

UNIVERSITY OF GHANA
COLLEGE OF HUMANITIES



MONETARY POLICY TRANSMISSION MECHANISM AND
INFLATION TARGETING IN GHANA

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LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR
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DECLARATION

I declare that this thesis is my own work produced from research undertaken under the supervision of Dr. Alfred Barimah and Prof. Amoah Baah-Nuakoh at the Department of Economics, University of Ghana, Legon.

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ABSTRACT

The primary objective of the study is to assess the effectiveness of the monetary policy rate and the transmission mechanism under the current inflation targeting regime in Ghana. This study shows, in particular, the importance of fiscal dominance on the effectiveness of monetary policy and the role of the four transmission variables in explaining inflation in Ghana. We trace out the eventual effect of the policy rate on the economy; assess the role of the four transmission variables; and assess the separate and combined effects of supply (oil) shocks and fiscal dominance on the effectiveness of monetary policy. Following Bernanke and Blinder (1992) and Sims (1992), this study identifies the monetary policy rate as the direct measure of monetary policy and assumes it is affected by economic variables with a lag whilst affecting all other variables contemporaneously. Therefore, the policy rate and inflation are ordered first and last respectively. This enables us to measure the true structural effects of monetary policy changes and uncover the transmission mechanism without specifying an explicit structural model.

We show that fiscal dominance significantly hampers the effectiveness of the policy rate whilst a supply shock renders the policy rate ineffective. We also provide evidence consistent with the view that the monetary policy rate is ineffective in the presence of both supply shocks and fiscal dominance. The two dominant transmission channels are the asset price and exchange rate channels with the latter being the most dominant channel. Our conclusions are robust to alternative Cholesky orderings. Finally, we observed that the two wholesale interest rates (treasury bill and interbank interest rates) are superior to the policy rate; an indication of weak policy credibility. We recommend that additional measures should be implemented to further deepen the financial system and improve financial intermediation in order to improve the transmission process. Also, foreign exchange earnings and retention should be enhanced to manage the exchange rate. New research can be conducted using an explicit structural model among others.

DEDICATION

This thesis is dedicated to my entire family.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
ERP	Economic Recovery Programme
FEVD	Forecast Error Variance Decompositions
FINSAP	Financial Sector Adjustment Programmes
FINSSP	Financial Sector Strategic Plan
FPE	Final Prediction Error Criterion
GDP	Gross Domestic Product
HIPC	Highly Indebted Poor Country
HQ	Hannan-Quinn Criterion
IMF	International Monetary Fund
IRFs	Impulse Responses Functions
LBVAR	Large Bayesian Vector Autoregressive
LR	Sequential modified LR test statistic
MPC	Monetary Policy Committee
OECD	Organisation of Economic Cooperation and Development
PP	Philip & Perron Test
SAP	Structural Adjustment Programme
SC	Schwarz Criterion
SVAR	Structural Vector Autoregression
SVECM	Structural Vector Error Correction Model
VAR	Vector Autoregression
VECM	Vector Error Correction Model
VECMX	Vector Error Correction Model with exogenous variable

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

One of the most topical issues in macroeconomics is the question of whether monetary policy affects the real sector economy and if so, what are the transmission channels through which these effects take place? According to Bernanke and Blinder (1992), this is one of the most important and controversial issues in macroeconomics. Basically, there are three main ultimate goals (objectives) of macroeconomic policy and these have been referred to, in the literature, as “Holy Trinity”. These are: economic growth, price stability, and low unemployment. In general, there is a consensus among economists that the “long-run objective of monetary policy must be price stability” (Friedman, 1982, p.100). In fact, the pursuit of price stability, as the preferred macroeconomic goal, has become necessary for many countries because of the following reasons: firstly, there is difficulty in achieving the other macroeconomic goals (Friedman, 1982); secondly, inflation is costly since it affects economic efficiency and growth; thirdly, it is generally accepted that, in the long run, monetary policy only affects the inflation rate; fourthly, it provides an important conceptual framework in the overall framework of policy making by serving as a “nominal anchor” (Bernanke, Laubach, Mishkin, & Posen 2001); and lastly, price stability produces better economic outcomes (Mishkin 1997).

According to Svensson (1999), price stability has been interpreted, in practice, to mean low and stable inflation. Among the various strategies for controlling inflation and achieving the ultimate objective of price stability, inflation targeting is now regarded as a superior monetary policy strategy. Inflation targeting can be simply defined as a monetary policy strategy, which involves the setting of low and stable inflation as the primary macroeconomic goal. Mishkin (2000, p.

105), argues that “inflation targeting is a monetary-policy strategy that encompasses five main elements:

- (i) the public announcement of medium-term numerical targets for inflation;
- (ii) an institutional commitment to price stability as the primary goal of monetary policy, to which other goals are subordinated;
- (iii) an information-inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments;
- (iv) increased transparency of the monetary-policy strategy through communication with the public and the markets about the plans, objectives, and decisions of the monetary authorities; and
- (v) increased accountability of the central bank for attaining its inflation objectives”.

In order for an inflation targeting framework to be successfully and effectively implemented, there are certain preconditions which have to be satisfied. Masson, Savastano, and Sharma (1997) identify them as: the ability of a monetary authority to independently conduct monetary policy free of fiscal dominance or a commitment to another nominal anchor, and that there should be in existence a quantitative framework, which links monetary policy instruments to inflation.

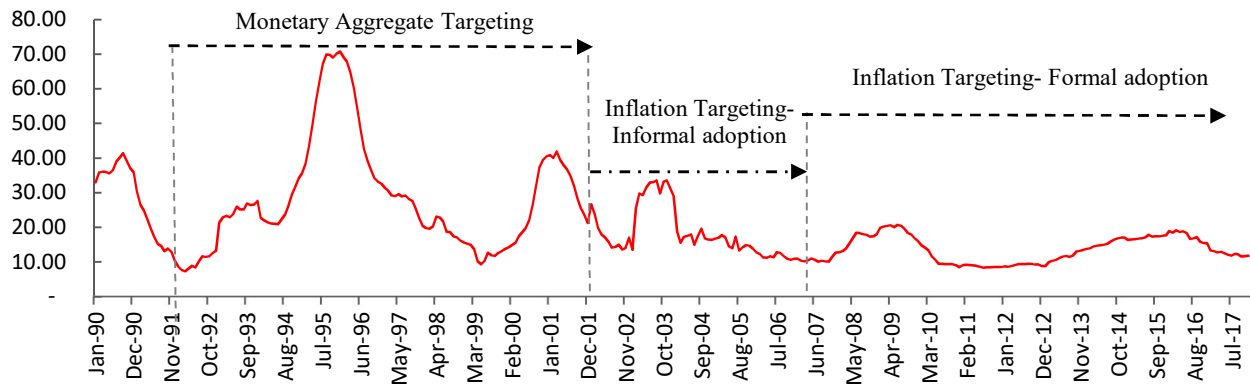
The basic premise for an inflation targeting framework is that the primary and overriding long-term goal of monetary policy is price stability; that is, attainment and preservation of low and stable inflation (Masson et al. 1997). However, Bernanke and Woodford (1997) argues that because the impact of monetary policy on inflation happens with a lag of uncertain duration and with variable strength, an effective monetary policy should be guided by forecasts of inflation itself, together with several other useful information.

It is generally accepted that monetary policy significantly affects economic variables such as economic growth and prices, even in the short-run. Nevertheless, there is an imperfect understanding on the nature and/or size of these effects and less agreement on how the effects of monetary policy is exerted on the economy. “To a large extent, empirical analysis of the effects of monetary policy has treated the monetary transmission mechanism itself as a black box.” (Bernanke and Gertler, 1995, p. 27).

It has been argued that there is a direct relationship between the effectiveness of monetary policy transmission and the effectiveness of monetary policy. The implication of this is that, without an effective transmission mechanism, monetary policy cannot have the desired impact on the economy. Therefore, according to Mishkin (1995, p.4), “to be successful in conducting monetary policy, the monetary authorities must have an accurate assessment of the timing and effect of their policies on the economy, thus requiring an understanding of the mechanisms through which monetary policy affects the economy”.

Many countries are now shifting to an inflation targeting regime; in 1990, New Zealand adopted an inflation targeting regime and by the end of the year 2010, approximately twenty (25) countries, both industrialized and non-industrialized countries had adopted the new policy with good success (Svensson, 2011). In Africa: Ghana, South Africa, and Uganda are the only African countries who have formally adopted an inflation targeting regime (Berg and Portillo, 2018). However, before the informal adoption of inflation targeting in 2002 and the subsequent formal adoption in May 2007, Ghana experienced high and variability in inflation rates. In an attempt to tame inflation, various strategies such as monetary aggregate targeting were implemented in 1992. However, inflation rates have relatively declined after the adoption of inflation targeting in Ghana. See Figure 1 for a pictorial view of the adoption of monetary targeting, informal and formal adoption of inflation targeting, and the inflation outturn since 1990.

Figure 1: Inflation Outturn (% , 1990M01-2017M12)

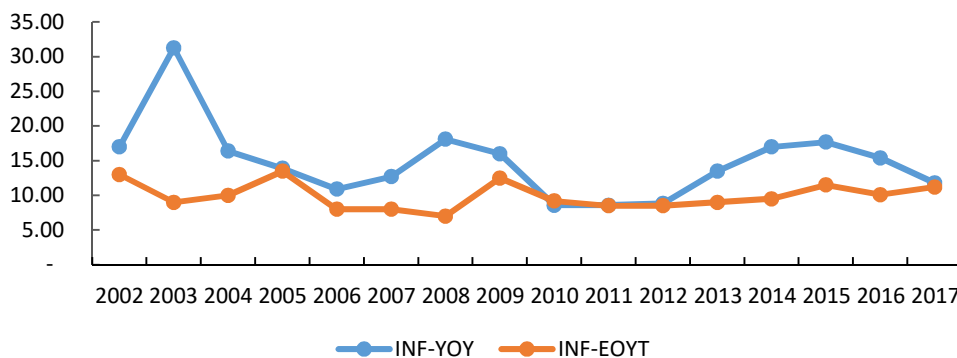


Source: Bank of Ghana

From a high of 41.40% in September 1990, inflation fell to 7.30% in March 1992 before rising to 70.80% in December 1995. Inflation declined to 9.40% in May 1999, but rose to 41.90% by end of March 2001. In June 2010, inflation declined to 9.50% and remained at single digit until the end of January 2013, after which it rose to 15.40% in December 2016 and ended the year ending December 31, 2017 at 11.8%.

Notwithstanding the relative decline in inflation after the adoption of the new policy regime, the Bank of Ghana has consistently and significantly missed its end of year inflation targets (INF - EOYT) eleven (11) times or 69% of the time (i.e., after taking into consideration the maximum tolerable variance of ± 2).

Figure 2: Actual Inflation vs. Inflation Targets (% , 2002-2017)



Sources: Bank of Ghana and Ministry of Finance

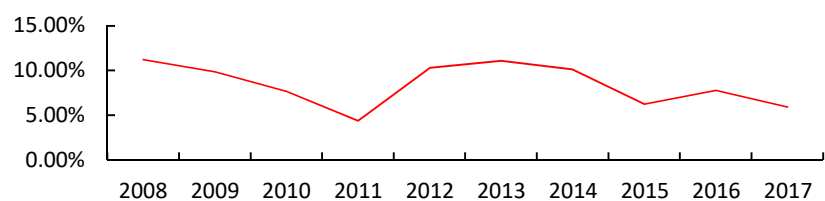
Therefore, these have led to debates on the effectiveness of the inflation targeting regime. Some economists have attributed the ineffectiveness of monetary policy to the following: relatively weak monetary policy transmission in Ghana; presence of fiscal dominance; and vulnerability of the economy to supply (oil price) shocks among others.

1.2 Statement of problem

It has been argued by Akosah (2015) that there is evidence to show that inflation rates in Ghana have been relatively higher than other sub-Saharan African countries and most African countries in general. Also, inflation rates have been variable and periodically high despite the implementation of the inflation targeting regime.

According to Alich, Clinton, Dagher, Kamenik, Laxton and Mills (2009), some of the preconditions, which need to be addressed by Ghana, for a successful and an effective implementation of an inflation targeting regime still persist. Some of these preconditions are: liability dollarization, fiscal dominance, financial dominance, and external dominance. In addition to the above, additional factors affecting inflation targeting in Ghana have been identified as: entrenched inflation inertia in wage setting, unstable inflationary expectation and vulnerability to supply shocks among others.

Figure 3: Overall Fiscal Deficit (% of GDP, 2008-2017)

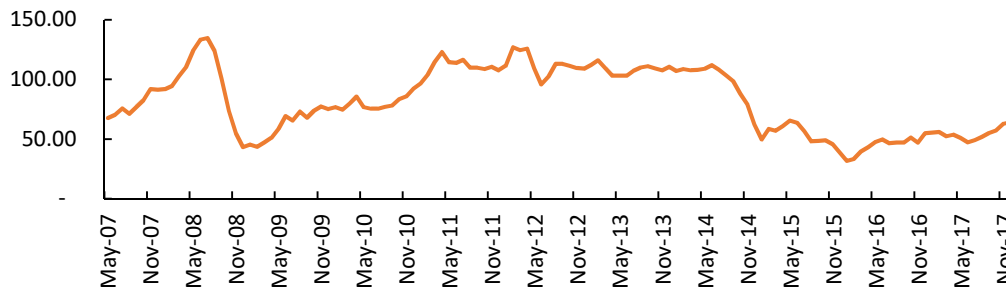


Source: Ministry of Finance, Ghana

Fiscal dominance in Ghana has been prevalent and this affects the effectiveness of monetary policy. Figure 3 shows fiscal deficit as a percentage of gross domestic product reaching double digits in 2008 (11.21%), 2012 (10.29%), 2013 (11.07%), and 2014 (10.11%).

Also, external shocks such as the price of crude oil have adverse effects on the economy causing cost-push inflation and affecting the potency of monetary policy. Figure 4 illustrates the volatility in crude oil prices over the period May 2008 – December 2017.

Figure 4: Brent Crude Oil Prices (May 2008- Dec. 2017)



Source: Bank of Ghana

Price of Brent crude oil rose to \$134.79 in July 2008, before falling to \$ 43.29 in December 2008. It rose to \$ 126.96 in February 2012 but declined to \$ 31.93 in January 2016, before rising to \$ 64.27 by the end of December 2017.

Aliche et al. (2009) and Kwakye (2010) argue that the transmission mechanism has been weak, with Kwakye (2010) attributing it to the fact that there is low financial intermediation and depth. Akosah (2015) states that there is a lack of financial system development and depth, coupled with very little secondary market and high non-banked population, all negatively impacting the effectiveness of monetary policy transmission in the country.

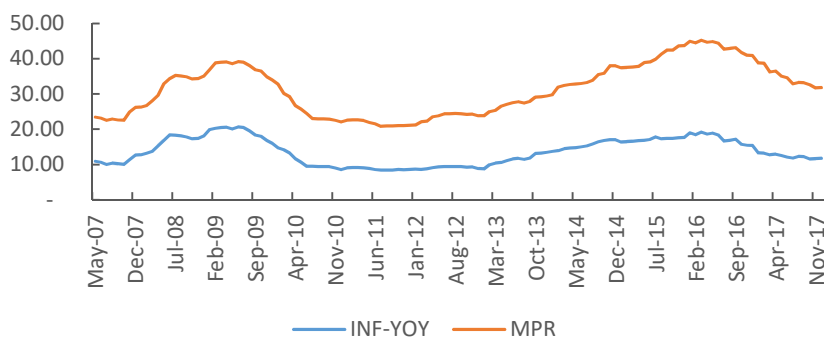
These issues have resulted in considerable interest or debates in respect of the appropriateness or effectiveness of monetary policy measures taken under the inflation targeting regime, taking into consideration the causes of inflation, management of inflation, and the monetary policy transmission mechanism in the country. Kwakye (2013) argues that the recent disinflation experienced cannot be entirely attributed to the adoption of inflation targeting since other factors, such as: lower global inflation after the 2007-2008 financial crises, lower food inflation,

subsidies, and close management of the exchange rate, all contributed to the relatively low inflation. According to Fosu (2015), who cited Amartey (2014), even the fall may just be a coincidence since low inflation levels had been consistently achieved before the initial implementation of the inflation targeting regime in 2002 and its official adoption in May 2007.

Although single digit inflation was achieved consecutively over a period of thirty-two (32) months, that is, from the month of June 2010 to January 2013 (Figure 1), the question still remains as to whether the low inflation was because of good policy, good luck or just a coincidence (Akosah, 2015).

Economic theory stipulates a dual-causality relationship between the monetary policy rate and inflation; monetary policy is expected to affect inflation even in the short-run whilst inflation is also expected to affect the policy rate via the fisher effect. The existence of this relationship is also partly due to the fact that monetary authorities react to inflation. Figure 5 (below) illustrates this relationship for Ghana for the period of May 2007 to December 2017.

Figure 5: Inflation and Policy Rate Outturns (% , May 2007- December 2017)



Source: Bank of Ghana and Author's estimates

Using the inflation and monetary policy data for the period of May 2007 to December 2017, the computed correlation coefficient is 0.66. This provides evidence of a strong positive correlation hence confirming the graphical relationship in Figure 5 and consistent with economic theory.

Kwakye (2013) argues that although a lot of studies have been done on the causes of inflation in Ghana, not much has been done in respect of the management of inflation, whilst Akosah (2015) argues that not much empirical work has been done on the monetary policy transmission mechanism in the country. Also, not much attention has been devoted to the study of the monetary policy transmission mechanism under the current inflation targeting regime in Ghana especially with regards to the role of fiscal dominance on the effectiveness of monetary policy. Finally, the contributions of the four transmission variables in explaining inflation in Ghana, have not been thoroughly studied.

Most of the research conducted so far on the effectiveness of inflation targeting in Ghana have been primarily limited to assessing the effectiveness of inflation targeting adoption on inflation and the economy in general. These previous studies looked at the pre and post inflation targeting adoption periods and then used a dummy variable to represent the adoption of an inflation targeting regime. The use of a dummy variable enables the determination of whether the impact of inflation targeting has been positive or negative. Kyereboah-Coleman (2012), Ayisi (2013), Puni, Osei, and Barnor (2014), and Fosu (2015).

In respect of the monetary policy transmission mechanism in Ghana, the notable studies include Abradu-Otoo, Amoah, and Bawumia (2003), Kovanen (2011), CEPA (2012), and Akosah (2015). In particular, Abradu-Otoo et al. (2003) employ a Structural Vector Error Correction Model (SVECM) to investigate the monetary policy transmission mechanisms in Ghana. In their structural model, they consider the following variables: inflation, output, credit to private sector, treasury bill, exchange rate, money supply, and oil prices in Ghana. They find that there is evidence of monetary policy affecting inflation in the long run, with a stronger exchange rate channel as the main channel.

Using a two-stage approach, Akosah (2015) examines the effectiveness of the transmission mechanism covering the period 2002-2014. First, by assessing the impact of the policy rate on wholesale money market (i.e., interbank interest and treasury bill rates) and retail interest rates using a Vector Error Correction Model (VECM), Granger Causality and Impulse Responses Functions (IRFs). Second, he investigates, in a single model, the important transmission channels and how monetary policy responds to and influences macroeconomic shocks by employing a Structural Vector Autoregression Model (SVAR). This second stage incorporated the monetary policy rate, four intermediate transmission variables (lending rate, exchange rate, credit, and asset price), two target variables (inflation and output), and oil price, but excluded the two wholesale interest rates.

In the first model, Akosah shows that the policy rate influences the two wholesale interest rates and that the treasury bill rate plays a very important role in the interest rate transmission process. The second model provided evidence of monetary policy affecting inflation in the long run through the interest rate channel, but with a stronger exchange rate channel in the short term. Surprisingly, he also finds that inflation initially rises after a positive shock or innovation in the monetary policy rate. Therefore, he concludes that this may be an indication that the country may not yet be successful at targeting inflation and/or may reflect the existence of a “*price puzzle*” phenomenon.

It is very imperative to study the effectiveness of monetary policy in Ghana within the context of the existing inflation targeting regime. This study seeks to assess the effectiveness of monetary policy and the transmission mechanisms in Ghana after the official implementation of the new monetary policy framework. This study is different in a number of ways; first, unlike Akosah (2015) who uses two different models in a two-stage approach, this study will, in a single model, combine all the variables. Therefore, the policy rate, treasury bill rate, interbank interest rate,

exchange rate, private sector credit, lending rate, asset price, output and inflation will all be included in one model. To our knowledge, this will be the first attempt at combining all the stages of the monetary transmission mechanism and their interactions with the real economy in a single model for Ghana.

Second, oil price is included to represent supply or external shock to the system since one of the additional factors affecting inflation targeting in Ghana is the vulnerability of the economy to supply shocks among others (Alichu et al., 2009), Third, this study will also include fiscal deficits as an additional external shock to the system. This is because, one of the preconditions for an effective inflation targeting regime is that monetary policy should not be constrained by fiscal dominance (Mason et al. 1997). Therefore, fiscal deficit will be included to assess its impact on the effectiveness of monetary policy under the current inflation targeting regime.

Finally, this study adopts a methodology, which is consistent with Bernanke and Blinder (1992), and Sims (1992). The study then uses Granger Causality (Block Exogeneity) Tests, Impulse Responses Functions and Forecast Error Variance Decompositions to enable it trace out the dynamic structural effects of the monetary policy rate on inflation and uncover the transmission mechanisms through which these effects take place, without specifying an explicit structural model.

In sum, this study is more comprehensive than Akosah (2015) who uses a two-stage approach, which can be classified as partial analysis. Unlike Akosah (2015), the study will also include fiscal deficits as an additional exogenous variable to ascertain the impact of fiscal dominance on the effectiveness of monetary policy in Ghana within the context of the existing inflation targeting regime. Finally, to determine the effectiveness of the policy rate, the study will assess if the policy rate influences the monetary policy transmission variables and inflation. To

determine the dominant transmission channels, the study will assess the contributions of the four transmission variables in explaining inflation.

1.3 Research Questions

The following research questions arise from the research problems identified above:

1. Does the monetary policy rate impact inflation?
2. What are dominant channels of monetary policy?
3. What is the impact of supply shock on the policy rate and the transmission mechanism?
4. What is the effect of fiscal dominance on the policy rate and the transmission mechanism?
5. What is the combined effect of supply shocks and fiscal dominance on the policy rate and transmission mechanism?

1.4 Objectives of the study

The primary objective of the study is to assess the effectiveness of the monetary policy transmission mechanism in Ghana. Specifically, the study seeks:

1. To investigate the impact of monetary policy rate on inflation,
2. To determine the dominant monetary policy transmission mechanism,
3. To assess the impact of supply shocks on the policy rate and transmission mechanism,
4. To assess the effect of fiscal dominance on the policy rate and transmission mechanism,
and
5. To assess the combined effect of supply shocks and fiscal dominance on the policy rate and transmission mechanism.

1.5 Scope of the Study

This study focuses on the effectiveness of the transmission mechanism and inflation targeting for the period starting May 2007 and ending December 2017. This study includes the following variables in a single model: monetary policy rate, interbank interest rate, 91-day treasury bill rate, lending rate, exchange rate, private sector credit, asset prices, output, inflation, crude oil prices, and fiscal deficits.

1.6 Organisation of the Study

The study is structured into six chapters as follows: Chapter one is the introduction which contains the following: background to the study, statement of problem, objectives of the study, research questions, motivation for the study, and the scope of the study. Chapter two contains the literature review. This relates to the theoretical and empirical review on both inflation targeting and monetary policy transmission mechanisms in general. Chapter three looks at an overview of inflation targeting and monetary transmission mechanism in Ghana whilst chapter four deals with the methodology. Chapter five deals with the presentation of results, analysis and discussion of those results. The final Chapter contains the summary of the study, conclusions, and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature review section is divided into main two parts. The first section contains a theoretical review on monetary policy, inflation targeting strategy, and the monetary policy transmission mechanism. The second section contains a review of empirical literature on the inflation targeting strategy and the monetary policy transmission mechanism.

2.2 Monetary Policy

2.2.1 Introduction

Monetary policy entails the setting of an ultimate policy objective, proximate targets, and the policy instruments that can be used to achieve the targets and ultimately the policy objective. Friedman (1968, p.13-14) states that monetary policy, in theory and practice, seeks to play an essential role because it: “*can prevent money itself from being a major source of economic disturbance*”, provide a stable macroeconomic environment; and “*contribute to offsetting major disturbances in the economic system arising from other sources.*” Monetary policy can be effective if monetary authorities ensure the following: first, they focus on objectives they can achieve and targets they can control and not the ones they cannot. Second, avoid swings in monetary policy, by publicly adopting their policy objectives and targets (Friedman, 1968).

2.2.2 Strategies

The ultimate goals of macroeconomic policy are: economic growth, price stability, full employment or low unemployment, exchange rate and financial system stability among others. According to Friedman (1982), experience and not theory has demonstrated that it is not feasible

to attain either full employment or economic growth, so he concludes that the long-term “*objective of monetary policy should be price stability.*” He states that this is because monetary policy affects economic variables with “*long and variable lags*” making it difficult for activist monetary policies aimed at promoting employment and/or economic growth. Friedman (1968) argues further that, contrary to the well-celebrated Philips curve theory, there is no long run trade-off between inflation and unemployment. According to him, if there is any relationship at all, it rather goes the other way, that is, a positive relationship and not a negative one. In his view, inflation results in economic inefficiency and inhibits growth; that is, an increase in inflation may rather cause an increase in unemployment in the long-run since it inhibits economic efficiency and economic growth.

“To state this conclusion differently, there is always a temporary trade-off between inflation and unemployment; there is no permanent trade-off. The temporary trade-off comes not from inflation per se, but from unanticipated inflation, which generally means, from a rising rate of inflation. The widespread belief that there is a permanent trade-off is a sophisticated version of the confusion between high and rising that we all recognize in simpler forms. A rising rate of inflation may reduce unemployment, a high rate will not” (Friedman, 1968, p. 11).

Bernanke et al. (2001) confirms Friedman’s (1982) position that price stability should be the ultimate objective by stating that the main reason for pursuing price stability as the primary and overriding long-term goal for monetary policy rests on three arguments. First, in the long-run, monetary policy affects only the inflation rate with no permanent effects on real variables such as output and unemployment. Therefore, any deliberate attempt at reducing unemployment in the short-run through the use of monetary policy might not be desirable since it can rather lead to higher inflation and not lower unemployment. Second, inflation can be harmful to the economy by affecting economic efficiency and growth.

However, price stability is necessary for the achievement of other macroeconomic goals such as higher economic output and growth. Third, price stability provides a key conceptual framework in the overall framework of policy making by effectively serving as a “*nominal anchor*” for monetary policy. Finally, Mishkin (1997) argues that “price stability is the appropriate overriding, long-run goal of monetary policy because it will produce better economic outcomes.”

Svensson (1999) states that price stability can also be defined as stability in the price-level, that is, a situation where there is low inflation and the price level is stationary. He indicates, however, that in practice, price stability “has often been interpreted as low and stable inflation.”

2.2.3 Tactics

The proximate targets and the policy instruments or tools that can be used to ultimately achieve the policy objective have been referred as “*Tactics*” (Friedman (1982). He also states that one fundamental issue is whether monetary policy should follow rules publicly promulgated or allow monetary authorities the discretion to conduct monetary policy. According to Friedman (1982), whatever the approach adopted, monetary authorities may adopt any of the following in their pursuit of price stability: interest rates (monetary conditions) as a target and also as an instrument, and monetary aggregates as a target with money market conditions or interest rates or control over the monetary base as instruments.

Friedman (1968) argues that out of the several magnitudes that monetary authorities can control, the best option should be the price level, which is defined by an appropriate index. But he states that this is hampered by the fact that the relationship between monetary policy actions and price level is indirect unlike the link between any of the monetary aggregates and the price level. He further argued that the impact of monetary policy on the price level takes a longer time than the time it takes to affect any of the monetary aggregates. According to him, even this time lag and

magnitude of the impact may vary depending on the circumstances. Therefore, he concludes that based on present knowledge or understanding of monetary phenomenon, the best option is the use of a monetary aggregate since the underlying theory is the quantity theory of money.

According to Mishkin (1997), however, central banks have used four main strategies to control inflation in practice and these are: exchange rate, monetary aggregate and inflation targeting, and finally the “just do it” strategy even though the price level and national growth income has also been suggested in the literature. Nonetheless, Bernanke and Mishkin (1997) argue that the relationship between intermediates like growth in money supply and inflation has become unreliable as a result of “velocity instability” hence more countries are dropping intermediate targets such as monetary aggregate targeting and directly targeting a goal variable.

It must be stated that monetary authorities cannot directly achieve macroeconomic goals using the instruments available to them; the instruments are expected to affect the operating and intermediate targets before ultimately impacting the goal variable. Among the instruments available are: discount rate, open market operations, reserve requirements, and the overnight interbank interest rates. The literature currently favours the following two main target goals: the inflation rate (or the price level) or output and a consensus that the two main operating or intermediate targets should be interest rates and monetary aggregates. A target variable is “one whose value the policy maker wants to change. An operating target variable is one on which the central bank can directly or almost directly operate through the instruments at its disposal.” (Handa, 2009, p. 307).

On a balance of costs and benefits, inflation targeting is generally considered superior to all the other alternatives. Therefore, there is a move towards the inflation targeting regime by many countries as the most appropriate monetary policy tool.

2.3 Inflation Targeting Strategy

2.3.1 Introduction

Inflation targeting is a monetary policy strategy, which involves the setting of price stability (low and stable inflation) as the primary long-term macroeconomic goal. Other economic goals such as employment and economic growth are subservient to the primary objective though they may be monitored and sometimes accommodated. As a result of this, it is argued that inflation targeting should not be regarded as an “*ironclad policy*” but rather a “*constrained discretionary*” monetary policy framework that can accommodate other objectives.

It is generally assumed that rules prevent inflationary bias inherent in discretionary monetary policy. Inflation bias is generally associated with the policy credibility (time inconsistency or dynamic) problem (Bernanke et al. 2001 and Bernanke & Mishkin, 1997). Therefore, inflation targeting is a “*rough compromise*” between rules and discretionary monetary policies, hence minimises the dynamic inconsistency problem. Yet, when there is a conflict between the objectives, the primary objective of price stability takes precedence.

“The hallmark of inflation targeting is the announcement by the government, the central bank, or some combination of the two that in the future the central bank will strive to hold inflation at or near some numerically specified level” and “that associated with the announcement of inflation targets, there is usually some statement to the effect that control of inflation is the primary or overriding goal of monetary policy and that the central bank will be held accountable for meeting the inflation targets”. (Bernanke & Mishkin, 1997, p. 98 & 100).

However, the degree of accountability varies - ranging from tying the tenure of a governor to achieving the inflation targets to implicit institutional and personal costs (lost reputation). Again, they argue that although the primary and overriding objective is price stability, central bankers can accommodate other objectives or short-run stabilisation policies such as output and exchange rate by: first, setting the inflation target as a range instead of point target; second, defining the

price index for the target to exclude or minimise the effects of supply shocks; third, adjusting the target to accommodate supply shocks; or lastly, suspending or modifying the inflation target in response to adverse supply or exogenous shocks.

Svensson (2011) argues that inflation targeting regime can also be considered as an optimal monetary policy strategy since it is a very comprehensive policy framework that ensures the following: a very clear price stability objective mandate that is publicly announced, independence of monetary authority, accountability and transparency, a framework and proper decision making process, which takes into account all available but relevant economic information and makes very good use of theoretical, as well as empirical methods and sound judgements.

Unlike a standard textbook optimal model, which sets up an optimisation model with the objective of maximising an objective function with the policy rate being a function of current economy conditions, the objective function in the case of inflation targeting is the objective function of the inflation targeting regime, which could be the minimisation of a loss function. Again, unlike a standard textbook optimal model, inflation targeting makes great use of forecasts, which is not dominant in a standard model. Lastly, the model is not mechanical in nature, which means it is not based on rules but rather on “constrained discretion.”

2.3.2 Premise for Inflation Targeting

Masson et al. (1997, p. 5) argue that the basic premise for inflation targeting is that the primary long-term goal of monetary policy is the attainment and preservation of low and stable inflation. According to him, this premise is supported by four main propositions or theories:

(1) “An increase in the money supply is neutral in the medium to long run; i.e., a monetary expansion has lasting effects only on the price level, not on output or unemployment.”

(2) “Inflation is costly, either in terms of resource allocation (efficiency costs) or in terms of long-run output growth (breakdown of supemeutrality), or both.”

(3) “Money is not neutral in the short run; i.e., monetary policy has important transitory effects on a number of real variables such as output and unemployment. There is, however, at best an imperfect understanding of the nature and/or size of these effects, of the horizon over which they manifest themselves and of the mechanisms through which monetary impulses are transmitted to the rest of the economy.! And, a corollary of”

(4) “Monetary policy affects the rate of inflation with lags of uncertain duration and with variable strength, which undermine the central bank's ability to control inflation on a period-by-period basis.”

2.3.3 Prerequisites

The preconditions for the adoption of inflation targeting are that, the monetary authorities should be independent in the conduct of monetary policy (including the choice of monetary policy). Finally, there should be a quantitative model for linking monetary policy instruments to inflation (Mason et al. 1997).

In principle, full independence is not required as what is necessary is: independence in choosing and deploying monetary policy instruments in achieving the ultimate policy objective. Therefore, independence in respect of the setting of the ultimate goal is not required.

However, this independence should not be constrained by fiscal dominance or commitment to any other policy objective or nominal anchor. This is because, in the presence of fiscal dominance, the central bank cannot freely and independently choose policy instruments. Fiscal issues such as low government revenue, high public sector domestic borrowing, seigniorage, and

high public debt impact or expose the economy to inflationary pressures. Also, fiscal dominance undermines the effectiveness of monetary policy in achieving its targets and compels the monetary authorities to be accommodative.

Independence is important because it encourages monetary authorities to focus on long-run objectives, such as price stability, instead of short-term objectives. This minimises the time inconsistency problem which “stems from the view that economic behaviour is influenced by expectations of future policy”. Time inconsistency problem leads to suboptimal behaviour by monetary policy makers who think they are operating optimally. That is, it results in higher than necessary inflation at a given output or economic growth (*inflation bias*). It is argued by Mishkin (1997) that one major source of time inconsistency and inflationary bias is pressure exerted by politicians who normally have short term objectives and are focused on the next election. According to Mishkin (1997) who cited Posen (1995), there is also evidence that independence results in better macroeconomic performance such as low inflation although it does not mean there is causality between the two.

2.3.4 Features

Inflation targeting is characterised by an announcement of an official target and explicit acknowledgement that price stability is the primary goal of monetary policy. It is further characterised by increased communication in respect of the plans and objectives of the central bank, and increased accountability for achieving set objectives (Bernanke & Mishkin, 1997).

“Inflation targeting is a monetary-policy strategy that encompasses five main elements: (i) the public announcement of medium-term numerical targets for inflation; (ii) an institutional commitment to price stability as the primary goal of monetary policy, to which other goals are subordinated; (iii) an information-inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments; (iv) increased transparency of the monetary-policy strategy through communication with the

public and the markets about the plans, objectives, and decisions of the monetary authorities; and (v) increased accountability of the central bank for attaining its inflation objectives.” Mishkin (2000, p. 105).

2.3.5 Inflation Target Regimes

According to Bernanke and Mishkin (1997), different forms of inflation targeting have been implemented by different countries and that countries customize the framework in various ways to suite their circumstances.

Inflation targeting regimes can be categorized into three main groups: full-fledged, electric, and lite regimes. According to Carare and Stone (2003), this categorization is grounded on the “*clarity*” and “*credibility*” of countries central banks commitment to their inflation targets. This classification provides insight into the appropriate monetary policy design subject to the circumstances of each country. Clarity is assessed by the public announcement of the inflation target and having the necessary institutional systems in place to ensure accountability. On the other hand, credibility is empirically related to structural differences and measured using the actual performance in terms of actual inflation figures and the ratings of long-term government debt (dominated in local currency) by the market.

2.3.5.1 Full-fledged inflation targeting

The most popular inflation targeting regime is the full-fledged inflation targeting regime. To be classified under this category, the level of a country’s credibility should be medium to high. The country should be clearly committed to the inflation target, institutionalise its commitment in terms of a transparent monetary framework that ensures accountability and have discipline of the monetary authority to the inflation target. This regime, if well implemented, will minimise the time inconsistency problem. The first country known to have adopted this regime is New Zealand, and since then, some advanced and emerging countries have adopted this regime.

Structurally, the countries that have adopted this regime are a mix of advanced and emerging economies but they have certain unique features: the gross domestic product (GDP) and GDP per capita are higher than inflation lite regimes but lower than electric regime; improved financial systems; strongest debt-to-GDP ratio - though this may be because of the need for credibility; and little or no central bank financing to their governments.

2.3.5.2 Electric inflation targeting

Economies with an electric regime are seen as ones with very high credibility to the extent that there is no need for setting inflation targets since they have a track record of achieving price stability and financial stability. Such countries already have high transparency and accountability in the conduct of monetary policy and can afford to pursue other objectives such as output stabilisation. The United States of America, Canada and the European Union are among developed economies classified under this category.

Structurally, electric inflation targeting countries are all advanced countries with very high GDP and GDP per capita, large and deep financial systems, relatively higher debt-to-GDP ratio compared with a full-fledged inflation targeting regime, and with little or no central bank financing to their governments.

2.3.5.3 Inflation targeting lite

Inflation targeting lite regimes are normally transitional regimes with low credibility as a result of weak institutional framework, financial instability, and vulnerability to economic shocks. In the presence of low credibility, the country is unable to adopt inflation target as a nominal anchor, but rather announce a broad inflation objective. During these transitional periods, the necessary structural and institutional reforms are implemented. A switch from a lite regime to a full-fledged

regime requires a deeper and broader financial system to help minimise systemic risks and allow the government to obtain most of its funding from the financial market.

These inflation targeting lite regime countries are all emerging countries with the lowest GDP and GDP per capita, weak financial systems, intermediate debt-to-GDP ratio, and with majority of government financing emanating from the central bank.

2.3.6 Inflation Target Measurement

Bernanke and Mishkin (1997) argue that central banks should choose an appropriate inflation measurement series that is accurate, timely and well understood by the public. They further argue that the price index for the inflation target is normally defined to exclude or minimise supply side factors like food, utility and energy prices, interest rate changes, and indirect tax changes among others. Also, policy makers should explain the choice of price index and explain to the public the relationship between the chosen price index and the headline inflation.

It is argued that inflation is difficult to predict even over short-periods. This results in operational and credibility issues for the conduct of monetary policy. These issues make inflation targeting difficult since monetary policy also affects inflation with a lag of uncertain duration and strength. In respect of the second issue of credibility, it is argued that it will be difficult to hold policy makers accountable for non-performance in achieving set targets and building the necessary credibility for the conduct of effective monetary policy since inflation is unpredictable (Bernanke & Mishkin, 1997).

As a result of such unpredictability of inflation, some economists have argued in favour of the use of intermediate targets such as monetary targets and inflation forecasts. Bernanke and Mishkin (1997) argue that, this is only acceptable and may be the preferred strategy if it satisfies the following criteria: contains all the necessary inflation for forecasting inflation, properly controlled

by the monetary authority, well understood by the financial markets and the general public, and strongly and reliably linked to the ultimate goal variable. Svensson (1997) argues that the most appropriate intermediate target to use is the current forecast of inflation itself. Svensson (2011) indicates that inflation targeting is also known as forecast targeting because of the important role inflation forecasts play within an inflation targeting regime. According to him, inflation forecast is very relevant because of the lag between the effect of policy actions on inflation.

Bernanke and Mishkin (1997) state that instead of a single number, inflation target is generally specified as a range. This is partly because the range provides the central bank some level of flexibility in the short run and partly because of lags and uncertainty in the transmission mechanism. In setting the inflation target, they further argue that the inflation rate should not be set too low because of the following reasons: first, the true inflation is normally overstated by official inflation rates, hence even if the inflation rate objective is zero inflation, the actual target should be more than zero.

According to them, the overstatement is due to the failure to account for quality changes and substitutional bias in the fixed-weight index. Second, it is argued that nominal wages are usually rigid downwards hence inflation is a way of introducing flexibility in real wages. Without such flexibility, there will be inefficiencies in the allocation of labour, which negatively affects unemployment. Third, if inflation is set at a very low level, the economy can be easily moved into deflation creating serious problems for the financial system and resulting in economic contraction. Therefore, inflation targets provide a ceiling as well as a floor for the inflation rate hence mitigating the effects of both negative and or positive shocks in aggregate demand.

However, Svensson (2011) states that the typical inflation target for most advanced countries has been set around 2% whilst the rate for other countries, such as the emerging and developing ones, are normally a few percentage points above 2%.

2.3.7 Special Preconditions for Emerging and Developing countries

There are certain conditions that affect inflation targeting in developing countries. Mishkin (2003) and Calvo and Mishkin (2003) identified five essential institutional differences between emerging market economies and advanced economies: fiscal dominance or weak fiscal institutions; financial dominance or weak financial and monetary institutions; low credibility of monetary institutions; liability dollarization; and external dominance or vulnerability of sudden stops in capital inflows. These weaknesses make emerging market economies susceptible to high inflation and currency crises as most of their liabilities are dominated in foreign currency.

In addition to the above, they also identified other issues affecting inflation targeting in emerging market economies. These are: transparency, formality, target bands, responding to shocks, and conditionalities from the IMF. According to them, because of the nature of emerging market economies, the target bands should be wider than advanced countries partly because of higher variability in inflation, though they argue that care must be taken in order not to focus too much on the lower and upper limits of the target band. The focus should rather be on the actual inflation rate and how far it is from the mid-point of the target band. They further argue that monetary policy in emerging countries should be formal and transparent in order for them to build credibility. According to them, emerging market economies also have to respond to bigger external shocks than advanced countries, hence posing a challenge to monetary authorities. Finally, most emerging market economies face loan conditionalities because they obtain loans from the International Monetary Fund. These conditions sometimes have an adverse effect on the conduct of monetary policy.

2.3.8 Advantages and Disadvantages

According to Bernanke and Woodford (1997), inflation targeting as a monetary policy strategy has both merits and drawbacks. One of the advantages is increased transparency of monetary policy, resulting from better communication of plans and objectives to the public and the financial markets. A second advantage is that, by directly targeting the goal variable itself instead of an intermediate indicator, the central bank avoids for example the "*velocity instability*" problem associated with monetary targeting. Bernanke and Mishkin (1997) state that the major advantage is that "*it provides a nominal anchor for policy and the economy,*" "*increased transparency and coherence of monetary policy,*" ensures accountability and discipline, and it is flexible enough to have discretionary monetary policy actions taken.

Inflation targeting strategy enables the monetary authorities to respond to domestic issues and shocks and avoid speculative attacks that are associated with exchange rate targeting. The strategy brings with it increased independence and accountability of monetary authority, hence avoiding or minimizing the time inconsistency trap. It is easily understandable by the public, increases communication and is highly transparent. Also, inflation targeting, unlike monetary targeting, does not require a "*stable relationship between money and inflation*" (Mishkin, 2000, p.105). Finally, inflation targeting enables the monetary authority to direct its attention on what monetary policy can do in the long run and not what it cannot do, such as increasing employment (Bernanke et al. 2001).

Bernanke and Woodford (1997) argue that the main disadvantages of the inflation-targeting approach are that since that monetary policy affects inflation with a substantial lag, this affects the effective conduct of monetary policy because of the inability to obtain quick feedback from the economy, hence affecting policy decisions. Therefore, the central bank is unable to quickly track their progress and this also negatively affects the financial markets, and the general public in taking

informed decisions. In addition, these have the potential to adversely impact the accountability and credibility of monetary authorities.

Inflation targeting, as a monetary policy tool, has been criticized that it enables monetary authorities to have too much freedom and flexibility, which can possibly increase output instability and lower output or economic growth. Also, it has been argued that it fosters weak central bank accountability since it is difficult to control inflation and because of time lags in the monetary policy transmission mechanism. It is further debated that it cannot prevent fiscal dominance, which is one of the preconditions for an effective implementation of an inflation targeting regime, and that the exchange rate flexibility required for a successful implementation of the regime can also result in financial instability (Mishkin, 2000).

According to Bernanke and Mishkin (1997), another disadvantage is that any unexpected shocks in the price level are ignored and that no attempt is made to offset same. The implication is that there might be large variances between actual inflation and inflation forecasts in the long-run, which can negatively impact private-sector planning.

2.3.9 Costs of Inflation

There is a consensus that low inflation is very important for economic growth and lowering unemployment. This implies that inflation can be detrimental to an economy. It leads to poor economic performance, results in the over expansion of the financial system as economic agents try to maximize their cash holding, leads to increased vulnerability and financial crisis as the financial system becomes fragile. It also affects the signalling ability of prices since prices become noisy therefore affecting the proper functioning of product and labour markets. It also leads to higher costs of repricing and monitoring of pricing by market participants, distributional and corrosive effects on social impact and a negative impact on capital formation as tax laws

only allow capital allowances to be based on historical costs of assets that have already been eroded by inflation, hence making the replacement of capital or assets problematic.

Technically, inflation is an indirect way of imposing taxation as it reduces the purchasing power of money. Finally, individuals and firms do not normally take inflation into consideration when making decisions, hence inflation affects decisions on savings and also distorts firms' decisions about production and investment (Bernanke et al. 2001).

2.3.10 Macroeconomic Effects of Inflation Targeting

2.3.10.1 Inflation

It is argued that there is no significant difference in inflation and inflation variability between inflation targeting and non-inflation targeting OECD (Organisation of Economic Cooperation and Development) countries. This means that inflation targeting does not seem to have had any significant impact on inflation and inflation variability in inflation targeting OECD countries (Ball & Sheridan, 2005; Mishkin & Schmidt-Hebbel, 2007; Lin and Ye, 2007; Angeriz & Arestis, 2008 as cited in Svensson, 2011). However, the situation is not the same in respect of inflation targeting in emerging and developing economies where inflation targeting has substantial influence on inflation variability and inflation (Batini & Laxton, 2007; Goncalves & Salles, 2008; and Lin & Ye, 2009 as cited in Svensson, 2011).

2.3.10.2 Inflation expectations

Inflation targeting, with an explicit inflation target, serves as an anchor and is able to stabilize inflation expectations (Johnson, 2002; Levin, Natalucci & Piger, 2004; Batini & Laxton, 2007; Gurkaynak, Levin, Marder, & Swanson, 2007, 2006; and Ravenna, 2008 as cited in Svensson, 2011). Also, the International Monetary Fund finds that inflation targeting seems to have been

more effective in providing an anchor for inflation expectations than alternative monetary policy frameworks within emerging economies after the 2007 oil and food shocks.

2.3.10.3 Output

It is argued that inflation targeting is too strict and focused on the inflation target at the expense of other real variables such as output, hence creating instability and lower growth (Cecchetti & Ehrmann, 2002; Friedman, 2002; and Friedman & Kuttner, 1996 as cited in Svensson, 2011). However, in a sample of Twenty (20) OECD countries, Ball & Sheridan (2005) as cited in Svensson (2011), found that inflation targeting has no significant effect on both average output growth and output volatility, whilst Batini & Laxton (2007), and Goncalves & Salles (2008) as cited in Svensson (2011), found evidence of reduction in volatility in output but no significant effect on output growth for emerging-market economies.

2.4 Monetary Policy Transmission Mechanism

2.4.1 Theoretical Review

There is a general consensus that monetary policy significantly affects economic variables such as economic growth and prices, even in the short-run. However, there is imperfect understanding and less agreement on the nature, and or size of these effects. Therefore, various theories have been used to explain and understand how monetary policies affect economic variables, that is, the mechanism through which monetary policies are transmitted to the real economy and inflation (Bernanke & Gertler, 1995).

“To be successful in conducting monetary policy, the monetary authorities must have an accurate assessment of the timing and effect of their policies on the economy, thus requiring an understanding of the mechanisms through which monetary policy affects the economy.” Mishkin (1995, p.4).

Theoretically, the monetary policy transmission mechanism involves two main stages. The first stage involves the transmission of monetary policy to the financial system, which directly and indirectly affects the decision of firms and individuals. The second stage involves the transmission from the financial system to the real economy and affecting inflation, output, and employment (Abradu-Otoo et al. 2003).

Boivin, Kiley, and Mishkin (2010) argue that the transmission mechanism can be classified into two broad categories; that is, neoclassical and non-neoclassical channels. According to them, the neoclassical or traditional channels are the: exchange rate, interest rate, and other asset price channels.

However, the non-neoclassical channel is basically the credit channel theory postulated by Bernanke and Gertler (1995). According to them, this channel is however not to be seen as an alternative theory, but rather amplifies, enhances, and propagates the interest rate effects and serves as the one that “fills the gaps associated” with the traditional interest rate or cost of capital theory. They further argue that the credit channel can be further divided into the banking lending and balance sheet channels because of the existence of an “external finance premium.” Mishkin (1995), on the other hand, simply classifies the transmission mechanisms into four: credit, exchange rate, interest rate, and asset prices channels.

2.4.2 Monetary Transmission Channels

2.4.2.1 Interest Rate (Cost of Capital) Channel

The traditional Keynesian (neoclassical) interest rate or cost of capital theory channel has been the standard monetary transmission mechanism considered in the literature for over 50 years (Mishkin, 1995). According to the interest rate channel, a monetary policy tightening such as an increase in the policy rate causes an increase in short-term interest rates, which also affects real interest rates, thereby leading to an increase in the cost of capital. This further leads to a reduction

in aggregate spending such as consumer and business spending (including fixed investment and inventories). The fall in aggregate expenditure ultimately leads to a decline in inflation and aggregate production (Mishkin,1995). According to Taylor (1995), as cited in Mishkin (1995), the increase in real interest rates arising from the increase in short-term interest rates is as a result of a “combination of sticky prices and rational expectations”.

Mishkin (1995), who cited Taylor (1995), argues that the interest rate channel is an important transmission channel. However, Bernanke and Gertler (1995) argue that the traditional theory has not been able to fully explain the magnitude, nature, composition, and timing of the effects of monetary policies on economic variables. This is as a result of the weak cost of capital effects on aggregate expenditure hence their credit channel theory.

2.4.2.2 Credit Channel Theory

According to the proponents of the credit channel theory (Bernanke & Gertler, 1995), this channel arises as a result of imperfections in the financial systems, such as asymmetric information, moral hazards, adverse selection and costly enforcement of contracts. They argue that the credit channel theory “*amplifies*” and even “*fill in the gaps associated*” with the traditional cost of capital theory, and that it is not intended to be an alternative theory. They further argue that because of the existence of an “*external finance premium*” and the impact of monetary policies on same, the impact of “*monetary policy on interest rates are amplified*” by changes in the “*external finance premium.*” This means that

“A change in monetary policy that raises or lowers open-market interest rates tends to change the external finance premium in the same direction. Because of this additional effect of policy on the external finance premium, the impact of monetary policy on the cost of borrowing broadly defined- and, consequently, on real spending and real activity-is magnified.” The external finance premium refers to “the difference in cost between funds raised externally (by issuing equity or debt) and funds generated internally (by retaining earnings). The size of the external finance

premium reflects imperfections in the credit markets that drive a wedge between the expected return received by lenders and the costs faced by potential borrowers.” (Bernanke & Gertler, 1995, p.28).

Monetary policy actions affect this external premium through two main linkages or channels: the bank lending and balance sheet channels. The bank lending channel is concerned with the effect of monetary policy on the supply of credit by depository institutions. The balance sheet channel, on the other hand, focuses on the potential impact of monetary policy on the financial performance, financial position, cash flow statements, and changes in equity of firms. The balance sheet channel arises because changes in policy decisions, aside its effect on general interest rates, also directly (changes in interest expenses) and indirectly (effects on revenue and profits from changes in demand) affect the financial performance, position, and cash flows of borrowers (Bernanke & Gertler, 1995).

2.4.2.3 Exchange Rate Channel

As a consequence of globalization, the internalization of most economies and flexible exchange rate systems, the exchange rate channel theory has become a standard monetary policy transmission channel. This theory operates via the impact of the exchange rate on net exports and finally on output. It is worth noting that the exchange rate channel is influenced by the interest rate channel. An increase in interest rates (monetary policy tightening) leads to an increase in real interest rates and currency appreciation as a result of a higher demand for the domestic currency by foreigners to invest in domestic assets, which comparatively have higher returns. However, the relatively higher interest rates and the resultant currency appreciation reduces the competitiveness of local firms by making domestic goods comparatively more expensive; this causes a decline in net exports and ultimately a decline in output (Mishkin, 1995).

2.4.2.4 Other Asset Prices Channel

Mishkin (1995) argues that monetary policy is also transmitted through the prices of other assets such as equities, land and properties among others. In respect of equity prices, it is argued that monetary policy has an important relationship with equity prices, Tobin's q , investment, and output. Therefore, a contractionary policy that causes a rise in interest rates negatively affects equity prices as investors shift from the equity market to the money and bond markets, thereby causing a reduction in demand for equities and resulting in a decline in equity prices. This fall in equity prices results in a fall in Tobin's q , which can be defined as the market value of firms over the replacement cost of capital; a fall in equity prices reduces the value of firms hence resulting in a fall in the ratio (Tobin's q). A fall in Tobin's q causes firms to lower their investment spending since they cannot easily raise equity funding. This fall in investment spending eventually results in lower output.

An alternative view is that the fall in equity prices results in a reduction in total wealth, which is made up of financial wealth, human capital and real capital. The reduction in total wealth results in a reduction in consumption and subsequently in output. The reduction in consumption is a result of a fall in wealth explained by the theory that consumption is dependent on the lifetime wealth of consumers. Finally, a monetary contraction also negatively affects property values causing a decline in total wealth, consumption, and output. The fall in land and property prices also mean that their market values fall relative to their replacement costs (i.e., fall in their q), which leads to lower investment or spending on new structures.

2.5 Review of Empirical Evidence on Transmission Mechanism

2.5.1 International Evidence

In their paper, “*the federal funds rate and the channels of monetary transmission*”, Bernanke and Blinder (1992) were particularly interested in finding out if monetary policy affects the real economy and the associated transmission mechanism. They employ the use of vector autoregression (VAR) and impulse response functions without explicitly specifying a structural model. They use monthly data for the United States covering the period 1959-1978 in respect of the following variables: federal funds rate as an indicator of monetary policy, three bank balance sheet variables (loans, securities, and deposits), and two target variables (unemployment and inflation). They find that monetary policy is transmitted through the economy partly through the credit (bank credit) and money (bank deposits) transmission channels, and eventually impacting the unemployment rate as expected. A positive innovation in the funds rate results in a reduction in loans and this correlates with an increase in the unemployment rate.

Sims (1992) examines the theory and evidence effects of monetary policy for five advanced countries (France, Germany, Japan, U.K and the U.S.A). He employs the use of vector autoregression (VAR) and impulse response functions without an explicit structural model. The monthly data covers 1957:1 and 1964:1 and ends in 1990 or 1991, which includes variables ordered as follows: short-term interest rate, exchange rate, commodity price index, monetary aggregate, inflation, and output. The short-term interest rate is ordered first and output ordered last. He finds that a positive innovation in interest rate causes a decline in output across all countries. Also, he finds that prices initially rise, before declining, after surprise increases in interest rates.

In analysing the transmission mechanism for the United States, Bernanke and Gertler (1995) employ a Vector Autoregression (VAR) framework using monthly data for the period 1965-1993. First, they include real GDP, GDP deflator, commodity price index, and the federal funds

rate. Second, they replace log real GDP with final demand and inventory investment. Third, they replace GDP with its various components (Consumer, Nondurable consumption, Residential Investment, and Business Fixed Investment). Finally, they investigate the various transmission (cost of capital, bank lending, and balance sheet) channels. They find among other things that after monetary policy tightening, GDP begins to decline after four months, price level remains constant after a year before declining, whilst commodity price index drops more quickly. Also, final demand declines faster than inventories after an unexpected tightening of monetary policy.

Levy and Halikias (1997) investigate the main monetary policy transmission channels in France and explore the role of intermediate variables such as exchange rate, credit, and money in the transmission process with the objective of assessing the effect of monetary policy on inflation and the economy in general. They employ the use of vector autoregression and they decomposed the interest rate into anchor currency (German) interest rate and discount premium component of domestic interest rate.

They then separately analysed the effects of each of the interest rates and the results indicate that both interest rates had little effect on prices though the effects of both on real economic activity were different; an increase in the anchor currency interest rate resulted in a strong and statistically significant dampening effect on output whilst the premium component had almost zero and statistically insignificant effect. They also find that the money channel played a negligible role, whilst the credit channel played a significant role in the transmission process of the German component of the interest rates. The importance of the credit channel appears to emanate from the significance of small and medium size companies, the insignificance of commercial papers, and the relatively low capital ratio of banks in the country.

Peersman and Smets (2001) employ Identified VAR methodology to examine the monetary transmission mechanism in the Euro Area covering the period 1980 to 1998. They show that a momentary rise in short-term interest rates is followed by an appreciation of real exchange rate and short-term fall in output. However, prices fall slowly and only fall significantly below zero several quarters after the fall in output.

2.5.2 Emerging and Developing Economies

Mukherjee and Bhattacharya (2011) employ the use of General Method of Moments with lagged endogenous variables as instruments (IV-GMM) to examine the interest rate channel using panel data for nineteen emerging market countries (five being likely inflation targeting countries in the Middle East North African region and fourteen being inflation targeting emerging countries). Their findings indicate that private sector (i.e., private consumption and private investment) in both groups is significantly affected by real interest rates, hence the rejection of the assumption that inflation targeting will be ineffective in the Middle East North African region because of weak or ineffective interest rate channel. Also, they find that the implementation or otherwise of inflation targeting does not significantly affect the interest rate transmission channel. Finally, capital account liberalization has opposite effects on both variables in the two groups of countries; capital account openness results in an increase in private investment and a decrease in private consumption in inflation targeting emerging economies with the opposite happening in the Middle East North African countries.

In investigating the dominance of the various monetary transmission channels for Brazil, Chile and Korea from the start of the adoption of inflation targeting to December 2009, Tahir (2012) employ a structural vector autoregression (SVAR) model. The results indicate that the share (asset) price and exchange rate channels are more important than the credit and interest rate channels in

respect of industrial production in the three emerging economies. There was a similar result in respect of inflation with the exception of Korea.

Ogunkula and Tarawalie (2008) employ the use of vector error correction (VEC) framework to examine the impact of monetary policy on inflation and output and transmission mechanism in Sierra Leone. Using a quarterly data covering the period 1990Q1 to 2006Q2, the study also finds strong evidence of monetary policies affecting inflation and output. The study found that monetary shocks significantly impacted the banking lending channel via private sector credit, ensuring the banks acted as an important conduit for the transmission of monetary policy to the real economy. Also, the exchange rate channel has a significant effect on inflation with the interest rate channel being insignificant. However, the effects on the output were insignificant.

Ishioro (2013) investigates the monetary policy transmission in Nigeria. Using a Granger-causality method, the study reveals that the credit, exchange rate, and interest rate channels are the three dominant transmission channels. However, he recommends that the exchange rate and the interest rate channels should be the basis of inflation targeting in Nigeria.

Waal and Eyden (2014) investigate monetary policy in South Africa, employing the use of an augmented vector error correction (VECX) model. They find that the transmission mechanism is effective between 1979 and 2009 with the monetary policy (repo) rate fully affecting inflation in about 24months.

Gumata (2013) examines the important monetary policy transmission channels in South Africa using quarterly data covering the period 1990Q1 to 2012Q2. He employs a Large Bayesian Vector Autoregressive (LBVAR) Model and found all channels as being potent but in the following order of importance: interest rate channel, exchange rate channel, expectation channel, credit channel, and asset price channel though the latter is relatively the weakest channel.

2.5.3 Empirics on Ghana

Addison (2008) and Kwakye (2010) argue that the transmission mechanism from the policy rate to the other interest rates, including lending and deposit rates, has been weak. Kwakye attributes it to the fact that there is low financial intermediation and depth remain whilst Akosah (2015, p.8), states that the “financial system remains shallow and underdeveloped with virtually non-existent secondary market while large segments of the populaces are also non-banked, having considerable toll on the effectiveness of monetary policy transmission.”

In respect of empirical work carried out on the monetary policy transmission in the country, some of the notable studies include Abradu-Otoo et al. (2003), Ghartey (2005), Kovanen (2011), CEPA (2012), and Akosah (2015). In particular, Abradu-Otoo et al. (2003) employs Structural Vector Error Correction Model (SVECM) to investigate the transmission mechanisms of the monetary policy in Ghana. In their structural model, they consider the following variables: inflation, output, private sector credit, money supply, exchange rate, treasury bill rate, and oil prices in Ghana. They find evidence of monetary policy having an effect on inflation in the long run, with a stronger exchange rate channel as the main transmission channel.

Ghartey (2005) examines the relationship between monetary policy and the yield curve during the period 1994-2004 in Ghana. The study reveals that treasury bill rate is significantly affected by monetary policy.

Acheampong (2005) examines the exchange rate transmission mechanism in Ghana for the period covering September 1994 to September 2004 using recursive VAR, impulse response functions, and variance decomposition. The results indicate that exchange rate transmission is modest, slow, and incomplete. He also finds that the transmission to non-food inflation is more significant in comparison with consumer prices. Finally, he finds that exchange rate, though not

very significant, is relevant as it accounts for some portion of the variability in inflation in the country.

Amidu (2006) employs the use of ordinary least squares model to examine “*whether bank lending is constrained by monetary policy in Ghana*” for the period covering 1998 to 2004. Amidu observes that the policy (prime) rate has a negative impact on bank lending behaviour though not statistically significant.

Kovanen (2001) investigates the “*interest rate channel of monetary policy in Ghana*” for the period starting 2005 and ending 2010. He employs the use of a vector autoregression (VAR) framework and simulation techniques by using monthly time series data and quarterly bank-specific panel data. He found that monetary policy significantly affects wholesale interest rates (treasury bill and interbank interest rates) in the short run with about one-half of the impact happening with a month lag. However, in the long run, impact on the interbank interest rates is delayed. Using a bank-specific panel data, he finds that the transmission from the policy rate to the retail interest rates (deposit and lending rates) is protracted and incomplete in the long run. Finally, he argues that the significant and sometimes persistent variations between these two wholesale interest rates and the policy rate may be an indication of unannounced changes in monetary policy, with the danger of creating public confusion regarding the policy stance of the central bank.

Using time series data obtained from the Bank of Ghana and covering November 2009 to May 2012, the CEPA (2012) finds that monetary policy impacts both the treasury bill rate and the interbank rate within one month. Also, there is a general positive correlation between the treasury bill rate and the lending rate, as well as between the interbank rate and the lending rate. However, the impact of treasury bill on the lending rate is higher than the effect of the interbank rate.

Loloh (2014) employs a recursive VAR to examine the exchange rate transmission mechanism in Ghana for the period covering January 1994 - December 2012. He finds that exchange rate transmission is modest, incomplete and decays after 18-24 months. He also finds that the transmission to non-food inflation is more significant in comparison with consumer price inflation confirming the finding of Acheampong (2005). Finally, he finds evidence in support of Taylor's hypothesis, which stipulates that the exchange rate transmission should be slower in a stable and lower inflationary environment.

Akosah (2015) examines, using a two-stage approach, the effectiveness of monetary policy transmission mechanism, covering an inflation targeting period 2002-2014. First, by using a VECM, Granger Causality Test, and IRFs to assess the effectiveness of the policy rate on wholesale (interbank interest and 91-day treasury bill) rates, and retail interest rates (i.e. deposit and lending rates). Second, he employs a SVAR Model to investigate (in a single model) the important transmission channels and how monetary policy respond to and influence macroeconomic shocks. This second stage incorporated the monetary policy rate, four intermediate transmission variables (lending rate, exchange rate, credit, and asset price), and two target variables (inflation and output). He finds that there is evidence of monetary policy affecting inflation in the long run via the interest rate channel, with a stronger exchange rate channel in the short term. Surprisingly, he also finds that inflation initially rises after a positive innovation in the monetary policy rate. Therefore, he concludes that this may be an indication that the country may not yet be successful at targeting inflation and or may reflect the existence of a "*price puzzle*" phenomenon as cited in Sims (1992).

This study is different in a number of ways; first, unlike Akosah (2015) who uses two different models in a two-stage approach, this study will, in a single model, combine all the variables. Therefore, the monetary policy rate, interbank interest rate, treasury bill rate, lending rate, private

sector credit, exchange rate, asset price, output, and inflation will all be included in one model. To the best of our knowledge, this will also be the first attempt at combining all the stages of the monetary transmission mechanism in a single model. Second, in addition to the use of oil prices to represent supply shocks to the system, this study will also include fiscal deficits as an additional external shock to the system. This is because, one of the conditions for an effective inflation targeting regime is that monetary policy should not be inhibited by fiscal dominance (Mason et al. 1997).

Finally, this study adopts a methodology, which is consistent with Bernanke and Blinder (1992), and Sims (1992). This study identifies the monetary policy rate as the direct measure of monetary policy and assumes it is affected by economic variables with a lag whilst affecting all other variables contemporaneously. Therefore, the monetary policy rate and inflation are ordered first and last respectively. The approach enables us to combine all the stages of the monetary transmission mechanism in a single model. Using Granger Causality (Block Exogeneity) Tests, IRFs and FEVD, the study is able to trace out the dynamic structural effects of the monetary policy rate on inflation and uncover the transmission mechanisms through which these effects take place, without specifying an explicit structural model.

2.5.4 Conclusion

This study contributes to the literature by providing evidence on the importance of fiscal dominance on the effectiveness of monetary policy and the role of the four transmission variables in explaining inflation since much attention has not been devoted to these areas. Unlike Akosah (2015), this study adopts an approach, which permits the use of a single model and most importantly, allows us to trace out the dynamic structural effects of the monetary policy rate on inflation and uncover the transmission mechanisms through which these effects take place.

CHAPTER THREE

INFLATION AND MONETARY POLICY IN GHANA

3.1 Introduction

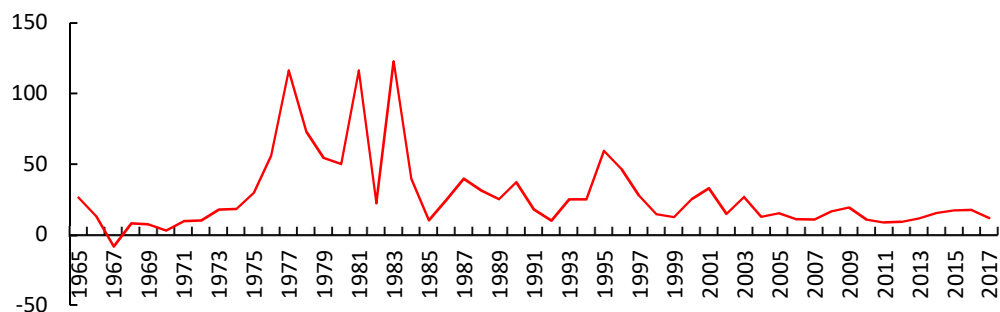
Inflation in Ghana has been persistently high over several decades and this may suggest that either the underlying causes of inflation have been stubborn, or an ineffective management of inflation, or a combination of the two. In order to reduce inflation and sustain such reduction, the underlying factors must be addressed on a more durable basis (Kwakye, 2010).

Ghana started implementing an inflation targeting regime in 2002 though the policy was officially adopted in May 2007. The adoption of the new macroeconomic strategy was meant to restore macroeconomic stability after the economy experienced severe crisis in 2000.

3.2 Inflationary Trends, Causes and Management

There is empirical evidence to support the assertion that Ghana has persistently experienced high and variable inflation during the course of its economic history. Figure 6 illustrates the inflationary trend in Ghana since 1965. Some authors have argued that the inflationary situation in Ghana can be classified into three episodes: first episode (1957-1971), second episode (1972-1982), and the third episode (from 1983 onwards), whilst others have just classified it as pre 1983 and post 1983.

Figure 6: Annual Inflation Rates (% , YOY, 1965-2017)



Source: World Development Indicators

The country experienced stable prices for the first five years after independence and this was characterized by single digit inflation. Inflation rose to double digits between the period 1964-1966 though this was again followed by a period of single digit inflation during the period 1968-1971. The country experienced a deflation of -8.42% in 1967 after the implementation of an International Monetary Fund (IMF)-Sponsored stabilisation programme in 1966.

Inflation started rising from 1971; inflation rose from 3.03% in 1970 to 9.56% in 1971. Inflation during the first episode (1957-1971) was largely caused by expansionary fiscal policies resulting from the desire of the government to rapidly industrialize the economy. A lot of import substitution state-owned enterprises were set-up and there were also massive infrastructural developments during this period. This rapid transformation of the economy resulted in budget deficits and an expansionary monetary policy.

The second episode (1972-1982) witnessed a lot of economic instability as a result of several military interventions and the period can be described as the most expansionary phase of economic management history in Ghana (Sowa and Kwakye, 1993). In fact, all the military regimes pursued expansionary fiscal policies and an accommodative monetary policy all exacerbating inflationary situation in the country.

In an attempt to control the high inflation, the country introduced interest rate and exchange rate controls. These resulted in severe shortage of goods, which brought about a lot of malpractices such as smuggling, distortion in relative prices, parallel market activities in foreign currencies and goods, corruption, and economic stagnation. Notwithstanding these controls and economic restrictions, inflation actually peaked at 116.45% and 116.50% in 1977 and 1981 respectively. There was an effort to stabilize the economy in 1979, hence an IMF-sponsorship stabilisation

programme was implemented in January 1979, though the programme ended abruptly because of another military intervention in June of the same year.

According to Sowa (1996), the government budgets recorded deficits from early 1965 to 1985 and that the drive to modernize and embark on import substitution resulted in excessive government expenditure, which was largely financed through domestic borrowing. An IMF-Sponsored programme during the era of the National Liberation Council (1966-1969) and the Progress Party (1969-1972) enabled external financing of government deficit and by 1970, the deficit was almost externally financed.

However, the unilateral cancellation of Ghana's external debt by the government of National Redemption Council (NRC) led to the country being black-listed by the international financial community. This even affected the governments of People's National Party (PNP) and the early years of Provisional National Defence Council (1979-1983). The implication is that Ghana was unable to raise much from external borrowing through 1973 to early 1983 to finance the deficit resulting in higher inflation from 1973.

Inflation fell drastically from 122.87% in 1983 to 10.31% in 1985 and has since not risen to the very high rates recorded in 1977 (116.45%), 1981(116.50%), and 1983 (122.87%). In mid-1983, the country in collaboration with the IMF and the World Bank implemented an Economic Recovery Programme (ERP) with the objective of controlling inflation and achieving sustainable economic growth among others. Some of the other benefits associated with the implementation of the Economic Recovery Programme are the following: the country was able to borrow from the external capital market; restrain in government expenditure; and an improvement in government revenue. The country also devalued the official exchange rate by an average of over 40% per annum over the period 1983-1988 as required by the programme. Therefore, the decline in inflation

after 1983 led some economists to attribute the fall in inflation rate to the implementation of the Economic Recovery Programme (ERP). However, Sowa and Kwakye (1993) argue that this assertion cannot be entirely correct as the programme did not fully take effect until 1984, therefore, the recovery of agriculture from the drought of the previous year and the good harvest in 1985 contributed greatly to the reduction in inflation after 1983.

The country started monetary aggregate targeting in 1992 before the informal commencement of inflation targeting in 2002 and the subsequent official adoption in May 2007. The period between January 2002 - April 2007 served as a transitional period during which both monetary aggregate and inflation targeting were used. The average rate of inflation during the monetary aggregate targeting regime (1992-2001) was 27.89%. Although, inflation rose to as high as 59.46% in 1995 resulting from weak performance from the agricultural sector, the inflation rate was significantly lower than the inflation rates recorded in 1977, 1981, and 1983. Inflation fell to 12.41% in 1999, before rising to 32.91% in 2001 and remained at double digits from 2001-2010. The higher inflation levels can be attributed to high budget deficits resulting from excessive spending during the 2000 and 2008 elections. Aside the high election spending, the country experienced global oil price shocks and food crises, thereby causing an increase in oil and food prices. These increases became entrenched in the prices of goods and services and also accounted for the higher inflation figures recorded.

In 2011 and 2012, the country recorded single digit inflation of 8.73% and 9.16% respectively even though inflation has since increased to double digits during the period 2013-2017. The end of year inflation for the year ending 2017 was 11.8%. However, average inflation, during the inflation targeting period (2002- 2017), declined to 14.30% lower than the 27.89% recorded during the monetary targeting regime (1992-2001).

Notwithstanding the above, Kwakye (2010) argues that the monetary aggregate targeting regime was ineffective in controlling inflation and that the inflation targeting regime has also not been very effective because of the stubbornness of underlying causes of inflation, structural conditions, and the absence of a key inflation targeting policy. However, some economists have attributed the relative decline and the achievement of single digit inflation to the adoption of the inflation targeting regime since the annual average inflation has been lower under the inflation targeting regime than all other previous regimes.

3.3 General Causes of Inflation

Theoretically, the underlying cause (s) of any inflationary situation can be either demand-pull or cost-push, or some combination of the two. In fact, the former is when there is excess aggregate demand over aggregate supply resulting in a situation where there is too much money chasing fewer goods and services. In this circumstance, inflation is deemed to be a “monetary phenomenon” (Gogo, 2009). According to Friedman and Paden (1983), this is as a result of “excess monetary demand for goods and services over supply”.

However, inflation is deemed as cost-push when supply shocks and or increased production costs cause firms to produce less for a given price, or only maintain their optional levels of production after increases in prices. The principal objective of any firm is maximization of profit, yet cost-push factors affect price levels regardless of the level of demand (Gogo, 2009).

The monetarists argue that although cost-push factors can cause a shift in the level of prices, they are unable to explain nor cause sustained price increases (inflation). For there to be a sustained increased inflation, there must be monetary accommodation otherwise inflationary process stalls. Although monetary factors are the proximate causes of inflation, cost-push factors are capable of

directly or indirectly initiating the monetary factors, that is, the rate of monetarization and velocity of money in circulation (Chhibber & Shafik, 1990).

As illustrated in Figure 6, high and variable inflation has been a major problem facing the country since independence, with an annual inflation average of 27.93% over a fifty-three year period, that is, from 1965 to 2017. The causes of inflation in Ghana have been varied and extensively researched by many economists and researchers.

Lawson (1966) and Ahmed (1970) argue that the major contributory factor to inflation in the country has been excessive monetary expansion to accommodate the increased fiscal expansion. According to them, these deficits were financed mainly through the borrowing of funds from the domestic banking system. Chhibber and Shafik (1990) indicates that though high inflation has also been attributed to devaluations in the official exchange rate, this could not be the case since there is no direct relationship between the exchange rate and inflation in the country. They argue that inflation in Ghana has primarily been a monetary phenomenon and as a result of financial system weaknesses.

According to Sowa and Kwakye (1993), demand theories have dominated the literature partly because they are more quantifiable than cost (supply) factors. They made references to that fact that studies conducted by other economists such as Cagan (1956) and De Silva (1977), just to mention a few, all confirmed demand-pull inflation. Sowa and Kwakye argue that the causes of inflation prior to 1983 are not in doubt and that several studies conducted during the pre-1983 period by several authors, such as Lawson (1966), Ewusi (1977), and Kwakye (1981) among others, all confirmed the major determinants of inflation were demand factors resulting from the financing of fiscal deficits. However, Sowa and Kwakye state that Lawson (1966), Ewusi (1977),

and Kwakye (1981) found out that there is evidence that supply factors, such as food prices, also influence inflation in Ghana.

Sowa and Kwakye (1993) concluded by stating that inflation in Ghana is caused by other factors aside just monetary factors as indicated by Chhibber and Shafik (1990). According to them, one possible explanation why most researchers identified monetary factors is the fact that real factors were wrongly captured as monetary factors; hence the real factors could not be isolated thereby magnifying the monetary factors.

Kwakye (2010) argues that over the past thirty years, the monetization of fiscal deficits (demand side effects) and cyclical food deficits (supply side effects) have been the primary causes of inflation. The monetization of fiscal deficits started after the country opted to have its own central bank after independence and the central bank significantly financed government deficits. However, food deficits have become a major ingredient in contributing to inflation although there are other supply-side factors. He asserts that the real or supply side factors were more prominent pre 1983 and that after the implementation of Economic Recovery Programme and subsequently the Structural Adjustment Programme, cost pressures have now become a significant factor in contributing to inflation. Some of the cost pressures are energy and utility prices, and currency depreciation. Inflation continued to increase as inflation and inflation expectations became embedded in interest rates, exchange rates, wages, and the general prices of goods and services.

According to Gyebi and Bofo (2013), however, the principal causes of inflation in Ghana between the period 1990 and 2009 were the growth rate of real GDP and the growth of money supply. However, the key determinant is the money supply.

3.4. Inflation Targeting in Ghana

The implementation of an inflation targeting regime was unofficially started in 2002 after the enactment of the Banking Act 612 in 2002. As at the time the new policy started, not all the necessary conditions or prerequisites for a full-fledged inflation targeting policy had been met. However, it was not until May 2005 before the new monetary policy was officially adopted. The official announcement of the new monetary policy meant a shift away from monetary aggregate targeting to a more comprehensive strategy, which takes into consideration a broad range of other economic variables before monetary policy decisions are made. The adoption of the new macroeconomic strategy was to restore macroeconomic stability after the economy experienced severe crisis (such as high and volatile inflation which exhibited inertia, high exchange rate depreciation and low growth) in 2000 (Addison, 2008).

Act 612 achieved two main objectives: first, it redirected the objectives of the central bank to price stability and also to support the achievement of other macroeconomic goals (including economic growth and employment). The inflation target, which is defined in terms of an annual rate of CPI inflation, is revised annually by the fiscal and monetary authorities and stated in each fiscal year's budget statement. Second, the Act enhanced Bank of Ghana's independence in taking monetary policy decisions including the setting of interest rates. Although, Act 612 does not legally bind the Bank of Ghana to explain developments in the economy to the government and/or public if the inflation target is not achieved, Parliament has the right to summon the Governor of the Bank of Ghana to provide further and better details on developments within the economy. This second objective (independence) was achieved in two ways: firstly, by establishing the Monetary Policy Committee (MPC) with the following responsibilities:

- a) “initiating proposals for the formulation of monetary policies of the bank;” and
- b) “providing the statistical data and advice necessary for the formulation of monetary policy.”

The membership of the MPC is made of the following members: “the Governor; the first and second deputy Governors; the head of monetary policy analysis of the Bank; the head of banking operations of the Bank; and two other persons appointed by minister being persons with knowledge or experience relevant to the functions of the Monetary Policy Committee.”

In an effort to achieve the inflation target, the MPC sets appropriate monetary policy rates. These policy rates are announced by the Governor at a press conference after the two-day meeting of the MPC, which is held every two months. Currently, the minutes of the meetings are not published, though the transcripts of the press briefings are published on the Bank’s website by the end of the week following the MPC meeting. Also, a wide range of economic reports such as the Inflation Outlook and Analysis Reports are made available to the public and subsequently published on the Bank of Ghana website.

To prevent or limit the monetization of government deficits, Act 612 placed limits on the total allowable public sector financing of government deficit. The total public sector borrowing for the year was limited to 10% of total government revenue of the previous fiscal year and the amount borrowed was to be paid within three months otherwise the Bank of Ghana may not provide any additional funding and if repayment is unduly delayed, the advance may be transferred to the public by the selling of treasury bills to the public. However, a new Bank of Ghana Law (Act 930) has further reduced the public sector borrowing or deficit financing limit to 5% of the total government revenue of the previous fiscal year.

To ensure that the inflation targeting regime provides a strong anchor to shape and stabilize inflation expectations, the Bank of Ghana needed to decide on the following: the price level to target, information set, statistical data and analysis, and econometric techniques, which are necessary to enable a better appreciation of the inflation process and transmission mechanisms in the country. Also, an understanding of the time horizon for the achievement of inflation objectives taking into consideration the lags and uncertainty in respect of the effects of monetary policy actions. These were necessary for use as a basis for monetary policy formulation.

In setting the inflation target, the Bank of Ghana initially focused on using the Headline inflation, though other indicators of core inflation were tracked. However, the Bank later moved to core inflation, which is defined to exclude utility and energy prices, on the basis of further technical work that was carried out. In taking monetary policy decisions, the Central Bank uses a lot of macroeconomic data such as fiscal data, monetary data, inflation data, external sector data, and real sector economic data as captured by the Composite Index of Economic Activity (i.e., as a result of lack of quarterly data of gross domestic data). In addition, the Bank of Ghana also relies on the results of Businesses and Consumers surveys conducted by the Bank.

“Together with simulations from a suite of models, an assessment is made on the risk to higher inflation in the form of a matrix of risk assessment and an inflation risk measure is derived for the MPC to take a decision on the Prime rate. The models in the Bank include a micro founded forward looking rational expectations macroeconometric model for key relations and variables as well as short term models such as the AR and the VECM models. The Bank decided on an 18-24month time horizon.” Addison (2008, p.5).

3.5 Fiscal Dominance

As indicated by Mason et al. (1997), one of the prerequisites necessary for the implementation of inflation targeting is that fiscal dominance should not constrain the conduct of monetary policy. According to Ali Aliche et al. (2009), fiscal dominance is one of the preconditions which needs to be addressed by a developing country like Ghana for a successful and an effective implementation of an inflation targeting regime.

Kwakye (2010) argues that over the past thirty years, aside cyclical food deficits (supply side effects), the monetization of fiscal deficits (demand side effects) has been the principal driver of inflation. According to him, this monetization of fiscal deficits started after the country opted to have its own central bank after independence and the central bank significantly financed government deficits.

Although there have been a lot of reforms aimed at rationalizing government expenditure and improving revenue, this fiscal dominance has persisted throughout most of the country's economic history (see Figure 3 for the fiscal deficits over the period 2008-2017). The country made huge saving both in terms of debts and associated interest expenditure after it applied and obtained a debt relief under the HIPC Initiative from IMF/ World Bank. Even though inflation targeting has returned relatively lower annual average inflation rates than all the previous inflation management strategies including monetary aggregate targeting, the pervasiveness of fiscal dominance has affected the effectiveness of the inflation targeting regime.

3.6 Monetary Policy Strategies and Transmission Mechanism

It has been established both theoretically and empirically that monetary policies affect economic variables even in the short-term and this occurs with a lag of uncertain duration and with variable strength (see Appendix Figure 7-10 for schematic representation of the monetary policy transmission for the European Central Bank, Federal Reserve Bank, Bank of England, and Ghana).

According to Quartey, Owusu-Brown, and Turkson (2017), the use of a nominal anchor is a principal feature of any monetary policy strategy and that the four main strategies are: exchange rate, monetary targeting, inflation targeting, and monetary policy, which has an explicit goal but with no explicit nominal anchor. The distinction between these strategies lie in the use of a nominal anchor unique to the strategy, the target variables, and instruments deployed in each case to achieve the desired policy objectives. They further state that over the period 1954-2014, monetary authorities in Ghana have pursued all four strategies. However, since the establishment of the Bank of Ghana, the Central Bank has perused a monetary targeting (both controlled and liberalized) regime and currently an inflation targeting regime.

Kovanen (2011), argues that significant changes or reforms in the financial system can affect the stability of the velocity of money and eventually the stability of money demand. He argues that this can cause significant shifts in the monetary transmission mechanism thereby affecting the effectiveness of monetary policy. It is worth noting that before the move to an inflation targeting regime, certain important changes were implemented in the financial system.

However, these changes started in the 1980's and they included the removal of controls on interest rate and foreign exchange, and the removal of some restriction on the country's external capital account thereby allowing foreigners to invest in long-term domestic bonds and Ghanaians to hold foreign currency bank accounts. The domestic capital markets were further developed via the

introduction of new investment options such as stocks, treasury bills and bonds. Also, it was expected that development of electronic banking, and new payment technology & instruments (i.e., credit and debit cards) will expand banking and minimise cash transactions to some extent. It can, therefore, be argued that these significant developments and reforms in the financial sector affected the transmission process and affected the effectiveness of the monetary aggregate targeting regime. This eventually resulted in the adoption of the inflation targeting regime.

Ghana's monetary policy management can be grouped into periods of direct monetary policy management and indirect or market based systems of monetary policy management. Monetary policy prior to 1983 was largely conducted by way of directly controlled systems of monetary policy management. This was undertaken largely via direct credit controls through the placing of limits or ceiling on commercial bank lending consistent with macroeconomic targets such as economic growth, inflation, and the external balance. These systems of direct controls were ineffective and resulted in inefficiencies in the various sectors of the economy. Several reforms were then undertaken after the implementation of the ERP in 1983. The reforms eventually resulted in financial market liberalization such de-regulation and institutionalization of market based systems by early 1992. According to Abradu-Otoo et al. (2003), the reforms resulted in the advent of indirect and or market based system of monetary policy through the use of indirect or market based monetary policy instruments.

A new monetary policy known as the IMF-POLAK (Financial Programming) model was then implemented and this monetary policy had three targets: reserve money, money supply, and the general price level which were the operating, intermediate, and the ultimate targets respectively. In theory, if the operating target is controlled, then it will impact on the intermediate target and eventually impact the ultimate target. This theory is based on the assumption that inflation is primarily "*a monetary phenomenon*".

In achieving its macroeconomic objectives, there were several instruments at the disposal of monetary authorities such as: credit ceilings, open market operations, reserve requirements, the bank rate, and moral suasion. However, some of the instruments were abandoned in favour of more market based instruments because of the evolution of time. Also, it is argued that the focus shifted from the balance sheet of commercial banks to that of the central bank. The methodology is as follows and based primarily on the quantity theory of money:

$$m^2 * v = p * y \quad (1)$$

$$m^2 = m * rm \quad (2)$$

$$NDA_{BOG} * NFA_{BOG} = RM \quad (3)$$

where m^2 is the money supply (i.e., intermediate target variable), p is the general price level, v is the velocity of money, and y is the gross economic output. In equation 2, m is the money multiplier and rm represents the operating target, reserve money. With an estimate of m^2 from (1) and an estimate of m , the rm which is target that can be determined. In respect of equation 3, the NFA (Net Foreign Assets) target of the Bank of Ghana, being equivalent to the overall balance of payments target is given. This means that the NDA (Net Domestic Assets) is regulated in order to achieve the operating target, RM. A major instrument used in regulating BOG's Net Domestic Assets is the Open Market Operations (OMO) where Treasury bills and Bank of Ghana instruments are sold in a weekly public auction. Bids are received from the public in terms of the quantity and rates, and the Bank accepts bids depending on the weekly sales target based on the projected reserve money level vis-à-vis the target level.

Although the IMF-POLAK Model was a good way of targeting the intermediate targets and good for short-run adjustment and stabilisation measures, the model was criticised on the grounds that it lacked the sophistication needed to evaluate the dynamics involved in the interaction of various

variables. Therefore, there was a need for a more comprehensive macroeconomic model that could handle multivariate modelling in analysing dynamic economic situations hence the technical recommendation by the IMF for Ghana was to develop such a dynamic model. Also, the model relied on the stability of the velocity of money, the quantity theory of money, and an assumption that there is only one transmission mechanism, which is the money demand channel (i.e., an effective use of the treasury bill affects the demand for money which also affects the aggregate demand and eventually affects prices). However, it has been argued that there were other transmission channels present in the Ghanaian economy and the velocity of money has also become unstable.

A new banking law (Act 612) was passed in 2002 and this provided the necessary operational independence to the Bank of Ghana in setting interest rates. This provided the necessary prerequisite for the transition from monetary aggregate targeting to inflation targeting. Under the inflation targeting regime, the primary objective is price stability with other objectives regarded being secondary or subservient. According to Akosah (2015), the inflation targeting strategy takes into account many variables. It is unlike monetary aggregate targeting, which assumes inflation is a monetary phenomenon hence focuses only on the money supply. Inflation targeting is able to accommodate other variables and or objectives because of the use of an inflation forecast, which takes into account many other macroeconomic variables in setting the forecast.

The monetary policy rate is the primary policy tool deployed by the central bank under the current inflation targeting regime. However, the operating target is the interbank interest rate, which is an overnight interest rate. The monetary policy rate communicates the policy stance of the central bank to the public; the central bank lends to the commercial (universal) banks at this rate and it guides all the other market interest rates in the country. It is expected that changes in the policy rates will be transmitted to the rest of the economy by affecting wholesale market (interbank and

treasury bill rates), the retail rates (lending and deposit rates) and ultimately impacting inflation and the overall economy (Akosah 2015).

The monetary policy rate is determined by the MPC and communicated to the public via several media: press briefing and releases, seminars, and publication of reports. In order to determine the appropriate policy rate, the MPC obtains and comprehensively assesses a lot of information on the entire economy. In an attempt to enhance the efficiency and effectiveness of the transmission of monetary policy, the BOG in 2005 introduced certain policy reforms such as the introduction of an interest rate corridor, bordered by repurchase (repo) and reverse repurchase agreements (reverse repos) rates to enable it influence liquidity in the interbank market. In implementing the policy rate, the Bank of Ghana uses several other tools and securities such as repurchase and reverse repurchase agreement activities in the interbank markets, Bank of Ghana and government securities, bond trading, and foreign exchange trading in the interbank market (Addison 2008).

However, Quartey et al. (2017) argues that the Bank of Ghana monetary policy rate is a short-term (overnight) money market interest rate, which is the Banks's operating target. They conclude that changes in the policy rates are expected to impact inflation and output by affecting asset prices, lending and deposit rates, exchange rates, and expectations in the economy. Appendix Figure 10 attempts to illustrative the monetary policy transmission mechanism as it pertains to Ghana.

Notwithstanding the above, Addison (2008) and Kwakye (2010) argue that the transmission mechanism from the policy rate to the other interest rates, including the lending and deposit rates, has been weak. Kwakye attributes it to the fact that low financial intermediation and depth whilst Akosah (2015), states that the "financial system remains shallow and underdeveloped with virtually non-existent secondary market while large segment of the populaces are also non-banked, having considerable toll on the effectiveness of monetary policy transmission". The following are

some of the major challenges affecting inflation targeting and the effectiveness of the transmission mechanism in Ghana. The economy is relatively small yet very opened to external trade with very little safeguards; persistently high fiscal dominance; shallow financial markets; irregular adjustments in petroleum and utility prices; adverse global oil and food trends, which sometimes makes it difficult in taking monetary policy decisions since the central bank has to determine whether the shock is temporal, one-off or persistent structural change; domestic currency depreciation, unpredictable wage setting behaviour; and the market sometimes resists the central bank's policies, therefore the policies fail to accomplish the intended purpose.

3.7 Developments in the Monetary and Financial Sectors

To be relevant and effectively respond to developments in both the domestic and global economies, monetary policy must be dynamic; an effective and efficient financial system directly impacts the effectiveness of any monetary policy. In an attempt to develop and further deepen the entire financial system, the country has undergone series of financial sector reforms. The Ghanaian financial system includes banks, savings and loan companies, microfinance institutions, rural and community banks, discount and finance houses, leasing companies, credit unions, insurance companies, investment advisory and management firms, trustees, and the stock exchange among others. However, the banking system remains the largest sector of the financial system whilst the other financial institutions and sectors remain largely underdeveloped.

In Ghana, monetary policy has evolved overtime from the period of using direct monetary policy control measures such as minimum reserve requirements, credit and interest rate controls to the usage of indirect or market based monetary policy instruments. Before the advent of the financial reforms in 1992, monetary policy was focused on controlling the money supply through the use of direct or indirect or market-based system measures. This approach was adopted primarily because of the strong presumption that inflation was predominately a monetary phenomenon, hence the

focus on the money supply. However, as the economy evolves and financial systems develop, many substitutes for money emerge and these affect the stability of the velocity of money and the measurement of money. The implication of this is that it becomes difficult to control the money supply and this eventually affects the effectiveness on monetary policy. According to Quartey and Afful-Mensah (2014), these developments in the financial system rendered the monetary targeting regime ineffective resulting in the country, like other countries, adopting an inflation targeting regime and abandoning the monetary targeting regime. Kovanen (2011), also argues that the significant developments and reforms in the financial sector affected the policy transmission process and affected the effectiveness of the monetary aggregate targeting regime, which eventually resulted in the adoption of the inflation targeting regime.

During 1960-1970, the government undertook massive state intervention programmes via the banking sector, which led to losses and high non-performing loans. In addition, the financial system witnessed severe crisis during the period 1983-1988. This crisis was characterised by high non-performing loans resulting from high default rates, and very high inflation, which eroded the banks' capital, and low confidence in the financial system thereby affecting bank deposits. According to Sowa (2003), this affected the recovery efforts initiated through the Economic Recovery Programme in 1983.

In an attempt to restructure the financial system, various measures were implemented some of which were the introduction of weekly auctioning of treasury bills in 1986 and the implementation of a Financial Sector Adjustment Programmes (FINSAP) in 1988-1995, Non-Bank Financial Institutions Assistance Project (NBFII) between 1996-2002, and Financial Sector Strategic Plan (FINSSP) between 2003-2016. The financial sector reforms were to, among other things, involve institutional restructuring, improve the legal and regulatory environment for the banking sector, liberalise interest rates, encourage savings, and develop the money and capital markets. However,

the reforms (FINSAP and FINSSP) were undertaken in phases: FINSAP-1(1988-1991); FINSAP-2 (1992-1995); FINSSP-1 (2003-2008), and FINSSP-2 (2012-2016).

In order to encourage competition among the banks and in accordance with the Structural Adjustment Programme (SAP), interest rates were liberalized. The nominal anchor under the financial programming was the money supply hence there was a need for interest rates, which is the price of money, to be determined by market forces. Initially, the minimum and maximum limits on deposits (excluding minimum saving deposit rate) were abolished in September 1987, followed by abolishing the minimum commercial banks' lending rates in February 1988 and by March 1989. Commercial banks had the liberty to determine their own rates and subsequently display same in their various banking halls. To further liberalise interest rates, the 20% mandatory lending to agriculture was also abolished and by the start of 1991, much liberalisation had been achieved in the financial sector.

On July 10, 1989, the Ghana Stock Exchange was incorporated, though trading started in 1990, with only twelve listed companies and one a single government bond. To strengthen the banking system, the banking law (PNDCL 225) was amended in August 1989. This led to the introduction of a minimum capital adequacy requirement of 6% of net assets, the placing of limits on single borrowers (single obligor), and the imposition of stringent reporting requirements just to mention a few. Also, there was an establishment of the first finance company in 1991 and the enactment of the Securities Industry Laws in 1993. The Securities Industry Law, 1993 (PNDCL 333) was meant to regulate the orderly growth and development of a fair, transparent, and an efficient securities industry

In 1997, Barclays Bank and Standard Chartered Bank introduced very innovative products. Barclays Bank introduced the Akafo Bond to encourage farmers to save whilst Standard

Chartered Bank introduced the Business Master to enable bank's clients to remotely access their bank accounts. These were followed by a lot of laws which were passed as part of the Financial Sector Strategic Plan. Act 612 (Bank of Ghana, Act 2002) was passed to regulate the banking sector and redirect the focus of the central bank whilst granting it operational independence. Also, a bill to modernise and introduce efficiency in financial transactions and the payment system was passed in 2003.

The Bank of Ghana then introduced the concept of universal banking license enabling banks to engage in all banking activities ranging from commercial, merchant, development, and investment banking. The central bank initially reduced the secondary reserve requirement from 35% to 15% in July 2005. This was to make more money available to the banks for onward lending to the private sector. However, this secondary reserve requirement was subsequently abolished in August 2006. The Non-Bank Financial Institutions Act, 2008, (Act 774) was enacted and was meant to regulate all the non-bank financial institutions in the country and related matters.

The Central Securities Depository (CSD) was established in November 2004 by the Bank of Ghana though it was incorporated in June 2010. After the passage of Central Securities Depository Act 2007 (Act 733), the Ghana Stock Exchange also established a second Securities Depository (GSE Securities Depository Limited) in the country. In 2014, the Central Securities Depository and GSE Securities Depository Limited were merged into a single entity with the CSD remaining as the surviving institution. The CSD was to, among other others, enhance the effectiveness and efficiency in the storing, clearing, and payment of all securities

In an attempt to minimise payments and settlement risks, a system for high-value interbank payments (Real Time Gross Settlement System (RTGS)) was introduced in 2006. This was followed by the introduction of manual credit clearing system in the country in 2007, to handle

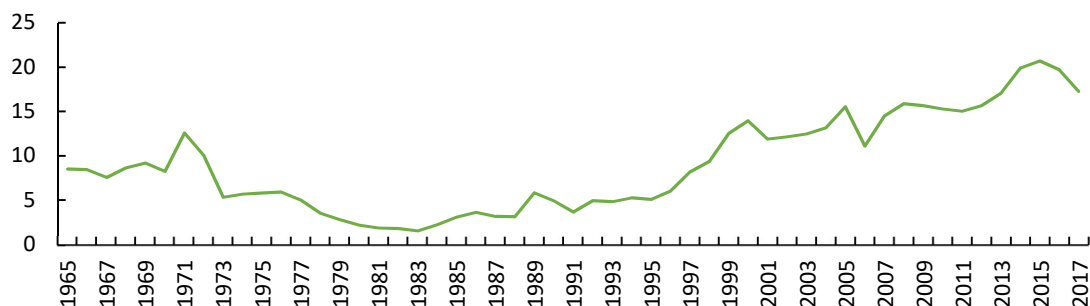
low-value payment transactions. The Ghana Interbank Payment and Settlement Systems Limited (GhIPSS) was incorporated in 2007 and this paved the way for various interventions in the attempt to deepen the payments system. In fact, this paved the way for the introduction of the National Switch (E-ZWICH) system in 2008 and subsequently the introduction of E-ZWICH cards and the interoperability of all Automated Teller Machines (ATMs) and other Point of Sale Terminals. In 2009, a Cheque Codline Clearing System was introduced to facilitate the clearing system. In addition to the above, the GhIPSS also introduced the Ghana Automated Clearing House (GACH) Systems and the National Switching and Processing System (gh-link). Finally, Mobile Money was introduced in addition the several interventions, which were aimed at transforming the economy into a cashless economy with all the associated benefits.

To further deepen the financial system, the Foreign Exchange Act (Act 723) was passed in 2006. This replaced the old law (Exchange Control Act, 1961) and this led to the liberalisation of the foreign exchange market, allowing the contracting of foreign loans between resident and non-residents, permitting foreign direct investments, and the participation by foreigners in the both the domestic capital and money markets. In 2007, the Credit Reporting Act, 2007 (Act 726) was enacted and this led to the establishment of the Credit Reference Bureau. Subsequently, the Borrowers and Lenders Act, 2008 (Act 773) and Anti-Money Laundering Act, 2008 (Act 749) were passed leading to the establishment of the Collateral Registry and the Financial Intelligence Centre respectively.

To minimise the cost of transactions, improve efficiency in the payment and recording systems, and ease the pressure on the payment systems, the country undertook a currency redenomination in July 2007. This was also to signal that the country was going to contain inflation in future to attract foreign direct investment, as well as to encourage local investment, and lastly to meet the convergence criteria from the West African Monetary Zone (WAMZ) for the adoption of single

currency in the West Africa Sub-region. In order to ensure that securities market is well regulated and to meet international standards, both the Securities Industry Law, 1993 (PNDCL 333) and the Amendment Law (Act 590) were replaced with the Securities Industry Law, 2016 (Act 929). In the same year, the two banking laws (Act 612 and Act 673) were replaced with two new ones (Depository Protection Act, 2016 (Act 931) and Banks & Specialised Deposit-Taking Institutions Act, 2016 (Act 930)), all in an attempt to properly regulate, supervise, protect and deepen the financial sector.

Figure 7: Domestic Credit to Private Sector (% of GDP, 1965-2017)

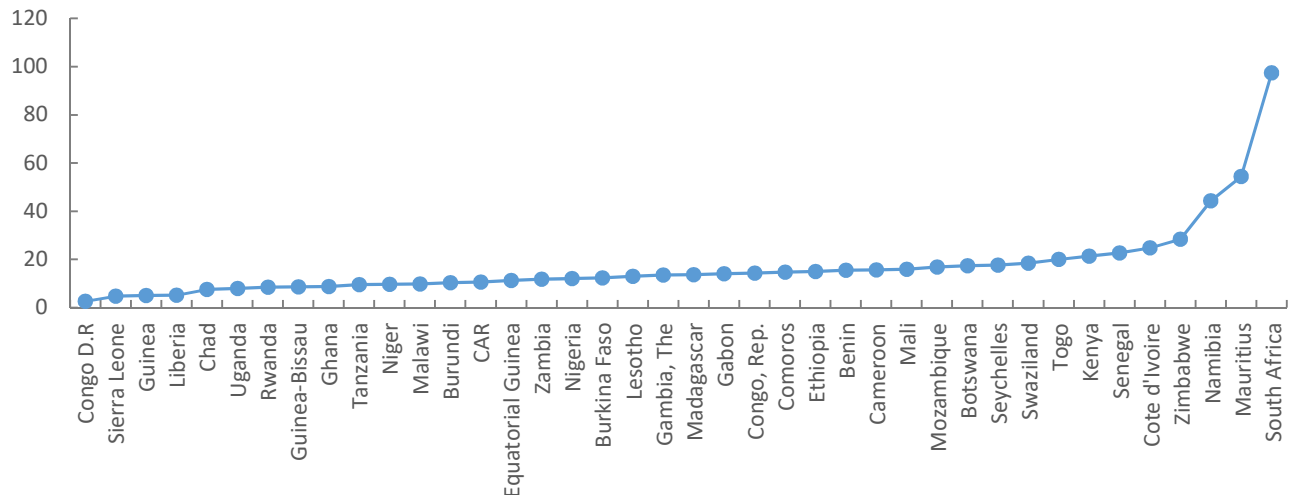


Source: World Development Indicators

Notwithstanding the above reforms, it is still argued that the financial system is still not very well developed, remains shallow, and the secondary market is still virtually underdeveloped with only very few securities listed. Using credit to private sector as a percentage of GDP to measure financial deepening, Figure 7 provides evidence to show that financial deepening is still low. Although financial deepening increased after the implementation of the various reforms. Prior to the implementation of the ERP in 1983, financial deepening had declined to 1.80%. Subsequent to the reforms, this improved to 3.14%, 5.07%, and 12.15% as at the end of 1988, 1995, and 2002 respectively. By the end of 2008 and 2014, it improved to 15.88% and 19.91% respectively, though it declined to 16.04% as at the end of 2017.

Ghana’s financial deepening average ratio of 8.85% (1965-2017) is significantly lower than South Africa and Mauritius who have an average of 97.40% and 54.39% respectively. As shown in Figure 8 above, Ghana is ranked 32nd among forty (40) Sub-Saharan African Countries.

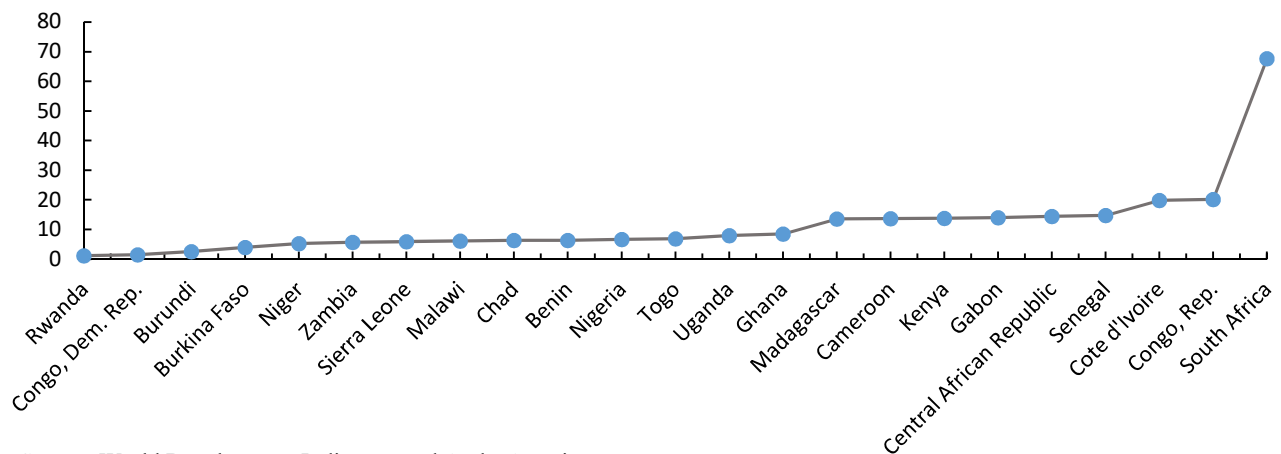
Figure 8: Financial Deepening Sub-Saharan African Countries (Credit to the Private Sector % of GDP, 1965-2017)



Source: World Development Indicators and Author’s estimates

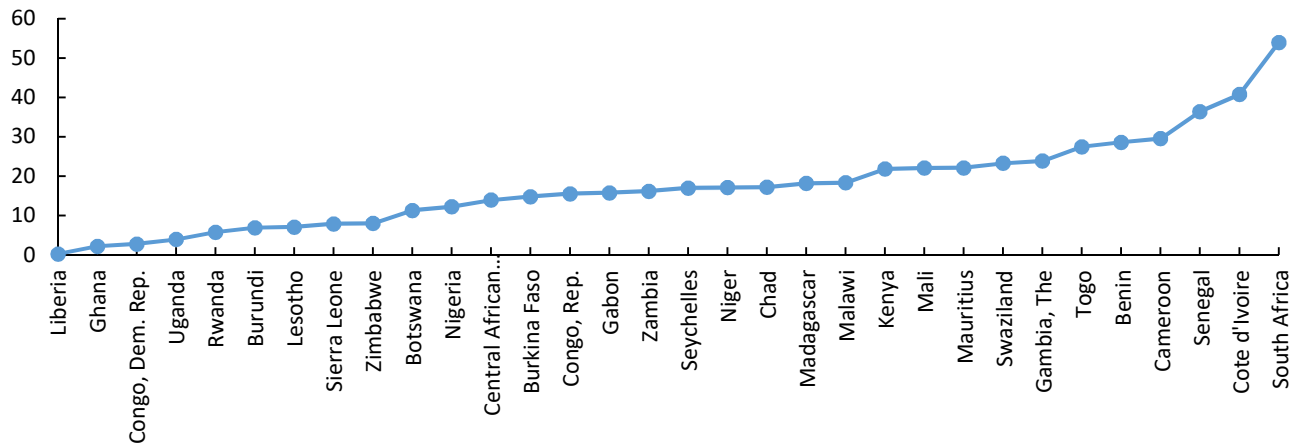
Figures 9, 10, 11, 12, 13, and 14 show the financial deepening for sub-Saharan African Countries for the periods 1965, 1980, 1990, 2000, 2007, and 2017 respectively. This enables us to unravel more dynamics over the period (1965-2017),

Figure 9: Financial Deepening Sub-Saharan African Countries (Credit to the Private Sector % of GDP, 1965)



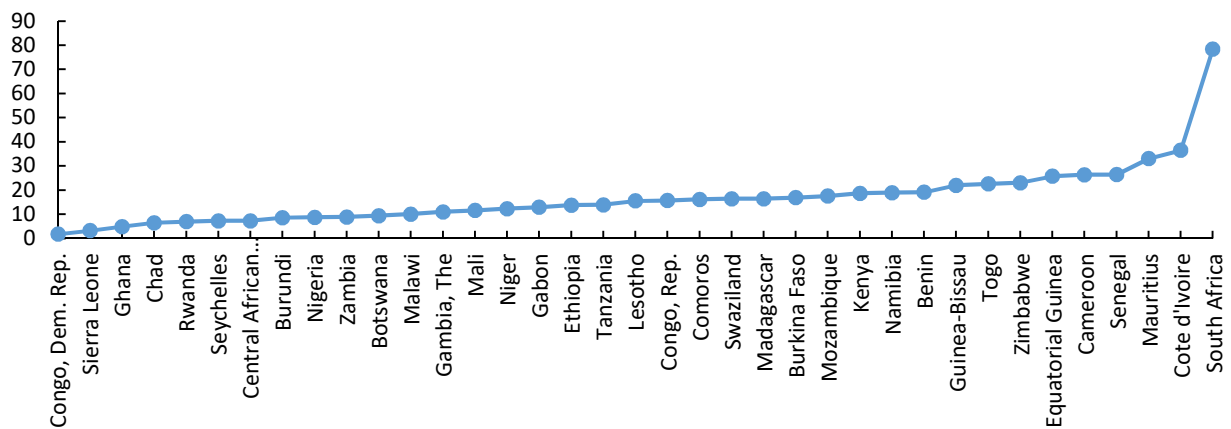
Source: World Development Indicators and Author’s estimates

Figure 10: Financial Deepening Sub-Saharan African Countries (Credit to the Private Sector % of GDP, 1980)



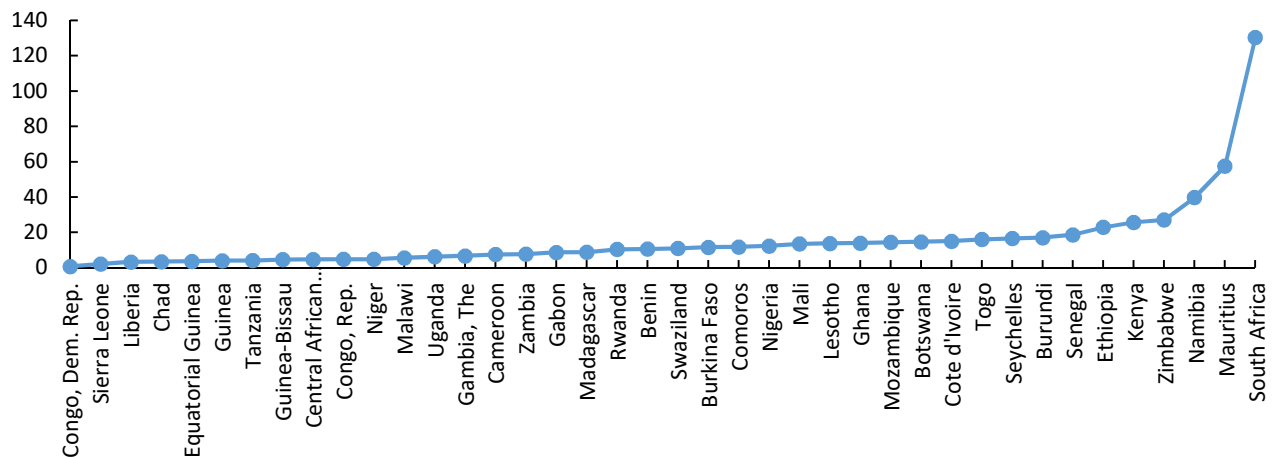
Source: World Development Indicators and Author's estimates

Figure 11: Financial Deepening Sub-Saharan African Countries (Credit to the Private Sector % of GDP, 1990)



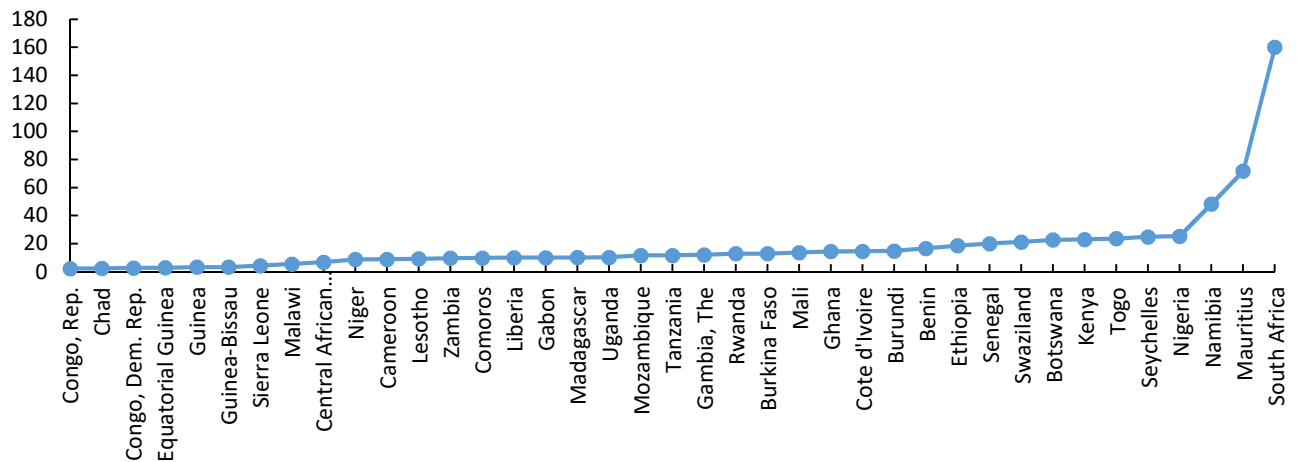
Source: World Development Indicators and Author's estimates

Figure 12: Financial Deepening Sub-Saharan African Countries (Credit to the Private Sector % of GDP, 2000)



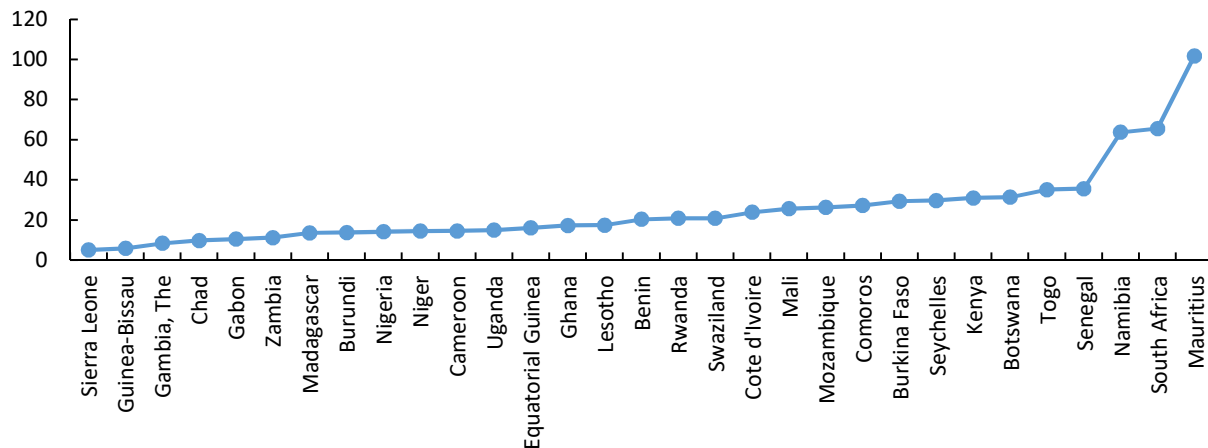
Source: World Development Indicators and Author's estimates

Figure 13: Financial Deepening Sub-Saharan African Countries (Credit to the Private Sector % of GDP, 2007)



Source: World Development Indicators and Author's estimates

Figure 14: Financial Deepening Sub-Saharan African Countries (Credit to the Private Sector % of GDP, 2017)



Source: World Development Indicators and Author's estimates

In 1965, Ghana ranked 10th out of 23 sub-Saharan African countries. In 1980, the country's ranking worsened to 31st out of 32 countries. This declined further to 35th out of 37 countries in 1990. However, the ranking improved to 14th out of 40 countries by end of the year 2000, 15th out of 39 countries by end of 2007, and 18th out of 31 sub-Saharan African countries. Although the rankings in 2007 and 2017 were better than earlier rankings, there was a deterioration compared with the previous ranking in 2000.

The financial system is currently dominated by the banking system, which is further dominated by few large banks, hence the potential for the few to influence price setting and distort competitive behaviour. This uncompetitive behaviour is akin to a monopolistic market structure and is also evidenced by the wide interest rate margins and spreads, which tend to deter potential savers and borrowers. Buchs and Mathisen (2005) argue that this unique cost structure and extremely high profit margins of Ghanaian Banks may be an indication that the banking sector may be monopolistic.

Finally, about 70%-80% of the economy is still informal with a lot of people still outside the banking system. The banking sector is the foundation on which the financial system evolves. Therefore, these factors affect the efficiency and effectiveness of financial intermediation, which ultimately affect the effectiveness of monetary policy because of their impact on the transmission process.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

The study adopts the methodology employed by Bernanke and Blinder (1992), and Sims (1992) in investigating the eventual impact of the monetary policy rate on inflation and the channels through which this transmission takes place. This approach will enable us to trace out the dynamic structural effects of the monetary policy rate and also unravel the transmission mechanism without specifying an explicit structural model.

This study employs econometric techniques such as: Vector Error Correction Model (VECM), Granger Causality (Block Exogeneity) Test, Impulse Responses Functions (IRFs), and Forecast Error Variance Decomposition (FEVD). However, since the VECM estimates, in and of themselves, are not very useful as a result of problems associated with them, the study focuses on the use of Granger Causality Test, IRFs and FEVD to assess the predictive power of the variables and also uncover the dynamic interrelationships among the variables. In fact, these three tools or statistics are actually generated from the VECM estimates and have been empirically proven to be useful. Finally, the study employs the Choleski decomposition approach to aid in ordering the variables for the purposes of generating the IRFs and FEVD.

We employ four models in addressing the five objectives of the study; firstly, the effects of oil price and fiscal deficits are not considered (Model I); secondly, only the oil price is included and the effects on the policy rate and transmission mechanism are assessed (Model II); thirdly, only the fiscal deficit is included (Model III); lastly, both oil price and fiscal deficits are included and their combined effects on monetary policy assessed (Model IV).

4.2 Model Specification

Bernanke and Blinder (1992) states that *“it is extremely risky to make structural inferences from an unrestricted vector-autoregression, which are after all only reduced forms”*. According to them, to measure the real structural effects of any monetary policy, there are only two options available. The first option is it to specify and estimate a structural model. They argue, however, that this option comes with a serious drawback which is that *“structural models are typically sensitive to the choice of specification and to the identifying assumptions”*. Enders (2015), who cited Sims (1980), Sims, Stock and Watson (1990) states that the primary objective of a VAR is to find the important interrelationships among the variables and not to necessarily ascertain the estimates of the parameters. Therefore, they argue against the imposition of *“incredible identification restrictions”* to obtain a structural model, since any improper imposition of restrictions can result in wasting or losing significant information. However, it is also argued that a VAR or VECM may not be very useful for any meaningful economic analysis if there is no economic theory or structure underpinning the model.

The second option is not to specify an explicit structural model, but rather to identify a direct measure of monetary policy, which is underpinned by two assumptions; first, innovations in the identified or isolated monetary policy variable can be interpreted as representing policy shocks. Second, the policy variable should be affected by other economic variables with a lag, that is to say, the policy variable is *“independent of contemporaneous economic disturbances”*. Under these assumptions, the dynamic response of the economy to changes in the policy variable, measures the true dynamic structural effects of monetary policy and by examining the responses to changes in the policy variable, the monetary policy transmission mechanism is revealed. Although not explicitly specified, the second approach is implicitly structural because we use a Choleski

decomposition to recover the underlying structural economic model from an estimated vector error correction model.

A violation of the underlying assumptions may render this approach unsuitable and results unreliable. In taking monetary policy decisions, the policy-makers performs a comprehensive review of the economy. This means that the policy rate may be affected by other economic variables. However, our assumptions are valid and results reliable considering the fact that the monetary policy rate is the main policy instrument employed by policy-makers and inflation is the ultimate policy objective under the current inflation targeting regime.

This study follows the second approach (option), therefore, there is no need to specify an explicit structural model. We identify the monetary policy rate as the direct measure of monetary policy in the country. Furthermore, we assume that changes in the monetary policy rate represents changes in policy actions and that the policy variable is affected by the economic variables with a lag whilst the policy variable affects all other variables contemporaneously. Therefore, the monetary policy rate and inflation are ordered first and last respectively for the purpose of generating the IRFs and FEVDs.

To address our first two objectives, we proceed to specify, in generic form, a vector error correction model (VECM) in equation form as:

$$\Delta Y_t = \sum_{i=1} \alpha_i \Delta Y_{t-i} + \sum_{j=0} \beta_j \Delta X_{t-j} + \lambda (Y_{t-1} - \pi - \psi X_{t-1}) + \varepsilon_t \dots \dots (1)$$

where Y_t represent the dependent variables, X_t represents the other independent variables, α_i and β_j represent short-run relationships, ψ is represents long-run adjustment or relationship, λ is the speed of adjustment towards long-run equilibrium. $Y_{t-1} - \pi - \psi X_{t-1}$ represents error correction/cointegrating term. In this equation, λ , π and ψ are assumed to remain constant. The error term is normally distributed with zero mean and constant variance.

To achieve the third, fourth, and fifth objectives of this study, oil price and fiscal deficits are separately and also jointly included as exogenous variables. Their inclusion transforms the VECM model into Vector Error Correction Models with exogenous variables (VECMX). The second equation includes only the oil price; the third includes only the fiscal deficit; and the fourth equation includes both oil price and fiscal deficit. The equations, in generic forms, are as follows:

$$\Delta Y_t = \sum_{i=1} \alpha_i \Delta Y_{t-i} + \sum_{j=0} \beta_j \Delta X_{t-j} + \sum_{n=0} \chi_n \Delta Z_{t-n} + \lambda(Y_{t-1} - \pi - \psi X_{t-1}) + \varepsilon_t \dots (2)$$

$$\Delta Y_t = \sum_{i=1} \alpha_i \Delta Y_{t-i} + \sum_{j=0} \beta_j \Delta X_{t-j} + \sum_{n=0} \chi_n \Delta \Phi_{t-n} + \lambda(Y_{t-1} - \pi - \psi X_{t-1}) + \varepsilon_t \dots (3)$$

$$\Delta Y_t = \sum_{i=1} \alpha_i \Delta Y_{t-i} + \sum_{j=0} \beta_j \Delta X_{t-j} + \sum_{n=0} \chi_n \Delta \infty_{t-n} + \lambda(Y_{t-1} - \pi - \psi X_{t-1}) + \varepsilon_t \dots (4)$$

where Z_t represents exogenous oil price, Φ_t represents exogenous fiscal deficit, and ∞_t represents exogenous oil price and fiscal deficit. All other definitions and assumptions remain the same and still valid.

4.3 Sources and Data Type

The study employs monthly time series data (sourced from the Bank of Ghana) to assess the impact of the monetary policy rate on the inflation rate via the various monetary policy transmission (interest rate, lending, exchange rate, and asset price) channels. Firstly, in order to explore the impact of the monetary policy rate on inflation and uncover the transmission mechanism, the following variables are used in the study: the monetary policy rate, interbank interest rate, 91-day treasury bill rate, exchange rate, lending rate, private credit, asset prices, output, and inflation. Secondly, oil price and fiscal deficit are included to enable us study the respective effects of supply shocks and fiscal dominance on the effectiveness of the policy rate and the transmission mechanism. Table 1 provides details of the variables and reasons for their selection.

Table 1: Variable Definitions and Explanations

Variable	Mnemonic	Explanation
Monetary policy rate	MPR	Monetary policy rate is included since it is the main monetary policy tool used by Bank of Ghana in the conduct of monetary policy. Therefore, changes in the policy rate indicate changes in monetary policy stance of the central bank. The dynamic response of inflation to changes in the policy rate will determine the effectiveness of the policy tool. Also, it will enable us uncover monetary policy transmission mechanism by examining the responses of the various variables to changes in the policy variable.
91-Day Treasury bill rate	TBR	It plays a key role in the transmission of the policy rate to the four main transmission channels (i.e. interest rate, exchange rate, credit, and asset price) and to the rest of the economy. It ranked second only to the monetary policy rate with regard the ranking of interest rates in the country.
Interbank interest rate	IBI	It is the rate at which the universal banks lend to each other. The interbank interest rate is expected to be affected by the monetary policy rate since the latter is the rate at which the central bank also lends to the universal banks. Finally, it a key determinant of lending rates and credit in the country and also serves as the central bank's operating target.
Lending rate	CBL	The lending rate is the rate at which the banks provide credit to consumers and firms. The lending rate is affected by the policy rate, treasury bill rate, and interbank interest rate. Also, it is key determinant for the delivery of loans as it represents the price of credit. In this study and like Akosah (2015), it represents the interest rate transmission channel.
Private sector credit	PSC	Private sector credit is included to represent the credit transmission channel. The credit channel is very important considering the significant role being played by banks and the dependence on credit by consumers and firms in the country. Higher treasury bill rates can easily crowd-out the private sector.
Exchange rate	EXR	The exchange rate is included to represent the exchange rate channel. It is affected by interest rates; higher interest rates attract foreign capital into the country for investment purposes to take advantage of the relatively higher interest rates, other things being equal. The cedi dollar exchange rate is used in this study because of the dominance of the United States Dollar in foreign trade and the apparent dollarisation of the Ghanaian economy. An increase in the exchange rate represents depreciation of the cedi whilst a decrease means an appreciation.
Share price	GSE	Share price is used as a proxy to represent asset prices and as such represents the asset price transmission channel. The stock market is expected to reflect real economic conditions. It is also expected to be inversely related to the money market; higher interest rates on say treasury bills cause movement of funds from the stock (capital) market to the money market. Such movements negatively impact share prices and the ability of firms to raise capital for the production and or supply of goods and services.
Output	GDP	Output (GDP) is a target variable and plays an important role since it represents demand and supply conditions in the economy. Output has an interesting relationship with inflation; low and stable inflation leads to higher output and economic growth whereas an overheated economy leads to inflation. In this study, real output is represented by the "Bank of Ghana Composite Index of Economic Activity" (CIEA-Real) and also used as a proxy for aggregate demand consistent with Bernanke and Blinder (1992), and Sims (1992).

Variable	Mnemonic	Explanation
Inflation rate	INF	The inflation rate is the primary and overriding target variable of interest under an inflation targeting regime and expected to be influenced by all the above variables.
Oil Price	Oil	This represents the crude oil price denoted in United States Dollars and included as an exogenous variable to represent supply shocks. It is argued that one of the several issues affecting inflation targeting in Ghana is the vulnerability of the economy to supply shocks.
Fiscal Deficit	FDB	It is included as an exogenous variable to represent fiscal dominance; it is argued that inflation targeting as monetary strategy cannot be very effective in the presence of fiscal dominance.

Generally, this study covers the period May 2007 to December 2017. However, data on the fiscal deficit (balance) is only up to December 2016. This is mainly due to time constraints and the difficulty in obtaining the monthly fiscal deficits for the entire period up to December 2017. It is also important to state that although inflation targeting in Ghana commenced in 2002, the official implementation date is May 2007. Therefore, we chose the official implementation date instead of the unofficial date for this study because of the following reasons: firstly, it is generally agreed that the *“hallmark of inflation targeting”* is the public announcement of the policy (Bernanke & Mishkin, 1997). Secondly, it is also argued that as at the initial adoption date in 2002, most of the prerequisites for an effective implementation of an inflation targeting regime in Ghana had not been met (Addison, 2008). Finally, Addison states that it was only after the official announcement that the Central Bank completely shifted away from targeting monetary aggregates.

4.4 Time Series Properties of Variables

In economic studies involving time series data, it is important to perform a unit root test on all the variables. This is intended to aid in the selection of the appropriate econometric methods to use and to avoid spurious analysis. To test for the presence of unit roots, we employ the Augmented Dickey Fuller (ADF) and the Philips-Perron (PP) Tests. These two methods are generally used in the literature. If after testing, all the variables are found to be $I(0)$, that is, stationary at levels, then the estimation can be done using a traditional Vector Autoregression (VAR) Model or an Autoregressive Distributed Lag (ARDL) Model. Nonetheless, if they are all found to be $I(1)$, that

is, non-stationary at levels but stationary at first difference, then it means there is a high possibility that the variables are cointegrated. This indicates the presence of both short-term and long-term relationships, that is, dynamic relationship between the variables. A cointegration test is then performed and if cointegration is found, then either a VECM or an ARDL can be used. Nonetheless, VECM is the most common method normally adopted when all the variables are I (1). However, if the tests show that one or more of the variables are I (1) whilst the others are I (0), then the most appropriate methodology is an ARDL Framework. But, the ARDL framework performs poorly if any of the variables is I (2), that is, stationary at second difference.

4.5 Cointegration Test

A linear combination of two I (1) variables can only be I (0) if the two variables are cointegrated. In fact, cointegration could be a result of long-term or equilibrium conditions between the variables or the fact the variables may be influenced by the same economic conditions (Brooks, 2014). The Johansen approach is the most widely used method for testing cointegration and this approach is basically based on examining the rank of the long-run coefficient matrix via its eigenvalues. There is no cointegration if the rank is not significantly different from zero.

There are basically two test (trace and maximal) statistics under this approach. In respect of the trace statistic, which is actually a joint test, the “*null is that the number of cointegrating vectors is less than or equal to r* ” whilst the alternative hypothesis is that the number of cointegrating vectors is more than r . Yet, the maximal test is not a joint test but a separate test of each eigenvalue with “*null hypothesis that the number of cointegrating vectors is r against the alternative hypothesis of $r + 1$* ”, where r represents the number of cointegrating vectors. Nonetheless, the cointegration test is affected by the choice of lag length hence the need to select an appropriate lag length (Brooks, 2014, p.387).

4.6 Choice of Appropriate Time Lag Structure

This study employs all the five measures, which have been widely used in the literature. These measures (information criteria) are: Schwarz Criterion (SC), Akaike Information Criterion (AIC), Final Prediction Error Criterion (FPE), Hannan-Quinn Criterion (HQ), and Sequential modified LR test statistic (LR). The main rationale is to choose an appropriate lag length that minimises the value of the given information criterion. In addition to these information criteria, Enders (2015) and Abradu-Otoo et al. (2003) state, among other things, that the final lag length must also be selected based on the principle of parsimony (meaning sparseness or stinginess) and absence of serial correlation. A parsimonious model describes all the characteristics of the data of interest with only few parameters. It also has an appropriate theoretical underpinning with all coefficients correctly signed and sized (Brooks, 2014).

4.7 Choleski Decomposition

This decomposition methodology has been commonly used in the literature for the purposes of ordering the variables in an econometric model. It is also one of the several ways of imposing identification restrictions. In a Choleski decomposition, “*all elements above the principal diagonal*” are zero and because of its triangular nature, it forces an exactly $(n^2 - n) / 2$ values on the B matrix to equal zero resulting in an exact identification of the system. In an n -variable system, B represents an $n \times n$ matrix with n regression residuals and n structural shocks (Enders, 2015). Therefore, this places significant value on the ordering of the variables, which also affects the impulse response functions and variance decompositions. The implication is that shocks to a variable have contemporaneous effects on the variables following it whilst affecting preceding variables only with a lag, that is, there is contemporaneous effects on preceding variables.

This study assumes that the innovations in a Choleski decomposition can be used to recover the underlying structural economic model from our estimated vector error correction model.

Consequently, and like Bernanke and Blinder (1992) and Sims (1992), the monetary policy rate is ordered first since we assume that a shock to the policy variable affects all other variables contemporaneously whereas the inflation rate is ordered last as we assume that inflation is contemporaneously affected by all the other variables. Therefore, following a Choleski ordering, the variables are ordered as follows: policy rate, 91-day treasury bill, interbank interest rate, lending rate, private sector credit, exchange rate, share prices, output, and inflation.

To recover the structural dynamic response of the estimated equations, there is a need to restrict the system to be able to recover ε_t from the observed values of e_t (regression residuals). It can be shown that $\varepsilon_t = B e_t$ or $e_t = B^{-1} \varepsilon_t$ hence ε_t represents a composite of e_t . In fact, the number of restrictions imposed by the Choleski decomposition in our nine-variable model is exactly 36 $((n^2 - n)/2)$ and that is what is required for our system to be exactly identified. The matrix below shows the restrictions imposed on our models:

$$\begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \\ e_{6t} \\ e_{7t} \\ e_{8t} \\ e_{9t} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{21} & b_{22} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & b_{33} & 0 & 0 & 0 & 0 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & b_{44} & 0 & 0 & 0 & 0 & 0 \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} & 0 & 0 & 0 & 0 \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & b_{66} & 0 & 0 & 0 \\ b_{71} & b_{72} & b_{73} & b_{74} & b_{75} & b_{76} & b_{77} & 0 & 0 \\ b_{81} & b_{82} & b_{83} & b_{84} & b_{85} & b_{86} & b_{87} & b_{88} & 0 \\ b_{91} & b_{92} & b_{93} & b_{94} & b_{95} & b_{96} & b_{97} & b_{98} & b_{99} \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \\ \varepsilon_{8t} \\ \varepsilon_{9t} \end{bmatrix}$$

As already indicated and shown in matrix above, the monetary policy rate is placed as the first variable which means it affects all the variables contemporaneously whilst all the other variables in the system affect the policy variable with a lag. In fact, in taking monetary policy decisions, the monetary policy committee conducts a comprehensive review of the local and global economy. The 91-day treasury bill rate is placed 2nd whilst the interbank interest rate is placed 3rd in

accordance with previous studies which provide evidence that the 91-day treasury bill plays a more significant role in the transmission process than the interbank interest rate. These two contemporaneously affects the lending rate as they play significant roles in the determination of lending rates.

Lending rate, credit, exchange rate, and share prices are ordered as 4th, 5th, 6th, and 7th respectively in accordance with theory and previous studies. It is expected that the lending rate affects the delivery of credit whilst exchange rate is affected by interest rates and credit. It is also expected that asset prices will be affected by the policy rate, wholesale interest rates (interbank interest and 91-day treasury bill rates), lending rate, private sector credit, and the exchange rate. Output reflects demand and supply conditions so has been ordered as the 8th variable and used as a proxy for aggregate demand (consistent with Bernanke & Blinder, 1992) and supply. We assume output affects inflation contemporaneously, whilst output is also contemporaneously affected by the other variables. As the ultimate target of monetary policy in the country, inflation is ordered last; we assume that it is affected contemporaneously by the other variables. The overall objective of monetary policy under an inflation targeting regime is that the policy rate will be transmitted through the economy and ultimately impact inflation and the economy in general.

For robustness testing purposes, two alternative Choleski orderings are considered as follows: first, policy rate, 91-day treasury bill rate, interbank interest rate, lending rate, credit, exchange rate, share price, inflation, and output. The difference between the two orderings is the change in the placement position of output and inflation; output is now placed last (8th) whilst is inflation is now placed in the 7th position. Theoretically, inflation and output affect each other (i.e., bi-directional relationship), therefore, their positions may be interchanged and tested. Akosah (2015), places output before inflation in his main model and later placed output as a last variable for robustness testing purposes. The second alternative ordering is as follows: output, inflation, policy rate,

treasury bill rate, interbank interest rate, lending rate, private sector credit, exchange rate, and asset price; this is the ordering used by Akosah (2015) in his main structural model. In effect, our two alternative orderings are consistent with Akosah (2015), who primarily used both alternative orderings; one as the main model and the other for robustness testing purposes. The only difference is the addition of the treasury bill rate and the interbank interest rate in our alternative orderings.

4.8 Other Econometric Tools

According to Brooks (2014), VAR or VECM estimates alone are not very useful and can be very difficult to interpret. This is because: VAR or VECM models are generally considered a-theoretical since they are generally assumed to have little theoretical underpinning in the specification or construction of the model regarding the relationship between the variables; they can involve large number of parameters and lags; coefficients of some lagged variables may change signs across the lags; and there are several interconnections between the variables or equations. Therefore, it is sometimes difficult to ascertain which of the variables significantly affects each dependent variable and which do not. Finally, states that it is very dangerous to draw conclusions of structural nature from an unrestricted vector-autoregression (Bernanke and Blinder, 1992).

To partly resolve these problems, additional econometric tools (block significance tests, impulse responses, and variance decompositions) have been employed in the literature to aid in understanding and interpreting the dynamic interrelationships among the variables (Brooks, 2014). Therefore, following Sims (1992), and Bernanke and Blinder (1992), we do not pay particular attention to the VEC regression results (estimates) hence we do not present the VECM estimates though we provide a summary of the major conclusions as compared with the other techniques (see section 5.12). We rather rely on VEC Granger Causality (Block Exogeneity) Test, Impulse Responses Functions, and Forecast Error Variance Decomposition, which are generated from the VECM estimates, to address our research objectives.

4.8.1 Granger Causality (Block Exogeneity)

Granger-causality test enables the placement of restrictions on the lags of the variables not under consideration leaving only the variable of interest to be able to assess its impact on the dependent variable. Actually, Granger causality is about the current and past values of one variable helping to forecast the value of another. If a variable does not improve the forecasting ability of another, then it does not Granger-cause it. “Granger-causality really means only a correlation between the current value of one variable and the past values of others; it does not mean that movements of one variable cause movements of another” (Brooks, 2014, p.335). Also, it can also be used to detect whether to include any additional variable into a VAR or VECM.

Bernanke and Blinder (1992), employ the use of Granger causality tests to assess the predictive power of monetary policy though they state that this has one major drawback which is that the right-hand variables are not orthogonalised. Therefore, if say the monetary policy rate drives the treasury bill rate, which in turn affects inflation, then the policy rate might not be significant in a regression that includes the treasury bill rate even though the policy rate truly impacts inflation. Also, Granger-causality tests do not indicate the sign of the relationship, that is, whether negative or positive. Finally, it is unable to provide an indication of when and how long these effects will take place (Brooks, 2014). These drawbacks are addressed by the impulse response functions and forecast error variance decompositions.

4.8.2 Impulse Responses Functions (IRFs)

Brooks (2014, p.336) states that “Impulse responses trace out the responsiveness of the dependent variables in the VAR to shocks to each of the variables.” It measures or traces the time profile of the effects of the shocks to the variables in system. This methodology enables us to assess the impact of the monetary policy rate on inflation and also uncover the channels through which these

effects take place. However, one major drawback of the approach is the reliance on the ordering of the variables in the system.

4.8.3 Forecast Error Variance Decomposition (FEVD)

According to Brooks (2014, p.337), “Variance decompositions offer a slightly different method for examining VAR system dynamics. They give the proportion of the movements in the dependent variables that are due to their ‘own’ shocks, versus shocks to the other variables.” What FEVD does is to essentially account for the total forecast error variance in a variable by attributing this total variance to each of the variables in the model including its own shocks. In citing Sims (1980) and Litterman and Weiss (1985), Bernanke and Blinder (1992) acknowledge that another way of assessing the predictive power of a policy variable is to use FEVD. Nevertheless, this also suffers from the same drawback as the IRFs; it depends on the ordering of the variables. Therefore, we rely on the Choleski decomposition to generate both the FEVD and IRFs.

4.9 Post-Estimation (Diagnostic) Tests

We perform post-estimation tests in accordance with the literature. These tests are important to ensure our model is well specified so that all inferences made regarding the influence of the variables are valid. We perform tests to check for the following: serial correlation, normality, and heteroscedasticity. Although estimates are still unbiased even in the presence of serial correlation, they are not efficient even for large sample sizes resulting in wrong estimates in respect of the standard error estimates. In the presence of heteroscedasticity, even though coefficient estimates remain unbiased, there will no longer be minimum variance among the estimates. Finally, normality implies that disturbances are normally distributed hence do not suffer from skewness or kurtosis. However, non-normality is inconsequential if the sample size is reasonably large because of the central limit theorem. Basically, this theorem states that, as the sample size tends to infinity, “the sample mean converges to a normal distribution”. “For sample sizes that are sufficiently large,

violation of the normality assumption is virtually inconsequential. Appealing to a central limit theorem, the test statistics will asymptotically follow the appropriate distributions even in the absence of error normality” (Brooks, 2014, p.210). This study tests for serial correlation using both the Portmanteau Autocorrelations and Breush-Godfrey LM Serial Correlation Tests. Normality is tested using the Jarque-Bera Normality Tests whilst we use the White Heteroscedasticity Tests (No Cross Terms) to test for heteroscedasticity.

4.10 Summary

The study adopts an approach, consistent with the literature, which requires us to assume that the monetary policy rate is the direct measure of monetary policy and that it is affected by economic variables with a lag whilst affecting all other variables contemporaneously. Therefore, the policy rate will be ordered first and inflation ordered last. This enables us to trace out the actual effects of the policy rate on inflation and assess the transmission mechanism through which these effects take place, without specifying an explicit structural model. An alternative approach would have required the specification of an explicit structural model.

We employ the following econometric techniques: VECM, VEC Granger Causality Tests, IRFs, FEVD, and Choleski Decomposition. However, there are problems associated with both VECM estimates and the Granger Causality Tests. We use variables sourced from the Bank of Ghana covering the period May 2007- December 2017: monetary policy rate, 91-day treasury bill rate, interbank interest rate, exchange rate, lending rate, private sector credit, share price, output, and inflation. Oil price and fiscal deficit will be separately and jointly included and their individual as well as their combined effects on the effectiveness of monetary policy and its associated transmission mechanism assessed. All appropriate pre and post-estimation tests will be performed in accordance with the literature. Finally, two alternative orderings will be considered for robustness testing purposes .

CHAPTER FIVE

ANALYSIS AND DISCUSSION OF RESULTS

5.1 Introduction

This chapter contains the results, analysis and discussion of those results. The chapter is divided into main two parts. The first part contains: preliminary analysis, unit root tests, lag order selection, cointegration tests, and post-estimation VECM diagnostic tests; and the second part contains the detailed empirical analysis and discussions of the results in respect of the four models (Model I-IV) using: VEC Granger Causality (Block Exogeneity) Tests, Impulse Responses Functions (IRFs), and Forecast Error Variance Decompositions (FEVD).

Part I: Preliminary Results and Analysis

5.2 Preliminary Data Analysis

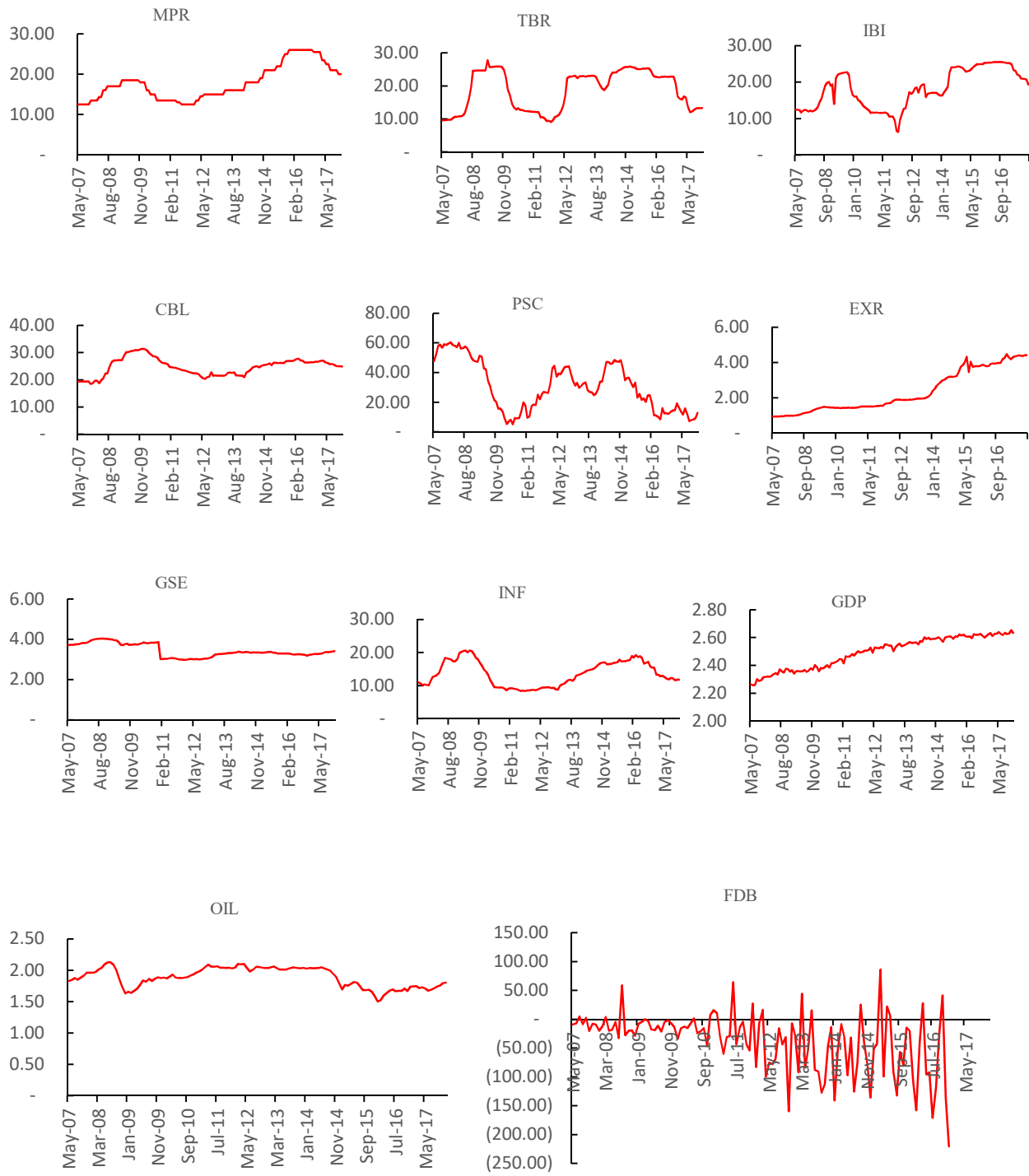
The preliminary graphical analysis and descriptive statistics provide an initial understanding about the behaviour of the variables under consideration. Figure 15 provides a graphical representation of the variables whilst Table 2 shows a summary of the descriptive statistics. It must be noted that output, stock market index, and oil prices are expressed in logarithmic forms whereas fiscal deficit is expressed in millions of Ghana Cedi. The rest are expressed in percentages.

5.2.1 Graphical Analysis

The diagrams (Figure 15) show that all the variables exhibit some trend characteristics; monetary policy rate, commercial bank base rate, and inflation exhibit a similar trend. Exchange rate and output show a consistent and upward trend whilst treasury bill and interbank interest rates show some cyclical trends. Meanwhile, private sector credit and fiscal balance show high variability over the period. The stock market index (share price), oil price, and output show less variability

because there are expressed in logarithmic forms, but also show high variability if not expressed in logarithmic forms.

Figure 15: Graph of Macroeconomic Variables, May 2007 to December 2017



Source: Bank of Ghana

5.2.2 Summary of Descriptive Statistics

In respect of the summary of descriptive statistics, Table 2 provides the mean, median, and standard deviation of the variables among others. The average monetary policy rate over the period has been relatively high at approximately 17.82%, ranging from a minimum of 12.5% to a maximum of 26% with a standard deviation of 4.42. As expected, the variability in inflation is very similar to that of the monetary policy rate though inflation averaged 13.65% with a minimum of 8.39% and a maximum of 20.7%. The two money market securities or wholesale interest rates show very similar results in terms of variability (standard deviation), single digit minimum rates, maximum values of over 20%, and average rates of over 18%. Finally, private sector credit and fiscal deficits are the most volatile and this confirms the preliminary graphical analysis.

Table 2: Descriptive Statistics of Macroeconomic Variables

Variable	Mean	Median	Maximum	Minimum	Std. Dev.
Monetary Policy Rate	17.81719	17.00000	26.00000	12.50000	4.322713
91-Day Treasury Bill Rate	18.80929	21.96500	27.80000	9.130000	5.968204
Interbank Interest Rate	18.20164	18.07500	25.51000	6.350000	5.302937
Lending Rate	24.81672	25.14000	31.40000	18.55000	3.239517
Private Sector Credit	30.83388	29.17707	60.43014	5.280414	16.43814
Exchange Rate	2.327422	1.879450	4.478600	0.927400	1.184994
GSE (Asset Price) Index	3.443754	3.348306	4.037060	2.986337	0.324518
Inflation	13.64672	13.20000	20.70000	8.390000	3.781112
Output	2.495718	2.529106	2.654184	2.258325	0.113540
Oil price	1.889877	1.896541	2.129667	1.504165	0.156160
Fiscal Deficit *	-37.57263	-21.03739	86.31882	-220.277	51.89592

Notes: * Fiscal deficits are as at December 2016.

Source: Author's estimates

The correlation coefficients for all the variables under consideration are presented in Table 3. There is a statistically significant correlation between monetary policy rate and inflation. This is expected as the monetary policy rate is expected to ultimately influence inflation under the current inflation targeting regime. Further, the monetary policy rate has a statistically significant positive correlation with both the treasury bill and interbank interest rates. As expected, the treasury bill rate and interbank interest rate are both significantly correlated with the lending rate. Also, the three (lending rate, exchange rate, and asset prices) of the four transmission variables are

significantly correlated with inflation. Although there is a correlation between private sector credit and inflation, it is not statistically significant. Surprising, there is a statistically significant negative correlation between oil prices and inflation. Finally, there is also an unexpectedly negative correlation between fiscal deficit and inflation though not statistically significant.

Table 3: Correlation Matrix of Macroeconomic Variables

	CBL	EXR	GDP	FDB	GSE	INF	IBI	MPR	OIL	PSC	TBR
CBL	1										
EXR	0.263***	1									
GD	0.053	0.865***	1								
FDB	0.033	-0.418***	-0.467***	1							
GSE	0.271***	-0.452***	-0.729***	0.331***	1						
INF	0.571***	0.423***	0.090	-0.076	0.417***	1					
IBI	0.497***	0.790***	0.562***	-0.321***	-0.052	0.762***	1				
MPR	0.502***	0.866***	0.600***	-0.340***	-0.102	0.742***	0.896***	1			
OIL	-0.566***	-0.536***	-0.162*	0.143	-0.202**	-0.647***	-0.639***	-0.758***	1		
PSC	-0.509***	-0.348***	-0.379***	0.167*	0.326***	0.135	-0.114	-0.292***	0.259***	1	
TBR	0.459***	0.542***	0.463***	-0.209**	-0.006	0.705***	0.849***	0.670***	-0.407***	0.048	1

Notes: All variables are restricted to 2016 to generate the correlation coefficients. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Author's estimates

5.3 Results from Unit Root Tests

The results from a unit root test based on the ADF and the PP tests are presented in Table 4. The results indicate that all the variables are non-stationary at levels but become stationary at first difference. This means that the variables are I (1) and a possibility that they are cointegrated. In respect of the fiscal deficit, the ADF test indicates non-stationarity at levels and stationarity at first difference, that is, when only constant term is used whilst the PP test indicates stationarity at levels. However, we proceed to conduct a cointegration test after the selection of an appropriate lag length.

Table 4: Time Series Properties of the Macroeconomics Variables: May 2007-Dec. 2017

Variable	Augmented Dickey-Fuller (ADF) Test				Philip & Perron (PP) Test			
	Levels		First Difference		Levels		First Difference	
	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Intercept	Intercept & Trend
INF	-1.887	-1.803	-7.134	-7.165	-1.7	-1.623	-7.6	-7.621
MPR	-1.418	-1.311	-5.55	-5.581	-1.369	-1.39	-11.424	-11.433
TBR	-2.356	-2.137	-6.081	-6.17	-2.114	-1.817	-6.051	-6.181
IBI	-1.549	-1.561	-10.672	-10.655	-1.742	-1.926	-10.776	-10.757
CBL	-2.183	-2.06	-5.314	-5.386	-2.04	-1.884	-9.003	-9.05
PSC	-1.213	-1.469	-9.752	-9.709	-1.489	-1.811	-9.799	-9.755
EXR	0.839	-1.517	-17.331	-17.453	0.536	-2.03	-16.54	-16.946
GSE	-1.506	-1.552	-10.763	-10.74	-1.543	-1.625	-10.763	-10.74
OIL	-2.235	-2.584	-6.993	-6.971	-1.912	-2.269	-6.937	-6.913
GDP	-2.415	-1.902	-12.632	-8.86	-2.139	-2.905	-21.015	-62.722
Critical Values **								
1%	-3.483	-4.033	-3.483	-4.032	-3.482	-4.032	-3.483	-4.032
5%	-2.885	-3.446	-2.884	-3.446	-2.884	-3.446	-2.884	-3.446
10%	-2.579	-3.148	-2.579	-3.148	-2.579	-3.148	-2.579	-3.148

Notes: The null hypothesis of a unit root is rejected if the test statistic is more negative (i.e. smaller) than the critical value and not rejected if test statistic is not more negative (i.e. greater) than the critical value.

Source: Author's estimates

5.4 Results from Choice of Appropriate Time Lag Structure

The information criteria results are summarised in Table 5. The five measures show conflicting results: Hannan-Quinn Criterion (HQ) and Schwarz Information Criterion (SC) selected a lag length of one month whilst the Final Prediction Error (FPE) and Akaike Information Criteria (AIC) indicated lag lengths of two months but, the Sequential modified LR test statistic(LR) selected a lag length of three (3) as compared to the lag lengths selected by the other four measures. In order to resolve such conflicts, we proceed to consider the principle of parsimony and absence of serial correlation. The LM serial correlation test is used to perform an initial (pre-estimation) serial correlation test and the results indicate that it only at length of 3 that there is an unambiguous evidence of no serial correlation at 5% level of significance (Table 6). Therefore, the final lag selected for this study is 3. In the cases of when oil price and fiscal deficit are separately considered and when both are included together, we still use a lag length of 3 after considering the issue of

serial correlation among others (summary of additional information criteria results are not presented).

Table 5: Criteria for Selecting Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1626.060	NA	5.529545	27.25100	27.46006	27.33590
1	-309.7971	2413.148	6.35e-09	6.663284	8.753903*	7.512294*
2	-222.2640	147.3474	5.82e-09*	6.554400*	10.52658	8.167518
3	-145.5462	117.6338*	6.60e-09	6.625771	12.47950	9.002999
4	-101.0606	61.53851	1.35e-08	7.234343	14.96963	10.37568
5	-33.07383	83.85031	2.02e-08	7.451231	17.06808	11.35668
6	16.11142	53.28402	4.59e-08	7.981476	19.47988	12.65103
7	112.9981	90.42754	5.49e-08	7.716699	21.09666	13.15036
8	235.6729	96.09527	5.28e-08	7.022119	22.28364	13.21989

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

Table 6: Serial Correlation LM Tests

Lags	LM-Stat	Prob
1	122.1565	0.0021
2	103.1590	0.0490
3	84.12813	0.3840

Probs from chi-square with 81 df.

Source: Author's estimates

5.5 Results from Cointegration Test

In performing the cointegration test, we include a constant term and assumed there is no deterministic trend in data. The assumption was based on the results from the unit root testing and also to avoid the possibility of quadratic terms in the model (Abradu-Otoo et al. 2003). The trace and max-eigenvalue tests indicate conflicting results; the trace selects a cointegration of 4 whilst the maximal indicates 3. However, we selected 4 as we assume that there are more cointegrating equations than 3. Table 7 provides a summary of the cointegration test results. These results do

not include the effects of oil price or fiscal deficit. In addition to the above, three additional cointegration tests were also performed. Firstly, in the case of Model II (only oil price included), both the trace and max-eigenvalue statistics indicated 2 cointegrating equations. Secondly, we use 6 cointegrating equations for model III (only fiscal deficit included). Finally, in model IV (both oil price and fiscal deficits included), we use 4 cointegrating equations. However, the summary of these additional cointegration results are not presented.

Table 7: Cointegration Test Summary

Hypothesis		Eigenvalue	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value
H ₀	H ₁					
r = 0	r=1	0.490669	295.7457	208.4374	84.33209	59.24
r = 1	r=2	0.350394	211.4136	169.5991	53.9236	53.18784
r = 2	r=3	0.339414	157.49	134.678	51.82845	47.07897
r = 3	r=4	0.215414	105.6616	103.8473	30.32483	40.9568
r = 4	r=5	0.172261	75.33674	76.97277	23.63214	34.80587
r = 5	r=6	0.140399	51.7046	54.07904	18.91089	28.58808
r = 6	r=7	0.104082	32.79371	35.19275	13.73829	22.29962
r = 7	r=8	0.087145	19.05542	20.26184	11.39732	15.8921
r = 8	r=9	0.059426	7.658101	9.164546	7.658101	9.164546

Notes: Trace test indicates 4 cointegrating equation(s) at the 5% significant level whilst Max-eigenvalue test indicates 3 cointegrating equation (s) at the 5% significant level

Source: Author’s estimates

5.6 Results from Multivariate Diagnostic (Post Estimation) Tests

Table 8 provides a summary of all the multivariate diagnostic tests for Model I. Although diagnostic tests are also performed for the other models (II - IV), those results and associated residuals graphs are not presented. All the tests are valid and indicate a well specified model with the exception of the normality test which rejected the null hypothesis of residual normality. However, the absence of normality is not very important for this study since our sample size of 128 is considered to be sufficiently large in conformity with the central limit theorem.

Table 8: VEC Residuals Multivariate Diagnostic Tests

Portmanteau Autocorrelations Tests	92.52489 [0.9946]
LM Serial Correlation Tests	75.63551 [0.6475]
Jarque-Bera Normality Tests	31585.86 [0.0000]
White Heteroscedasticity Tests: No Cross Terms	2007.554 [0.3276]

Source: Author's estimates

Finally, we did not consider any of the alternatives proposed by Brooks (2014), which could be deployed in the presence of non-normality. This is because: other estimation methods that do not assume normality may be difficult to implement and we are not too sure of their properties or their appropriateness for this study. Secondly, the use of dummy variable to replace any outlier is not considered because of its potential to artificially improve the features of the model and the fact that all the data points in this study represent very significant pieces of information, therefore, it was very important for us to retain all data points. Finally, the sample size is not increased since we use the official inflation targeting of May 2007 instead of unofficial inflation targeting date which was in 2002. Appendix Figure 1 provides graphs of the residuals.

Part II: Empirical Results and Analysis

This second part is sub-divided into four sections. The first section (Model I) does not consider the effects of oil price and fiscal deficits. This enables us to achieve the first two objectives of the study. In the second section (Model II), only the oil price is included and its impact on the policy rate and transmission mechanism is assessed. This enables us to achieve the third objective of the study. In section three (Model III), we include only fiscal deficit and assess its impact. By doing this, we are able to achieve our fourth objective. The final section (Model IV) deals with the inclusion of both the oil price and fiscal deficits and their combined effects on monetary policy are assessed to enable us achieve the fifth objective of the study.

However, we employ VEC Granger Causality (Block Exogenous) Tests, Impulse Response Functions (IRFs), and Forecast Error Variance Decompositions (FEVD) for all four models. These techniques will enable us to assess the ultimate effect of the monetary policy rate on inflation and the channels through which this effect takes place.

5.7 Model I - Oil Price & Fiscal Deficit Excluded

In this section, no exogenous variable is included into the model. This model enables us to achieve the first two objectives of the study.

5.7.1 Granger Causality (Block Exogenous) Tests

Table 9 shows a summary of the VEC Granger Causality (Block Exogeneity) Test results. This enables us to assess the predictive or explanatory power for each of the variables in relation to the other variables in the system. Nonetheless, there is a need to be a little cautious with these results and conclusions bearing in mind the problems associated with the Granger Causality Tests.

Table 9: VEC Granger Causality (Block Exogeneity) Test Results

Forecasted variable	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
MPR	0.0000	0.7270	0.5838	0.3447	0.6152	0.0128	0.9424	0.1314	0.0623
TBR	0.0013	0.0000	0.0000	0.8884	0.0243	0.0021	0.6416	0.0052	0.1840
IBI	0.2246	0.5907	0.0000	0.7600	0.6312	0.6072	0.7091	0.2527	0.1317
CBL	0.084	0.0051	0.0394	0.0000	0.0244	0.8395	0.7598	0.7135	0.1098
PSC	0.5894	0.5308	0.1127	0.8229	0.0000	0.1360	0.0417	0.8845	0.6800
EXR	0.1080	0.2687	0.6279	0.7569	0.7074	0.0000	0.5429	0.9926	0.2400
GSE	0.7661	0.8477	0.7124	0.9332	0.4554	0.9439	0.0000	0.8097	0.5870
GDP	0.2788	0.1900	0.3368	0.5831	0.0671	0.3288	0.0024	0.0000	0.4275
INF	0.5401	0.3209	0.8904	0.4821	0.4554	0.9862	0.6168	0.0200	0.0000

Notes: For each forecasted variable, the entries across each row are the p-values (marginal significance levels) for omitting lags of other column variables not under consideration.

Source: Author's estimates

The results indicate that the monetary policy rate Granger-cause the 91-day treasury bill rate at 1% level of significance but do not Granger-cause the interbank interest rate. This means that the policy rate has explanatory power for the 91-day treasury bill but no explanatory power for the interbank interest rate. Also, the policy rate Granger-cause the lending rate at 10% level of significance but does not Granger-cause private sector credit, asset price, exchange rate, and output. Surprisingly, the policy rate does have any explanatory power for inflation. Only output has an explanatory power for inflation at 5% level of significance. This may provide some tacit support for the placement of output before inflation in the Choleski ordering process.

The treasury bill rate does not Granger-cause the interbank interest rate, though the latter Granger-causes the former at a significance level of 1%. However, the treasury bill rate and interbank interest rate explain the lending rate at 1% and 5% levels of significance respectively. Surprisingly, both do not Granger-cause credit, exchange rate, share price, output, and inflation. Unexpectedly, none of the variables representing the four transmission channels Granger-causes inflation even though the policy rate and the two wholesale interest rates all have explanatory powers for the lending rate at 10%, 1%, and 5% levels of significance respectively. Finally, only credit and asset price Granger-cause output at 10% and 1% levels of significance respectively.

In summary, the monetary policy rate is not effective as it does not Granger-cause inflation. Also, the transmission mechanism is also incomplete and consequently ineffective as there is no complete transmission from the policy rate to inflation. Although the policy rate predicts the treasury bill which in turn predicts the lending rate, the latter do not Granger-cause output and inflation. Also, even though credit and asset price have explanatory power for output and inflation, there is no transmission from the policy rate, treasury bill rate, and interbank interest rate. Finally, we observed that the treasury bill rate plays a more significant role than the other wholesale money market interest rate (i.e., interbank interest rate). This is consistent with Ghartey (2005), who finds that the treasury bill rate is significantly affected by the monetary policy rate. It is also consistent with Kovanen (2001), who finds the transmission from the policy rate to lending rates protracted and incomplete in the long run. He also finds that monetary policy significantly affects wholesale interest rates but with a delayed response on the interbank interest rate in the long run.

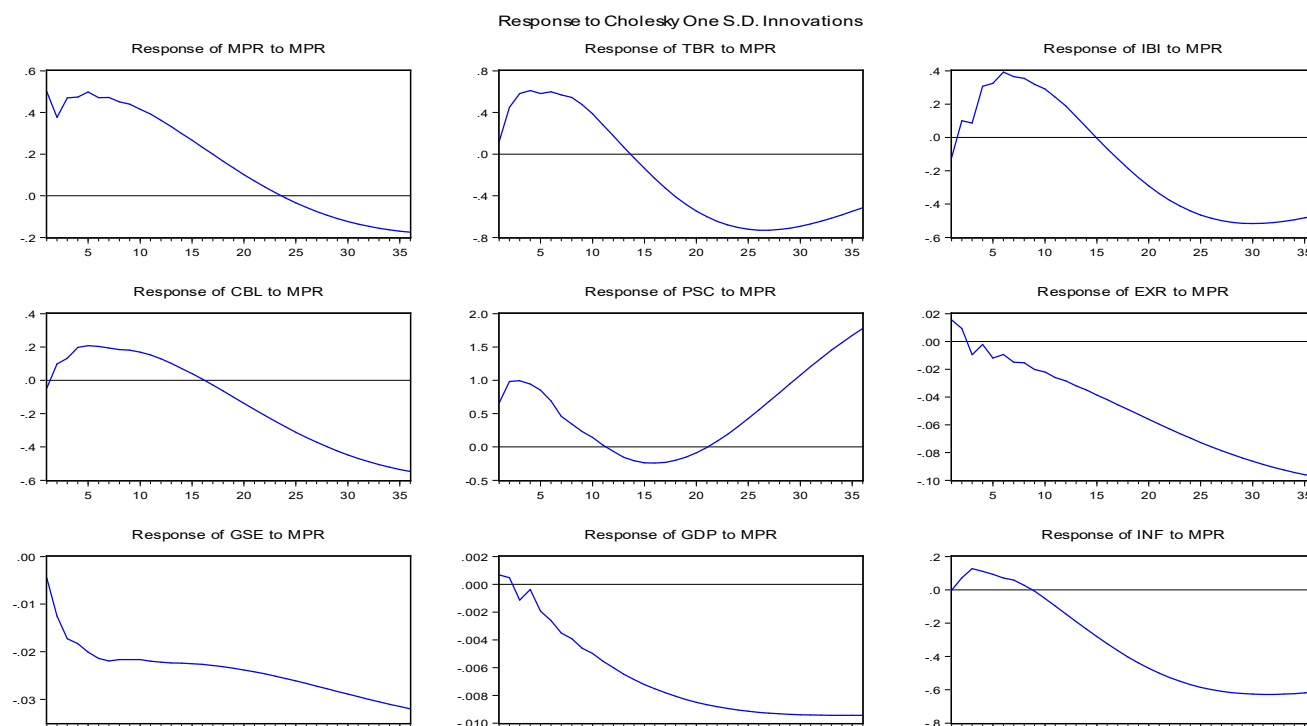
5.7.2 Impulse Response Functions (IRFs)

Figure 16 displays graphs of impulse responses from a one-standard-deviation shock to the monetary policy rate over a horizon of 36 months. Sims (1992) and Bernanke and Blinder (1992) adopted 48 months whilst Tahir (2012) and Akosah (2015) adopted 36 months. Nevertheless, the time horizon adopted by the Bank of Ghana is between 18-24 months. The study uses 36 months horizons and to some extent 24 months horizon. Appendix Figure 2 shows the detailed interactions between all the variables. All impulse responses have been displayed without error bands, but like Bernanke and Blinder (1992), and Sims (1992), this does not affect our conclusions.

A positive innovation (monetary tightening) in the policy rate results in increases in both the treasury bill rate and the interbank interest rate. Both immediately begin to increase and then decline at the same time (after 6 months). This finding confirms CEPA (2012), that found that

monetary policy impacts both the treasury bill rate and the interbank interest rate within one month (one-month lag). However, the treasury bill rate rises higher and later falls faster than the interbank interest rate. The implication is that the impact of the policy rate on interbank interest rate is less significant than on the treasury bill rate.

Figure 16: Response to One S.D. Innovations to MPR



Source: Author

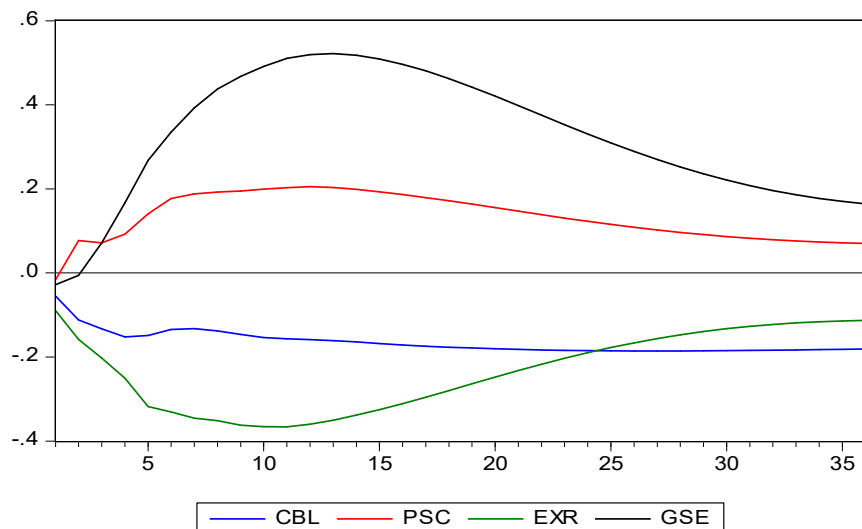
Also, a positive innovation in the policy rate leads to an initial increase in lending rate as expected, before declining permanently. Asset prices decline in accordance with theory; higher interest rates results in the movement of funds from the stock market to the money market. But, the decline in the exchange rate is contrary to economic theory; the decline in exchange rate (depreciation of the currency) as a result of a positive innovation in the policy rate may be a result of the relative immobility of foreign capital due to the under-developed nature of the financial system (Abradu-Otoo et al. 2003), exchange rate overshooting, and political risk issues. Interestingly, private sector credit initially increases, reaches its peak at about 5 months before it starts to decline in the 6th month. This is because loans are quasi-contractual and that it may take a longer time for loans to

react to changes in monetary policy actions (Bernanke & Blinder, 1992). Output declines in response to monetary policy tightening in accordance with theory. However, inflation initially increases in response to a positive innovation in the policy rate and only starts to decline after 3 months with the decline appearing to be permanent.

A positive innovation in the treasury bill rate causes lending rate to rise, reaches its peak, then it starts to decline after a period of 4 months. Private sector credits start declining immediately and this continues until it starts rising from the 11th month. In respect of the exchange rate and stock market index, they both decline immediately. Although the decline in the asset price is expected, the decline (depreciation) in the exchange rate is again not as expected. Also, the decline in inflation after a positive shock to the treasury bill rate is expected. Unexpectedly, a one-standard-deviation positive innovation to the interbank interest rate rather leads to an initial decline in the lending rate though private sector credit, stock market index (asset price) and inflation rate all decline as expected. This confirms the findings by CEPA (2012), who finds that the impact of treasury bill on the lending rate is larger than the effect of the interbank rate. Again, the exchange rate declines (depreciates) whilst the impact on output initially appears erratic (see Appendix Figure 2).

Figure 17 shows the impact of positive shocks to the four standard transmission variables. The results indicate that inflation is not very responsive to a positive shock to the lending rate even though there is an initial decline which appears to be permanent. Also, a positive innovation in the exchange rate (appreciation) causes a decline in inflation which continues up to the 11th month before it starts rising. This finding is consistent with those of Akosah (2015, p.20), who states that “a real appreciation reduces imported inflation as there are a considerable number of imported items in the CPI basket”.

Figure 17: Response of INF to Cholesky One S.D in CBL, PSC, EXR, and GSE



Source: Author

A positive shock to private sector credit immediately results in rise in inflation as expected. This is because an increase in credit has the potential to increase aggregate demand as a result of increased consumption demand. If this increased demand is not matched by an increase in supply or there is a delay in supply response, then it may result in inflation. A positive innovation to the share price results in an immediate rise in inflation, which gradually peaks, before it starts to decline from the 14th month. However, the impact appears to be permanent. Intuitively, if the increase in share prices results in dividend income and realised capital gains, then this increase in wealth will lead to an increase in aggregate demand as a result of increased consumption. It is evident that the asset price and exchange rate channels are the two dominant transmission channels.

In summary, it can be said that the monetary policy rate is effective since it ultimately impacts inflation. However, the impact on inflation is not immediate as it takes about three months before inflation starts to decline after a positive innovation in the policy rate. This confirms the finding by Akosah (2015), who states that this may be an indication that the country may not yet be successful at targeting inflation. Also, Sims (1992) state that this may reflect the “*price puzzle*” phenomenon, which is the likelihood for inflation to initially rise after unexpected increases in

interest rates. Finally, the results show that the two dominant transmission channels are the asset prices and exchange rate channels with the asset price channel being more dominant in the long-run whilst the exchange rate channel is more dominant in short-term (i.e. for about 5 months).

5.7.3 Forecast Error Variance Decomposition

Table 10 provides a summary of the results of the variance decompositions for inflation over selected time horizons whilst Appendix Table 1 provides the detailed results. Again, the results are presented over a time horizon of 36months as in case of the estimated impulse responses. Also, given that the adopted time horizon for Ghana is 18-24months, attention is also devoted to analysing the results up to the 24th month.

Table 10: Variance Decomposition of INF (Selected Horizons)

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
3	1.794749	6.022913	0.018216	2.774764	0.950148	6.188945	0.498706	1.083937	80.66762
6	1.354321	13.76546	0.231895	2.748547	2.025560	9.889839	6.202767	0.400452	63.38116
12	0.771880	22.53740	0.904353	2.068635	2.764451	10.15964	14.10782	0.379928	46.30590
24	8.000872	32.41680	0.546014	2.156608	2.314258	7.319046	14.21895	0.579830	32.44763
36	16.28303	35.41235	0.510333	2.414528	1.771333	5.425837	10.98129	0.558640	26.64265

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF.

Source: Author's estimates

The results indicate that the monetary policy rate is very insignificant in explaining the forecast error variance in inflation in the short-term; it explained only 1.35% and 0.77% at the end of 6months and 12months respectively. These percentages improved to 8% and 16.28% by the end of 24months and 36months respectively. Therefore, in the long-term, the policy rate becomes significant. Moreover, the policy rate explains 19.66% of the forecast error variance in treasury bill rate and 12.05% of the variance in interbank interest rate (table of results not shown).

The treasury bill rate explained a significant portion of the forecast error variance in inflation; its percentage contribution increased from 6.02% at the end of 3months to 13.77%, 22.54%, 32.42%, and 35.41% at the end of 6months, 12months, 24months and 36months respectively. This confirms the importance of the treasury bill rate in the conduct of monetary policy. It is also evident that the treasury bill rate is even more significant than the monetary policy rate in explaining inflation. On the contrary, the interbank interest rate is not significant in explaining inflation.

Appendix Table 2 shows the contributions of both the treasury bill and interbank interest rates in explaining the forecast error variances in the four transmission variables. The results show that the treasury bill rate is still more significant than the interbank interest rate in explaining the forecast error variance in the lending rate. In the long-run, the treasury bill rate also performs significantly better than the interbank interest rate in explaining both credit and exchange rate whilst the variance in asset price is not significantly explained by both treasury bill and interbank interest rates.

The exchange rate explained a higher percentage of the total forecast error variance in inflation than the lending rate, credit, and asset price over the initial 6months. In fact, the exchange rate explained 6.19% of the variance at the end of 3months and 9.89% at the end of 6months. The asset price channel becomes more significant at 12 months, 24months, and 36months by explaining 14.11%, 14.22%, and 10.98% of the forecast error variance in inflation respectively. These confirm the results and conclusions from the impulse response functions.

In summary, the monetary policy rate is effective (impacts inflation) in the long run (24months and 36months) though ineffective in the short run (even up to 12months). This finding is consistent with the findings from the impulse responses as the effect of changes in the monetary policy rate on inflation is not immediate. This also confirms the finding by Akosah (2015), who states that this may be an indication that the country may not yet be successful at targeting inflation. Also,

Sims (1992) state that this situation may reflect the “*price puzzle*”. Unexpectedly, the treasury bill rate is significantly superior to the policy rate and the interbank interest rate in explaining the forecast error variance in inflation. In terms of the transmission mechanism, the exchange rate channel is dominant in the short-run (up to say 6months), whilst the asset price channel is dominant in the long run.

5.7.4 Conclusion about Model I

Monetary policy impacts inflation in the long run though not effective in the short run. In the long run, monetary policy works through the asset price channel with dominant exchange rate channel in the short term. The treasury bill rate is superior to the monetary policy rate and the interbank interest rate in explaining inflation. Surprisingly, the interbank interest rate fails to significantly explain the lending rate. These findings could explain the reason why in April 2018, the central bank introduced the Ghana Reference Rate to aid in the determination of lending (base) rates. According to the Bank of Ghana, a bank is required to add or subtract its risk premium during the pricing of loans. Finally, the significant role being played by the treasury bill rate may be an indication that the treasury bill rate may be a very good indicator of monetary policy actions.

5.8 Model II - Only Oil Price Included

In this section, only the oil price is included into the model as an exogenous variable and its impact on the effectiveness of the policy rate and the transmission channels is assessed. This enables us to achieve the third objective of the study.

5.8.1 Granger Causality (Block Exogeneity) Test

Table 11 provides the results of marginal significance levels (p-values) after taking into consideration supply shocks as represented by exogenous oil price.

Table 11: VEC Granger Causality (Block Exogeneity) Test Results (including oil price)

Forecasted variable	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
MPR	0.0000	0.9192	0.7529	0.1488	0.7082	0.0503	0.9373	0.1675	0.0145
TBR	0.0008	0.0000	0.0000	0.9961	0.0352	0.0008	0.6152	0.0116	0.1781
IBI	0.2686	0.1748	0.0000	0.9561	0.1427	0.7372	0.3390	0.2201	0.0731
CBL	0.1650	0.0314	0.2788	0.0000	0.0774	0.9486	0.9370	0.3766	0.0862
PSC	0.4335	0.1024	0.0074	0.9480	0.0000	0.0900	0.1066	0.9418	0.7373
EXR	0.0915	0.3591	0.6560	0.8282	0.6941	0.0000	0.5763	0.9288	0.4210
GSE	0.7632	0.9545	0.7717	0.8773	0.4725	0.8503	0.0000	0.8732	0.5212
GDP	0.4232	0.0180	0.0911	0.9422	0.0315	0.5341	0.0012	0.0000	0.6277
INF	0.6931	0.2442	0.8025	0.9161	0.4836	0.9856	0.8260	0.0951	0.0000

Notes: For each forecasted variable, the entries across each row are the p-values (marginal significance levels) for omitting lags of other column variables not under consideration.

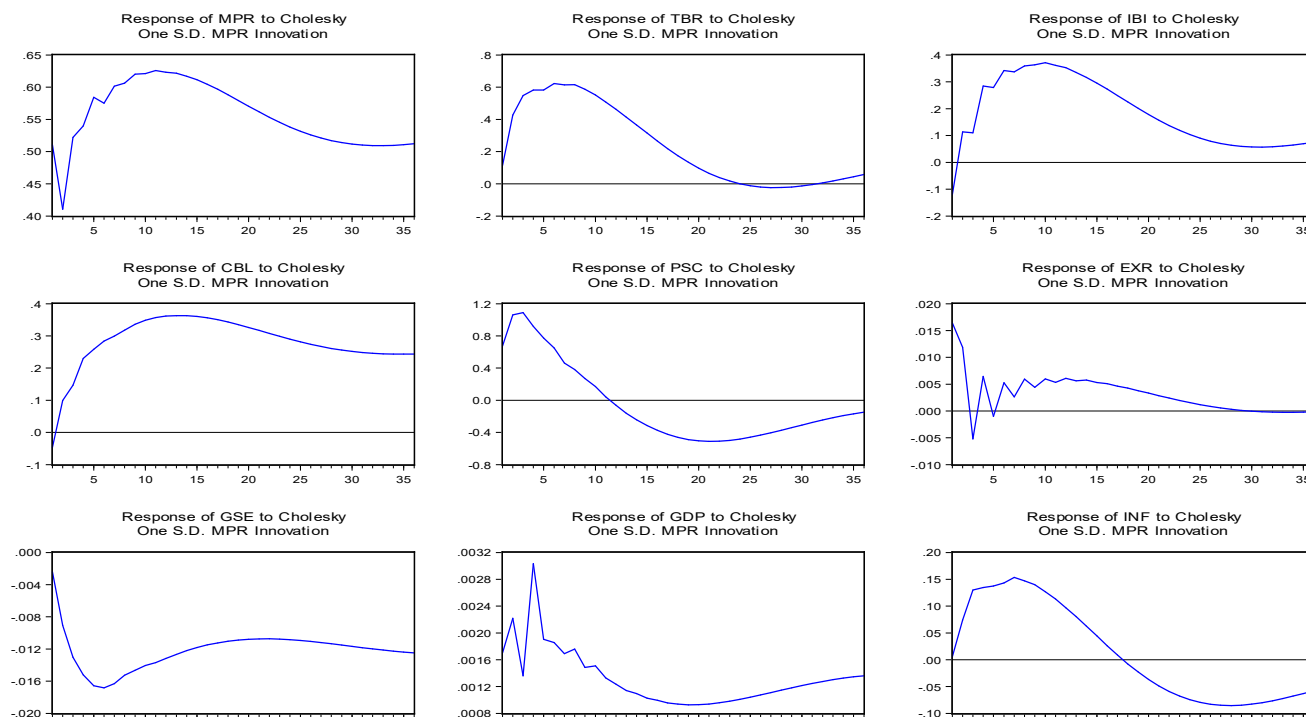
Source: Author's estimates

The results are very similar in almost all respects to the earlier results in Model I; the monetary policy rate does not Granger cause inflation. Furthermore, the monetary policy rate Granger-cause the treasury bill rate which in turn Granger-cause the lending rate though the lending rate does not Granger-cause inflation. Again, the interbank interest rate does not also Granger-cause the lending rate and none of the four transmission variables Granger-cause inflation. In this case, aside credit and asset price, the treasury bill rate and interbank interest rate also Granger-cause output with the asset price still being the most significant variable predicting output.

5.8.2 Impulse Response Functions

Figure 18 shows the responses of the variables to one standard deviation in the monetary policy rate over 36 months period (after including oil price). This enables us to assess the impact of supply shocks on the policy rate and the transmission mechanism. Appendix Figure 3 shows the detailed interaction among all the variables.

Figure 18: Responses to Cholesky One S.D to MPR



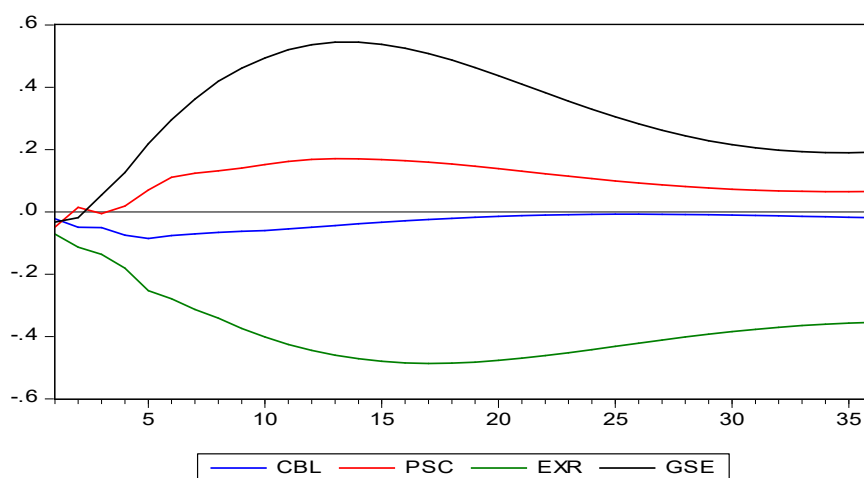
Source: Author's estimates

A positive innovation in the monetary policy rate causes both the treasury bill and interbank interest rates to rise with the influence on the treasury bill rate higher than on the interbank interest rate. The lending rate increases as expected whilst private sector credit again rises temporarily before declining after 3 periods. The exchange rate again rather declines (depreciates) confirming the earlier findings. Asset prices decline as expected and this decline persist until the end of period six (6), after which it increases slightly with the overall decline appearing to be permanent. Inflation rises up to the end of the 7th month before it starts declining in response to a positive

innovation in policy rate, therefore, the period of the “price puzzle” is extended from 3months to 7months in the presence of oil price shocks thereby negatively affecting the influence of the policy rate. The effects of wholesale interest rates are significantly similar to the earlier results. However, in the case of private sector, although it starts declining immediately as previously identified in response to a positive innovation in the treasury bill rate, it starts rising before the 11th month. Also, private sector credit declines for about 3months and starts increasing contrary to the earlier results after a positive innovation in the interbank interest rate. See Appendix Figure 3.

Figure 19 provides a summary of the response of inflation to positive innovation in the four variables representing the transmission channels.

Figure 19: Response of Inflation to Cholesky One S.D Innovations



Source: Author's estimates

A positive innovation in the lending rate causes inflation to immediately decline, but this appears to die out instead of being permanent as in the case of Model I. Also, a positive innovation in the exchange rate (appreciation) again results in decline in inflation which appears more significant in this case. A positive innovation in credit immediately results in rise in inflation as expected though not very significant as compared with the impact from positive shock to the asset price. In fact, a positive innovation to asset price results in an immediate rise in inflation which reaches its peak by the end of the 14th forecast horizon before starting to decline though the impact appears to be

permanent. Therefore, the two dominant transmission channels are the asset price and exchange rate channels with the exchange rate channel being more slightly dominant in the long-term; the exchange rate channel is significant for the first 5 months and after 19 months whilst the asset price channel is dominant during 6-18 forecast horizons.

5.8.3 Forecast Error Variance Decomposition

Table 12 provides a summary of the variance decompositions in inflation for some selected forecast horizons after taking into consideration exogenous oil price. Appendix Table 3 provides the detailed summary for the entire 36 months period.

Table 12: Variance Decomposition of Inflation (Oil Price Included)

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
3	1.809703	4.973557	0.342925	0.440207	0.212209	2.952990	0.350316	0.059728	88.85837
6	2.145458	12.35881	1.326093	0.649043	0.540810	5.666696	4.172914	1.666925	71.47325
12	1.432560	19.90571	2.184684	0.363649	1.176223	8.663412	11.57368	4.283450	50.41663
24	0.689004	25.85323	1.183724	0.173011	1.317817	12.14513	13.16212	6.148204	39.32775
36	0.687753	27.08917	1.305810	0.133951	1.155375	13.41279	11.36397	6.205748	38.64542

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36 months horizon. Variance decomposition estimates are based on the vector error correction model regression (including exogenous oil price) with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF.

Source: Author's estimates

In the presence of oil price shocks, the monetary policy rate becomes very insignificant in explaining the forecast error variance in inflation over the different time horizons; the forecast error variance in inflation explained by the monetary policy rate declined from 8% (Model I) to an insignificant amount of approximately 0.68% by the end of 24th forecast horizon. Also, the percentage contribution by the policy rate reduced from approximately 16.28% to approximately 0.69% by the end of 36th forecast horizon. These results indicate that the monetary policy rate becomes virtually redundant in the face of supply (oil price) shocks. The ineffectiveness of

monetary policy is contrary to the finding by Abradu-Otoo et al. (2003) and Akosah (2015), who found an effective monetary policy.

However, the treasury bill rate remains very significant in explaining inflation although its influence is reduced in the presence of supply shocks. Again, it is evident that the treasury bill rate is more important than the monetary policy rate in explaining inflation. Finally, the interbank interest rate still remains very insignificant in explaining inflation though its ability to explain the forecast error variances in the four transmission variables improved across board. In this instance, it explained a higher percentage of the forecast error variances in all four transmission channel variables better than the treasury bill rate (Appendix Table 4).

Together, the exchange rate and asset price explained approximately 24.78% of the total forecast error variance in inflation as compared with 16.41% in Mode I by the end of 36 months. Nonetheless, the asset price slightly dominates the exchange rate channel at the end of the 12th and 24th month's forecast horizons whilst the exchange rate channel becomes slightly more dominant by the end of the 36th month. This contradicts the results from the impulse response functions, which indicated that the asset price channel rather dominates within 16 -18 months. However, the results from both the impulse response and variance decomposition are unambiguous by the end of the 36th month. The exchange rate channel becomes the dominate channel albeit marginally. Although, Akosah (2015) found a dominant interest channel, Abradu-Otoo et al. (2003) found evidence of a stronger exchange rate channel as the main channel consistent with our findings.

5.8.4 Conclusion about Model II

In the presence of supply shocks, the monetary policy rate becomes ineffective and this could be explained by the extended period of the "price puzzle". However, the treasury bill rate remains more significant than the policy rate in explaining inflation although its influence is hampered.

Again, this may be an indication that the treasury bill rate may better communicate monetary policy stance more than the monetary policy rate. Yet, in this case, the interbank interest rate becomes more significant than the treasury bill rate in explaining four transmission channel variables. Finally, the asset price and exchange rate channels are the two dominant monetary policy channels with the exchange rate channel slightly dominating the asset price channel by the end of 36months although the asset price channel dominates by the end of 12 and 24 months. The influence of the exchange rate is expected as oil prices are denominated in United States Dollars and this impacts the exchange rate.

5.9 Model III - Only Fiscal Deficit Included (May 2007 – December 2016)

In this section, only fiscal deficit is included into the model and its impact on the effectiveness of the policy rate and the transmission channels is assessed (fourth objective).

5.9.1 Granger Causality (Block Exogeneity) Test

Table 13 provides the results of marginal significance levels (p-values) after taking into consideration the presence of fiscal dominance as represented by exogenous fiscal deficit.

Table 13: VEC Granger Causality (Block Exogeneity) Test Results (including fiscal deficit)

Forecasted variable	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
MPR	0.0000	0.6545	0.8332	0.7103	0.4987	0	0.9166	0.2156	0.6475
TBR	0.0234	0.0000	0.0000	0.1801	0.0494	0.19	0.744	0.0105	0.1947
IBI	0.3907	0.347	0.0000	0.9863	0.7149	0.4404	0.7212	0.4591	0.3528
CBL	0.2062	0.0054	0.0524	0.0000	0.0126	0.9984	0.6322	0.6503	0.2326
PSC	0.3435	0.0559	0.0149	0.4051	0.0000	0.2742	0.0344	0.8028	0.8793
EXR	0.0902	0.7912	0.9264	0.8928	0.9744	0.0000	0.5782	0.6368	0.1191
GSE	0.8116	0.8994	0.5677	0.8489	0.3391	0.963	0.0000	0.9626	0.6572
GDP	0.3717	0.2316	0.3769	0.5286	0.2027	0.3095	0.0073	0.0000	0.8397
INF	0.3573	0.3132	0.9549	0.8157	0.1862	0.425	0.5296	0.1897	0.0000

Notes: For each forecasted variable, the entries across each row are the p-values (marginal significance levels) for omitting lags of other column variables not under consideration. However, the monthly data covers May 2007 – December 2016 and not up to December 2017. This is because the monthly fiscal balances do not include 2017 hence the data for all the variables are restricted to December 2016.

Source: Author's estimates

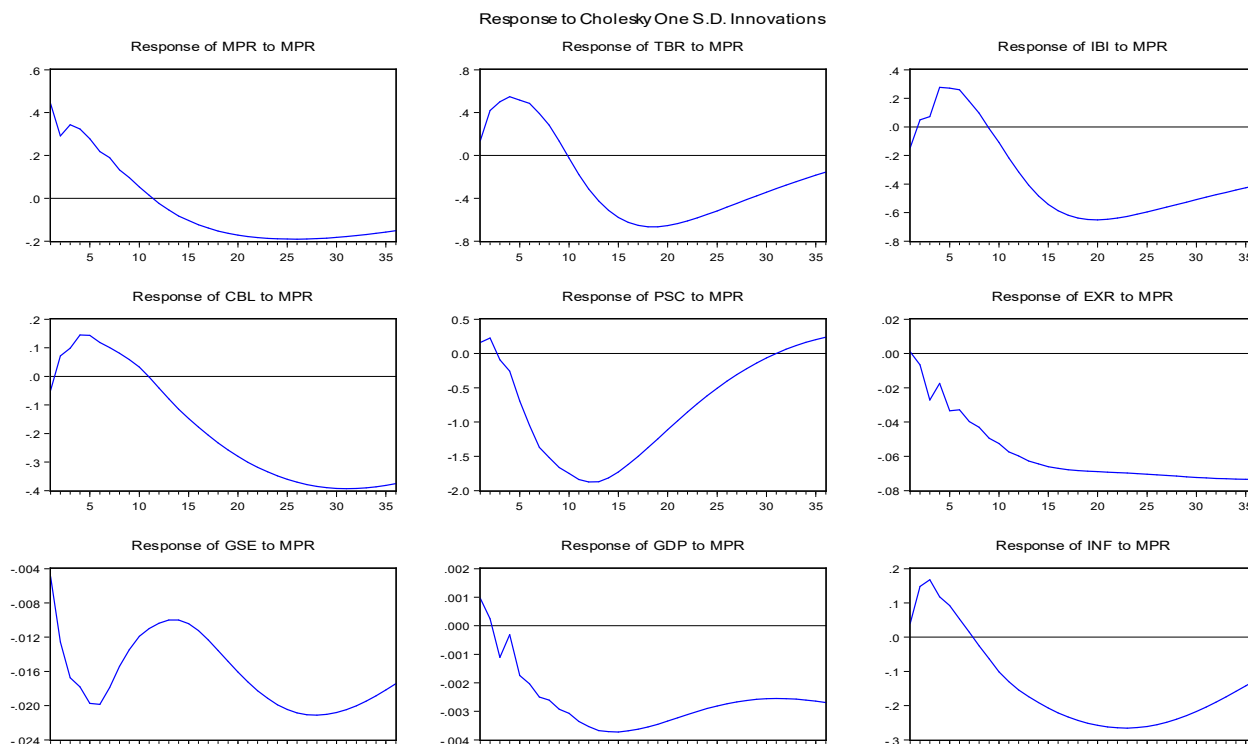
The results are again very similar in almost all respects to earlier results; the policy rate still does not Granger cause inflation. Furthermore, the monetary policy rate Granger-cause the treasury bill rate which in turn Granger-cause the lending rate though the lending rate does not Granger-cause inflation. However, in this case, interbank interest rate Granger-causes the lending rate at 10% level of significance with only the asset price Granger-causing output. Finally, none of the four transmission channel variables Granger-cause inflation and this is consistent with previous results.

5.9.2 Impulse Response Functions (IRFs)

Figure 20 shows the responses of the variables to a positive innovation in the monetary policy rate (monetary tightening) over 36months period (after including only fiscal deficit). This enables us to assess the effect of fiscal dominance on the policy rate and the transmission mechanism.

Appendix Figure 4 shows the detailed interaction among all the variables.

Figure 20: Responses to Cholesky One S.D to MPR (Only Fiscal Deficit Included)

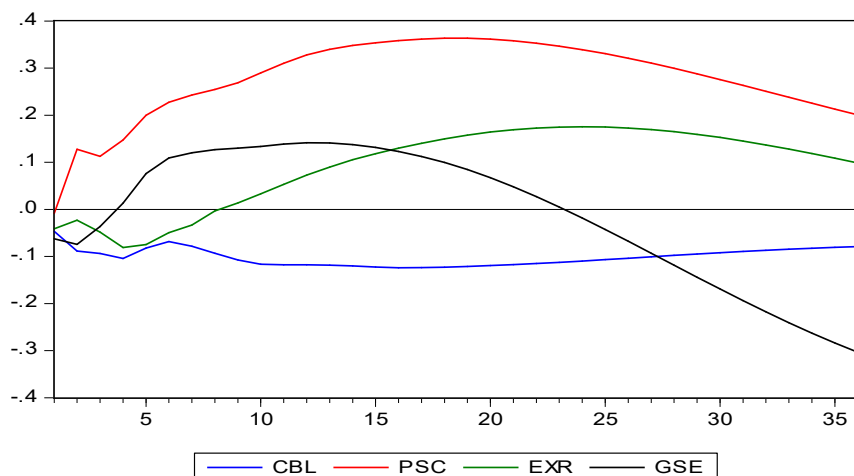


Source: Author

The results from a positive innovation in the policy rate are very similar to results from Model I. The lending rate increases as expected whilst credit initially rises before declining after 2 months. The exchange rate again rather declines (depreciates) confirming the earlier findings. Asset prices decline as expected and this decline persist until the end of period six (6), after which it increases slightly with the overall decline appearing to be permanent. Inflation rises up to the end of the 4th month before it starts declining after a positive innovation in the monetary policy rate, therefore, the period of the “price puzzle” is 4months in this case. A positive innovation in the treasury bill rate causes lending rate to rise, reaches its peak, then it starts to decline after a period of 4months. Also, inflation declines as expected after a positive innovation in the treasury bill rate. Although the exchange rate decline as previously identified, both the stock market index and inflation rate now appear to initially increase. However, credit declines for about 3months and starts increasing contrary to Model I results (Appendix Figure 4).

Figure 21 provides a summary of the response of inflation to positive innovation in the four variables representing the transmission channels.

Figure 21: Response of Inflation to Cholesky One S.D Innovations (Only Fiscal Deficit Included)



Source: Author

The results appear to confirm the initial finding that inflation seems not to be very responsive to a positive innovation in the lending rate. On the contrary, a positive innovation in the exchange rate

(appreciation) results in an initial increase in inflation followed by a decline, then an overall increase over the forecast horizon. In respect of the other transmission channels, results similar to the initial ones were also obtained; a positive shock to both credit and asset price result in an immediate rise in inflation but the impact from credit appears to be more dominant than the asset price channel.

5.9.3 Forecast Error Variance Decomposition

Table 14 provides a summary of the variance decomposition in inflation for some selected forecast horizons after taking into consideration only exogenous fiscal deficit. Appendix Table 5 provides the detailed summary for the entire 36months period.

Table 14: Variance Decomposition of Inflation (Only Fiscal Deficit Included)

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
3	4.756688	5.505794	0.546939	1.735740	2.682580	0.420529	0.991750	0.661678	82.69830
6	3.237082	14.20640	0.276783	1.736440	6.003005	0.810600	1.205363	0.310421	72.21391
12	2.766541	21.98691	0.595441	2.271110	13.06011	0.619832	2.773342	0.163252	55.76346
24	8.797938	27.11506	0.765238	3.015235	23.02431	3.170398	2.614274	0.091002	31.40654
36	10.43169	29.24666	0.579561	2.971970	23.52890	4.295638	5.507116	0.150559	23.28791

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression (including only exogenous fiscal deficits) with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF. However, the data only covers up to December 2016.

Source: Author's estimates

The policy rate appears to be relatively effective in the long-run as it explained approximately 8.80% and 10.43% of the forecast error variance in inflation by the end of 24months and 36months respectively. However, its significance reduced from 16.28% (Model I) to 10.43% by the end of 36months. These results indicate that fiscal dominance seems to affect the effectiveness of the monetary policy rate in the long-run. This is in conformity with the literature on inflation targeting; Ali Alichu et al. (2009) argues that inflation targeting cannot be very effective in the presence of fiscal dominance.

The treasury bill rate remains very significant as it explained approximately 27.12% and 29.25% of the forecast error variance in inflation respectively. However, its influence is also reduced in the presence of fiscal deficits; its contribution reduces from approximately 32.42% and 35.41% at the end of 24months and 36months to approximately 27.12% and 29.25% respectively. Again, the treasury bill rate is shown to be more important in influencing inflation than the monetary policy rate. In respect of the interbank interest rate, it remains very insignificant in explaining inflation though its ability to explain the forecast error variances in the lending rate and credit improved across board. In this instance, it explained a higher percentage of the forecast error variances in those two than the treasury bill rate (Appendix Table 6).

Surprisingly, the credit channel becomes the main transmission over the entire forecast horizon as it explained a very significant percentage of the forecast error variance in inflation; it explained approximately 13.06%, 23.02%, and 23.53% of the variance in inflation by the end of 12months, 24months, and 36months respectively. This could be as a result of increase in credit to the private sector to undertake government contracts. Although the exchange rate and asset price channels still explained some of the variance in inflation, they were not very significant as their contributions were reduced. This confirm the results from the impulse responses.

5.9.4 Conclusion about Model III

The results indicate that although monetary policy remains largely effective in the long run, its effectiveness is significantly dampened in the presence of fiscal dominance. Also, although still significant, the influence of the treasury bill rate is also hampered. Yet, is it still more significant than the policy rate in explaining inflation. However, the interbank interest rate becomes more important than the treasury bill rate in explaining the forecast error variance in the lending rate and credit channel variables. Surprisingly, the main transmission mechanism is the credit channel.

5.10 Model IV - Oil Price & Fiscal Deficit Included

In this section, both oil price and fiscal deficit are included into the model and their impacts on the policy rate and the various transmission channels are assessed. This enables us to achieve the last objective of the study.

5.10.1 Granger Causality (Block Exogeneity) Test

Table 15: VEC Granger Causality (Block Exogeneity) Test Results (including oil price and fiscal deficit)

Forecasted variable	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
MPR	0.0000	0.3748	0.8684	0.9257	0.4686	0.0001	0.9106	0.2823	0.7169
TBR	0.0476	0.0000	0.0000	0.3711	0.0445	0.1436	0.7464	0.0322	0.1321
IBI	0.4143	0.2061	0.0000	0.691	0.4627	0.5341	0.7044	0.429	0.3325
CBL	0.3215	0.0119	0.0878	0.0000	0.016	0.9906	0.6765	0.4962	0.1523
PSC	0.2768	0.045	0.0233	0.2585	0.0000	0.2432	0.0308	0.8317	0.905
EXR	0.0547	0.9268	0.9547	0.922	0.9074	0.0000	0.6481	0.7294	0.2044
GSE	0.8723	0.7323	0.6087	0.9818	0.5083	0.9573	0.0000	0.8669	0.5403
GDP	0.4547	0.0778	0.131	0.5663	0.0595	0.4516	0.0039	0.0000	0.8794
INF	0.1935	0.8594	0.7365	0.8085	0.1933	0.2334	0.519	0.1035	0.0000

Notes: For each forecasted variable, the entries across each row are the p-values (marginal significance levels) for omitting lags of other column variables not under consideration. However, the data only covers up to December 2016.

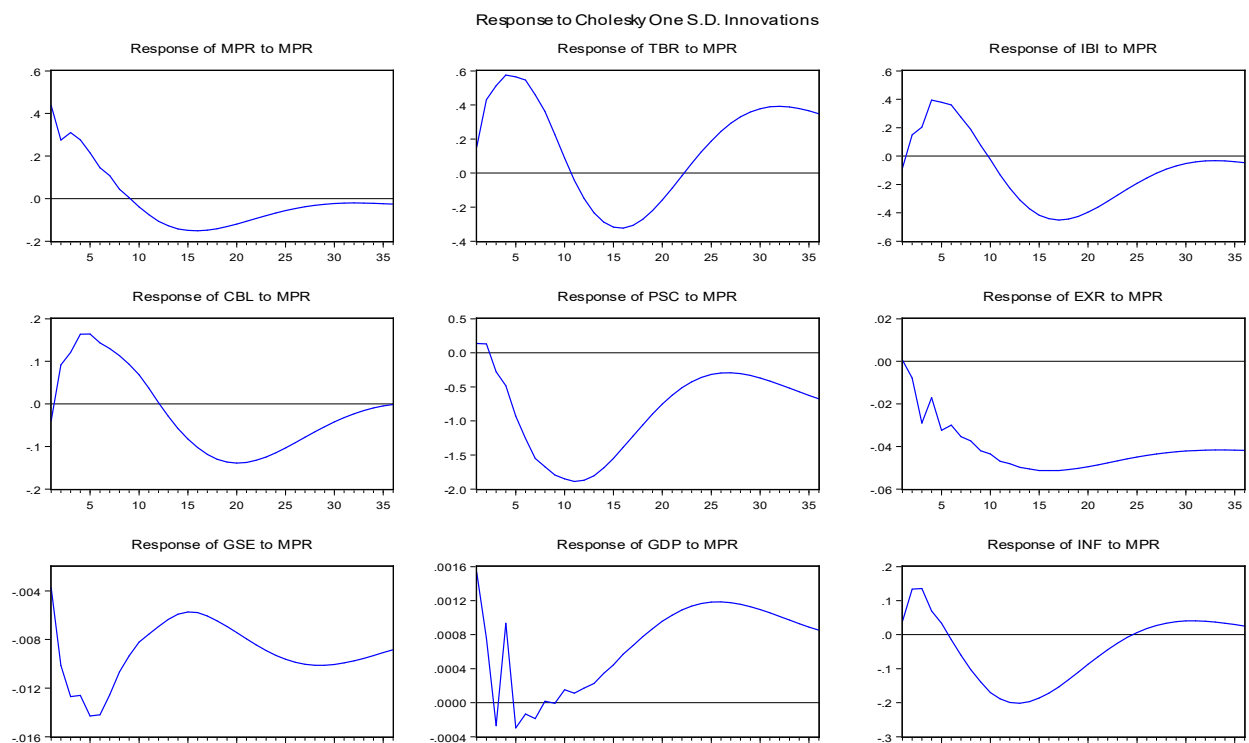
Source: Author's estimates

Table 15 provides the results of marginal significance levels (p-values) after taking into consideration both supply shocks and fiscal dominance. The results are very similar in almost all respects to the earlier results; the policy rate still does not Granger cause inflation. Again, the policy rate Granger-cause the treasury bill rate which in turn Granger-cause the lending rate, though the lending rate does not Granger-cause inflation. However, in this case, interbank interest rate does Granger-cause the lending rate at 10% level of significance with the asset price, treasury bill rate, credit, and asset price Granger-causing output. Finally, none of the four transmission channel variables Granger-causes inflation and this also confirms our earlier results in Model I-III.

5.10.2 Impulse Response Functions (IRFs)

Figure 22 shows the responses of the variables to a positive innovation in the monetary policy rate over 36 months period (after the inclusion of both oil price and fiscal deficit). This enables us to assess the impact of both supply shocks and fiscal dominance on the monetary policy rate and the transmission mechanism. Appendix Figure 5 shows the detailed interactions among all the variables.

Figure 22: Responses to Cholesky One S.D to MPR (Both Oil Price and Fiscal Deficit Included)



Source: Author's estimates

The results of a positive innovation in the monetary policy rate are also very similar to the earlier results because both the treasury bill and interbank interest rates rise with the influence on the treasury bill rate being higher than on the interbank interest rate. Also, the increase in the lending rate is expected. In this case, however, private sector credit declines immediately and this continues until the 11th month before it starts to rise again. Although this is in accordance with theory, it contradicts the earlier results. In respect of the exchange rate, it again declines (depreciates)

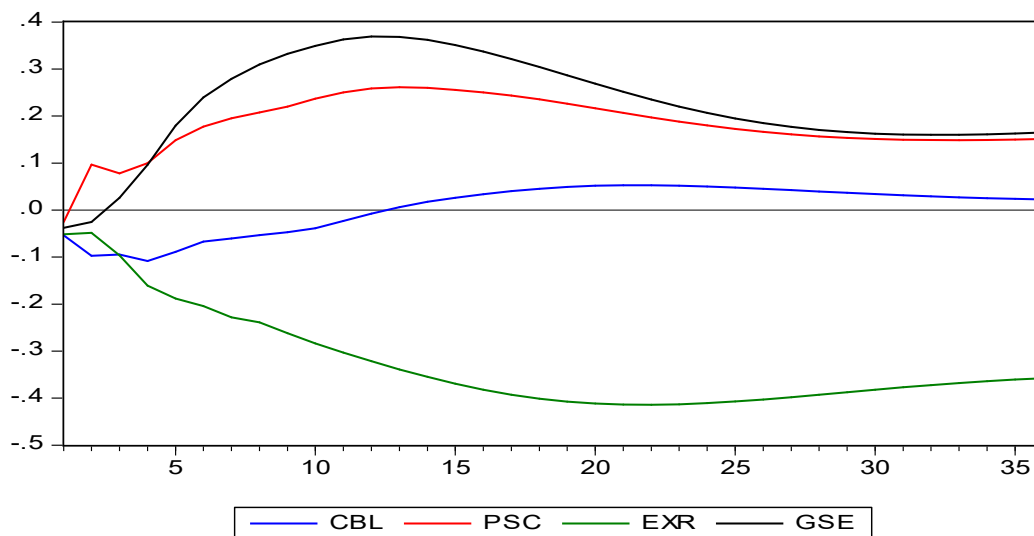
confirming the earlier findings. Asset prices decline as expected and this decline persist until the end of period five (5), after which it starts increasing up to 15th month, declines again up to the 30th month before it starts increasing again. Inflation rises up to the end of the 3rd month before it starts declining after a positive innovation in the monetary policy rate, therefore, the period of the “price puzzle” is limited to 3 months confirming the initial results.

We observed significantly similar results from a positive shock to both wholesale interest rates; the treasury bill rate causes lending rate to rise, reaches its peak, then it starts to decline after a period of 5 months. In the case of private sector credit, it starts declining immediately and before it starts rising from around the 10th month. In respect of the exchange rate and stock market index (asset price), they also both decline immediately as previously identified. The exchange rate bottoms out around the 15th month before it starts to rise again whilst the asset price bottoms out around the 6th month although there is some fluctuation around the 2nd and 3rd months. The decline in exchange rate (depreciation) confirms our earlier findings of the relative immobility of foreign capital in responding to higher domestic interest rates. Finally, inflation declines as expected after a positive innovation in the treasury bill rate.

On the other hand, a positive innovation in the interbank interest rate again leads to a decline in the lending rate for the initial three months before it starts rising. Also, output declines immediately, then fluctuates, before it starts to permanently decline from around the 7th month. Although the exchange rate decline as previously identified, it also fluctuates afterwards, before it starts increasing from around the 5th month. In the case of asset price, it fluctuates for the initial months before starts to increase again around the 4th month. However, private sector credit declines for about 3 months and starts increasing, contrary to the earlier results (Appendix Figure 5).

Figure 23 provides a summary of the response of inflation to positive innovation in the four variables representing the transmission channels, that is, after taking into consideration the effects of oil price and fiscal deficit.

Figure 23: Response of Inflation to Cholesky One S.D Innovations (Both Oil Price and Fiscal Deficit Included)



Source: Author's estimates

A positive innovation in the lending rate leads to an immediate decline in inflation though inflation starts to rise again around the 5th month and this increase appears to be permanent. However, a positive innovation in the exchange rate (appreciation) results in an initial increase in inflation in the 2nd month after which it declines with the effects appearing to be permanent. In respect of the other transmission channels, the results are similar to the initial ones obtained; a positive shock to both credit and asset price, results in an immediate rise in inflation but the impact from credit appears to be more dominant in the first few months, whilst asset price dominates from around the 5th month onwards. The two dominant channels appear to be the asset price and exchange rate channels with the latter channel being dominant in the long run.

5.10.3 Forecast Error Variance Decomposition

Table 16 provides a summary of the variance decomposition in inflation for some selected forecast horizons after taking into consideration the two exogenous variables (oil price and fiscal deficit).

Appendix Table 7 provides the detailed summary for the entire 36months period.

Table 16: Variance Decomposition of Inflation (Both Oil Price and Fiscal Deficit Included)

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
3	3.033956	4.912675	6.356049	1.702202	1.292065	1.150680	0.220030	0.263391	81.06895
6	1.189587	10.65616	11.56494	1.227218	2.155659	3.175811	2.748265	3.112544	64.16982
12	1.404287	14.21624	21.26232	0.433868	3.052221	4.412426	5.993871	6.544256	42.68051
24	1.199281	12.98810	31.92455	0.237376	3.113985	7.401499	5.610326	7.146120	30.37876
36	0.882476	11.97026	34.26058	0.200805	2.848562	9.070310	4.747242	6.550526	29.46924

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression (including both oil price and fiscal deficits as exogenous) with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF. However, the data only covers up to December 2016.

Source: Author's estimates

In this case, the monetary policy rate appears to be totally ineffective. This finding is consistent and further supports the argument by Ali Aliche et al. (2009) who indicated that inflation targeting cannot be very effective in the presence of fiscal dominance and supply shocks. In comparison with the results from Model I, the percentage contribution of the policy rate reduced from approximately 8.00% and 18.28% by the end of 24months and 36months to approximately 1.20% and 0.88% respectively. However, in both cases, the policy rate was also not effective for the initial periods.

Although the treasury bill rate remains important than the monetary policy rate, the interbank interest rate now appears far significant than the treasury bill rate. In fact, the interbank interest rate now explained more than 30% of the forecast error variance in inflation whereas the treasury bill rate explained approximately 13% and 12% by the end of 24 months and 36months respectively. The contribution from the interbank interest rate is very surprising as its influence in

explaining inflation has so far been very insignificant. Also, with the exception of the exchange rate, the interbank interest rate explained a higher percentage of the forecast error variances in the lending rate, credit, and asset price more than the treasury bill rate (Appendix Table 8).

In this case, the two main channels are the asset price and exchange rate channels with the exchange rate channel being the most dominant; it explained the forecast error variance in inflation more than the asset price channel at 3months, 24months, and 36months. These findings confirm the results from the impulse responses and are also consistent with the findings by Abradu-Otoo et al. (2003), who found evidence of a stronger exchange rate channel as the main channel.

5.10.4 Conclusion about Model IV

In summary, the results show that the monetary policy rate is totally ineffective in the presence of both supply shocks and fiscal dominance. Although the treasury bill rate still plays a very significant role and more important than the monetary policy rate, its influence is hampered significantly. Surprising, the interbank interest rate is now more significant and plays a more important role than the treasury bill rate as it explained inflation better. Finally, the two dominant channels are the asset price and exchange rate channels with the exchange rate channel being the main channel of monetary policy transmission.

5.11 Robustness Testing Results

Two alternative Cholesky orderings are used for robustness testing. First, Appendix Figure 6 provides a summary of the results of the detailed IRFs whilst Appendix Table 9 shows the summary results of the FEVD for inflation. Second, Appendix Table 10 shows the summary results of the FEVD for inflation in respect of the second alternative ordering. For our robustness testing purposes, the analysis is restricted to only Model IV (i.e. the model with both the oil price and fiscal deficit included). Nonetheless, our conclusions do not change even when the other three

models are used, that is, when none of the two exogenous variables is included (Model I); only oil price considered (Model II); and when only fiscal deficit is included (Model III). The change in the orderings do not change the results and or the conclusions in any significant respect. In fact, the results and conclusions in respect of the impact of the monetary policy rate on inflation, the role of wholesale interest rates, and the transmission channels are not affected.

5.12 Conclusions from VECM Estimates

The VECM estimates were considered even though we do not present the results. The conclusions in respect of Model I and II do not change when compared with the IRFs and FEVDs. Although the effectiveness of monetary policy is the same in respect of Model III, the exchange rate and asset price become the dominant channels in the short run and long run respectively. In respect of Model IV, while the exchange rate channel is still the main transmission mechanism, monetary policy is now effective. However, it is very dangerous to make structural deductions from an unrestricted VAR, hence we do not rely on the conclusions from our unrestricted VECM estimates.

5.13 Conclusion

We show that although fiscal dominance significantly affects the effectiveness of the policy rate, it does not render it ineffective. This is consistent with the literature. However, a supply shock renders the policy rate ineffective and this is also consistent with the view that an inflation targeting regime cannot be very effective if inflation is caused by cost-push factors. Considering the combined effects of supply shocks and fiscal dominance, we have also provided evidence consistent with the view that the monetary policy rate is ineffective under the current monetary policy regime.

The two dominant transmission channels are the asset price and exchange rate channels with the exchange rate channel being the most dominant channel. Our findings are partly consistent with

Abradu-Otoo et al. (2003), who found an effective monetary policy but with a stronger exchange rate channel. However, the findings are inconsistent with Akosah (2015) who found an effective monetary policy with a dominant interest rate channel. Finally, our results and conclusions are robust since the two alternative Cholesky orderings produced the same results and conclusions.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

Although there are several goals (objectives) of macroeconomic policy, it is generally accepted that the long-term objective of monetary policy should be price stability with inflation targeting regime now regarded superior to all the other strategies for achieving this objective. Therefore, many countries are shifting to an inflation targeting regime. In Ghana, it was first implemented in 2002, but it was not until May 2007 before the policy was officially adopted.

Subsequently, inflation has relatively declined and even reached single digit inflation over a period of 32 months (June 2010-January 2013). However, it has been argued that this relative decline should not be entirely attributed to the new monetary policy regime since the decline may be because of coincidence and/or good luck and not necessarily as a result of good policy. The following are some of the reasons that have been provided: the central bank has consistently missed its inflation targets; inflation rates in Ghana have been relatively higher than other African countries; inflation rates have been variable and periodically high; existence of fiscal dominance, financial dominance, and external dominance; entrenched inflation inertia in wage setting; unstable inflationary expectation and vulnerability to supply shocks and finally; weak transmission mechanism resulting partly from low financial depth and intermediation.

6.2 Summary

The primary objective of the study was to assess the effectiveness of the monetary policy transmission mechanism in Ghana and in particular: to investigate the impact of monetary policy rate on inflation; to determine the dominant monetary policy transmission mechanism; to assess

the impact of supply shocks on the policy rate and transmission mechanism, to assess the effect of fiscal dominance on the policy rate and transmission mechanism, and to assess the combined effect of supply shocks and fiscal dominance on the policy rate and transmission mechanism.

This study investigated one of the most topical issues in economics; that is, the question of whether monetary policy affects the economy and if so, what are transmission channels through which these effects take place? It is generally accepted that monetary policy affects inflation and the economy in general with a lag of uncertain duration and variable strength. However, it has been argued that there is a direct relationship between the effectiveness of the monetary transmission mechanisms and the effectiveness of monetary policy. Therefore, there is a need for monetary authorities to obtain a proper understanding of the transmission process to be able to accurately assess the timing and effects of their policies on the economy.

The study adopted and followed the approach employed by Sims (1992) and Bernanke and Blinder (1992). The monetary policy rate was identified as the direct measure of monetary policy and we assumed it is affected by economic variables with a lag whilst affecting all other variables contemporaneously. Therefore, the policy rate was ordered first and inflation ordered last with the Choleski decomposition approach employed to aid in ordering all the variables.

Using VEC Granger Causality (Block exogeneity) Tests, Impulse Responses Functions (IRFs), and Forecast Error Variance Decomposition (FEVD), we were able to trace out the actual effects of the monetary policy rate on inflation and assess the transmission mechanism through which these effects take place, without specifying an explicit structural model. The variables used in the study are: monetary policy rate, 91-day treasury bill rate, interbank interest rate, exchange rate, lending rate, private sector credit, share price, output, and inflation. Oil price and fiscal deficit

were separately and jointly included and their individual as well as their combined effects on the effectiveness of monetary policy and its associated transmission mechanism were assessed.

The results were presented in four parts as follows: firstly, in the absence of oil price and fiscal deficit, the policy rate is effective in the long run though ineffective in the short run. The exchange rate and asset price channels are dominant in the short run and long run respectively. These findings are partly consistent with Akosah (2015), who found evidence of monetary policy ultimately affecting inflation via the exchange rate channel in the short-run and the interest rate channel in the long-run. The impact of the policy rate on inflation is not immediate as it takes about three months before inflation starts to decline after a positive innovation in the policy rate. Akosah states that this may be an indication that the country may not yet be effective at targeting inflation. But, Sims (1992) states that such a situation may rather reflect the “price puzzle” phenomenon, which is the likelihood for inflation to initially rise after unexpected increase in interest rates.

Nonetheless, the study made some interesting findings; we found out that the treasury bill rate is significantly superior to the monetary policy rate in explaining inflation. Also, the interbank interest rate, which serves as Bank of Ghana’s operating target, is not very effective as it does not influence the lending rate neither does it explain inflation.

Secondly, the policy rate is ineffective in the presence of supply shocks; the monetary policy rate becomes totally ineffective in influencing the inflation rate. The treasury bill rate remains very significant than the policy rate in explaining inflation. However, the asset price and exchange rate channels are dominant with the latter being the main channel. These findings partly confirm the finding by Abradu-Otoo et al (2003), who found that there is evidence of monetary policy affecting inflation in the long run, with the exchange rate channel as the main transmission channel.

Thirdly, in the presence of fiscal dominance, the policy rate is largely effective in the long run, though its impact is dampened. This finding confirms one of the prerequisites of inflation targeting, which is that for an effective inflation targeting regime, monetary policy should be free of fiscal dominance (Masson et al. 1997; Ali Aliche et al. 2009). In addition, even though the treasury bill rate still plays a significant role and even still more significant than the monetary policy rate, its role is also dampened by the presence of fiscal dominance. In this case, however, the interbank interest rate unexpectedly explained the forecast error variance in the lending rate and credit channel variables more than the treasury bill rate. Another surprisingly finding, in the case, is the observation that the credit channel is the main transmission mechanism.

In the last model, the policy rate is ineffective in the presence of both supply shocks and fiscal dominance. These results are consistent with the argument by Ali Aliche et al. (2009), who states that inflation targeting cannot be very effective in the presence of fiscal dominance and that another issue affecting inflation targeting in Ghana is the vulnerability of the economy to supply shocks. Although the treasury bill rate still plays a very significant role and still more important than the monetary policy rate, its influence is significantly hampered. Unexpectedly, the interbank interest rate becomes more significant than the treasury bill rate in explaining inflation. Finally, we observed that the two dominant transmission channels are the exchange rate and asset price channels with the exchange rate channel being the main channel. This finding is again partly consistent with findings by Abradu-Otoo et al. (2003).

Overall, we observed that the interbank interest rate and treasury bill rate are superior to the policy rate in explaining inflation. This may be an indication that the two may be good indicators of monetary policy. Also, this could indicate tacit monetary policy changes without the full knowledge of the public. This is consistent with Kovanen (2011), who argued that the significant and sometimes persistent variations between these two wholesale interest rates and the policy rate

may be an indication of unannounced changes in monetary policy with the danger of creating public confusion regarding the policy stance of the central bank and eroding policy credibility.

Unlike Akosah (2015) who found a dominate interest rate channel, this study did not find any evidence to support the existence of an effective interest rate transmission channel. However, our findings rather seem consistent with the recent activities of the Bank of Ghana; in an attempt to better influence the lending rates and possibly make the interest rate channel more effective, the central bank has just introduced (in April 2018) what is called the Ghana Reference Rate. In the pricing of loans, a universal bank is expected to either add or subtract its risk premium to the reference rate. According to the Bank of Ghana, this is to among others things “fulfil its commitment to move towards a more market based model of base rate setting, in the medium to long term”. Only time will tell if the introduction of this reference rate will influence bank lending rates and eventually result in an effective interest rate transmission channel as anticipated since previous attempts, by the Bank of Ghana, to influence the lending rates through the introduction of a base rate calculation model, failed to achieve desired objectives.

6.3 Conclusion

Using an approach that required us to identify the monetary policy rate as the direct measure of monetary policy and deploying econometric techniques such: VEC Ganger Causality (Block exogeneity) Tests, Impulse Responses Functions (IRFs), Forecast Error Variance Decomposition (FEVD), and Choleski Decomposition in ordering the variables, we found the following: firstly, fiscal dominance significantly affects the effectiveness of the policy rate but it does not render it ineffective. This is consistent with the literature.

Secondly, a supply shock renders the policy rate ineffective and this is also consistent with the view that an inflation targeting regime cannot be very effective if inflation is caused by cost-push

factors. Thirdly, considering the combined effects of supply shocks and fiscal dominance, we have also provided evidence consistent with the view that the monetary policy rate is ineffective under the current monetary policy regime. Fourthly, we observed that the two dominant transmission channels are the asset price and exchange rate channels with the exchange rate channel being the most dominant channel. Finally, our results and conclusions are robust to two alternative Cholesky orderings.

6.4 Recommendations and Policy Implications

The findings from this study have important monetary policy implications for the country. This study supports recommendations aimed at deepening the financial system and improving financial intermediation. Particular attention should be given to the development and deepening of the stock market; more companies should be incentivised to list on the stock exchange. The government should also fast-track the introduction of the commodities exchange to further deepen the financial system. These measures are important considering the significance of the asset price channel in the transmission process.

As a small open economy with dependence on oil and imported inputs, huge external debt, and a strong taste for imported goods, there is a need to properly monitor the exchange rate and implement appropriate measures to manage the exchange rate since it performs a significant role in the transmission process. These measures should be targeted at diversifying the export market by providing the needed incentives, including subsidies (if possible), in order to generate the needed foreign exchange. Additionally, measures must be put in place to drastically minimise the smuggling of cocoa as this affects the foreign exchange earnings of the country. Also, pragmatic measures should be implemented in order to retain more foreign exchange from the extractive industry. Finally, measures must be introduced to minimise speculative attacks and the

dollarisation of the economy. These measures, in addition to others, will stabilise the exchange rate to enable the country achieve desirable macroeconomic benefits.

Our findings are consistent with the arguments that inflation in Ghana is mainly caused by cost-push factors and not demand-pull factors. This is because although the inclusion of fiscal deficit (demand-pull factor) into Model III only dampened the effectiveness of the policy rate, the inclusion of oil price (supply-push factor) in Model II rendered the policy rate totally ineffective. Therefore, we recommend that policy-makers should at all times properly identify the causes of inflation in order to implement the right measures to control it. Lastly, the central bank should consider formally adopting the treasury bill rate as its policy rate, that is, if it is not already implicitly using it on the blind side of the public. This is because, we have provided evidence to show that the treasury bill rate may be a good indicator of monetary policy actions as it significantly explains inflation more than the current monetary policy rate.

6.5 Areas for Further Research

This study presents new research opportunities. First, a new research can be conducted, on the effectiveness of the just introduced Ghana Reference Rate. Secondly, further research can be conducted to confirm or otherwise, if the treasury bill rate and interbank interest rates are indeed good indicators of monetary policy actions. Finally, an explicit structural model approach can be deployed to conduct another research and the results compared with this study.

6.6 Research Limitations

Non-availability of monthly data on aggregate demand and supply. However, since output (GDP) reflects demand and supply conditions, we used it as a proxy for aggregate demand (consistent with Bernanke & Blinder, 1992) to obtain a complete transmission mechanism. Finally, non-availability of 2017 monthly fiscal deficit data. Nonetheless, and consistent with literature, the

analysis, discussion of results and conclusions involving fiscal deficit were restricted to December 2016.

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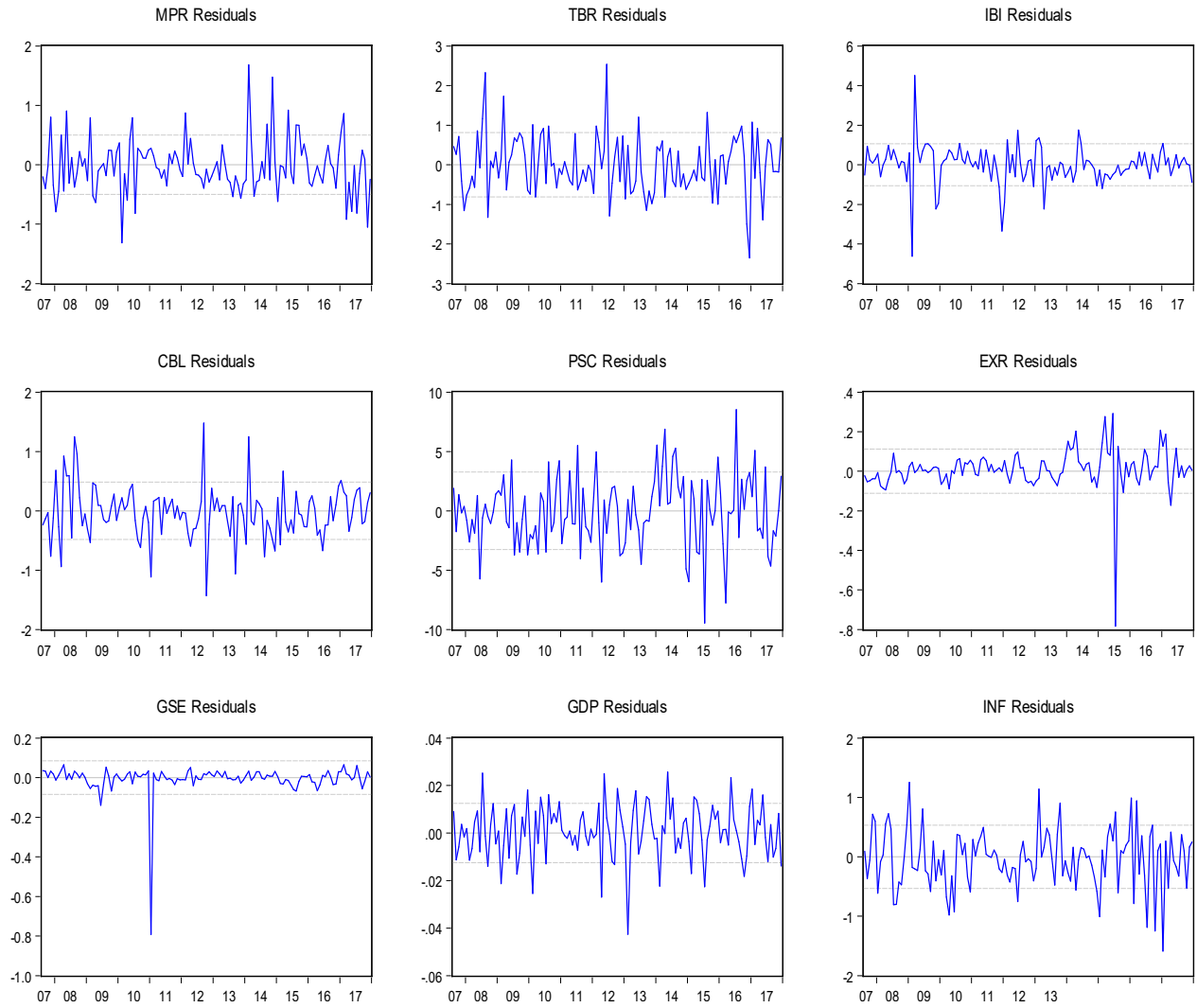
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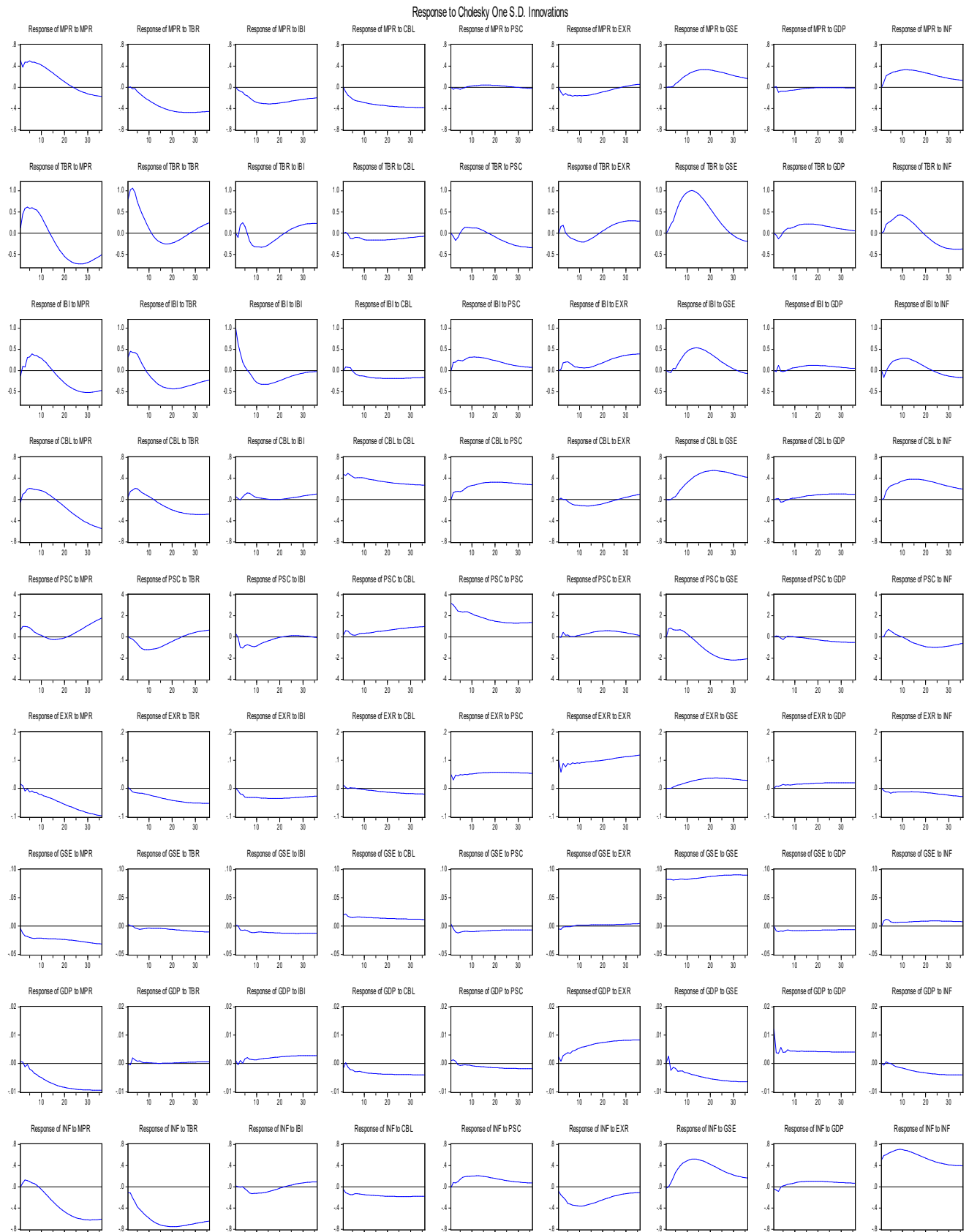
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Appendix Figure 1: Residual Plot of the VEC Model



Source: Author

Appendix Figure 2: Responses to Cholesky One S.D Innovations



Source: Author

Appendix Table 1: Variance Decomposition of INF

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
1	0.001824	4.743747	0.057155	1.059432	0.089393	2.820119	0.272893	0.524114	90.43132
2	0.732478	4.006684	0.023442	2.214394	0.888925	4.723166	0.116015	0.774717	86.52018
3	1.794749	6.022913	0.018216	2.774764	0.950148	6.188945	0.498706	1.083937	80.66762
4	1.861913	8.689002	0.012081	3.105027	1.095438	7.527242	1.863699	0.720116	75.12548
5	1.634753	11.51033	0.075418	3.018155	1.525767	9.145435	4.056822	0.515022	68.51829
6	1.354321	13.76546	0.231895	2.748547	2.025560	9.889839	6.202767	0.400452	63.38116
7	1.120519	15.53410	0.485459	2.507077	2.338843	10.25462	8.176388	0.359253	59.22374
8	0.907751	17.09745	0.698026	2.335632	2.517380	10.35320	9.889444	0.337652	55.86346
9	0.746792	18.53305	0.808696	2.227711	2.618101	10.40377	11.28007	0.323191	53.05862
10	0.661430	19.92188	0.864717	2.162109	2.685247	10.38025	12.42111	0.333051	50.57021
11	0.666099	21.26846	0.892282	2.109960	2.731046	10.29890	13.36559	0.354156	48.31350
12	0.771880	22.53740	0.904353	2.068635	2.764451	10.15964	14.10782	0.379928	46.30590
13	0.974034	23.72874	0.905648	2.038954	2.778947	9.977305	14.67080	0.407761	44.51781
14	1.272698	24.84609	0.893518	2.020919	2.775030	9.760844	15.07656	0.434136	42.92021
15	1.663776	25.89412	0.868642	2.014113	2.755626	9.527822	15.34216	0.458084	41.47566
16	2.144242	26.87694	0.834597	2.016112	2.725109	9.282430	15.48807	0.480519	40.15198
17	2.705077	27.79478	0.795285	2.023964	2.686426	9.030315	15.53409	0.501070	38.92900
18	3.337412	28.64590	0.753858	2.036021	2.641884	8.774466	15.49588	0.519475	37.79511
19	4.029246	29.43035	0.712435	2.051298	2.592667	8.518423	15.38825	0.535448	36.74188
20	4.769663	30.14899	0.672459	2.069205	2.539914	8.264884	15.22423	0.548871	35.76178
21	5.547390	30.80401	0.635071	2.089245	2.484688	8.016587	15.01545	0.559799	34.84776
22	6.351985	31.39812	0.601168	2.110851	2.428080	7.775294	14.77236	0.568462	33.99369
23	7.173007	31.93456	0.571371	2.133454	2.371016	7.542468	14.50421	0.575069	33.19484
24	8.000872	32.41680	0.546014	2.156608	2.314258	7.319046	14.21895	0.579830	32.44763
25	8.826624	32.84868	0.525189	2.179990	2.258379	7.105729	13.92331	0.582936	31.74916
26	9.642482	33.23427	0.508809	2.203382	2.203824	6.902915	13.62287	0.584582	31.09686
27	10.44171	33.57778	0.496651	2.226620	2.150929	6.710808	13.32218	0.584965	30.48836
28	11.21875	33.88343	0.488392	2.249573	2.099953	6.529398	13.02485	0.584282	29.92137
29	11.96908	34.15538	0.483628	2.272131	2.051078	6.358525	12.73368	0.582715	29.39378
30	12.68919	34.39754	0.481909	2.294211	2.004418	6.197907	12.45080	0.580432	28.90359
31	13.37649	34.61365	0.482765	2.315753	1.960027	6.047174	12.17769	0.577576	28.44888
32	14.02920	34.80712	0.485732	2.336722	1.917914	5.905898	11.91537	0.574276	28.02777
33	14.64633	34.98107	0.490367	2.357095	1.878050	5.773615	11.66442	0.570643	27.63841
34	15.22750	35.13832	0.496256	2.376860	1.840382	5.649837	11.42510	0.566774	27.27897
35	15.77287	35.28135	0.503022	2.396005	1.804838	5.534073	11.19745	0.562751	26.94764
36	16.28303	35.41235	0.510333	2.414528	1.771333	5.425837	10.98129	0.558640	26.64265

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36 months horizon. Variance decomposition estimates are based on the vector error correction model regression with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF.

Source: Author's estimates

Appendix Table 2: Variance Decompositions of Transmission Channels

A. Variance Decomposition of CBL:										
Period	S.E.	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
3	0.914076	3.493145	7.095729	0.402036	81.43859	4.663343	0.056990	0.003160	0.050802	2.796209
6	1.403635	7.729065	8.709081	1.485399	63.58206	5.728285	0.324798	0.967804	0.252121	11.22138
12	2.211538	6.653115	4.304923	1.178560	45.59290	10.15131	1.549091	11.68407	0.182503	18.70351
24	3.622079	4.498643	4.302437	0.450668	27.54089	13.19508	1.361735	28.79516	0.687047	19.16834
36	4.720496	13.70979	6.671208	0.542555	20.58597	12.59366	0.982090	29.28396	0.963345	14.66742
B. Variance Decomposition of PSC:										
3	5.714932	7.310874	0.213767	3.232081	2.103542	81.96198	0.577821	3.868111	0.037041	0.694778
6	7.640538	7.679715	2.652338	5.757377	1.430731	75.44019	0.431329	4.413112	0.159111	2.036092
12	10.14321	4.754427	9.540650	7.192581	1.430592	71.68989	0.390401	3.582244	0.099016	1.320202
24	13.35404	2.992275	8.628217	4.616166	3.164827	58.78696	1.932566	14.33099	0.472960	5.075039
36	17.22232	7.669994	6.040364	2.803690	5.078620	42.46887	1.769865	27.08495	1.226887	5.856765
C. Variance Decomposition of EXR:										
3	0.166514	1.513641	0.705426	1.612117	0.584057	19.51339	74.86776	0.000466	0.449032	0.754111
6	0.245119	1.094053	1.641705	4.843623	0.290716	20.04868	69.31424	0.404386	0.956329	1.406263
12	0.376539	2.468091	2.842465	6.599894	0.196085	19.58018	63.94407	1.896905	1.189768	1.282539
24	0.620988	9.379845	5.978034	6.271191	0.542990	17.04518	53.90676	4.335578	1.427044	1.113380
36	0.858265	17.21268	7.458425	4.806625	0.846265	13.89561	48.80449	4.003071	1.397498	1.575331
D. Variance Decomposition of GSE:										
3	0.150384	2.101321	0.036253	0.230103	5.001197	0.655694	0.273059	89.92980	0.757409	1.015168
6	0.213428	3.672378	0.167422	0.500452	4.027161	1.145467	0.145170	88.51995	0.850853	0.971143
12	0.305144	4.875542	0.204726	1.010016	3.516049	1.154541	0.082130	87.56113	0.822393	0.773470
24	0.443461	5.706674	0.296210	1.374534	2.809894	0.941689	0.065169	87.27207	0.740511	0.793250
36	0.557707	6.895278	0.532950	1.513702	2.341654	0.779660	0.084831	86.44145	0.638652	0.771820

Notes: All the entries are percentage contributions of the column variables including the forecasted variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF.

Source: Author's estimates

Appendix Figure 3: Responses to Cholesky One S.D. Innovations (Oil Price Included)



Source: Author

Appendix Table 3: Variance Decomposition of INF(Oil Price Included)

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
1	0.010092	4.095502	0.013801	0.168926	0.801814	1.712663	0.359784	0.059302	92.77811
2	0.756175	3.202623	0.152901	0.399485	0.355803	2.456194	0.192913	0.072524	92.41138
3	1.809703	4.973557	0.342925	0.440207	0.212209	2.952990	0.350316	0.059728	88.85837
4	2.149304	7.385914	0.509126	0.588137	0.158109	3.677426	1.075438	0.495597	83.96095
5	2.185104	10.11095	0.886994	0.677717	0.289357	4.904158	2.504144	1.133884	77.30769
6	2.145458	12.35881	1.326093	0.649043	0.540810	5.666696	4.172914	1.666925	71.47325
7	2.107109	14.07233	1.783985	0.594147	0.723137	6.297029	5.832633	2.247738	66.34189
8	1.999431	15.53118	2.101858	0.535855	0.845084	6.802451	7.385841	2.752146	62.04616
9	1.869986	16.79607	2.236657	0.483065	0.937723	7.311166	8.717347	3.166190	58.48180
10	1.722339	17.93770	2.272782	0.439005	1.024709	7.790184	9.843321	3.574477	55.39549
11	1.574921	18.97853	2.248727	0.399226	1.104976	8.242049	10.79535	3.948646	52.70758
12	1.432560	19.90571	2.184684	0.363649	1.176223	8.663412	11.57368	4.283450	50.41663
13	1.301814	20.73421	2.094052	0.332386	1.232834	9.059063	12.19652	4.583072	48.46605
14	1.183689	21.48008	1.984081	0.305077	1.275296	9.429713	12.68337	4.847628	46.81107
15	1.079320	22.15417	1.863867	0.281545	1.306291	9.783732	13.04781	5.079738	45.40353
16	0.988961	22.76537	1.742320	0.261314	1.328654	10.11923	13.30664	5.284545	44.20297
17	0.912577	23.31847	1.626070	0.243875	1.343719	10.43671	13.47615	5.463476	43.17895
18	0.849586	23.81689	1.519736	0.228846	1.352474	10.73551	13.56996	5.618543	42.30846
19	0.799060	24.26425	1.426293	0.215891	1.355630	11.01582	13.60069	5.751443	41.57093
20	0.759861	24.66405	1.347555	0.204713	1.354094	11.27756	13.57964	5.864031	40.94849
21	0.730669	25.01968	1.284348	0.195053	1.348769	11.52116	13.51681	5.958164	40.42535
22	0.710095	25.33436	1.236612	0.186679	1.340505	11.74669	13.42119	6.035759	39.98810
23	0.696680	25.61119	1.203532	0.179389	1.329994	11.95454	13.30070	6.098542	39.62543
24	0.689004	25.85323	1.183724	0.173011	1.317817	12.14513	13.16212	6.148204	39.32775
25	0.685696	26.06359	1.175406	0.167401	1.304458	12.31915	13.01118	6.186342	39.08678
26	0.685505	26.24535	1.176553	0.162440	1.290333	12.47739	12.85258	6.214491	38.89535
27	0.687307	26.40160	1.185023	0.158028	1.275788	12.62078	12.69014	6.234089	38.74724
28	0.690141	26.53529	1.198684	0.154087	1.261100	12.75034	12.52684	6.246473	38.63705
29	0.693213	26.64925	1.215520	0.150552	1.246483	12.86711	12.36495	6.252851	38.56007
30	0.695900	26.74613	1.233724	0.147373	1.232097	12.97217	12.20614	6.254311	38.51215
31	0.697745	26.82835	1.251751	0.144510	1.218061	13.06658	12.05161	6.251813	38.48957
32	0.698442	26.89814	1.268351	0.141931	1.204459	13.15138	11.90217	6.246200	38.48893
33	0.697815	26.95747	1.282580	0.139608	1.191353	13.22752	11.75838	6.238201	38.50707
34	0.695800	27.00809	1.293784	0.137518	1.178784	13.29593	11.62060	6.228446	38.54104
35	0.692418	27.05155	1.301578	0.135639	1.166784	13.35743	11.48907	6.217475	38.58805
36	0.687753	27.08917	1.305810	0.133951	1.155375	13.41279	11.36397	6.205748	38.64542

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF

Source: Author's estimates

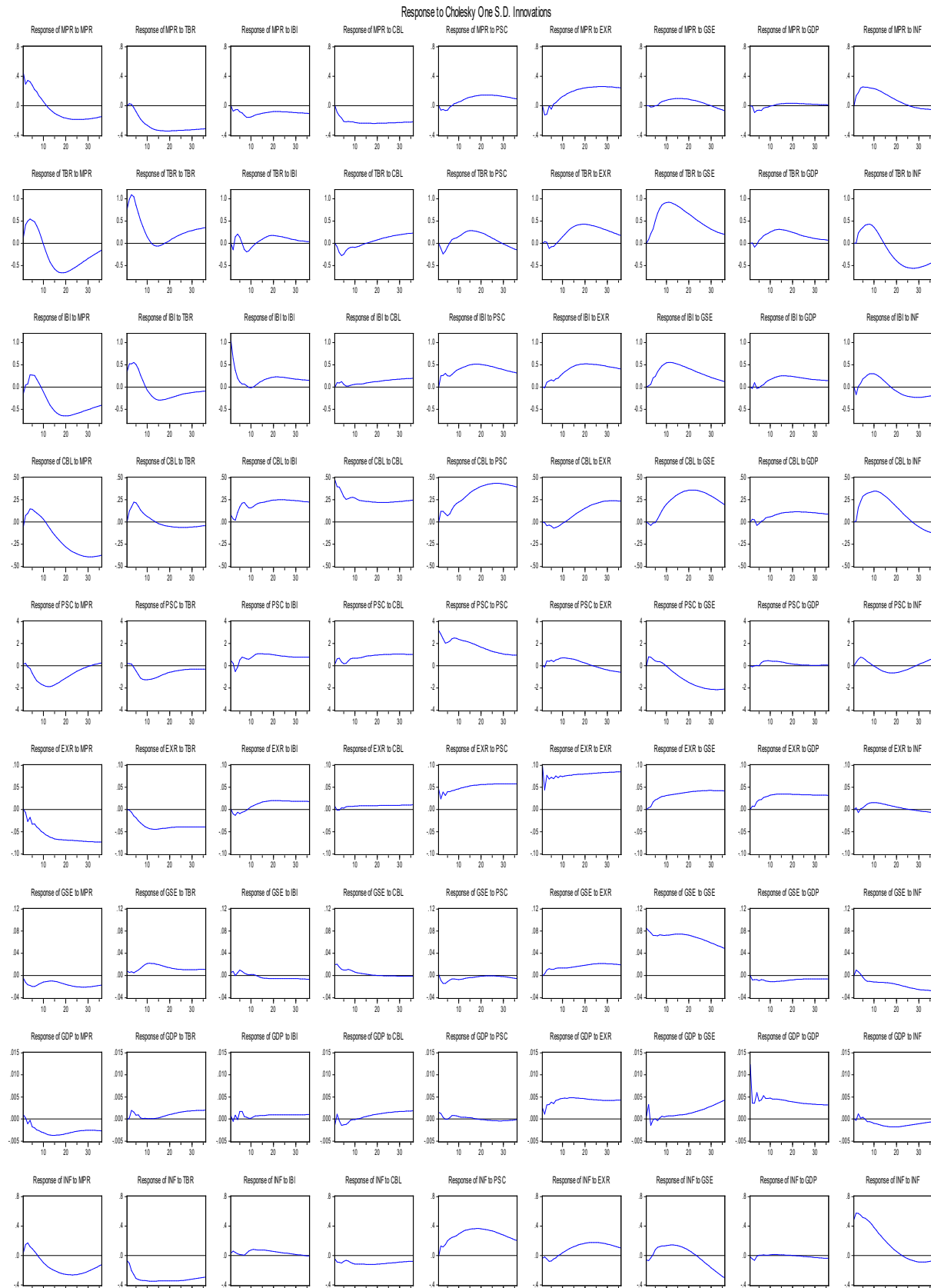
Appendix Table 4: Variance Decompositions of Four Transmission Channels (Oil Price Included)

A. Variance Decomposition of CBL:									
Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
3	3.629693	6.611199	2.623035	80.16438	2.535365	0.440383	0.039548	0.070637	3.885761
6	9.622002	7.293589	4.109331	61.85067	1.719181	0.589015	0.114566	0.158296	14.54335
12	13.59282	3.046044	9.391867	41.77223	2.766751	0.374984	5.034722	0.605029	23.41555
24	11.24108	2.907879	10.98360	27.67346	3.918796	1.799060	14.44200	2.718512	24.31560
36	9.959942	3.011961	9.670744	28.00656	4.211345	2.425924	15.58332	3.341448	23.78875
B. Variance Decomposition of PSC:									
3	7.593665	0.226805	1.833325	0.384182	84.21170	0.245904	4.517999	0.757778	0.228642
6	6.793786	1.836335	2.012283	0.298906	78.99904	0.413465	7.424910	1.447053	0.774225
12	3.517665	4.827721	5.811620	0.475867	72.41426	1.380137	7.979252	2.931880	0.661595
24	2.378262	3.003614	21.82868	0.875706	58.67414	0.974843	5.212905	1.832788	5.219064
36	1.801835	2.630975	27.38420	0.874413	51.51485	0.852961	6.262536	1.315793	7.362433
C. Variance Decomposition of EXR:									
3	1.776437	0.797623	1.366113	1.425698	20.97317	72.62185	0.053130	0.474364	0.511610
6	1.010641	2.199668	5.040878	1.644518	23.24800	63.29459	1.373352	1.381313	0.807039
12	0.609622	4.170568	9.176614	1.792878	23.87918	52.86252	4.601426	2.472782	0.434412
24	0.362869	7.428272	10.90852	1.879848	24.46719	42.07503	8.640140	4.031553	0.206577
36	0.243363	8.309233	10.47084	2.053354	24.95048	40.18809	9.086510	4.467790	0.230350
D. Variance Decomposition of GSE:									
3	1.148046	0.043784	0.153525	3.469455	0.277292	0.179732	93.65798	0.126724	0.943466
6	2.281520	0.096493	0.144964	3.054745	0.432507	0.091422	92.92470	0.135923	0.837730
12	2.416887	0.102289	0.659209	2.969526	0.338570	0.051740	92.50809	0.120502	0.833190
24	1.812200	0.302030	1.632787	2.599750	0.201758	0.031078	92.02791	0.065585	1.326907
36	1.623762	0.555563	1.916645	2.448052	0.136666	0.050050	91.71097	0.050145	1.508145

Notes: All the entries are percentage contributions of the column variables including the forecasted variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF.

Source: Author's estimates

Appendix Figure 4: Responses to Cholesky One S.D. Innovations (Only fiscal deficit)



Source: Author

Appendix Table 5: Variance Decomposition of Inflation (Only Fiscal Deficit Included)

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
1	0.632205	1.950986	0.331304	0.852858	0.029365	0.663447	1.534822	0.139944	93.86507
2	3.578497	2.574145	0.664433	1.533141	2.501792	0.340803	1.437503	0.438626	86.93106
3	4.756688	5.505794	0.546939	1.735740	2.682580	0.420529	0.991750	0.661678	82.69830
4	4.343508	8.612561	0.422100	1.971996	3.374217	0.740639	0.726108	0.486849	79.32202
5	3.819745	11.76768	0.335705	1.884587	4.684517	0.865221	0.862390	0.379537	75.40062
6	3.237082	14.20640	0.276783	1.736440	6.003005	0.810600	1.205363	0.310421	72.21391
7	2.753836	16.08371	0.235367	1.693096	7.203900	0.727732	1.538481	0.265966	69.49792
8	2.419443	17.64684	0.229472	1.746348	8.301229	0.634518	1.842758	0.232357	66.94703
9	2.260486	18.95682	0.295656	1.871926	9.375689	0.568992	2.104588	0.206931	64.35891
10	2.292272	20.10740	0.403037	2.026075	10.54086	0.539580	2.339553	0.188484	61.56274
11	2.471083	21.12119	0.512286	2.159289	11.78162	0.555150	2.567022	0.174437	58.65793
12	2.766541	21.98691	0.595441	2.271110	13.06011	0.619832	2.773342	0.163252	55.76346
13	3.144204	22.72528	0.653978	2.372166	14.31431	0.728561	2.949563	0.153477	52.95846
14	3.585603	23.35401	0.700511	2.469060	15.50543	0.878417	3.087138	0.144370	50.27546
15	4.076634	23.89851	0.740430	2.564277	16.61899	1.057497	3.180977	0.136008	47.72668
16	4.606245	24.38012	0.773534	2.654007	17.65552	1.261363	3.230243	0.128354	45.31061
17	5.158859	24.81541	0.797667	2.733774	18.61491	1.484268	3.237211	0.121364	43.03654
18	5.722381	25.21413	0.811334	2.801908	19.49554	1.721857	3.205468	0.114996	40.91238
19	6.284791	25.58365	0.815663	2.858713	20.29306	1.968799	3.140619	0.109233	38.94547
20	6.837165	25.92816	0.812915	2.905577	21.00468	2.220107	3.049720	0.104105	37.13757
21	7.371544	26.25135	0.805225	2.943883	21.63029	2.470170	2.941460	0.099662	35.48642
22	7.880900	26.55569	0.794126	2.974493	22.17256	2.714527	2.825681	0.095960	33.98607
23	8.358364	26.84318	0.780579	2.998058	22.63565	2.949032	2.713000	0.093052	32.62908
24	8.797938	27.11506	0.765238	3.015235	23.02431	3.170398	2.614274	0.091002	31.40654
25	9.194475	27.37217	0.748668	3.026805	23.34333	3.375790	2.540237	0.089884	30.30863
26	9.544160	27.61495	0.731377	3.033629	23.59747	3.562960	2.501142	0.089775	29.32454
27	9.844406	27.84368	0.713800	3.036541	23.79142	3.730133	2.506479	0.090749	28.44279
28	10.09388	28.05847	0.696278	3.036259	23.92988	3.876130	2.564736	0.092864	27.65151
29	10.29237	28.25929	0.679070	3.033380	24.01737	4.000283	2.683200	0.096160	26.93888
30	10.44072	28.44597	0.662369	3.028388	24.05822	4.102456	2.867805	0.100653	26.29342
31	10.54075	28.61823	0.646329	3.021683	24.05644	4.182955	3.123033	0.106339	25.70424
32	10.59513	28.77563	0.631078	3.013593	24.01575	4.242487	3.451837	0.113187	25.16130
33	10.60726	28.91770	0.616714	3.004386	23.93957	4.282090	3.855605	0.121136	24.65554
34	10.58109	29.04389	0.603312	2.994274	23.83108	4.303086	4.334149	0.130097	24.17901
35	10.52102	29.15370	0.590920	2.983425	23.69326	4.307027	4.885728	0.139952	23.72496
36	10.43169	29.24666	0.579561	2.971970	23.52890	4.295638	5.507116	0.150559	23.28791

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression (including only exogenous fiscal deficits) with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF. However, the data excludes 2017; this will be updated when the 2017 monthly fiscal balances are obtained.

Source: Author's estimates

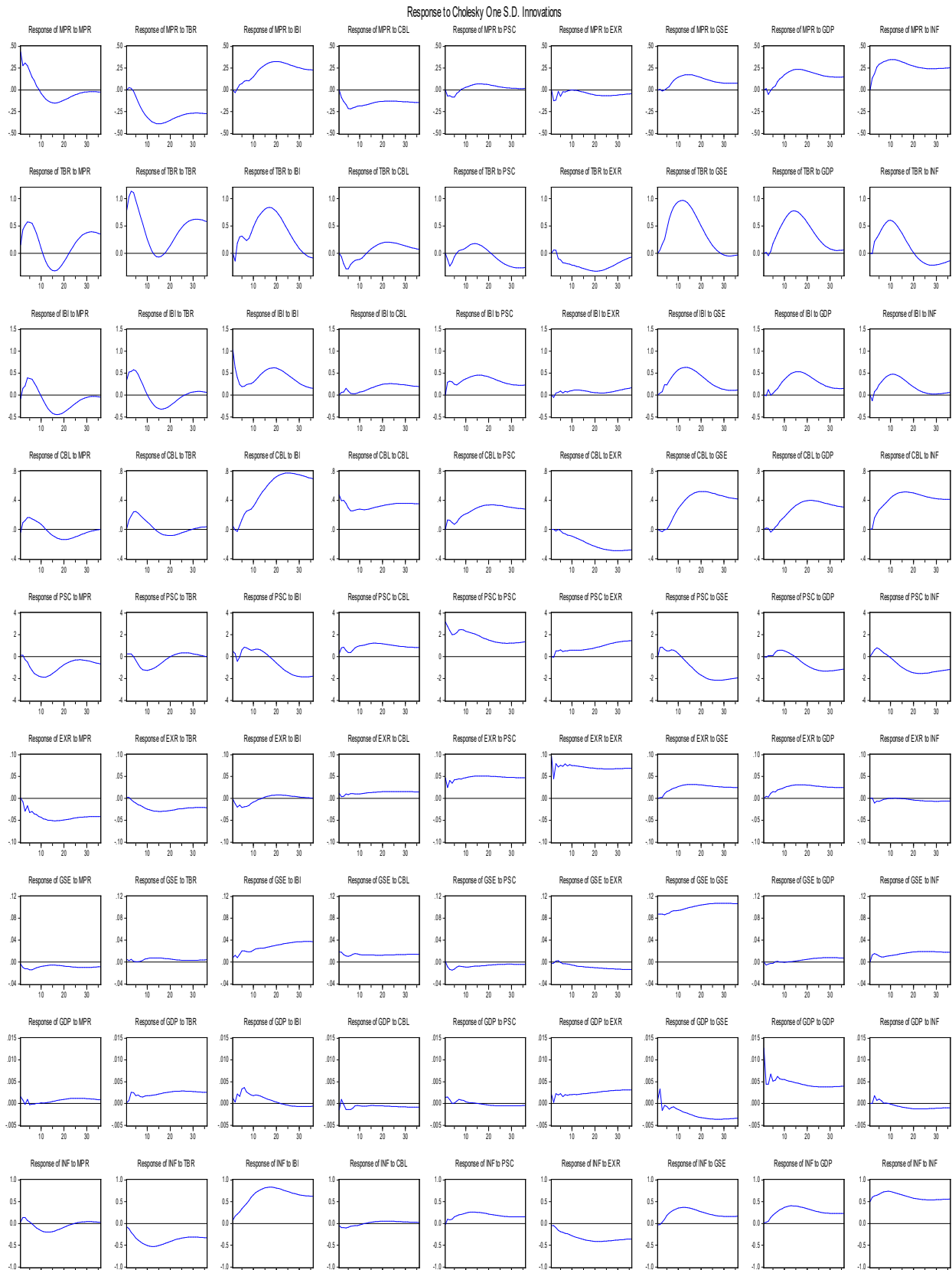
Appendix Table 6: Variance Decompositions of Four Transmission Channels (Only fiscal deficit Included)

A. Variance Decomposition of CBL:									
Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
3	2.588642	6.681099	1.147028	80.59167	4.363269	0.262203	0.290172	0.205479	3.870442
6	4.989787	11.73807	6.371281	54.55700	3.476155	0.684765	0.228118	0.215913	17.73891
12	2.861657	6.429172	8.832009	36.41016	9.627059	0.534872	6.282430	0.667110	28.35553
24	8.896727	2.524661	10.26224	19.51322	21.44814	2.590790	16.73258	1.695521	16.33611
36	15.77314	1.656424	9.984243	15.07615	25.23292	5.403274	15.42153	1.716433	9.735892
B. Variance Decomposition of PSC:									
3	0.306347	0.368327	1.989484	3.203208	87.19854	0.761332	4.517044	0.022912	1.632806
6	3.653761	2.072226	3.073884	2.320206	79.11242	1.541347	4.083709	0.165333	3.977113
12	15.75208	8.446902	4.239855	3.027774	60.89875	2.751255	2.025392	1.005300	1.852692
24	17.02748	7.216888	7.244404	5.805990	47.03177	2.183681	10.19569	0.805131	2.488970
36	12.49506	5.581886	7.486887	8.060631	38.17652	2.181065	23.21345	0.589914	2.214584
C. Variance Decomposition of EXR:									
3	3.387241	0.186809	1.184616	0.251589	18.22000	75.83593	0.237200	0.454861	0.241752
6	6.725808	2.573423	0.881446	0.249111	17.29877	66.30885	2.802884	2.856249	0.303452
12	14.12832	7.783543	0.516966	0.333280	15.91043	49.59774	5.232478	5.418694	1.078542
24	20.57488	8.775495	1.323435	0.381640	15.96196	39.56348	6.806088	5.979747	0.633276
36	22.58252	8.281865	1.471539	0.414273	16.14299	37.41339	7.627587	5.660402	0.405440
D. Variance Decomposition of GSE:									
3	2.096532	0.607660	0.358361	4.666826	1.264593	0.456226	89.39867	0.533099	0.618031
6	3.869526	0.751346	0.602069	3.303344	1.665180	1.207673	87.25935	0.796568	0.544943
12	3.392991	3.209522	0.341633	2.142509	1.207966	1.961687	85.21284	1.238789	1.292063
24	3.405365	3.645118	0.375126	1.103249	0.676932	3.385457	83.64727	1.221261	2.540218
36	4.674840	3.256065	0.474121	0.801797	0.540260	4.812508	79.02410	1.089840	5.326471

Notes: All the entries are percentage contributions of the column variables including the forecasted variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression (including only exogenous fiscal deficits) with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF. However, the data excludes 2017; this will be updated when the 2017 monthly fiscal balances are obtained.

Source: Author's estimates

Appendix Figure 5: Responses to Cholesky One S.D. Innovations (Both Oil Price and Fiscal Deficit Included)



Source: Author

Appendix Table 7: Variance Decomposition of Inflation (Both Oil Price and Fiscal Deficit Included)

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
1	0.548734	2.338536	2.216959	1.065759	0.241516	0.980138	0.522753	0.076948	92.00866
2	2.718673	2.804183	4.639343	1.717858	1.396173	0.700777	0.286852	0.118206	85.61793
3	3.033956	4.912675	6.356049	1.702202	1.292065	1.150680	0.220030	0.263391	81.06895
4	2.255406	7.059931	8.043273	1.741687	1.377474	2.122578	0.636026	1.192479	75.57115
5	1.619465	9.143715	9.854429	1.511318	1.781479	2.797487	1.638036	2.210815	69.44326
6	1.189587	10.65616	11.56494	1.227218	2.155659	3.175811	2.748265	3.112544	64.16982
7	0.979675	11.76166	13.05482	1.008633	2.423624	3.490670	3.694496	3.969410	59.61701
8	0.938168	12.61450	14.70501	0.837680	2.599457	3.661634	4.451514	4.672238	55.51980
9	1.004734	13.23067	16.48295	0.703197	2.721510	3.839809	5.017588	5.259824	51.73972
10	1.137332	13.68625	18.20852	0.594894	2.841381	4.022551	5.437781	5.772645	48.29865
11	1.278113	14.01054	19.81017	0.505214	2.954225	4.211781	5.759213	6.198193	45.27255
12	1.404287	14.21624	21.26232	0.433868	3.052221	4.412426	5.993871	6.544256	42.68051
13	1.500323	14.32241	22.59474	0.379165	3.127001	4.629698	6.150792	6.814369	40.48150
14	1.562668	14.34555	23.84388	0.338145	3.178138	4.858893	6.240282	7.015261	38.61718
15	1.592243	14.30333	25.01981	0.307735	3.209436	5.103002	6.273834	7.158432	37.03218
16	1.593394	14.21391	26.11925	0.285526	3.226659	5.357659	6.264625	7.254416	35.68456
17	1.570881	14.09161	27.13525	0.269745	3.233158	5.620180	6.224429	7.312251	34.54250
18	1.530890	13.94767	28.06307	0.258890	3.231256	5.886916	6.162257	7.339642	33.57942
19	1.479233	13.79046	28.90334	0.251647	3.222243	6.154632	6.084767	7.342440	32.77124
20	1.421312	13.62635	29.65939	0.246866	3.207370	6.419807	5.996955	7.325814	32.09613
21	1.361540	13.46044	30.33520	0.243621	3.187897	6.679636	5.902749	7.294258	31.53466
22	1.303267	13.29682	30.93499	0.241238	3.165132	6.931281	5.805336	7.251670	31.07027
23	1.248747	13.13861	31.46314	0.239259	3.140187	7.172522	5.707231	7.201379	30.68893
24	1.199281	12.98810	31.92455	0.237376	3.113985	7.401499	5.610326	7.146120	30.37876
25	1.155360	12.84686	32.32473	0.235393	3.087224	7.616885	5.515953	7.088057	30.12954
26	1.116867	12.71584	32.66963	0.233196	3.060449	7.817779	5.424996	7.028902	29.93235
27	1.083265	12.59558	32.96529	0.230729	3.034085	8.003739	5.338005	6.969974	29.77933
28	1.053779	12.48630	33.21765	0.227988	3.008465	8.174674	5.255291	6.912285	29.66357
29	1.027556	12.38796	33.43228	0.224997	2.983844	8.330825	5.176999	6.856589	29.57895
30	1.003770	12.30035	33.61440	0.221799	2.960406	8.472681	5.103154	6.803434	29.52001
31	0.981706	12.22307	33.76877	0.218442	2.938274	8.600935	5.033700	6.753194	29.48191
32	0.960794	12.15561	33.89972	0.214975	2.917523	8.716426	4.968525	6.706106	29.46032
33	0.940621	12.09735	34.01113	0.211442	2.898185	8.820094	4.907476	6.662294	29.45141
34	0.920922	12.04756	34.10646	0.207882	2.880265	8.912942	4.850377	6.621794	29.45180
35	0.901557	12.00547	34.18873	0.204328	2.863739	8.996002	4.797034	6.584570	29.45857
36	0.882476	11.97026	34.26058	0.200805	2.848562	9.070310	4.747242	6.550526	29.46924

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression (including both oil price and fiscal deficits as exogenous) with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF. However, the data excludes 2017; this will be updated when the 2017 monthly fiscal balances are obtained.

Source: Author's estimates

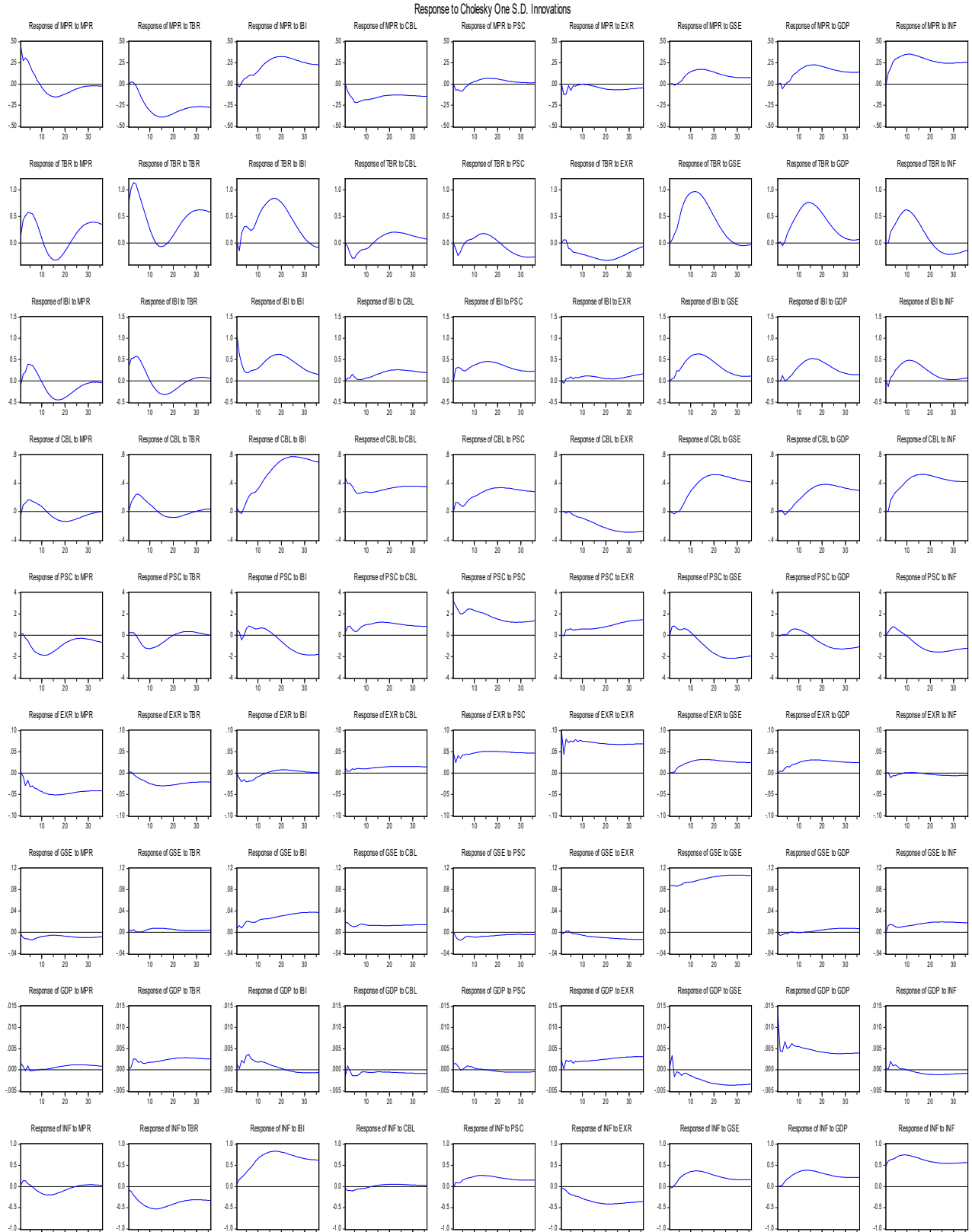
Appendix Table 8: Variance Decompositions of Four Transmission Channels (Both Oil Price and Fiscal Deficit Included)

A. Variance Decomposition of CBL:									
Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
3	3.603945	7.592556	0.475563	79.40290	4.905575	0.070670	0.213449	0.080863	3.654484
6	6.528573	14.67372	4.491492	54.25109	3.738548	0.215901	0.274886	0.204166	15.62163
12	3.087490	6.842014	14.80582	27.15636	6.580290	1.172502	9.286000	3.706140	27.36339
24	1.447992	1.787929	29.15932	11.87161	7.398006	2.923600	16.22341	8.634719	20.55340
36	0.905790	1.023940	34.16443	10.75294	7.096260	4.296273	15.75138	8.638037	17.37095
B. Variance Decomposition of PSC:									
3	0.405115	0.693150	1.868655	5.202036	83.94299	1.043225	5.103755	0.039447	1.701628
6	5.645412	1.621157	3.276787	4.100071	73.93395	2.349573	4.879885	0.379391	3.813773
12	17.69020	7.502023	3.519264	5.760364	56.86165	2.516981	2.811075	1.422384	1.916054
24	14.35072	4.919546	3.917612	9.006237	40.27972	3.962919	11.57067	3.209715	8.782851
36	8.942578	3.039820	10.67377	7.489426	27.86602	7.043872	18.63525	6.195608	10.11365
C. Variance Decomposition of EXR:									
3	3.736484	0.083883	2.270909	0.696447	18.52229	74.04172	0.031340	0.148926	0.467996
6	6.209542	0.805071	3.127325	0.889763	18.50040	67.49915	1.332405	1.201861	0.434485
12	11.52015	2.999217	2.008967	0.948520	18.52717	56.55351	3.931129	3.322669	0.188677
24	15.80221	4.733624	1.039205	1.350935	19.37328	46.28898	5.859803	5.419201	0.132766
36	16.11027	4.615066	0.743034	1.619568	19.95904	45.14077	5.961935	5.638651	0.211669
D. Variance Decomposition of GSE:									
3	1.104641	0.202941	1.067722	3.312959	1.024625	0.079198	91.44178	0.193000	1.573136
6	1.647386	0.103313	2.537579	2.345348	1.440139	0.073662	90.23944	0.123115	1.490016
12	1.244347	0.211104	3.613783	2.154220	1.086743	0.197096	90.05976	0.058386	1.374561
24	0.780952	0.258256	5.593989	1.675918	0.668319	0.555561	88.37652	0.111189	1.979298
36	0.744208	0.184689	7.224893	1.555711	0.460011	0.829076	86.59905	0.231610	2.170754

Notes: All the entries are percentage contributions of the column variables including the forecasted variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression (including both oil price and fiscal deficits as exogenous) with 3 lags of each variable. The ordering of the variables is the same as ordering of the columns (left to right): MPR TBR IBI CBL PSC EXR GSE GDP INF. However, the data excludes 2017; this will be updated when the 2017 monthly fiscal balances are obtained.

Source: Author's estimates

Appendix Figure 6: Responses to Cholesky One S.D. Innovations (Both Oil Price and Fiscal Deficit Included)– First Alternative Cholesky Ordering



Source: Author

Appendix Table 9: Variance Decomposition of Inflation (Oil price and Fiscal Deficit Included) – First Alternative Cholesky Ordering

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
1	0.548734	2.338536	2.216959	1.065759	0.241516	0.980138	0.522753	0.000000	92.08561
2	2.718673	2.804183	4.639343	1.717858	1.396173	0.700777	0.286852	0.008511	85.72763
3	3.033956	4.912675	6.356049	1.702202	1.292065	1.150680	0.220030	0.082586	81.24976
4	2.255406	7.059931	8.043273	1.741687	1.377474	2.122578	0.636026	0.816507	75.94712
5	1.619465	9.143715	9.854429	1.511318	1.781479	2.797487	1.638036	1.684574	69.96950
6	1.189587	10.65616	11.56494	1.227218	2.155659	3.175811	2.748265	2.478941	64.80342
7	0.979675	11.76166	13.05482	1.008633	2.423624	3.490670	3.694496	3.254792	60.33163
8	0.938168	12.61450	14.70501	0.837680	2.599457	3.661634	4.451514	3.904305	56.28773
9	1.004734	13.23067	16.48295	0.703197	2.721510	3.839809	5.017588	4.458409	52.54113
10	1.137332	13.68625	18.20852	0.594894	2.841381	4.022551	5.437781	4.950708	49.12058
11	1.278113	14.01054	19.81017	0.505214	2.954225	4.211781	5.759213	5.365237	46.10550
12	1.404287	14.21624	21.26232	0.433868	3.052221	4.412426	5.993871	5.706400	43.51836
13	1.500323	14.32241	22.59474	0.379165	3.127001	4.629698	6.150792	5.975901	41.31996
14	1.562668	14.34555	23.84388	0.338145	3.178138	4.858893	6.240282	6.179249	39.45319
15	1.592243	14.30333	25.01981	0.307735	3.209436	5.103002	6.273834	6.326935	37.86367
16	1.593394	14.21391	26.11925	0.285526	3.226659	5.357659	6.264625	6.428707	36.51027
17	1.570881	14.09161	27.13525	0.269745	3.233158	5.620180	6.224429	6.492997	35.36175
18	1.530890	13.94767	28.06307	0.258890	3.231256	5.886916	6.162257	6.527073	34.39198
19	1.479233	13.79046	28.90334	0.251647	3.222243	6.154632	6.084767	6.536533	33.57715
20	1.421312	13.62635	29.65939	0.246866	3.207370	6.419807	5.996955	6.526392	32.89555
21	1.361540	13.46044	30.33520	0.243621	3.187897	6.679636	5.902749	6.501054	32.32786
22	1.303267	13.29682	30.93499	0.241238	3.165132	6.931281	5.805336	6.464360	31.85758
23	1.248747	13.13861	31.46314	0.239259	3.140187	7.172522	5.707231	6.419602	31.47070
24	1.199281	12.98810	31.92455	0.237376	3.113985	7.401499	5.610326	6.369492	31.15539
25	1.155360	12.84686	32.32473	0.235393	3.087224	7.616885	5.515953	6.316186	30.90141
26	1.116867	12.71584	32.66963	0.233196	3.060449	7.817779	5.424996	6.261396	30.69985
27	1.083265	12.59558	32.96529	0.230729	3.034085	8.003739	5.338005	6.206446	30.54286
28	1.053779	12.48630	33.21765	0.227988	3.008465	8.174674	5.255291	6.152356	30.42350
29	1.027556	12.38796	33.43228	0.224997	2.983844	8.330825	5.176999	6.099891	30.33564
30	1.003770	12.30035	33.61440	0.221799	2.960406	8.472681	5.103154	6.049612	30.27383
31	0.981706	12.22307	33.76877	0.218442	2.938274	8.600935	5.033700	6.001909	30.23319
32	0.960794	12.15561	33.89972	0.214975	2.917523	8.716426	4.968525	5.957038	30.20939
33	0.940621	12.09735	34.01113	0.211442	2.898185	8.820094	4.907476	5.915145	30.19856
34	0.920922	12.04756	34.10646	0.207882	2.880265	8.912942	4.850377	5.876291	30.19730
35	0.901557	12.00547	34.18873	0.204328	2.863739	8.996002	4.797034	5.840466	30.20268
36	0.882476	11.97026	34.26058	0.200805	2.848562	9.070310	4.747242	5.807601	30.21216

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression (including both oil price and fiscal deficits as exogenous) with 3 lags of each variable. The ordering of the variables is as follows: MPR TBR IBI CBL PSC EXR GSE INF GDP. However, the data excludes 2017; this will be updated when the 2017 monthly fiscal balances are obtained.

Source: Author's estimates

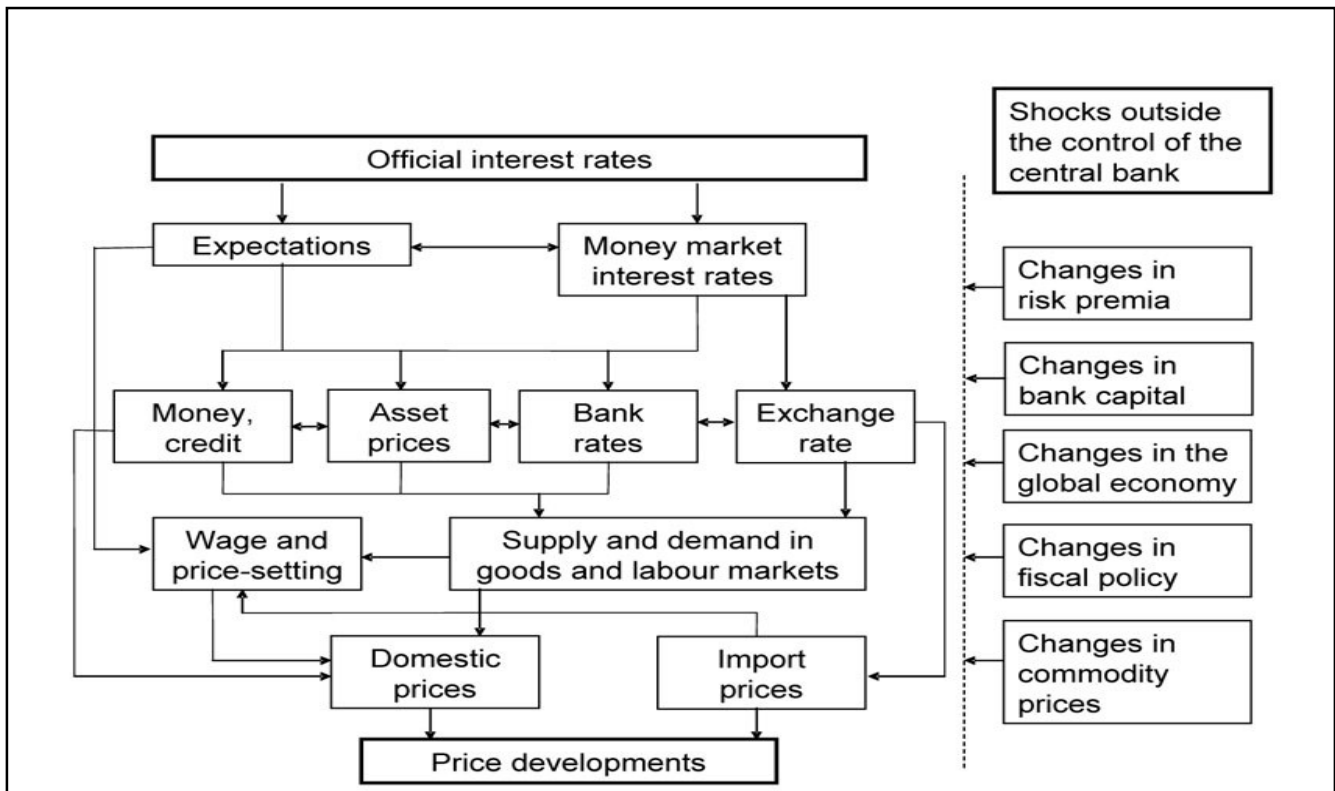
Appendix Table 10 : Variance Decomposition of Inflation (Oil price and Fiscal Deficit Included) – Second Alternative Cholesky Ordering

Period	MPR	TBR	IBI	CBL	PSC	EXR	GSE	GDP	INF
1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.116020	99.88398
2	0.940758	0.059190	0.652645	0.124020	2.192186	0.019349	0.053476	0.661402	95.29697
3	1.024228	0.835776	1.367240	0.110701	2.164483	0.122277	0.439076	0.986876	92.94935
4	0.675137	1.941781	2.168351	0.104008	2.183058	0.765838	1.275984	2.144583	88.74126
5	0.551565	3.260283	3.214596	0.073252	2.513361	1.355711	2.643791	3.382222	83.00522
6	0.687124	4.313898	4.298188	0.083637	2.802958	1.762153	4.009310	4.416161	77.62657
7	1.017370	5.153180	5.299001	0.109680	2.978793	2.147442	5.095941	5.328744	72.86985
8	1.463842	5.856858	6.481770	0.142018	3.066719	2.415775	5.919252	6.070342	68.58342
9	1.951218	6.418530	7.823980	0.174951	3.107932	2.694544	6.497132	6.672125	64.65959
10	2.439920	6.881292	9.181125	0.211377	3.152912	2.980538	6.893845	7.183880	61.07511
11	2.861739	7.250459	10.48280	0.259767	3.199611	3.267261	7.176134	7.597042	57.90519
12	3.203611	7.523680	11.69156	0.317841	3.241238	3.555158	7.365727	7.921061	55.18013
13	3.458077	7.709549	12.82034	0.380164	3.269830	3.847129	7.476980	8.163325	52.87461
14	3.631487	7.818877	13.89207	0.442264	3.284249	4.138295	7.522841	8.335214	50.93471
15	3.733210	7.865496	14.91075	0.501108	3.287043	4.432436	7.515832	8.449671	49.30445
16	3.775137	7.864315	15.87034	0.556068	3.282624	4.726207	7.469798	8.518571	47.93694
17	3.767830	7.827320	16.76209	0.607472	3.273266	5.017698	7.396894	8.551216	46.79622
18	3.722877	7.764210	17.57953	0.655292	3.260346	5.304028	7.306170	8.555347	45.85220
19	3.650472	7.682581	18.32143	0.699288	3.244366	5.582667	7.204072	8.536796	45.07833
20	3.559869	7.588532	18.98938	0.739109	3.225835	5.850955	7.095205	8.500734	44.45038
21	3.458660	7.487110	19.58603	0.774548	3.205340	6.107028	6.983035	8.451548	43.94670
22	3.352864	7.382450	20.11455	0.805662	3.183598	6.349047	6.870308	8.393029	43.54850
23	3.246877	7.277767	20.57843	0.832689	3.161223	6.575795	6.759141	8.328337	43.23974
24	3.143753	7.175474	20.98182	0.855954	3.138726	6.786380	6.651090	8.260044	43.00676
25	3.045365	7.077273	21.32953	0.875806	3.116477	6.980381	6.547198	8.190155	42.83781
26	2.952693	6.984318	21.62686	0.892592	3.094757	7.157739	6.448110	8.120249	42.72268
27	2.866053	6.897350	21.87926	0.906655	3.073781	7.318772	6.354176	8.051526	42.65243
28	2.785327	6.816812	22.09213	0.918334	3.053724	7.464059	6.265544	7.984895	42.61918
29	2.710151	6.742923	22.27059	0.927958	3.034714	7.594417	6.182224	7.921023	42.61600
30	2.640057	6.675731	22.41947	0.935840	3.016839	7.710808	6.104131	7.860376	42.63675
31	2.574572	6.615152	22.54317	0.942263	3.000151	7.814308	6.031112	7.803256	42.67602
32	2.513275	6.560996	22.64571	0.947481	2.984667	7.906044	5.962966	7.749835	42.72903
33	2.455820	6.512987	22.73071	0.951717	2.970380	7.987167	5.899462	7.700180	42.79158
34	2.401939	6.470777	22.80137	0.955166	2.957262	8.058818	5.840347	7.654273	42.86005
35	2.351425	6.433958	22.86053	0.957996	2.945267	8.122110	5.785354	7.612029	42.93134
36	2.304114	6.402075	22.91063	0.960352	2.934338	8.178104	5.734211	7.573306	43.00287

Notes: All the entries are percentage contributions of the column variables including the inflation variable itself over 36months horizon. Variance decomposition estimates are based on the vector error correction model regression (including both oil price and fiscal deficits as exogenous) with 3 lags of each variable. The ordering of the variables is as follows: GDP INF MPR TBR IBI CBL PSC EXR GSE. However, the data excludes 2017; this will be updated when the 2017 monthly fiscal balances are obtained.

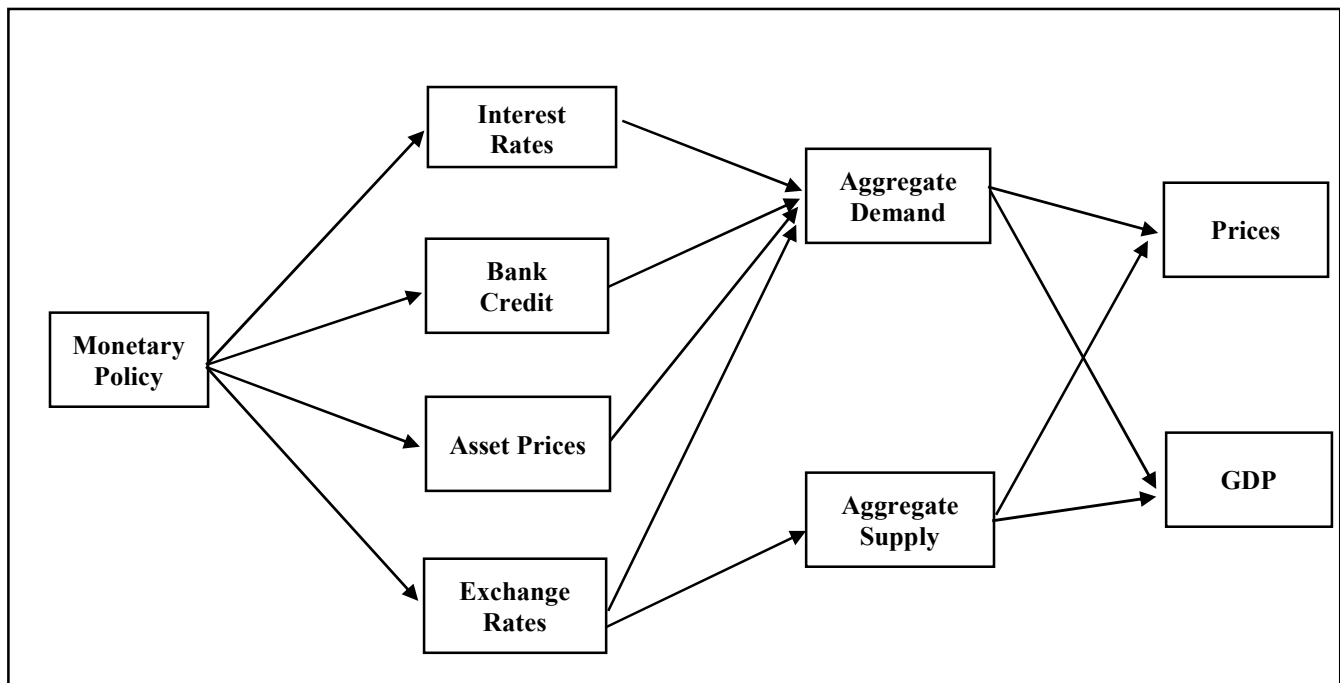
Source: Author's estimates

Appendix Figure 7: An Overview of the Transmission Mechanism of the European Central Bank



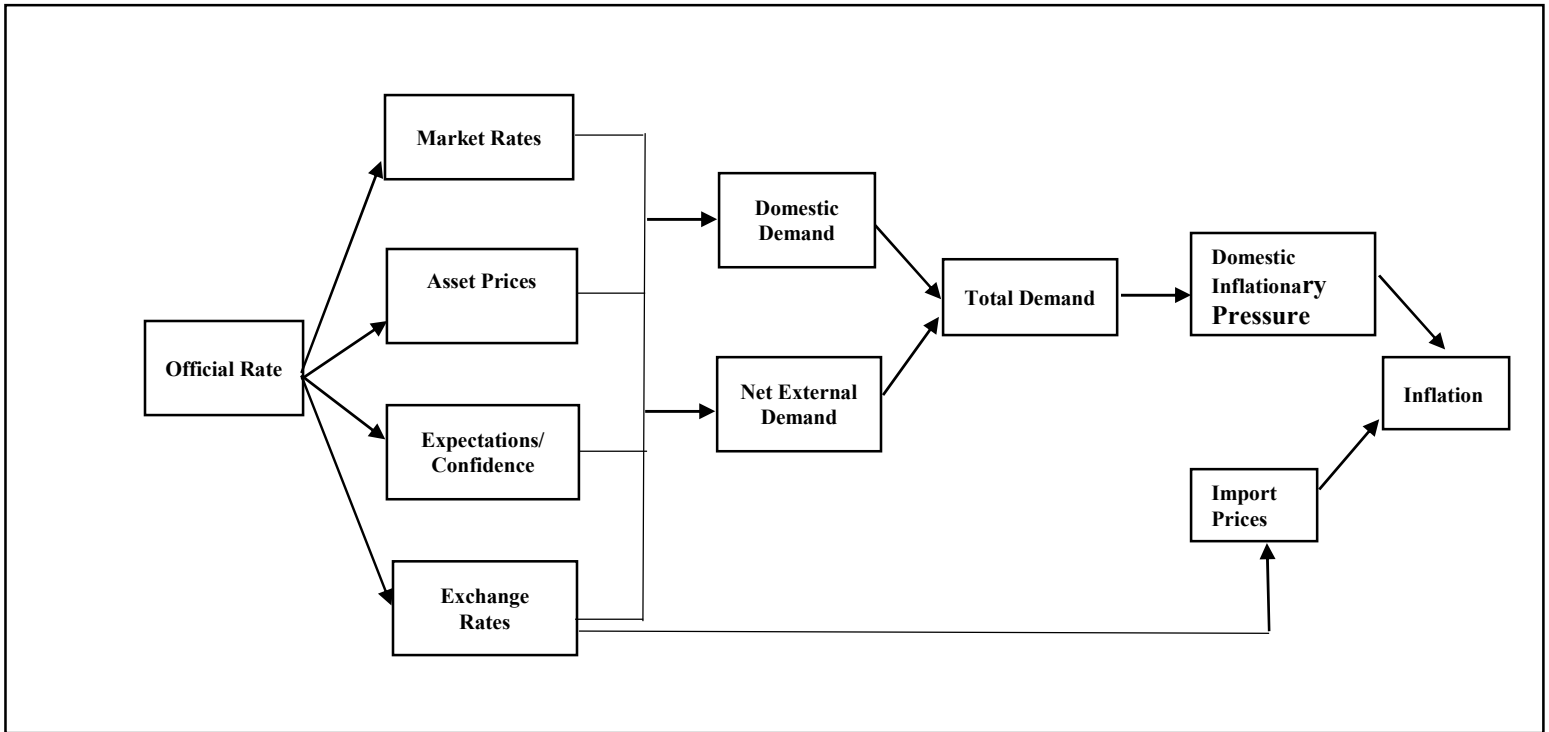
Source: European Central Bank

Appendix Figure 8: An Overview of the Transmission Process of The Federal Reserve Board



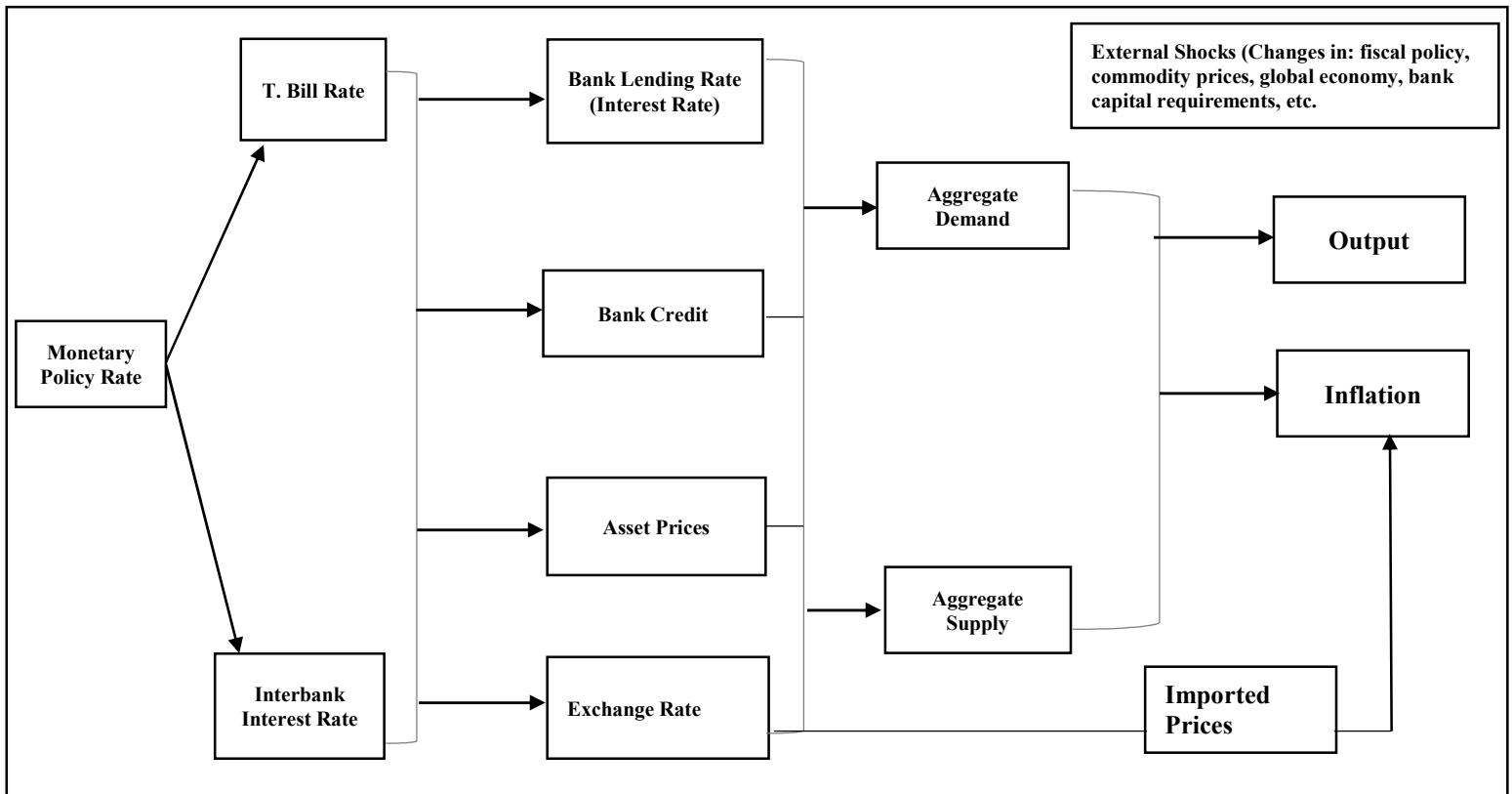
Source: Federal Reserve Board

Appendix Figure 9: An Overview of the Transmission Process of The Bank of England



Source: Bank of England

Appendix Figure 10: An Overview of the Transmission Process of The Bank of Ghana



Source: Author