unrestricted model

Model 1: Money Supply Model		**Model 2: Interest Rate Model**
Variable	Value	Value
d	0.793 (0.038)	1.236(0.042)
$\hat{\delta}$	-0.238	6.037

Note: Figures in parentheses are probability values.

Since the MS model exhibits a long-memory property, it becomes necessary to dig into its long-run impact on output growth and inflation. As presented in Table 4.6, the obtained results are counterintuitive and do not align with the theoretical proposition of a positive correlation between inflation and money. Though, statistically insignificant, the long-run impacts derived from the model estimates suggest that money growth reduces inflation. This result is not surprising in view of earlier accounts in the literature that point to the fact that it is difficult to discern a systematic money and inflation relationship in Ghana. Indeed, the evolution of MP discussed in chapter two revealed that there were episodes in Ghana's economic history when inflation and growth in money were uncorrelated. The result on the relationship between GDP, inflation and its past value are in accordance with apriori expectations. The obtained results on RGDP, inflation and its past level suggest that past level of inflation has positive and significant effect on current inflation. Thus, inflation in Ghana exhibits a strong inertia. Specifically, GDP growth has 0.073 coefficient and 2.116 standard error (significant at 5% level). The statistical significance is obtained as half of the coefficient of the estimated parameter is greater than the standard error. Also, the previous level of inflation has 0.837 and 0.134 standard error (1% level of significance), which is less than half of the estimated coefficient.

Table 4. 6. Long-run impacts from the FCVAR

Variables	**Coefficient**	**Std. Error**
GDPR	0.073	2.116**
MS	-0.04	0.028
INF_1	0.837	0.134***
GDPR_1	0.063	0.051
MS_1	0.000	0.00

Note: *** 1% significance; **5% significance, and *10% significance. Endogenous variable = inflation.

Generally, the results obtained are largely consistent with the empirical literature on the implication of MP regimes on inflation and outputs. The results in this research is significantly corroborated by both country-specific and cross-sectional studies that sought to compare the outcomes of different MP policy regimes under different macroeconomic environment and policy context. For instance, Abo-Zaid and Tuzemen (2012) were able to show that countries - both developed and developing - that conducted MP in the context of IT have been able to achieved a lower level of inflation compared to non-IT countries. Studies such as Brito and Bystedt (2006), Mishkin and Schmidt-Hebbel (2007) and Goncalves and Salles (2008) all conclude that IT is associated with low and stable inflation. In Goncalves and Salles (2008), the study focused solely on developing countries with countries in the sample that adopted IT experiencing low inflation during the study period.

There are however, few studies in the literature whose outcomes do not align with what is obtained in this study. On the strength of theoretical proportion that low inflation is achievable under IT regime, Abo-Zaid and Tuzemen (2012) found mixed implication for IT for two groups of countries. An explicit IT for developing countries resulted in significant drop in inflation of about 3.2 percentage point than non-IT countries. Essentially, most of the studies are sensitive to data span, methodology and the economic characteristics of the country.

4.3.1 Robustness checks and diagnostics tests

Table 4.7 presents results of the diagnostic tests and robustness checks. It is evident that there is absence of serial correlation both at the multivariate and individual variable level based on the unrestricted model. In Panel A of Table 4.7, the Q-statistics with 24.75 and probability value of 0.92 rejects the null hypothesis of serial correlation. Considering the individual variables, except for Var. 2 (which represents RGDP) in the Q-statistics, all other variables are non-serially correlated. Since FCVAR model largely accounts for co-movement, the multivariate value of 24.75 for non-serial correlation is more valid in this case. In fact, this position is considered more appropriate as the LM statistic has the null hypothesis of the presence of serial correlation rejected for all individual variables. Panel 4B presents the robustness results for the preference of FCVAR to the standard CVAR,

while Panel 4C has the diagnostic results for the restricted model of money supply being long-run exogenous. The LR statistic of 22.6 and probability value of 0.00 clearly suggests that the null hypothesis that the model is CVAR should be rejected at the 5% level of significance.

Table 4. 7. Diagnostic test and robustness check

Panel 4A: Diagnostic Test for Unrestricted Model				
Value	**Q-Diagnostic**		**LM-Diagnostic**	
	Q	**P-value**	**LM**	**P-value**
Multivariable	24.75	0.92	-	-
Var. 1	2.80	0.59	2.52	0.64
Var. 2	9.72	0.05	5.64	0.23
Var. 3	6.84	0.15	1.13	0.89
Panel 4B: Robustness for the Preference of FCVAR to CVAR Models				
Test Statistics	**Values**			
LR Statistics	22.6			
Probability Value	0.00			
Panel 4C: Restricted Model that Monetary Growth is Long-Run Exogenous				
Test Statistics	**Values**			
LR Statistics	177.5			
Probability Value	0.00			

For Model 2, however, the robustness is established from the standard Cointegrated Vector Autoregressive (CVAR) model that is estimated through the use of the Johansen Cointegration model. As shown in Table 4.8, both the trace and maximum eigenvalue statistics suggest that there is at least one (1) cointegrating vector (equation) for the IR model. Specifically, the trace statistics indicate the existence of five cointegrating equation at the 5% level of statistics. On the other hand, the maximum eigenvalue test indicates two cointegrating equations at the 5% level of statistics. Summarily, it is found that long-run equilibrium condition exists between the variables of inflation, IR, MS, RGDP and EXCHR. The existence of cointegrating equations indicates that these variables can co-move into the long-run situation. Intuitively, monetary policy can be used to stabilise inflation and output in the long-run.

Table 4. 8. Standard cointegrated vector autoregression for long run

$H_0 : r$	**Trace**			**Max. Eigenvalue**		
	Trace Stat.	0.05 Critical Value	Pvalue	Max-Eigen Stat.	0.05 Critical Value	Pvalue
$r = 0$	115.43*	69.82	0.000	45.27*	33.88	0.002
$r \leq 1$	70.16*	47.86	0.000	34.97*	27.58	0.005
$r \leq 2$	35.20*	29.80	0.011	17.98	21.13	0.131
$r \leq 3$	17.21**	15.49	0.027	12.78	14.27	0.085
$r \leq 4$	4.43**	3.84	0.035	4.43**	3.84	0.035

Having established a long-run equilibrium condition, an investigation into the short-run dynamics becomes imperative. The estimates for the short-run are given in Table 4.9. The error correction term is properly signed and significant too. The magnitude also conforms to theoretical expectation. It is expected that it ranges between zero and one, negatively signed and significant at the 5% level. These three criteria are fulfilled. The ECT has -0.405 negative coefficient and statistically significant as the coefficient is greater than half of the standard error. The implication is that for any shock to the economy, the recovery rate is 40.5% and that it will take two and a half ($2^1/_2$) quarters before equilibrium is attained after the shock. The lagged inflation is positively related to the current inflation. At a period of onelag, the coefficient is 0.548 with absolute T-statistics value of 8.295 but 0.186 coefficient with absolute T-statistics value of 2.626 at a period two lags. This indicates that an increase in the previous rate of inflation will bring about an increase inflation rate in the current period too. This aligns with the rational expectation hypothesis as the private agents in the economy will be expecting the current rate of price level in the economy to increase given the increase in its previous level.

The effect of IR on the price level is mix and significant in both cases. The effect of one-period lagged IR on inflation is positively related while that of two-period lagged is negatively related. By theoretical expectation, inflation and IR are negatively related. This conforms to estimates obtained in the two-period lagged. As a result, an upward adjustment in MP rate, which provides a direction for lending rate, allows individuals to prefer to keep more money in their bank accounts as against consumption. This would further lead to lower inflation as economic activities falls. The impact of MS, RGDP and EXCHR are negligible at the 5% level of significance. These results are robust to the 0.58 obtained for the adjusted coefficient of determination (Adjusted R-squared). The overall specification of the model has goodness fit with F-statistics value of 18.87.

Table 4. 9. Short-run dynamics

Variables	Coefficient	Standard Error	T-Statistics
C	-0.713	0.792	-0.899
ECT	-0.405*	0.045	-9.059
D(INF(-1))	0.548*	0.066	8.295
D(INF(-2))	0.186*	0.071	2.626
D(IR(-1))	0.889*	0.285	3.123
D(IR(-2))	-0.606**	0.289	-2.095
D(MS(-1))	0.154	0.146	1.055
D(MS(-2))	-0.197	0.144	-1.366
D(RGDP(-1))	-1.010	0.763	-1.324
D(RGDP(-2))	3.217*	0.774	4.156
D(EXCHR(-1))	-9.578	18.415	-0.520
D(EXCHR(-2))	21.692	18.631	1.164
R-squared	0.61		
Adjusted R-squared	0.58		
F-statistics	18.87		

Note: *** 1% significance; **5% significance, and *10% significance. Endogenous variable = inflation.

4.4 Asymmetric relationship betweenmonetary policy,prices and Output

Findings from the estimation of the implication of MP on inflation and RGDP growth using the technique of FCVAR suggested that RGDP growth and inflation exhibited short-memory properties when MPwas conducted using IT framework. Thus, the nominal anchor is inflation while the MP instrument is represented by nominalIR. Since inflation and output exhibited short-memory properties, the long-run impacts cannot be obtained from the system using FCVAR. It was also observed from the pre-estimation test that the control variables indicated different order of integration. Consequently, a non-Linear Autoregressive Distributed Lag (NLARDL) model isemployed to investigate the long-run asymmetric effects of MP on inflation and output. The idea of the NLARDL is to suggest that MP could not have a proportional impact on prices and output, especially in the midst of structural breaks. Just like the conventional ARDL, the NLARDL is fitted as the model consists of variables with a mix of I(0) and I(1) stationarity.

A stepwise regression approach suggests a total of eight regressors including lagged GDP growth (RGDP(-1)) and lagged exchange rate (EXCHR (-1)). The other variables are positive and negative changes in the values of consumer price index (CPIPOSITIVE and CPINEGATIVE), interest rate (INTPOSITIVE and INTNEGATIVE) and money supply (MSPOSITIVE and MSNEGATIVE). The essence of having negative and positive changes in MS, CPI andIR in the model is to establish whether the direction of changes in these variables have same proportional effects. If the effects are same across the positive and negative dichotomy, it indicates that both are symmetric. However, we have asymmetry if both give different effects. The negative values is interpreted to mean fall in the value of that variable.

Specifically, a long-run equilibrium condition and the coefficient are estimated. The former is to ascertain whether the variables co-move together into the long-run situation while the latter is to estimate the long-run impacts. For the long-run equilibrium condition, the F-statistics ratio of 4.63 indicates the existence ofa long-run equilibrium condition. This value is greater than the Upper bound of the Pesaran et al. (2001) critical values of 4.01 for K = 4 (K represents the number of variables in the model). This impliesthat the

explanatory variables together with GDP growth have equilibrium conditions that keep them together into the long-run.

Table 4. 10. Long-run equilibrium condition

Test Statistics	**Statistical Values**
F-statistics	4.63
Upper Bound (5%, K = 4)	4.01
Lower Bound (5%, K = 4)	2.86
Conclusion	Cointegration exists

Next is to establish the long-run impacts as reported in Table 4.8. To achieve this, both positive and negative changes in prices, interest rate and growth in money were obtained. Essentially, the main idea is to ascertain whether good news and bad news associated with these variables have same the long-run impacts. Except for the lagged positive and negative changes in interest rates, the other explanatory variables have significant impacts on output. Specifically, exchange rate has negative and significant coefficient of -3.128 at 5% level of significance. This suggests that exchange rate depreciation reduces output in Ghana, while an appreciation of the exchange rate increases output over the long-run in Ghana. The finding regarding exchange rate depreciation and growth may seem theoretically inconsistent in line with international trade theory. Assuming that the Marshall-Lerner condition[26] holds, a depreciation of the domestic currency in a country is expected to boost export and consequently, output. This is not surprising, however, due to the nature of the Ghanaian economy. The domestic supply capacity is relatively weak and a large import relative to exports exist. A depreciation of the domestic currency tends to exert negative rather than positive effect on domestic producers as they face a higher cost of operation.The higher cost of production is passed on to consumers in the form of higher prices. Both positive and negative values of the consumer price index are positively related to output. However, it is only a positive consumer price index that significantly affects output at the 5% level. The negative consumer price index only significantly affects output at the 10% level of significance. The implication of these results is that positive changes in the consumer price index have a positive effect on output while negative changes are considered negligible.

Also, negative and positive changes in money supply are significantly related to inflation in Ghana. This indicates that positive and negative changes in broad money supply have the same impact on inflation. This lends credence to the submission that monetary targeting as a monetary policy strategy would not be efficient in controlling inflation in the Ghanaian economy. Going by this long-run impacts, the hypothesis of no asymmetric

[26]The Marshall–Lerner condition states that an exchange rate depreciation will result in an improvement in the trade balance if the absolute sum of the long-term export and import demand elasticities is greater than unity. If the domestic currency devalues, imports become more expensive and exports become cheaper due to the change in relative prices.

relationship between the variables and output becomes imperative. This is to examine whether the captured long-run impacts will always be in direct proportion or otherwise.

Table 4.11. Long-run impacts

Variables	Coefficients	Probability Values
EXCHR (-1)	-3.128**	0.0022
CPINEGATIVE (-1)	1.791*	0.076
CPIPOSITIVE (-1)	4.109	0.0001
D (INTNEGATIVE (-1))	1.137	0.258
D (INTPOSITIVE (-1))	0.924	0.357
MSNEGATIVE (-1)	-2.479*	0.014
MSPPOSITIVE (-1)	-2.038*	0.044

Note: ***1% level of significance, **5% level of significance, and *10% level of significance.

Table 4. 12. Testing the hypothesis of no asymmetry among the variables

Null Hypothesis: No Asymmetry between –	**F-statistics**	**Probability Values**
Positive and Negative Consumer Price Index	1.114	0.293
Positive and Negative Interest Rate	0.0009	0.977
Positive and Negative Broad Money Supply	5.315	0.023

The results showed that the null hypothesis of no asymmetry between the positive and negative changes in the consumer price index could not be rejected at the 5% level of significance. Also, the null hypothesis of no asymmetry between positive and negative changes in IR could not be rejected at the 5% level of significance. This implies that both the positive and negative changes in the consumer price index and interest rate have the same direct proportional effect on output. This lends credence to the Fisher effect[27] which suggests that the real IR is the difference between the nominal IR and the expected rate of inflation. For a perfect foresight, expected inflation is the same as the actual level of inflation. Thus, the price level in the economy determines the nominal interest rate. Therefore, similar behaviour of both positive and negative changes in prices and interest rates are understood. However, testing the null hypothesis of no asymmetry between positive and negative changes in money supply indicates that the null hypothesis is rejected at the 5% level. This suggests that there is asymmetry and implies that positive changes in money supply and negative changes in broad money supply do not have the same direct proportional impact on output.

The basic outcome of these results is that there is a direct proportionality between the consumer price index and GDP growth, on the one hand, and IR and GDP growth, on the other hand. However, no direct proportionality between money and GDP growth output was established. This suggests that increasing broad money supply by n^{th} number of times does not affect output by equal proportion. This is unlike inflation and interest rate where the captured long-run effects of both variables on output hold in direct proportion. It is not surprising that monetary targeting as a monetary policy strategy could not produce the desired effect on inflation and output.

The result of this study as compared to what pertains in the empirical literature is mixed. It is not surprising that the literature points to conflicting outcomes on the implication of MP of RGDP growth and unemployment. This could be driven by the existence of inflation-output trade-offs in the face of MP response to non-systematic shock. In Issaoui et

[27]The Fisher Effect states that the real interest rate equals the nominal interest rate minus the expected inflation rate. Therefore, real interest rates fall as inflation increases, unless nominal rates increase at the same rate as inflation.

al.(2015), the short-term effect of MP on RGDP growth was found to be positive and decreasing while the long-run effect was not systematically zero. However, De Guimaraes e Souza (2016) and Amira et al. (2013) reported positive effect of MP on RGDP while Ayres et al. (2014) noted that the effect of MP on RGDP growth differ among developing and developed countries. In the same vein, Hayat et al. (2016) concluded that monetary discretion has significant long-run bias against inflation without imputed RGDP growth benefit. However, in the short run, only an occasional but perceptible real growth gain of monetary discretion was found.

An important implication from the results is that the BoG should consider interest rate targeting within the IT framework. In fact, the larger degree that its null hypothesis could not be rejected at the 5% level gives an indication that it could outperform IT in its traditional form. The null hypothesis of no asymmetry cannot be rejected for the interest rate at the 97.7% while the null hypothesis of no asymmetry cannot be rejected for the consumer price index at the 29.3% level of significance reinforce the argument. Adopting interest rate targeting can provide economic agents with certainty, and help anchor their expectations with respect to the stance of monetary policy. It gives the monetary authority very precise way to adjust their behaviour in light of prevailing macroeconomic conditions, especially if it follows a modified Taylor rule parameterized to the current state of the macroeconomy. The downside to interest rate targeting is that if the parameters that underlie the Taylor rule shift without the monetary authority being aware of it, conducting monetary policy according to the incorrectly specified rule can negatively affect the economy. Also, if the IR is positioned such that IR in the money market deviates from the equilibrium IR, it can affect the incentive to invest and other miscoordination of economic activity.

4.5 Structural transmission of shocks

4.5.1 Before inflation targeting

The monetary aggregate indicator adopted for this study is the growth of broad money supply. Inferences about the stabilising role of monetary aggregates on prices and, by extension, on output in Ghana are drawn from the variance factor decomposition and

impulse response function of the structural model. Basically, the structural model provides estimates about the shock effects and the propagation of the effects, as estimated from the impulse response function. The variance factor decomposition indicates the degree of shock effects. Inferences about the stabilisation role of MP can also be obtained by considering the depth (in addition to the timeliness obtained through the impulse response function) of impacts. The shock effect of money supply is reinforcing as its effects on the other variables within the structure of the economy is largely negligible. Particularly, the shock effect of money supply on the price level is marginal and it quickly returns to equilibrium around the eight-quarter. The implication is that the use of monetary aggregate as an intermediate variable was not efficient in stabilising inflation in Ghana.

Expansion in money growth led to exchange rate depreciation. However, thetransition to equilibrium following the money supply shock is relatively slow. As gleaned from chapter two on the dynamics of exchange rate in Ghana, it was noted that there are several factors that affect the path of exchange rate in Ghana. These include external factors such as global oil price shocks and domestic seasonal factors. These factors work independently to affect the path of the domestic currency against major international currencies. Innovations in MS led to increase in money supply up to the fifth quarter. The same impact is noticed with regards to RGDP growth and IR. Essentially, the effect of the money supply conforms to a similar behaviour it has on the price level. The shock became effective at about the second quarter with a marginal response and returned to equilibrium at about the eight quarter.

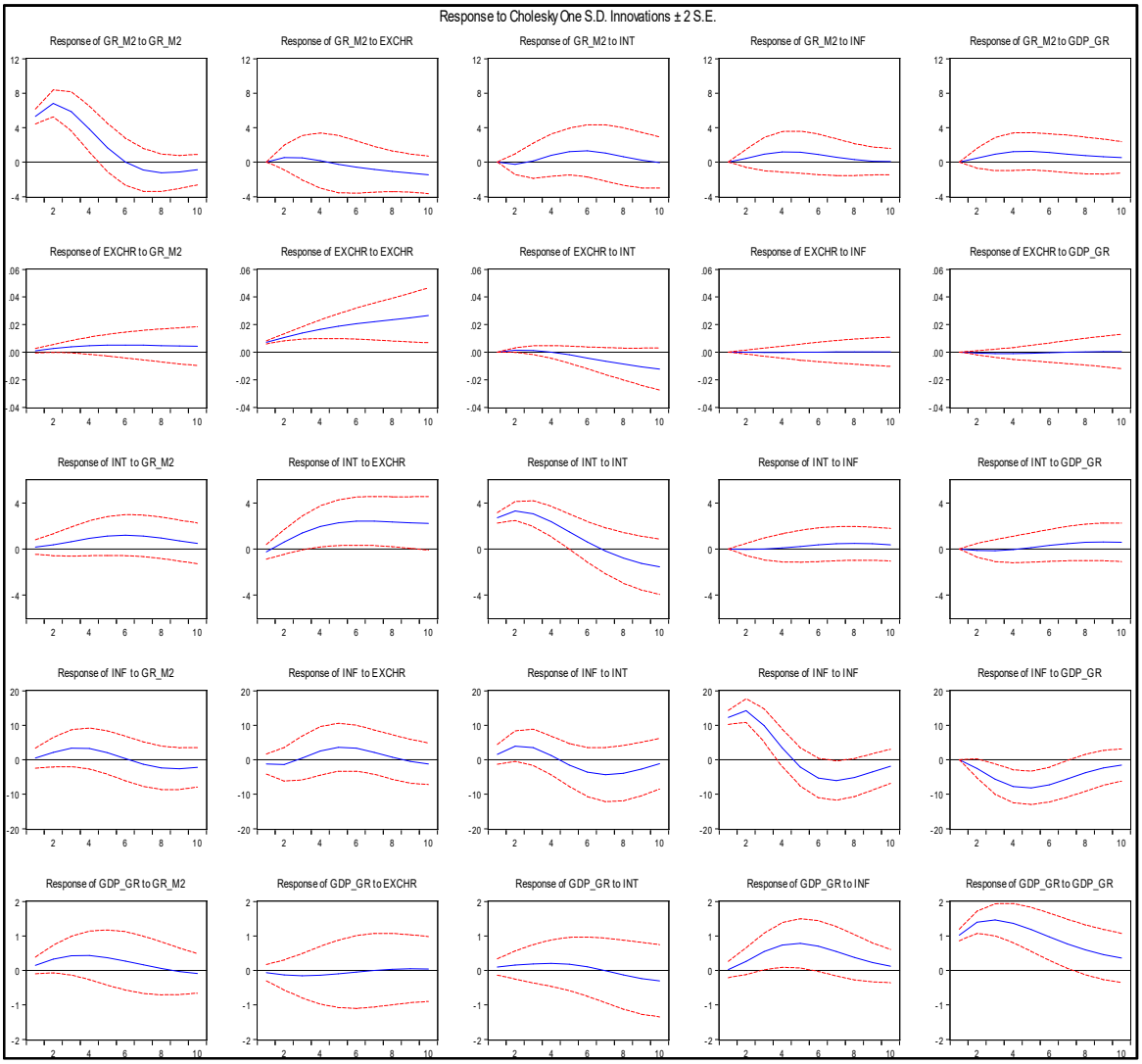

Figure 4.1. Impulse response functions of structural shocks, pre-IT regime

It is instructive to note that the impulse response function comprises both positive and negative effects of shocks. The result of the net effect is presented in Table 4.13. It could be inferred that money supply did not significantly impact on prices and output. Specifically, money supply has a negative impact on inflation with -0.102 coefficient and probability value of 0.708, while the corresponding impact on GDP growth is negative with -0.028 coefficient. Again, the growth of money supply impacted negatively on the exchange rate with -0.0002 coefficient and 0.192 probability value and correspondingly, has negative effect on the rate of interest with -0.040 and 0.503 probability value.

The result partly agrees with what is obtained in Issaoui, Boufateh and Guesmi (2015) who revisited the money neutrality proposition using data for the USA, Morocco and Gabon. Though they established a short-term effect of MP on RGDP growth, they could not provide empirical evidence of the proportion of neutrality of money. They however, suggested that growth in MS created inflationary pressures in the countries.

Table 4.13. Net Structural shocks of money supply on prices and output

Exogenous Variables	Coefficient	Z-Statistics	Prob. Value
EXCHR	-0.0002	-1.305	0.192
INT	-0.040	-0.670	0.503
INF	-0.102	-0.370	0.708
RGDP	-0.028	-1.215	0.225

Note: Endogenous variables = Growth of broad money supply

The result of the variance decomposition is presentedin Tables 4.14 to 4.18. The analysis is conducted in terms of how shocks to various variables in the model affect other variables. It is evident that 3.2% and 4.8% of variation in inflation and RGDP is explained by shock to MS. This is small, implying that inflation and output is not impacted much for a given shock to MS. For exchange rate shock, the contribution is quite insignificant as only 0.005% of variation in inflation is attributable to exchange rate shock while 0.08% is for RGDP growth. Interest rate shock contribute 1.1% and 1.6% to inflation and output, respectively. Shock from inflation causes26% variation in RGDP growth. RGDP growth shock causes 17% variation in inflation. It is evident that the shock effect of monetary aggregates is reinforcing as the self-effect is 84.2%. Its effects on prices and output, and on interest rate and exchange rate is less than 5%. A possible explanation in this regard is to posit that monetary aggregates are exogenously determined by the monetary authority.

Table 4.14. Variance decomposition (MS shock): pre-IT

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	99.01495	0.376102	0.096189	0.243058	0.269701
3	97.58291	0.476362	0.084954	0.906214	0.949558
4	95.24079	0.429775	0.552268	1.841718	1.935451
5	92.25862	0.449320	1.626550	2.697997	2.967516
6	89.57754	0.679232	2.779718	3.188496	3.775018
7	87.76294	1.166482	3.463666	3.329356	4.277559
8	86.57805	1.916646	3.643998	3.303473	4.557839
9	85.50297	2.945999	3.595786	3.239434	4.715811
10	84.21690	4.280582	3.522383	3.174588	4.805544

Note: [a] MS; [b] Exchange rate; [c] Interest rate; [d] Inflation; [e] RGDP

Table 4.15. Variance decomposition (exchange rate shock): pre-IT

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	2.248436	97.75156	2.72E-30	0.000000	3.97E-28
2	4.545227	94.19808	1.077697	0.001358	0.177635
3	5.862291	92.89359	0.924259	0.004997	0.314865
4	6.439304	92.70658	0.521626	0.006085	0.326407
5	6.505010	92.53440	0.688931	0.004465	0.267193
6	6.235627	91.91687	1.647134	0.003295	0.197078
7	5.772687	90.81922	3.259386	0.004102	0.144602
8	5.225065	89.40713	5.249871	0.005636	0.112298
9	4.667856	87.89190	7.342007	0.006079	0.092155
10	4.145917	86.44896	9.323186	0.005168	0.076768

Note: [a] MS; [b] Exchange rate; [c] Interest rate; [d] Inflation; [e] RGDP

Table 4.16. Variance decomposition (interest rate shock): pre-IT

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	0.421241	0.776548	98.80221	0.000000	0.000000
2	0.846841	2.296446	96.78513	0.005468	0.066111
3	1.852384	7.747131	90.29211	0.003428	0.104946
4	3.482529	15.07178	81.33836	0.022668	0.084665
5	5.448516	22.82481	71.50681	0.121181	0.098680
6	7.223215	29.80808	62.38545	0.328994	0.254268
7	8.361542	35.31338	55.14736	0.607160	0.570560
8	8.742283	39.23571	50.18416	0.869861	0.967990
9	8.536871	41.87977	47.20581	1.043834	1.333722
10	8.019082	43.68558	45.60155	1.106423	1.587365

Note: [a] MS; [b] Exchange rate; [c] Interest rate; [d] Inflation; [e] RGDP

Table 4.17. Variance decomposition (inflation shock): pre-IT

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	0.144903	1.034144	1.607236	97.21372	8.55E-30
2	1.268169	0.892797	4.663505	91.52715	1.648377
3	2.944776	0.688295	5.656233	83.63963	7.071065
4	4.197108	1.623274	5.074278	73.54710	15.55824
5	4.250723	3.186127	4.777688	64.88516	22.90030
6	3.724129	4.114299	5.737159	60.07223	26.35218
7	3.539826	4.206698	7.209249	58.01809	27.02613
8	3.881874	3.991674	8.295619	57.07281	26.75802
9	4.432083	3.887946	8.730392	56.48501	26.46457
10	4.847079	3.974486	8.746214	56.08622	26.34600

Note: [a] MS; [b] Exchange rate; [c] Interest rate; [d] Inflation; [e] RGDP

Table 4.18. Variance decomposition (RGDP shock): pre-IT

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	1.947405	0.406691	0.856617	0.042268	96.74702
2	3.938944	0.670858	1.032330	2.180348	92.17752
3	5.194838	0.765103	1.174988	6.245123	86.61995
4	5.745371	0.760006	1.303316	10.62263	81.56868
5	5.846494	0.699935	1.341343	14.13751	77.97472
6	5.723703	0.631532	1.266902	16.40029	75.97757
7	5.523856	0.587881	1.179545	17.54470	75.16402
8	5.339572	0.574295	1.256633	17.91924	74.91026
9	5.224230	0.575594	1.620776	17.87692	74.70248
10	5.191241	0.576719	2.239122	17.66998	74.32294

Note: [a] MS; [b] Exchange rate; [c] Interest rate; [d] Inflation; [e] RGDP

4.5.2 Inflation-targetingperiod

Here, an examination of the structural transmission of monetary policy shock is conducted for the period during which IT has been used as the monetary policy framework. Thus, the data for this analysis covered the period of 2002 to 2017. As highlighted in the previous chapters, the BoG adopted IT lite in 2002 and formally moved into a full-fledged IT in 2007 and subsequently,IRwas adopted asthe key instrument of MP. To achieve the inflation target, the BoG shaped the expectation of economic agents on inflation through its actions on the policy rate. For an IT central bank, changes in the policy rate served as a signal to the commercial banks through the interbank market of which the central bank is a participant. The commercial banks accordingly, adjust their lending rates in line with the movements in interbank rates.

The focus of the analysis is on IR shock to inflation, real GDP growth and other control variables. Figure 5.2 presents results obtained from the impulse response function based on the Structural Vector Autoregression (SVAR) model. Inferences from the results obtained from impulse response functions suggest that monetary policy shock to money supply takes time to react – occurring sixth quarters – and takes a much longer time to revert to equilibrium. The contemporaneous effect of interest rate shock on the price level is instantaneous and substantial but takes up to ten quarters to return to equilibrium.

This aligns with Bernanke and Mihove (1997). They observed that significant contemporaneous response of MP is an indication that the recursive identification would be erroneous and that the assumption of independence innovations in IR invalidated. Thus, the measured impulse response to innovation in the IR would not capture pyre estimates of MP shocks on the economy. The sluggishness of the transition to equilibrium could be due to the effects of other economic dynamics that affect the transmission process. For instance, the actual factors driving the inflation process may be supply side factors while the central bank may believe that it is dealing with demand driven pressures. The impact on the exchange rate is marginal and returns to equilibrium at the ninth quarter.

The impulse response of the exchange rate does not reveal the puzzling exchange rate response to MP shocks referred to by Cushman and Zha (1997) and Kim and Roubini

(2000), where positive IR innovations lead to a significant depreciation of the exchange rate. However, the opposite is not the case as the relatively larger size of the response of the IR to the shock in exchange rate reflecting in part the role of exchange rate in the conduct of MP for a small open economy like Ghana. In fact, the BoG uses the monetary condition index of which exchange rate pressures is a variable to inform policy decision.

For instance, Armour et al. (1996) finds that a large part of the intended policy actions in Canada were continuous response to large changes in the exchange rate. A particular factor that affects the path of the exchange rate is a misalignment in the nominal IR. When the IR does not reflect its true market rate, the incentive to invest in domestic securities is diminished and investors would choose to keep their funds in foreign currencies. Demand for foreign currencies relative to domestic currency increase and a depreciation ensues. Among the short-term policies at the disposal of the central bank is to increase the interest rate in order to diversify portfolio in favour of domestic securities.

In 2015, the domestic currency in Ghana came under intense pressure, recording a depreciation of about 19% by the end of the year. To stem the passthrough effect of the depreciation to domestic price, the central bank increased the policy rate by 500 basis points cumulatively in the year. In addition to the interest rate adjustment, the Bank merged the MP rate and the reverse repo rate into a new policy rate and positioned at 24%, effectively increasing the MPR by another 200 basis points (Bank of Ghana Annual Report, 2015). It is important to note that the shock effect on inflation exhibited some level of cyclicality. It reacted both positively and negatively while that of output reacted negatively throughout the transmission period. The shock effects of interest rate on money supply, exchange rate and interest rate were all positive throughout the period.

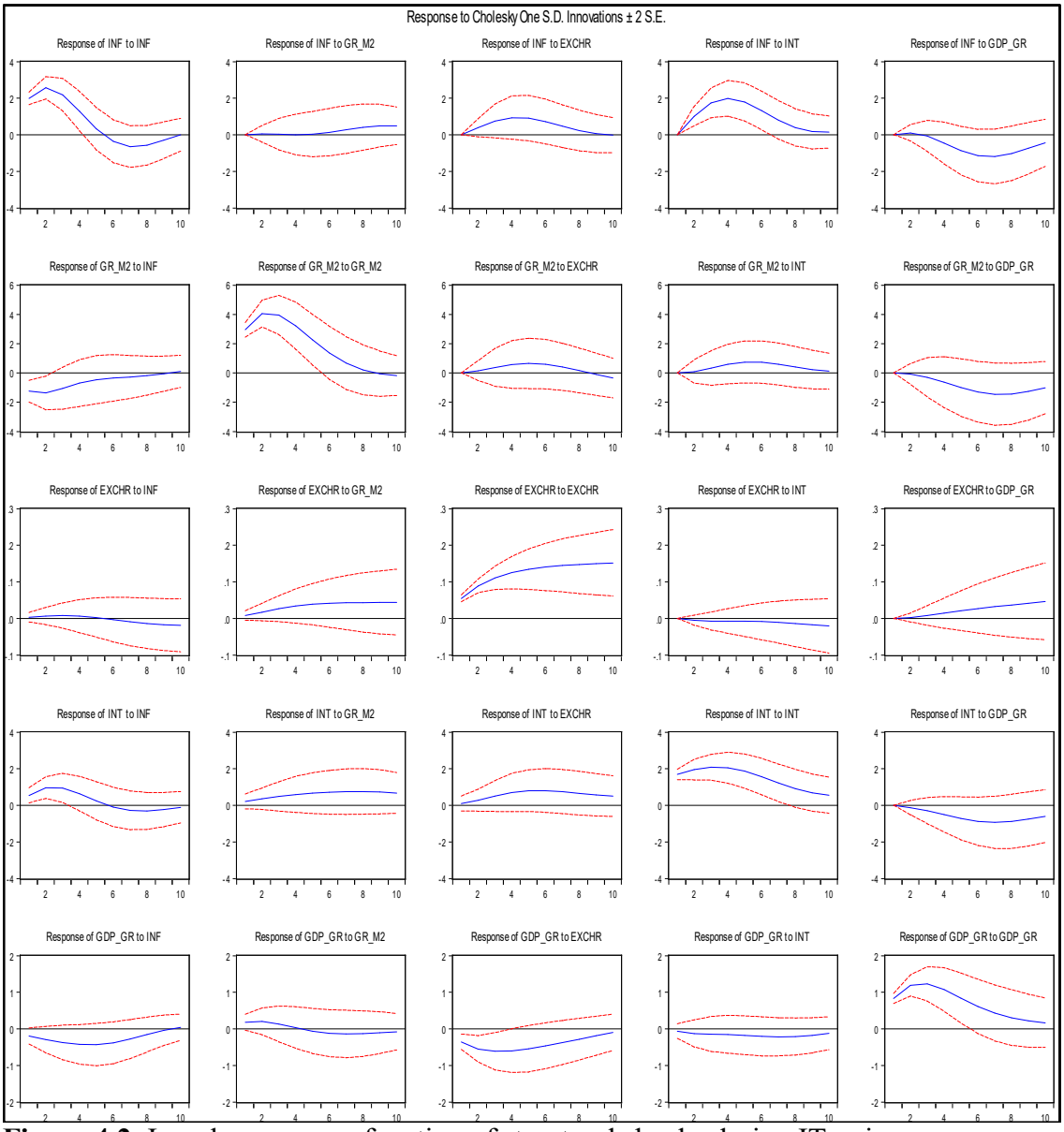

Figure 4.2. Impulse response function of structural shocks during ITregime

Beyond the impulse response functions, the analysis is extended to quantitatively examine MP shocks to prices and other control variables in the form variance decomposition. The derived variance decomposition is evaluated to gain further insight into how monetary policy reacts to shock to inflation and the subsequent reactions of other control variables including money supply, exchange rate, and GDP growth. Specifically, the analysis is extended to evaluate how IR response to innovations in variables other than output gap or inflation.

Thus, it may be understood as the measure of the non-systematic policy actions undertaken by the central bank (Bernanke and Milhove, 1998; Primiceri, 2005; and Sims and Zha, 2006). An important assumption worth highlighting is that the shock to inflation is driven by aggregate demand factors rather than supply side factors. Under IT MP framework, the central bank is able to adjust short-term IR to stem rising inflation expectation, without having to deal with significant trade-off between inflation and output growth. The situation is different when the underlying cause of inflation is a supply side factor. The shock effect of the price level mainly impacts on the rate of interest while the effects on GDP growth is marginal.

The impact on money supply and the exchange rate are negligible. The contemporaneous effect of price level tapers off slowly with 43.78% self-shock effects. Also, reaction of interest rate grows slowly and reached 33.37% level by the tenth quarter. The next significant variable is RGDP growth which experience about 13% variation as a result of inflation shock. As expected in an IT framework, IR, which is the policy rate, does not react to changes in MS. Evidently, only2.7% of variation in IR is explained by changes in MS. Also, only 7% is attributed to inflation. This is consistent with the results obtained for the monetary-targeting case, suggesting that inflation affects output in the long-run. These estimates reinforce the behaviour of the impulse response function derived earlier. More so, shock effect of price level, within the IT regime on output in Ghana was marginal and only reached 13.3% at the tenth quarter. It is important to note that when the exchange rate is hit by a shock, it moves the exchange rate onto a higher path that persists into the long-run. For instance, during the IT period, the exchange rate retained 86% of self-shock up to

the 10th quarter. This is similar to the pre-IT period where over 80% of self-shock is obtained (Tables 4.19 to 4.23).

In addition, the net effects from the corresponding negative and positive shock to monetary policy on output are presented in Table 4.24. Evidently, monetary policy impacts significantly on inflation, money supply and output. As expected, monetary policy stabilises the price level as the net shock effects have 1.989 coefficient and 0.000 probability value. Also, there is a net positive shock effect on output with 0.027 but insignificant with 0.225 probability value.

Table 4.19. Variance decomposition (inflation shock): IT period

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	89.83114	0.018232	1.256146	8.799371	0.095106
3	76.22333	0.014714	3.508843	20.17727	0.075846
4	63.44194	0.011226	5.888408	29.84163	0.816804
5	53.99617	0.014043	7.583709	35.32486	3.081223
6	48.67939	0.066115	8.255786	36.53887	6.459833
7	46.24784	0.265470	8.224997	35.56507	9.696633
8	45.04787	0.680052	7.993945	34.38976	11.88838
9	44.26812	1.256362	7.825380	33.70211	12.94803
10	43.77970	1.829351	7.740481	33.37702	13.27345

Note:[a] Inflation; [b] MS; [c] Exchange Rate; [d] Interest Rate; [e] RGDP

Table 4.20. Variance decomposition (money supply shock): IT period

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	15.23314	84.76686	0.000000	0.000000	0.000000
2	12.02064	87.84841	0.079594	0.027812	0.023541
3	9.933650	89.23396	0.357306	0.265661	0.209419
4	8.720081	88.75418	0.840262	0.825988	0.859485
5	8.071888	86.64583	1.393614	1.581214	2.307459
6	7.717159	83.62683	1.807536	2.247419	4.601051
7	7.486045	80.58253	1.967322	2.634390	7.329712
8	7.298896	78.12933	1.943147	2.766184	9.862441
9	7.143068	76.42767	1.914620	2.771869	11.74278
10	7.045904	75.30017	2.043215	2.746283	12.86442

Note:[a] Inflation; [b] MS; [c] Exchange rate; [d] Interest rate; [e] RGDP

Table 4.21. Variance decomposition (exchange rate shock): IT period

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	0.284004	1.967870	97.74813	0.000000	0.000000
2	0.448368	3.165820	96.10185	0.241410	0.042555
3	0.441187	4.334761	94.64677	0.322275	0.255007
4	0.344426	5.297540	93.38802	0.322298	0.647713
5	0.238249	5.995519	92.29992	0.308811	1.157502
6	0.189080	6.449900	91.33118	0.311782	1.718059
7	0.223904	6.716312	90.42071	0.346293	2.292778
8	0.326448	6.852969	89.52443	0.421394	2.874758
9	0.457273	6.905619	88.62675	0.537929	3.472426
10	0.579564	6.904425	87.73558	0.686024	4.094402

Note:[a] Inflation; [b] MS; [c] Exchange rate; [d] Interest rate; [e] RGDP

Table 4.22. Variance decomposition (interest rate shock): IT period

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	9.203700	1.474247	0.317664	89.00439	6.60E-32
2	15.03784	2.130817	1.024788	81.60123	0.205329
3	15.20356	2.951945	2.437429	78.68547	0.721604
4	12.85711	3.856808	4.213700	77.28203	1.790356
5	10.42137	4.816544	5.913840	75.34438	3.503866
6	8.887727	5.826554	7.244691	72.42429	5.616734
7	8.165770	6.882587	8.152526	69.12791	7.671207
8	7.812577	7.953073	8.744226	66.20282	9.287306
9	7.544237	8.964303	9.154796	64.00615	10.33052
10	7.306984	9.821289	9.475865	62.51338	10.88249

Note:[a] Inflation; [b] MS; [c] Exchange rate; [d] Interest rate; [e] RGDP

Table 4.23. Variance decomposition (RGDP shock): IT period

Period	Shock[a]	Shock[b]	Shock[c]	Shock[d]	Shock[e]
1	4.257447	3.700808	14.27985	0.431263	77.33064
2	4.577981	2.696327	15.62272	0.741959	76.36102
3	5.556716	1.909633	16.76996	0.849229	74.91446
4	6.888927	1.421107	17.85995	0.990057	72.83996
5	8.200291	1.246294	18.84226	1.245471	70.46568
6	9.121944	1.298019	19.63632	1.633724	68.30999
7	9.510079	1.446067	20.19215	2.100118	66.75159
8	9.512036	1.591416	20.50249	2.531494	65.86257
9	9.401070	1.692642	20.60338	2.827812	65.47510
10	9.359347	1.748981	20.57315	2.967490	65.35103

Note:[a] Inflation; [b] MS; [c] Exchange rate; [d] Interest rate; [e] RGDP

Table 4.24. Net structural shocks of inflation on output

Exogenous Variables	Coefficient	Z-Statistics	Prob. Value
INF	1.989	11.832	0.000
MS	0.629	3.55	0.0004
EXCHR	-0.003	-0.879	0.380
INT	-0.314	-2.829	0.0047
RGDP	-0.028	-1.215	0.225

Note: Endogenous variable = inflation

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of findings

The conduct of effective monetary policy that is capable of delivering low and stable inflation is central to Ghana's long-term macroeconomic policy agenda. This thesis investigated the implication of monetary policy on inflation and output growth in Ghana before and during periods when monetary policy has been conducted usinginflation-targeting framework.

To gain some insight into Ghana's macroeconomic background, a discussion on the historical evolution of monetary policy and macroeconomic developments was provided.It has been observed that Ghana has had a chequred history of macroeconomy developments. Inflation has been high and volatile while output growth exhibited uneven growth trends especially from the early post-independence period through the late 1970s. Attempts by the authorities to address the lingering macroeconomic challenges led to the implementation of different monetary policies. These included system of direct control (1957-1970), indirect approach to monetary policy (1981-1987) and market-based approach.

The failure of previous policy regimes to control inflation and achieve long-term growth led to the introduction of inflation-targeting in 2002 by the Bank of Ghana. This meant moving away from targeting monetary aggregates to directly targeting-inflation. Thus, inflation expectations (or inflation forecast) and actual inflation are the intermediate and final targets respectively while short-term nominal interest rate is the nominal anchor. It is observed that inflation and output growth performed better under inflation-targeting compared to previous regimes. Average inflation in 1971 was 9.6% but rose consistently to 116.4% in 1977, and

to 122.9% by 1983. It averaged 47% between 1980 and 1990, and 23% between 1991 and 2006. However, annual average inflation dropped to about 13% between 2007 and 2016, the period following the adoption of full-fledged inflation-targeting regime.

The study used Fractional Cointegration Vector Autoregression (FCVAR), Nonlinear Autoregressive Distributed Lag (NARDL) and Structural Vector Autoregression (SVAR) models to achieve the research objective. The FCVAR was used to determine the stabilisation role of monetary policy by examining the short and long-memory properties of inflation and output growth, while the NARDL was used to examine the long-run symmetry (or asymmetry) impact of monetary policy on inflation and output growth. The SVAR was employed to determine the structural impulse response functions and variance decomposition.

Quantitative estimates indicate that it takes a shorter time horizon for monetary policy to contain inflation and steer output growth to its long-run path when short-term interest rate is used as a stabilisation tool compared to monetary aggregates. While both money supply and the interest rate model have long-run equilibrium conditions in their respective models, only the inclusion of money supply resulted in long-memory property for inflation and output growth. The finding is consistent with that of Lovcha and Parez (2018) and rejects the null hypothesis that money supply is long-run exogenous. The result also indicates a statistically significant negative relationship between short-term interest rate and inflation. This means that a tight monetary policy, such as an increase in the monetary policy rate would dampen inflation. Thus,conducting monetary policy under inflation-targeting[28] helps the central bank to effectively anchor inflation expectations of economics agents such that policy is able to steer their expectations in line with that of the central bank.

The impact of short-term interest rate on output growth was symmetric, as a percentage change in interest rate exerts a proportionate effect on output growth. However, the relationship between growth in money supply and output growth was asymmetric. Result show that the long-run effects of monetary policy on inflation are asymmetric. Thus, the

[28]Under inflation-targeting, short-term nominal interest rate (monetary policy rate) is the nominal anchor. It is adjusted in response to inflationary pressures.

dynamic reaction to inflation drifting from target cannot be uniform and that monetary policy action that attempts to close the output gap and reduce inflation is less effective than that which is inflationary. This is theoretically plausible since prices are sticky downwards given the nominal rigidities in Ghana's economy. However, in the case of monetary policy rate and output growth, the symmetric relationship obtained has important implication for the conduct of monetary policy since a negative or positive change in interest rate exerts equivalent effects on output as in De Guimarães e Souza et al. (2016), Ayres et al. (2014) and Amira et al. (2013). Under inflation-targeting, an upward pressure on inflation creates an output gap. This means that the actual output is higher than the potential output, thereby creating excess demand in the economy. To close the gap, a contractionary monetary policy implies increase in interest rate. Assuming an efficient transmission mechanism exists in the economy, credit will fall since lending rate will go up. Consequently, aggregate demand will fall, output gap narrows and inflation falls. The fall in output gap is equivalent to aslowdown in output growth. The opposite reasoning applies when the economy is experiencing deflation caused by a negative output gap.

Results from the impulse response and variance decomposition analyses show that a one-standard-deviation shock from monetary policy rate increased inflation up to the fourth quarter, while output growth declines in response to the same shock. Shocks from money supply contributes less to variations in inflation and output growth. Shocks from output accounted for 5.1% and 17.7% of the variation in money and inflation, respectively, while the response of growths in money and output to shock from inflation were 4.8% and 26%, respectively. During inflation-targeting period, shock from monetary policy rate contributed 7.3% and 10.8% to variations in inflation and output, respectively. Also, shocks from inflation contributed 33% to the variation in monetary policy rate and 13% to output growth, while inflation and monetary policy rate changed by 9.3% and 2.9% respectively in response to output growth shock. The results also show that inflation exhibits a high level of persistence during the monetary targeting era compared to inflation-targeting period. Specifically, following a similar shock, inflation retained 43% of self-shock under inflation-targeting period compared to 56% under monetary targeting, indicative of a relatively high inflation inertia. A significant variation in monetary policy

rate (33%) following inflation shock is an indication that monetary policy responds quickly to deviation of inflation from the target during the inflation-targeting period. During the period of monetary targeting, the response of money growth to inflation shock was only 4.8%.

5.2Policy recommendations

Following from the findings that inflation targeting is more effective in controlling inflation and ensuring output growth, monetary policy should continue to be oriented towards disinflation. The core mandate of the Bank of Ghana, which is to ensure low and stable inflation, should be sustained, while the inflation-targeting framework should be developed further to make it more potent in controlling inflation.

As the results indicates that money supply shock contributed to variation in inflation during the inflation targeting period, Bank of Ghana should continue to monitor money growth as an additional information to inform policy decisions. While the case for inflation-targeting is strongly made, the role of money should not be completely discounted. Certainly, the growth and sophistication in financial services and products, the relatively large informal sector and the cash-based nature of economic transactions havesignificant implications for money supply in particular and monetary policy in general. Going forward, the central bank should strive to promote a cashless policy in the economy.

The fact that inflation exhibited relatively high inertia as reflected in the results has important implication for policy and effective anchoring of inflation expectations of private economic agents.In this regard, effective communication from the central bank is important for a successful anchoring of expectation of private economic agents. Thus, the public should have full information about the economy and the future path of macroeconomic variables. They should also be made to understand the policy of the central bank and the factors that inform those decisions.

There is alsothe need to address structural macroeconomic issues.For instance, ensuring fiscal discipline is key in this regard.Also, the Bank of Ghana should speed up efforts at achieving the remaining preconditions to enhance the effectiveness of monetary policy.

These include: (i) complete central bank independence through zero financing of government deficits; (ii) strict adherence to the fiscal rule; (iii) exchange rate stability; and (iv) strong and sound financial system.

5.3 Limitations and agenda for future research

This thesis employed quarterly data for the analysis. However, quarterly data are not available for real GDP growth for the greater period of the study. Hence, a splicing method was adopted to generate quarterly series for real GDP growth. In the case of money supply, the study used broad money supply (M2+), which includes foreign currency deposits. Given the relatively unstable nature of the exchange rate, growth in money may not necessarily reflect growth in output or underlying demand or supply of money.

The study used the policy rate for the inflation-targeting period and 91-day treasury bill rate for the period before inflation-targeting. Future study could use inter-bank rate as a measure of policy rate. This is because, the monetary policy rate serves as a transaction rate between the Bank of Ghana and the commercial banks as well as a signal to the market on policy stance. Because the inter-bank market was relatively not well developed during the period prior to and the early stages of inflation-targeting, using the inter-bank rate became problematic as it did not accurately mimic the stance of monetary policy.

The scope of this research did not extend to estimate a reaction function to gauge the policy reaction in the context of regime-switching that allows for contemporaneous policy reactions. Even though the result suggests that monetary policy under inflation-targeting is effective in controlling inflation, it does not indicate how monetary policy reacts to deviation of inflation from target and the relative weights assigned to inflation and growth objectives. Future study in this area could extend the analysis to capture this. Lastly, this is a country specific study on Ghana. A comparative study can be undertaken for inflation-targeting countries in Africa.

5.4Contribution to knowledge

The broad objective of the thesis is to study the implication of monetary policy on inflation and output in Ghana. Most of the studies in this area focus extensivelyon structural error correction models to assess the effects of monetary policy shocks. In this study, fractional vector error correction model was employed to ascertain the long-memory properties of inflation and output in the context of monetary policy shocks. This has been complemented with non-linear auto distributed lag and structural vector error correction models to address the other research objectives. To the best of our knowledge, this is the first time such an approach is being applied using Ghana data. This would therefore, create an opportunity for future studies to leverage on and introduce new perspectives to the study of monetary policy in Ghana.

Also, the findings and conclusions from the study would add enormously to the raging empirical and policy debate on the implication of monetary policy on inflation an output Ghana. The data has been divided into two sub-periods to reflect the two distinct monetary policy regimes in Ghana over the past three decades. This has provided a tractable way of understanding the efficacy of monetary policy under different regimes in Ghana.

5.5 Conclusion

Monetary policy management in Ghana has witnessed significant changes in both the framework and instruments since the attainment of political independence in 1957. These ranged from controlled regimes to the current framework where the formulation and implementation of monetary policy has been allowed to be guided by market fundamentals.

As strongly articulated in the preceding chapters, the quest to achieve a low and stable inflation remained elusive for the greater part of the post-independent period. Therefore, the shift to inflation-targeting informally in 2002 and formally in 2007 was part of attempts by the Bank of Ghana to adopt a framework that was capable of anchoring inflation expectation, in order to reduce inflation to a single digit path. The literature points to various arguments on the appropriateness of inflation-targeting for developing

countries amidst weak macroeconomic fundamentals.The emerging consensus is that developing countries need not meet all the preconditions to implement inflation-targeting. In fact, inflation-targeting would introduce enhanced discipline in macroeconomic management which is needed for macroeconomic stability (Gonçalves and Salles, 2008).

The theoretical framework employed is the New Neoclassical synthesis that emphasised interest rate as a major tool for controlling inflation. The econometric models adopted for the study were the fractional cointegration vector autoregression, nonlinear autoregressive distributed lag and structural vector auto regression.

An important inference from the study is that there has been a reduction in inflation and its volatility during the period of inflation-targeting, compared to the period before. Monetary policy has been able to better anchor inflation expectation when interest rate was used as a nominal anchor as in the case of inflation-targeting regime. When inflation deviates from the target due to positive output gap, the short-term interest rate tool is effective in restoring inflation and output growth to their respective potential paths. The negative relationship between monetary policy rate and inflation suggests that an increase in interest rate would dampen inflation in the long-run. This is in line with the theoretical proposition that interest rate is key instrument for controlling inflation (Goodfriend and King, 1997). It is also consistent with most of the empirical results reported by Gonçalves and Salles (2008), Thornton (2016), Abo-Zaid and Tuzemen (2012), Brito and Bystedt (2006) and Mishkin and Schmidt-Hebbel (2007). However, it failed to support the conclusion reached by Ball and Sheriden (2005) who concluded that the positive effect of interest rate tool on inflation diminishes once mean reversion is accounted for.

The relationship between money growth and output growth was asymmetric. This conclusion is not surprising because of the behaviour of money supply and inflation discussed earlier and the conclusions of studies on money supply and inflation in Ghana. This is consistent with studies such as Addison et al. (1996) and Bawumia, et al. (2008). What was noted in Ghana prior to the adoption of inflation-targeting was the general breakdown in the stability of the money demand function. Part of this is due to the assumption of stable money multiplier which is a function of a constant growth in output.

To the extent that this assumption fail to hold, a symmetric relationship between money growth and output growth would be difficult to establish. Also, monetary policy rate responds significantly to shocks from inflation. This is indicated by the fact that significant variation in monetary policy rate is attributed to inflation shock during the period. This implies that monetary policy responds quickly to deviation of inflation from the target, the central tenet of inflation-targeting.

While conclusions from the research point to the fact that monetary policy in Ghana in its current form and structure has been relatively effective in reducing inflation and ensuring high output growth, the single digit inflation target remains elusive. Inflation has overshot its target for much of the period studied with exceptional episodes when inflation stayed briefly at lower double digits. Though average output growth remained high and broad-based during the inflation-targeting period compared to the period before, it has been erratic for most part of the period. A major reason that explains the high inflation during the inflation-targeting period (albeit lower than the period before on average) is due to the weak transmission of monetary and frequent aggregate demand and supply shocks. If the bank lending channel, which emphasises the special nature of bank credit in the financial structure is impaired, a policy action may be ineffective in influencing bank lending, making it difficult to control inflation.

On output growth performance, the issue has to do more with external factors and weak fiscal management. Excessive borrowing by the central government has resulted in a high interest rate and exchange rate depreciation, both of which imposed significant burden on private enterprises. External shocks including global crude oil price shocks also impacted negatively on growth. The inflation-targeting regime should be sustained while improving its effectiveness through continuous financial sector reforms and prudent fiscal policy management to enhance the interest rate transmission mechanism.

REFERENCES

Abo-Zaid, S. and Tuzemen, D. 2012. Inflation targeting: a three-decade perspective. *Journalof Policy Modelling* 34.5: 621-645.

Adam, K. 2009. Monetary policy and aggregate volatility. *Journal of Monetary Economics* 56: 1-18.

Addison, E.K.Y. 2008. Lessons from inflation targeting in developing countries: the case ofGhana. International symposium on monetary policy and price stability in the WestAfrican economic and monetary union zone.

_____,Kwakye, J.K., and Wampah H.A.K. 1996. Inflation management by Bank of Ghana: the strategies, the difficulties and the way forward. Inflation management roundtable, Akosombo.

Aguirre, H., Alessandro, M. and Llach, L. 2016. The transition to inflation targeting in an emerging economy: selected issues.Meeting of Deputy Governors, Bank for International Settlements.

Akram, O.F. and Eitrheim, O. 2008. Flexible inflation targeting and financial stability: is it enough to stabilise inflation and output? *Journal of Bank and Finance* 32.7: 1242-1254.

Alagidede, P., Baah-Boateng, W. and Nketiah-Amponsah, E. 2013. The Ghanaian economy: an overview. *Ghanaian Journal of Economics* 1.1: 4-34.

Amira, B., Mouldi, D. and Feridun, M. 2013. Growth effects of inflation targeting revisited: empirical evidence from emerging markets. *Applied Economics Letters* 20.6: 587-591.

Andersson, B. and Claussen, C. A. 2017. Alternatives to inflation targeting. *Sveriges Riksbank Economic Review* 1: 52-82.

Andrés, J., Lopez-Salido, J.D. and Nelson, E. 2009. Money and the natural rate of interest: structural estimates for the United States and the Euro area. *Journal of Economic Dynamics and Control* 33.3: 758-776.

Angelis, C., Aziakpono, M. and Faure, A. P. 2005. The transmission of monetary policy under the repo system in South Africa: an empirical analysis. *South African Journal of Economics* 73.4: 657-673.

Angeriz, A. and Arestis, P. 2006. Has inflation targeting had any impact on inflation? *Journal of Post Keynesian Economics* 28.4: 559-571.

Apergis, N. 2002. The Inflation-output volatility trade-off: a case where anti-inflation monetary policy turns out to be successful, a historical assessment. *Journal of policy modelling* 25.9: 881-892.

Ardakani, O.M., Kishor, N. and Song, S. 2018. Re-evaluating the effectiveness of inflation targeting. *Journal of Economic Dynamics and Control* 90: 76-97.

Arestis P. 2009. The new consensus in macroeconomics: a critical appraisal. *Macroeconomic theory and macroeconomic pedagogy*. Giuseppe Fontana and Mark Setterfield. Eds. Palgrave Macmillan: London. Chapter 5: 100-117.

_____, Chortareas, G. and Tsoukalas, J. D. 2010. Money and information in a new neoclassical synthesis framework. *The Economic Journal* 120.542: 101-128.

Armour, J., Engert, W. and Fung, B. 1996. Overnight innovations as a measure of monetary policy shocks in vector autoregressions. *Bank of Canada Working Paper* 96.

Aron, J. and Muellbauer, J. 2006. Review of monetary policy in South Africa since 1994. *Centre for the Study of African Economies Working Paper Series* 7.

Aryeetey, E. and Harrigan, J. 2000. Macroeconomic and sectoral developments since 1970. *Economic reforms in Ghana: the miracle and the mirage*. E. Aryeetey, J. Harrigan and M. Nissanke. Eds. Trenton, NJ: Africa World Press. 5-31.

_____. and Tarp, F. 2000. Structural adjustment and after: which way forward? *Economic reforms in Ghana: the miracle and the mirage*. E. Aryeetey, J. Harrigan and M. Nissanke. Eds. Trenton, NJ: Africa World Press. 344-365.

Ayres, K., Belasen, A.R. and Kutan, A.M. 2014. Does inflation-targeting lower inflation and spur growth. *Journal of Policy Modelling* 36:2. 373-388.

Balfoussia, H., Brissimis, S.N. and Delis, M.D. 2011. The theoretical framework of monetary policy revisited. *Bank of Greece Working Paper* 138.

Ball, L.M. 2010. The performance of alternative monetary regimes. *The handbook of monetary economics.* Benjamin M. Friedman and Michael Woodford.Eds. Elsevier Science. Vol. 38. Chapter 23:1303-1343.

_____. and Sheridan, N. 2005. Does inflation-targeting matter? *The Inflation Targeting Debate*. Ben S. Bernanke and Michael Woodford. Eds. Chicago: The University of Chicago Press. Chapter 6: 249-276.

Barro, R. J. and Gordon, D. B. 1983. A Positive theory of monetary policy in a natural rate model. *Journal of Political Economy* 91.4: 589-610.

Batini, N. and Laxton, D. 2006. Under what conditions can inflation targeting be adopted? the experience of emerging markets. *Central Bank of Chile Working Paper* 406.

Bawumia, M., Amoah, B. and Mumuni, Z. 2008. Choice of monetary policy regime in Ghana. *Bank of Ghana Working Paper*7.

Beck, G. W. and Wieland, V. 2007. Money in monetary policy design: a formal characterization of ECB-style cross-checking. *Journal of the European Economic Association*5.2: 524-533.

Benati, L. and Surico, P. 2008. Evolving U.S. monetary policy and the decline of inflation predictability. *Journal of the European Economic Association* 6.2: 634-646.

Bernanke, B.S. 2004. The Great moderation. Speech at the Meetings of the Eastern Economic Association. Washington, DC.

_____. and Blinder, A.S. 1992. The federal funds rate and the channels of monetary transmission. *The American Economic Review* 82.4: 901-921.

_____. and Mishkin, F.S. 1997. Inflation targeting: a new framework for monetary policy? *National Bureau of Economic Research* 5893

_____. and Mihov, I. 1996. What does the Bundesbank target? *European Economic Review* 41.6: 1025-1053.

Berument, H. and Yuksel, E. 2006. Effects of adopting inflation targeting regimes on inflation variability. *Physca* 375.1: 265-273.

Bhaduri, A. and Marglin, S. 1990. Unemployment and the real wage: the economic basis for contesting political ideologies. *Cambridge Journal of Economics* 14.4: 375-393.

Bhasin, K. V. 2004. Reaction functions of the Bank of Ghana: dynamic interlinks among the exchange rate, price level and terms of trade in a managed floating exchange rate system.*African Economic Research ConsortiumResearch Paper* 141.

Birol, O. H. 2015. What it means to be a new classical economist. *Procedia-Social and Behavioural Science* 195: 574-579.

Bleaney, M., Morozumi, A. and Mumuni, Z. 2020. Inflation targeting and monetary policy in Ghana. *Journal of African Economics* 29.2: 121-145

Bleich, D., Fendel, R. and Rulke, J. 2012. Inflation targeting makes the difference: novel evidence on inflation stabilisation. *Journal of International Money and Finance* 31.5: 1092-1105.

Boivin, J. and Giannoni M.P. 2006. DSGE models in a data-rich environment. *NBER Working Paper* 12772.

Briec, W., Gabillon, E., Laselle, L. and Ratsimbanierana, H. 2012. On measuring the efficiency of monetary policy. *Economic Letters* 117.1: 182-185.

Brito, R.D. and Bystedt, B. 2010. Inflation targeting in emerging economies: panel evidence. *Journal of Development Economics* 91.2: 198-210.

Calvo, G. 1983. Staggered prices in a utility maximizing framework. *Journal of Monetary Economics* 12: 383-398.

Canarella, G. and Miller, S. M. 2017. Inflation targeting and inflation persistence: new evidence from fractional integration and cointegration. *Journal of Economics and Business*. 92:45-6.

Canova, F. and Gambetti, L. 2009. Structural changes in the US economy: is there a role for monetary policy? *Journal of Economic Dynamic and Control* 33: 477-490.

Cecchetti, S. C. 2000. Making monetary policy: objectives and rules. *Oxford Review of Economic Policy* 16.4: 43-59.

_____.and Ehrmann, M. 1999. Does inflation-targeting increase output volatility? an international comparison of policymakers' preferences and outcomes. *NBER Working Paper* 7426.

Chadha, B. and Tsiddon, D. 1998. Inflation, nominal interest rates and the variability of output. *Journal of Monetary Economics* 42.3: 547-573.

Choi, J. and Ratti, R.A. 2000. The predictive power of alternative indicators of monetary policy. *Journal of Macroeconomics* 22.4: 581-610.

Clarida, R., Gali, J. and Gertler, M. 2000. Monetary policy rules and macroeconomic stability: evidence and some theory. *The Quarterly Journal of Economics* 115.1: 147-180.

Croce, E. and M. S. Khan. 2000. Monetary regimes and inflation targeting. *Finance and Development*37.

Defina, R.H., Stark, T.C. and Taylor, H.E. 1995. The long-run variance of output and inflation under alternative monetary policy rules. *Journal of Macroeconomics* 18.2: 235-251.

De Mendonça, H. F. and De Guimaraes e Souza, G. J. 2012. Is inflation targeting a good remedy to control inflation?*Journal of Development Economics* 98.2: 178-191.

Divino, J.A. 2009. Optimal monetary policy for a small open economy. *Economic Modelling* 26.2: 352-358.

Do, H., Brooks, R. and Treepongkaruna, S. 2016. Generalized impulse response analysis in a fractionally integrated vector autoregressive model. *ARCDiscovery Grant Paper* 1093344.

Douch, M. and Essadam, N. 2010. Monetary policy conduct: a hybrid framework. *Journal of Economics and International Finance* 2.7: 127-145.

Drew, A. and Hunt, B. 2000. Efficient simple policy rules and implications of potential output uncertainty. *Journal of Economics and Business* 52.1: 143-160.

Duesenberry, J.S. 1949. Income, saving and the theory of consumer behaviour. Harvard University Press, Cambridge.

Duerker, M. J. and Fischer, A. M. 2006. Do inflation targeters outperform non-targeters? *Reserve Bank of St. Louis Review* 88.5: 431-450

Dwyer, G.P. and Fisher, M. 2009. Inflation and monetary regimes. *Journal of International Money and Finance* 28.7: 1221-1241.

Ewusi, K. 1997. The determinants of price fluctuations in Ghana. *ISSER Discussion Paper.*

Fontana G. and Palacio-Vera A. 2004. Monetary policy uncovered: theory and practice. *International Review of Applied Economics*. 18.1: 25-41

Friedman, M. 1968. The Role of monetary policy. *American Economic Review* 58.1: 1-17.

_____. and Schwartz, A.J. 1963. Money and business cycles. *Review of Economics and Statistics* 45.1: 32-64.

Ftiti, Z. and Hichri, W. 2014. The price stability under inflation targeting regime: an analysis with a new intermediate approach. *Economic Modelling*. 38: 23-32.

Gavin, W.T. 2018. Monetary policy regimes and real interest rate. *Federal Reserve Bank of St. Louis Review* 100.2: 151-170.

Gerlach, S. and Tillmann, P. 2012. Inflation targeting and inflation persistence in Asia-Pacific. *Journal of Asian Economics* 23.4: 360-373.

Gertler, M. and Gilchrist, S. 2018. What happened: financial factors in the great recession. *NBER Working Paper* 24746.

Gonçalves, C. E. S., and Salles, J. M. 2008. Inflation targeting in emerging economies: what do the data say? *Journal of Development Economics* 85.1: 312-318.

Goodfriend, M. 2004. Monetary policy in the new neoclassical synthesis: a primer. *Federal Reserve of Richmond Economic Quarterly* 90.3: 21-45.

_____. and King, R. G. 1997. The new neoclassical synthesis and the role of monetary policy. NBER Macroeconomics Annual. B. Bernanke and J. Rotemberg. Eds.Chicago, Ill:University of Chicago Press. 231-83.

Haslag, J.H. and Hein, S.E. 1995. Does it matter how monetary policy is implemented? *Journal of MonetaryEconomics* 35.2: 359-386.

Hayat, Z., Balli, F., Obben, J. and Shakur, S. 2016. An empirical assessment of monetary discretion: the case of Pakistan. *Journal of Policy Modelling* 38.5: 954-970.

Issaoui, F., Boufateh, T. and Guesmi, M. 2015. Money neutrality: rethinking the myth. *Panoeconomicus*, 62.3: 287-320.

Johnson, D. 2002. The effect of inflation targeting on the behaviour of expected inflation: evidence from 11 country panel. *Journal of Monetary Economics* 49.8: 1493-1519.

Kandil, M. 2015. Monetary shifts and co-movements in spending, growth and inflation: evidence from developing and advanced countries. *Borsa Istanbul Review* 15.2: 76-92.

_____. 2014. On the effects of monetary policy shocks in developing countries, *Borsa Istanbul Review* 14.2: 104-118.

Keen, B.D. 2009. Output, inflation and interest rates in an estimated optimizing model of monetary policy. *Review of Economic Dynamics* 12.2: 327-343.

_____.2004. In search of the liquidity effect in a modern monetary model. *Journal of Monetary Economics* 51.7: 1467-1494.

Kimura, T. and Kurozimi, T. 2010. Endogenous nominal rigidities and monetary policy. *Journal of Monetary Economics* 57: 1038-1048.

Klingelhofer, J. and Sun, R. 2018. China's regime switching monetary policy. *Economic Modelling* 68: 32-40.

Kwakye, J. K. 2012. Key issues in the choice of an appropriate monetary policy framework for Ghana. *IEA Monograph* 32

Kydland, F. and Prescott, E. 1977. Rules rather than discretion: the inconsistency of optimal plans. *Journal of Political Economy* 85.3: 473-491.

Lee, J. 1999. The inflation output variability trade-off: evidence from GARCH model. *Economics Letters* 62: 63-67.

Leith, J. C. and Söderling, L. 2000. Ghana: long term growth, atrophy, and recovery. *OECD Emerging Africa Research Report* 125.

Levin, A., Natalucci, F. M. and Piger, J. 2004. The macroeconomic effects of inflation targeting. *Federal Reserve Bank of St. Louis Review* 86.4: 51-80.

Lovcha, Y. and Perez-Laborda, A. 2018. Monetary policy shocks, inflation persistence and long-memory. *Journal of Macroeconomics* 55: 117-127.

Lucas, R.E. 1996. Expectations and the neutrality of money. *Journal of Economic Theory*. 4.2: 103-124.

_____. 1976. Econometric policy evaluation: a critique. *Carnegie-Rochester Conference Series on public policy* 1.1: 19-46.

_____. 1973. Some international evidence on output-inflation tradeoffs. *The American Economic Review* 63.3: 326-334.

Lucotte, Y. 2012. Adoption of inflation targeting and tax revenue performance in emerging market economies: an empirical investigation. *Economic Systems* 36.4: 609-628

McCallum, B.T.1999. Issues in the design of monetary policy rules. *Handbook of Macroeconomics*. J. B. Taylor and M. Woodford. Eds. Amsterdam: Elsevier Science.Chapter 23: 1483-1530.

_____. and Nelson, E. 1999. An optimizing IS-LM specification for monetary policy and business cycle analysis.*Journal of Money, Credit and Banking* 31.1: 296-316.

Meh, C.A., Rios-Rull, V.J. and Terajima, Y. 2010. Aggregate and welfare effects of redistribution of wealth under inflation and price-level targeting. *Journal of Monetary Economics* 57.6: 637-652.

Miles, W. 2008. Inflation targeting and monetary policy in Canada: what is the impact on inflation uncertainty? *North American Journal of Economics and Finance* 19.2: 235-248.

Mishkin, F. S. 2000. Inflation targeting in emerging-market countries. *American Economic Review* 90.2: 105-109

_____. 1999. International experiences with different monetary policy regimes. *Journal of Monetary Economics* 43.3: 579-605.

_____. and Schmidt-Hebbel, K.2007. Does inflation targeting make a difference? *NBER Working Paper* 12876.

Mollick, A., Cabral, R. and Carneiro, F. 2011. Does inflation-targeting matter for output growth? evidence from industrial and emerging economies.*Journal of Policy Modeling* 33.4: 537-51.

Moore, B.J. 1988. Horizontalists and verticalists: the macroeconomics of credit money. Cambridge University Press.

Moura, M.L. and Carvalho, A. 2010. What can Taylor rules say about monetary policy in Latin America? *Journal of Macroeconomics* 32.1: 392-404.

Mumuni, Z. and Owusu-Afriyie, E. 2004. Determinants of the cedi/dollar rate of exchange in Ghana: amonetary approach.*Bank of Ghana Working Paper* 6.

Muth, J.1961. Rational expectations and the theory of price movements.*Econometrica* 29.3: 315-335.

Nakahira, S. 2009. A structural VAR analysis of monetary policy stance in Japan. *The International Journal of Economic Policy Studies* 4.1: 77-103.

Narayan, K.P., Narayan, S. and Smyth, R. 2009. Understanding the inflation-output nexus for China. *China Economic Review* 20.1: 82-90.

Nelson, E. 2003. The future of monetary aggregates in monetary policy analysis. *Journal of Monetary Economics* 50.5: 1029-1059.

Neumann, M. J. M. and von Hagen, J. 2002. Does inflation-targeting matter? *Federal Reserve Bank of St. Louis Review* 84.4: 127-148.

Nielsen, M.A. and Popiel, M.K. 2018. A matlab program and user's guide for the fractionally cointegrated VAR Model. *Queens's Economics Department Working Paper* 1330.

Nojkovic, A. and Petrovic, P. 2015. Monetary policy rule in inflation targeting emerging countries: a discrete choice approach. *Journal of Policy Modelling* 37.4: 577-595.

Odria, L. R. M. and Rodríguez, G. 2013. Inflation expectations formation in the presence of policy shifts and structural breaks: an experimental analysis. *The Journal of Socio-Economics* 44: 59-67.

Onyukwu, O. E., Nwosu, E. O. and Ito, D. 2011. Monetary policy and output-inflation volatility interaction in Nigeria: evidence from bivariate GARCH-M model, *Journal of Economics and Sustainable Development* 2.6: 46-64.

Orphanides, A. and Williams, J. C. 2006. Inflation targeting under imperfect knowledge. *Working Papers Central Bank of Chile* 398.

_____, Porter, R., Reifschneider, D., Tetlow, R. and Finan, F. 2000. Errors in the measurement of the output gap and the design of monetary policy. *Journal of Economics and Business* 52.2: 117-143.

Palley T.I. 2007. Macroeconomics and monetary policy: competing theoretical frameworks. *Journal of Post Keynesian Economics* 30.1: 61-78.

Paranavithana, H., Tyers, R. and Magnusson, L. 2017. The Transition from exchange rate targeting: the case of Sri Lanka:tenth international research conference.

Pearce, D. K. and Sobue, M. 1997. Uncertainty and the inflation bias of monetary policy. *Economic Letters* 57.2: 203-207.

Pesaran, M. H. and Shin, Y. 1998. Generalized impulse response analysis in linear multivariate models. *Economics Letters* 58.1: 17-29.

_____, _____. and Smith, R. J. 2001. Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics* 16.3: 289-326.

Phelps, E. 1967. Phillip curves, expectations of inflation and optimal unemployment over time. *Economica* 34.3: 254-281.

Pigou, A.C. 1917. The value of money. *The Quarterly Journal of Economics* 32.1: 38-65.

Poole, W. 1970. Optimal choice of monetary policy instruments in a simple stochastic macro model. *The Quarterly Journal of Economi*cs 84.2: 197-216.

Quartey, P. and Afful-Mensah, G. 2014. Financial and monetary policies in Ghana: a review of recent trends. *Review of Development Finance* 4.2: 115-25.

Richardo, D. 1945. Ricardo's theory of money matters. *Revue e'conomique* 45.5: 1251-1268.

Rogoff, K. 1985. The optimal degree of commitment to an intermediate monetary target. *Quarterly Journal of Economics* 100.4: 1169-190

Røisland, Ø. 2017. On the interplay between monetary policy and macroprudential policy: a simple analytical framework. *Norges Bank Working Paper*

Rotemberg, J.J. and Woodford, M. 1997. An optimization-based econometric framework for the evaluation of monetary policy. *NBER Macroeconomics Annual* 12: 297-346.

Sanchez, M. 2010. What does south Korean inflation-targeting target? *Journal of Asia Economics* 21.6: 526-539.

Sargent, T. and Wallace, N. 1975. Rational expectations, the optimal monetary instrument, and the optimal money supply rule. *Journal of Political Economy* 83.2: 241-254.

Sheng, A. andTannor, A.A. 1996. Ghana's financial restructuring, 1983-91.*Bank restructuring: lessons from the 1980s*.AndrewSheng. Eds. Washington,DC World Bank Group. 8:123-132

Sim, C. 2008. Improving monetary policy models. *Journal of Economic Dynamics and Control* 32.8: 2460-2475.

Simons, H. 1936. Rules versus authorities in monetary policy. *Journal of Political Economy* 44.1: 1-30.

Smets, F. and Wouters, R. 2007. Shocks and frictions in US business cycles: a bayesian DSGE approach. *American Economic Review* 97.3: 586-606.

Sowa, N. K. 1994. Fiscal deficits, output growth and inflation targets in Ghana.*World Development* 22.8: 1105-1117.

Steinsson, J. 2003. Optimal monetary policy in an economy with inflation persistence. *Journal of Monetary Economics*50.7:1425-1456.

Stephanos P. and Vangelis A. 2015. The effect of the market-based monetary policytransparency index on inflation and output variability. *International Review of Applied Economics,* 29.1: 105-124.

Stock, J. H. and Watson, M. W. 2003. Forecasting output and inflation: the role of asset prices. *Journal of Economic Literature* 41:788-829.

Stone, M. R. 2003. Inflation targeting lite. *IMF Working Paper* 12.

Svensson, L. E. O. 1999. Inflation targeting as a monetary policy rule. *Journal of Monetary Economics* 43.3: 607-654.

_____. 1997. Inflation forecast targeting: implementing and monitoring inflation targets. *European Economic Review* 41.6: 1111-1146.

Taylor, J. B. 1993. Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy* 39:195-214.

_____. 1979. Estimation and control of macroeconomic model with rational expectations. *Econometrica.* 47.5:1267-1286.

Thornton, J. 2016. Inflation targeting in developing countries revisited. *Finance Research Letters* 16:145-153.

Tillman, P. 2012. Cross-checking optimal monetary policy with information from the Taylor's rule. *Economic Letters* 117.1: 204-207.

Toda, H.Y. and Yamamoto, T. 1995. Statistical inference in vector autoregression with possibly integrated processes. *Journal of Econometrics*66: 225-250.

Vega, M. and Winklried, D. 2005. Inflation targeting and inflation behavior: a successful story? *International Journal of Central Banking* 1.3:153-175.

Vestin, David, 2006. Price-level versus inflation targeting. *Journal of Monetary Economics* 53.7: 1361-1376.

Walsh, C. E. 2009. Inflation targeting: what have we learned? *International Finance* 12.2:195-233.

_____. 2003. Monetary theory and policy. The MIT Press.

Wang, K.M. and Chong, T.T.L. 2014. A tale of two regimes: classifying and revisiting the monetary policy regimes. Retrieved Jan. 10, 2019, fromhttps://mpra.ub.uni-muenchen.de/75922/.

Westelius, N.J. 2005. Discretionary monetary policy and inflation persistence. *Journal of Monetary Economics* 52.2: 477-496.

Woodford, M. 2003. Interest and prices: foundations of a theory of monetary policy. Princeton: Princeton University Press.

Yetman, J. 2003. Probing potential output: monetary policy credibility and output optimal learning under certainty. *Journal of Macroeconomics* 25.3: 311-330.

Yun, T. 1996. Nominal price rigidity, money supply endogeneity and business cycles. *Journal Monetary Economics*. 37.3: 345-70.

APPENDICES

Appendix 1: Interest Rate Model

LAG SELECTION

k	r	d	b	LogL	LR	pv	AIC	BIC	pmvQ	pQ1	pLM1	pQ2	pLM2	pQ3	pLM3
5	1	2.000	2.000	-1083.97	-14.52	1.000	2275.94	2437.79	0.00	0.74	0.89	0.00	0.02	0.00	0.00
4	1	1.236	1.236	-1076.71	98.54	0.000	2243.43*	2378.30*	0.04	0.34	0.16	0.01	0.20	0.01	0.05
3	1	1.641	1.641	-1125.98	100.91	0.000	2323.96	2431.86	0.00	0.17	0.43	0.00	0.00	0.00	0.00
2	1	2.000	2.000	-1176.44	26.19	0.002	2406.87	2487.80	0.00	0.00	0.24	0.00	0.00	0.00	0.00
1	1	0.926	0.926	-1189.53	43.09	0.000	2415.06	2469.01	0.00	0.00	0.28	0.00	0.02	0.00	0.00
0	1	1.585	1.585	-1211.08	0.00	0.000	2440.15	2467.13	0.00	0.00	0.28	0.00	0.01	0.00	0.00

COINTEGRATING RANKS

Rank	d	b	Log-likelihood	LR statistic	P-value
0	1.121	1.121	-1098.738	63.536	0.000
1	1.236	1.236	-1076.713	19.487	0.097
2	1.278	1.278	-1067.009	0.078	1.000
3	1.280	1.280	-1066.970	----	----

FCVAR results

CIRank:	1	AIC:	2243.427
Log-Likelihood:	-1076.713	BIC:	2378.301

Fractional parameters:

	COEF	ESTSDE
d	1.236	0.042

CI Equations:

Variable	CI equation 1
V1	1.000
V2	5.042
V3	-0.771

Imposed identifying restriction on the model.

Adjustment matrix (alpha):

Variable	CI EQ 1
V1	-0.297
SDE 1	(0.037)
V2	-0.003
SE 2	(0.003)
V3	0.017
SDE 3	(0.019)

Long-run matrix:

Variable	V1	V2	V3
V1	-0.297	-1.498	0.229
V2	-0.003	-0.014	0.002
V3	0.017	0.087	-0.013

Level parameter (mu):

V1	87.201
SDE 1	(3.104)
V2	-0.165
SED 2	(0.530)
V3	81.120
SED3	(2.704)

Lag Matrix 1:

Variable	V1	V2	V3
V1	0.335	-0.138	0.151
SDE 1	(0.061)	(0.705)	(0.108)
V2	0.008	0.322	0.004
SDE 2	(0.005)	(0.058)	(0.010)
V3	0.031	0.257	0.337
SDE 3	(0.026)	(0.329)	(0.057)

Lag Matrix 2:

Variable	V1	V2	V3
V1	0.075	0.525	-0.175
SDE 1	(0.043)	(0.473)	(0.089)
V2	-0.007	0.150	-0.001
SDE 2	(0.004)	(0.043)	(0.008)
V3	-0.032	-0.107	0.117
SDE 3	(0.022)	(0.245)	(0.046)

Lag Matrix 3

Variable	V1	V2	V3
V1	0.184	0.986	-0.002
SED1	(0.035)	(0.376)	(0.072)
V2	0.018	0.077	0.003
SDE 2	(0.004)	(0.034)	(0.006)
V3	0.033	-0.068	0.080
SDE 3	(0.018)	(0.195)	(0.037)

Lag Matrix 4:

Variable	V1	V2	V3
V1	-0.109	1.074	-0.096
SDE 1	(0.053)	(0.316)	(0.060)
V2	0.006	-0.199	-0.001
SDE2	(0.003)	(0.044)	(0.005)
V3	-0.020	0.096	-0.246
SDE 3	(0.017)	(0.163)	(0.052)

ROOTS OF THE CHARACTERISTIC POLYNOMIAL

Number	Real Part	Imaginary Part	Modulus
1	5.212	0.000	5.212
2	-1.095	1.090	1.545
3	-1.095	-1.090	1.545
4	-0.789	1.313	1.532
5	-0.789	-1.313	1.532
6	-0.997	1.085	1.473
7	-0.997	-1.085	1.473
8	1.141	0.734	1.357
9	1.141	-0.734	1.357
10	1.026	0.786	1.292
11	1.026	-0.786	1.292
12	1.110	0.480	1.209
13	1.110	-0.480	1.209
14	1.000	0.000	1.000
15	1.000	0.000	1.000

White Noise Test Results (lag = 4)

Variable	Q	P-val	LM	P-val
Multivar	51.685	0.044	----	----
V1	4.543	0.337	6.584	0.160
V2	13.552	0.009	6.007	0.199
Va3	14.106	0.007	9.460	0.051

HYPOTHESES TESTING

CIRank:	1	AIC:	2274.368
Log-likelihood:	-1093.184	BIC:	2406.245
log(det(Omega_hat)):	6.259	Free parameters:	44

Fractional parameters:

Coefficient	Estimate	Standard error
d	1.000	0.000

CIEq:

Variable	CI equation 1
V1	1.000
V2	4.519
V3	-0.960

Imposed Identifying Restriction.

Variable	CI equation 1
Var 1	-0.262
SE 1	(0.053)
Var 2	0.004
SE 2	(0.005)
Var 3	0.008
SE 3	(0.029)

Long-Run Matrix:

Variable	Var1	Var2	Var3
V1	-0.262	-1.186	0.252
V2	0.004	0.020	-0.004
V3	0.008	0.038	-0.008

Level Parameters:

V1	89.267
SDE 1	(3.999)
V2	-0.177
SDE 2	(0.701)
V3	79.747
SDE 3	(3.070)

Lag Matrix 1:

Variable	V1	V2	V3
V1	0.492	0.894	0.101
SDE 1	(0.063)	(0.742)	(0.134)
V2	0.011	0.481	0.008
SDE 2	(0.006)	(0.075)	(0.014)
V3	0.024	0.299	0.417
SDE 3	(0.03)	(0.410)	(0.074)

Lag Matrix 2

Variable	V1	V2	V3
V1	0.024	1.161	-0.302
SDE 1	(0.074)	(0.764)	(0.148)
V2	-0.017	0.119	-0.001
SDE 2	(0.008)	(0.077)	(0.015)
V3	-0.030	-0.060	0.150
SDE 3	(0.041)	(0.417)	(0.081)

Lag Matrix 3:

Variable	V1	V2	V3
V1	0.249	0.777	0.099
SDE 1	(0.073)	(0.759)	(0.150)
V2	0.039	0.089	0.011
SDE 2	(0.007)	(0.077)	(0.015)
V3	0.065	-0.048	0.109
SDE 3	(0.040)	(0.418)	(0.083)

Lag Matrix 4:

Variable	V1	V2	V3
V1	-0.495	0.149	-0.235
SDE 1	(0.074)	(0.754)	(0.143)
V2	-0.019	-0.436	-0.002
SDE2	(0.007)	(0.074)	(0.014)
V3	-0.037	0.262	-0.530
SE 3	(0.040)	(0.401)	(0.077)

Roots of the characteristic polynomial

Number	Real part	Imaginary part	Modulus
1	-0.960	1.015	1.397
2	-0.960	-1.015	1.397
3	1.291	0.000	1.291
4	-0.809	0.907	1.215
5	-0.809	-0.907	1.215
6	-0.674	0.945	1.161
7	-0.674	-0.945	1.161
8	0.916	0.627	1.110
9	0.916	-0.627	1.110
10	0.950	0.558	1.101
11	0.950	-0.558	1.101

12	0.835	0.708	1.094
13	0.835	-0.708	1.094
14	1.000	0.000	1.000
15	1.000	0.000	1.000

White Noise Test Results (lag = 4)

Variable	Q	P-val	LM	P-val
Multivar	61.013	0.006	----	----
Var1	5.213	0.266	10.016	0.040
Var2	24.127	0.000	12.623	0.013
Var3	19.822	0.001	14.504	0.006

Unrestricted log-likelihood: -1076.713
Restricted log-likelihood: -1093.184
Test results (df = 1):
LR statistic: 32.941
P-value: 0.000

Appendix 2: Money supply model

Lag Selection Results

k	r	d	b	LogL	LR	pv	AIC	BIC	pmvQ	pQ1	pLM1	pQ2	pLM2	pQ3	pLM3
10	1	2.000	2.000	-595.50	-29.52	1.000	1388.99	1685.72	1.00	0.94	1.00	0.31	0.51	0.34	0.78
9	1	1.626	1.626	-580.74	18.72	0.028	1341.48	1611.23	1.00	0.99	1.00	0.51	0.45	0.73	0.92
8	1	1.547	1.547	-590.10	3.99	0.912	1342.19	1584.97	1.00	0.65	0.93	0.49	0.56	0.53	0.94
7	1	1.463	1.463	-592.09	33.44	0.000	1328.18*	1543.98	1.00	0.74	0.95	0.58	0.65	0.54	0.92
6	1	1.710	1.710	-608.81	67.30	0.000	1343.62	1532.44	0.99	0.45	0.80	0.25	0.31	0.52	0.84
5	1	2.000	2.000	-642.46	32.53	0.000	1392.92	1554.77	0.00	0.59	0.89	0.00	0.00	0.00	0.28
4	1	1.658	1.658	-658.73	13.65	0.135	1407.45	1542.33	0.04	0.16	0.72	0.00	0.00	0.03	0.48
3	1	1.640	1.640	-665.55	91.82	0.000	1403.11	1511.01	0.01	0.16	0.64	0.00	0.00	0.02	0.41
2	1	2.000	2.000	-711.46	29.78	0.000	1476.92	1557.85	0.00	0.00	0.45	0.00	0.00	0.00	0.09
1	1	1.622	1.622	-726.35	3.64	0.934	1488.70	1542.65	0.00	0.00	0.55	0.00	0.00	0.00	0.27
0	1	1.652	1.652	-728.17	0.00	0.000	1474.34	1501.31*	0.00	0.00	0.49	0.00	0.00	0.00	0.23

Number of CI Eqs in the model

Likelihood Ratio Tests for Cointegrating Rank

Rank	d	b	Log-likelihood	LR statistic	P-value
0	1.435	1.435	-610.436	45.843	0.009
1	1.463	1.463	-592.089	9.148	0.847
2	1.455	1.455	-589.422	3.815	0.458
3	1.454	1.454	-587.515	----	----

FCVAR Results

Fractional parameters:

Coefficient	Estimate	Standard error
d	0.793	0.038

CI Eqs:

Variable	CI equation 1
V1	1.000
V2	-1.913
V3	1.364

Adjustment Matrix:

Variable	CI Eq 1
V1	-0.295
SDE1	(0.082)
V2	-0.017
SDE2	(0.036)
V3	0.000
SDE3	(0.000)

Long-run matrix:

Variable	V1	V2	V3
V1	-0.295	0.564	-0.402
V2	-0.017	0.033	-0.023
V3	0.000	-0.000	0.000

Level parameters

V1	89.913
SDE 1	(4.64)
V2	78.903
SDE 2	(2.116)
V3	-0.004
SDE 3	(0.028)

Lag matrix 1:

Variable	V1	V2	V3
V1	0.837	-0.152	3.755
SDE 1	(0.134)	(0.263)	(22.825)
V2	0.063	0.924	-0.089
SDE 2	(0.051)	(0.144)	(12.027)
V3	-0.000	0.000	1.152
SDE 3	(0.000)	(0.001)	(0.142)

Lag Matrix 2:

Variable	V1	V2	V3
V1	0.115	-0.835	6.167
SDE 1	(0.155)	(0.358)	(40.148)
V2	-0.030	-0.062	6.055
SDE 2	(0.080)	(0.193)	(20.748)
V3	0.000	0.000	0.054
SDE 3	(0.001)	(0.001)	(0.196)

Lag matrix 3:

Variable	V1	V2	V3
V1	0.311	-0.148	12.950
SDE 1	(0.211)	(0.412)	(47.917)
V2	0.133	-0.131	0.383
SDE 2	(0.102)	(0.210)	(24.644)
V3	-0.001	0.000	-0.060
SDE 3	(0.001)	(0.002)	(0.220)

Lag matrix 4:

Variable	V1	V2	V3
V1	-1.483	-0.793	-12.829
SDE 1	(0.418)	(0.520)	(66.201)
V2	-0.166	-1.723	-51.514
SDE 2	(0.127)	(0.428)	(33.661)
V3	0.000	0.004	-1.266
SDE 3	(0.001)	(0.002)	(0.367)

Lag matrix 5:

Variable	V1	V2	V3
V1	0.588	0.041	28.286
SDE1	(0.493)	(0.737)	(91.148)
V2	0.078	2.250	73.864
SDE2	(0.184)	(0.852)	(51.179)
V3	-0.001	-0.006	1.832
SDE 3	(0.002)	(0.004)	(0.755)

Lag matrix 6:

Variable	V1	V2	V3
V1	1.180	-0.522	-21.523
SDE 1	(0.454)	(1.045)	(116.027)
V2	0.177	-1.025	-12.487
SDE 2	(0.221)	(0.859)	(61.356)
V3	0.000	0.002	-1.021
SDE 3	(0.002)	(0.005)	(0.862)

Lag matrix 7:

Variable	V1	V2	V3
V1	-1.079	-0.830	14.490
SDE 1	(0.426)	(0.847)	(72.857)
V2	-0.201	-0.259	-22.613
SDE 2	(0.165)	(0.457)	(36.876)
V3	-0.001	0.001	0.337
SDE 3	(0.001)	(0.004)	(0.444)

Roots of the characteristic polynomial

Number	Real part	Imaginary part	Modulus
1	2.283	8.356	8.662
2	2.283	-8.356	8.662
3	1.036	0.872	1.354
4	1.036	-0.872	1.354
5	1.159	0.310	1.200
6	1.159	-0.310	1.200
7	-1.175	0.000	1.175
8	0.843	0.765	1.138
9	0.843	-0.765	1.138
10	1.000	0.000	1.000
11	1.000	-0.000	1.000
12	0.559	0.825	0.997
13	0.559	-0.825	0.997
14	0.839	0.466	0.960
15	0.839	-0.466	0.960
16	0.956	0.000	0.956
17	0.593	0.696	0.915
18	0.593	-0.696	0.915
19	-0.617	0.602	0.862
20	-0.617	-0.602	0.862
21	-0.663	0.507	0.835
22	-0.663	-0.507	0.835
23	-0.482	0.659	0.817
24	-0.482	-0.659	0.817

White Noise Test Results (lag = 4)

Variable	Q	P-val	LM	P-val
Multivar	24.749	0.922	----	----
Var1	2.796	0.592	2.519	0.641
Var2	9.718	0.045	5.642	0.228
Var3	6.841	0.145	1.127	0.890

Hypotheses testing for restricted models and long-run exogenous variables

FCVAR: Results (Fractional Parameters)

Coefficient	Estimate	Standard error
d	1.000	0.000

CI Eqs:

Variable	CI equation 1
V1	1.000
V2	-1.830
V3	-5.015

Imposed Identifying restrictions.

Adjustment matrix

Variable	CI equation 1
V1	-0.150
SDE 1	(0.035)
V2	0.036
SDE 2	(0.018)
V3	-0.000
SDE 3	(0.000)

Long-Run Matrix:

Variable	V1	V2	V3
V1	-0.150	0.275	0.753
V2	0.036	-0.067	-0.183
V3	-0.000	0.000	0.000

Level parameter:

V1	94.983
SDE 1	(4.682)
V2	77.856
SDE 2	(2.273)
V3	-0.009
SDE 3	(0.028)

Lag matrix 1:

Variable	V1	V2	V3
V1	0.473	0.188	-5.278
SDE 1	(0.080)	(0.168)	(18.774)
V2	0.036	0.638	-0.814
SDE 2	(0.040)	(0.084)	(9.496)
V3	-0.000	-0.000	0.737
SDE 3	(0.000)	(0.001)	(0.083)

Lag matrix 2:

Variable	Var 1	Var 2	Var 3
V1	0.078	-0.374	4.498
SDE 1	(0.087)	(0.199)	(23.496)
V2	-0.043	0.149	3.158
SDE 2	(0.044)	(0.099)	(11.564)
V3	0.000	0.000	0.236
SDE 3	(0.000)	(0.001)	(0.103)

Lag matrix 3:

Variable	V1	V2	V3
V1	0.171	-0.111	9.036
SDE 1	(0.085)	(0.198)	(22.679)
V2	0.031	0.028	3.081
SDE 2	(0.042)	(0.099)	(11.337)
V3	-0.000	-0.000	0.051
SDE 3	(0.000)	(0.001)	(0.101)

Lag matrix 4

Variable	V1	V2	V3
V1	-0.491	-0.193	-8.336
SDE 1	(0.075)	(0.156)	(22.457)
V2	-0.051	-0.592	-19.388
SDE 2	(0.037)	(0.075)	(10.155)
Var 3	0.000	0.002	-0.474
SE 3	(0.000)	(0.001)	(0.091)

Lag matrix 5:

Variable	V1	V2	V3
V1	-0.097	0.046	4.029
SDE 1	(0.084)	(0.188)	(22.621)
V2	-0.001	0.373	11.139
SDE 2	(0.042)	(0.093)	(11.168)
V3	-0.000	-0.001	0.304
SDE 3	(0.000)	(0.001)	(0.099)

Lag matrix 6:

Variable	V1	V2	V3
V1	0.236	-0.174	-4.350
SDE 1	(0.083)	(0.199)	(22.774)
V2	0.049	0.035	2.559
SDE 2	(0.041)	(0.099)	(11.231)
V3	0.000	-0.000	0.074
SDE 3	(0.000)	(0.001)	(0.101)

Lag matrix 7:

Variable	V1	V2	V3
V1	-0.052	-0.312	-2.622
SDE 1	(0.078)	(0.178)	(18.624)
V2	-0.025	-0.079	-2.255
SDE 2	(0.039)	(0.089)	(9.275)
V3	-0.000	-0.000	-0.015
SDE 3	(0.000)	(0.001)	(0.083)

Roots of the characteristic polynomial

Number	Real part	Imaginary part	Modulus
1	13.094	0.000	13.094
2	-2.882	3.114	4.243
3	-2.882	-3.114	4.243
4	-3.322	0.000	3.322
5	1.524	0.432	1.584
6	1.524	-0.432	1.584
7	-1.524	0.000	1.524
8	1.015	0.822	1.307
9	1.015	-0.822	1.307
10	0.767	0.961	1.230
11	0.767	-0.961	1.230
12	1.135	0.467	1.228
13	1.135	-0.467	1.228
14	-0.765	0.886	1.170
15	-0.765	-0.886	1.170
16	-0.868	0.757	1.152
17	-0.868	-0.757	1.152
18	-0.599	0.921	1.099
19	-0.599	-0.921	1.099
20	0.825	0.719	1.094
21	0.825	-0.719	1.094
22	1.057	0.000	1.057
23	1.000	0.000	1.000
24	1.000	-0.000	1.000

White Noise Test Results (lag = 4)

Variable	Q	P-val	LM	P-val
Multivar	30.231	0.739	----	----
Var1	6.326	0.176	2.491	0.646
Var2	10.704	0.030	5.499	0.240
Var3	6.772	0.148	1.873	0.759

Apendix 3: Selected economic indicators

	2013	2014	2015	2016	2017	2018
(Annual percentage change; unless otherwise indicated)						
National Income and Prices	5.70	4.60	2.80	3.00	8.40	4.80
Agriculture	6.60	0.80	-0.30	-0.5	16.70	10.60
Industry	10.00	5.60	6.30	5.70	4.30	2.70
Services	7.30	4.00	3.80	3.70	8.50	6.30
Real GDP (incl. Oil)	7.30	2.90	2.20	3.40	8.10	6.30
Real GDP (excl. Oil)	6.70	2.70	2.20	4.60	4.60	6.50
Nominal GDP (GHS Billions)	123,650.00	155,433.00	180,399.00	215,077.00	256,671.00	300,596.00
Consumer price index (end of period)						
Overall	13.50	17.00	17.70	15.40	11.80	9.40
Food	7.20	6.80	8.00	9.70	8.00	8.70
Non-food	18.10	23.90	23.30	18.20	13.60	9.80
Exchange rate (end of period)						
GHS/US$	2.20	3.20	3.79	4.20	4.42	4.80
GHS/GBP	3.67	4.98	5.63	5.20	5.97	6.20
GHS/Euro	3.10	3.90	4.15	4.44	5.30	5.50
Money and credit						
Reserve Money	15.10	30.20	24.20	29.60	13.1	4.60
Broad Money Supply (M2)	18.20	33.00	26.60	24.60	19.8	16.10
Broad Money Supply (M2+)	19.10	36.80	26.10	22.00	16.7	15.70
Credit to the private sector	28.60	42.10	24.70	14.70	12.80	11.20
Real credit to the private sector	13.30	21.90	5.90	1.00	0.90	1.10
Interest Rate (%)						
Monetary policy rate	16.00	21.00	26.00	25.50	20.00	17.00
Interbank rate	16.30	23.90	25.30	25.20	19.30	16.10
91-Day treasury bill rate	18.80	25.80	23.10	16.80	13.30	14.60
182-day treasury bill rate	18.80	26.40	24.40	18.50	13.80	15.00
1-year treasury note rate	17.00	22.50	22.75	21.50	15.00	15.00
2-year treasury note rate	16.50	23.00	23.30	22.50	17.50	19.50
Averate lending rate	25.60	29.00	27.50	31.20	29.30	26.90
3-month averate deposit rate	12.50	13.90	13.00	13.00	13.00	11.50
Lending–deposit rate spread	13.10	15.10	14.50	18.20	16.30	15.40
External Sector (Cummulative)						
Exports of Goods and services	13,751.90	13,217.00	10,321.00	11,138.30	13,835.00	14,868.10
Imports of Goods ansd Services	17,600.30	14,600.00	13,465.00	12,920.10	12,647.40	13,089.30
Trade balance (US$M)	-3848	-1383	-3144	-1781.8	1,187.70	1,778.80
Current account balance (US$M)	-5784	-3694.5	-2823.8	-2840.5	-2004.9	-2071.72
% of GDP	-11.9	-9.2	-7.5	-6.5	-4.6	-4
Overall balance of payments (US$M)	-699.2	-86.1	-15.9	247.4	1,091.40	-671.5
Commodity Prices (International)	2,779.00	2,914.00	3,301.00	2,268.40	1,904.60	2,256.30
Cocoa ($/tonne)	1,223.00	1,199.00	1,069.00	1,151.20	1,266.60	1,251.10
Gold ($/ounce)	110.60	64.80	38.90	54.90	64.30	57.70
Crude oil ($/barrel)						
Gross Foreign Assets (US$M)	5,632.20	5,461.00	5,885.00	6,161.60	7,554.80	7,024.80
months of imports coveer	3.60	3.80	3.50	3.50	4.30	3.60
Gross international reserves (US$M)	5,550.00	4,360.00	4,403.00	4,862.00	5,491.00	5,317.20
months of imports coveer	3.00	2.50	2.60	2.80	3.10	2.70
Net international reserves (US$M)	3,286.00	3,199.00	3,094.00	3,431.00	4,522.50	3,851.00
External debts (US$M)	11,902.00	13,871.80	15,781.90	16,461.00	17,160.40	17,895.30
Government Budget (% of GDP)						
Domestic revenue	15.20	15.40	16.30	15.10	15.60	15.50
Grants	0.60	1.00	0.50	0.60	0.40	0.40
Total expenditure	22.10	20.60	20.70	23.80	20.30	19.40
Overall balance (including divestiture)	-7.5	-7.4	-5.2	-6.1	-4.8	-3.9
Domestic primary balance	-0.2	2.30	3.10	0.40	2.70	2.30