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The Effect of Monetary Policy on Output and Prices in Ghana

By

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DECLARATION

I hereby declare that this submission is my own work towards the degree of Master of Philosophy (Economics) and that, to the best of my knowledge, it contains no material previously published by another person, nor material which has been accepted for the award of any other degree of the University, except where acknowledgement has been made in the text.

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ABSTRACT

The study sought to investigate the effect of monetary policy on output and prices by specifically identifying the responsiveness of output and prices to monetary policy innovations and the variations in output and prices that is explained by the monetary policy variables. The study employed the Structural Vector Autoregressive (SVAR) modelling technique on quarterly time series data on real GDP, Consumer Price Index (CPI), the Monetary Policy Rate (MPR), broad money supply (M2) and real effective exchange rate from 1980 to 2012. The study further used the Impulse response functions and Forecast Error Variance Decomposition to examine the stochastic shocks of the monetary policy variables' innovations on output and prices. The study found a weak and slow ability of monetary policy to influence output and price in Ghana. The study however, found evidence of MPR as the most effective monetary policy variable that influences output whilst money supply is the most effective monetary policy variable that influences prices.

DEDICATION

I dedicate this thesis to GOD ALMIGHTY, for his grace and favor to embark on this study. I also dedicate it to my son, Dennis Mike Obeng, my husband, Kwame Obeng and my parents for their support.

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TABLE OF CONTENTS

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Monetary authorities all over the world implement monetary policies to achieve macroeconomic goals such as price stability, economic growth, high level of employment, interest rate stability, balance of payment equilibrium, and promoting a more stable financial institution, among others (Handa, 2009). In general, monetary authorities are concerned with adjusting the supply of money to achieve some combination of inflation and output stabilization. Prices and wages according to the New Keynesians, do not adjust immediately to changes in the economy in the short run, therefore any change in money supply affects just output; the actual production of goods and services. However, in the long run, output is assumed to be fixed; at full employment level. As a result, any change in money supply affect predominantly the general price level resulting in inflation (Korshy, 2012).

The ability of monetary policy to influence output and prices is broadly accepted in economic theory and well documented by a number of empirical studies on monetary transmission mechanism. According to Sims (1992), Jaroncinski (2008), Borys and Horvath (2007) and Miyao (2002), monetary policy impacts positively on both prices and output. Based on their study, an economy can expand when monetary authorities either increase money supply or decrease interest rate. Increase in money supply increases funds available to individuals, which may lead to an increase in expenditure and hence aggregate demand. The increase in demand relative to supply pushes prices up and firms expand output to take advantage of the higher prices. Also a reduction in the rate at which the Central Bank lends to the commercial banks; the interest rates, increases

investments and consumption since firms and individuals can have access to funds at lower rates. These affect the demand side of the economy and that, such policy will increase output and eventually employment.

Monetary policy regime in Ghana has evolved from the period with direct monetary controls to periods where monetary policy has been allowed to operate in a liberalized environment. Prior to 1983, the Bank of Ghana (BoG) operated a direct controlled monetary system, this period entailed largely a reliance on direct monetary intervention instruments which embraced the imposition of ceilings on commercial bank's lending which usually had to be consistent with macroeconomic targets like growth, inflation and external balance. This system proved to be highly inefficient and ineffective in all sectors of the economy and necessitated reforms in the conduct of monetary policy which led to the advent of liberalized monetary system. Here the BoG uses indirect instruments such as the Monetary Policy Rate (MPR) to target inflation directly without influencing money supply per se (Kwakye, 2012).

The BOG in 2002 gained its independence in the discharge of its duties when the BoG Act 617 was passed, which specifically considers the BoG as an inflation targeting for conducting monetary policy. According to Quartey and Afful-Mensah (2014), in 2007 the Inflation Targeting (IT) framework was implemented, in which a specified level of inflation is targeted by the BoG using its MPR and together with the Ministry of Finance work towards achieving the set level. When inflation stays above the target for some reasons, authorities regulate or maneuver the policy rate so that inflation can be brought back to the target within reasonable time period without creating instability in the economy.

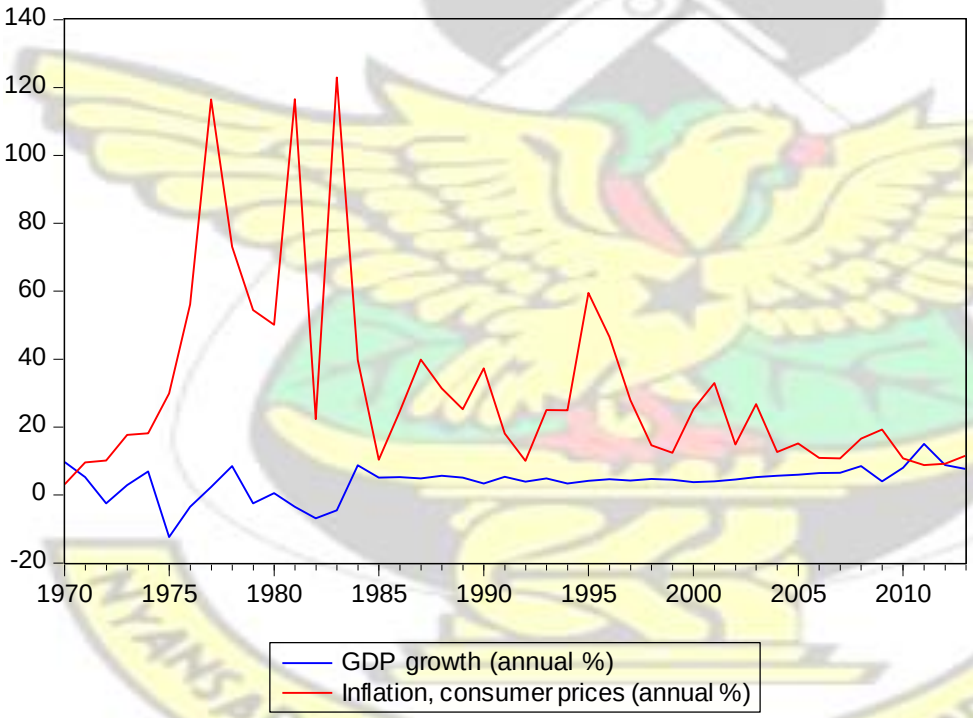
The ability of monetary authorities to achieve their set targets depends on several factors of which one major factor is the credibility of monetary policy. If monetary policy is not credible, then it undermines the ability of authorities to use monetary innovations to boost output and this will rather increase prices instead as posited by Kyland and Prescott (1977) and Barro and Gordon (1983). The ability of the BOG to achieve their goals will depend on how the public understand and have confidence in the financial authorities to deliver.

Kwakye (2012) also argued that, monetary policy implementation in Ghana has faced major challenges as inflation rates have been generally high and set targets are more often than not missed. The large informal sector, data gyration, inconsistency and fiscal indiscipline by the government also cast doubts on the effectiveness and credibility of monetary policy in Ghana. The effectiveness of monetary policy innovations also depends on the structure of the economy, the development of the financial sector as well as how well the economy is able to absorb changes in money supply. The impact of monetary policy cannot also be considered in isolation from the nature of the country's financial institutions. (Epstein and Heintz, 2006).

Monetary policy in Ghana essentially has been geared towards maintaining price stability and output growth. The growth path of the Ghanaian economy prior to 1983 was periods of high inflation accompanied by predominantly negative output growth rates; it is the deteriorating phase of the economy which was marked essentially by series of military interventions. These military rulers usually embarked on expansionary economic innovations in some sectors that did not necessarily lead to an increase in output. This low output levels eventually resulted in increased deficit in the country. They however, embarked on expansionary monetary policies such as

increasing money supply to finance these deficits, which subsequently resulted in higher prices. During this period, output fell from a high level of 9.72% in 1970 to a minimum of -12.43 in 1975, with inflation averaging 7.95% annually. Following the implementation of the Economic Recovery Program (ERP) and the Structural Adjustment Program (SAP) in 1983, output grew from -4.6% in 1983 to 8.6% in 1984 and inflation fell from a high record of 123% in 1983 to 39.7% in 1984. Considering the periods after 1984, GDP has been growing consistently though modestly with relatively lower inflationary trends as depicted by Figure 1.1 (World Bank 2014, WDI).

Figure 1.1: Trends in real GDP and Inflation



1.2 Problem statement

The Bank of Ghana over the years has employed various monetary policy frameworks to achieve its main goals of price stability and output growth. These frameworks have evolved from direct controls to more market based with policy targets being mainly money supply and prices. However, in spite of all these policies, an important question can be raised regarding the effectiveness of these policies since the economy has for decades not been able to achieve price stability and constant growth overtime (Quartey and Afful-Mensah, 2014).

Though the Inflation Targeting period may have been effective in its early stages when it was able to achieve single digit inflation for almost 32 consecutive month period (from June 2010 to January 2013), Akosah (2015) argued that the debate about this unprecedented achievement has been whether it was as a result of good policy or sheer good luck.

In most industrialized economies, empirical evidence shows that monetary policy has been used to boost output and stabilize prices over the years. Studies by Cushman and Zha (1997), Bernanke and Mihov (1995), Christiano *et al*. (1998), Khan *et al*. (2002), Berument (2007) as cited by Starr (2005) has shown a lucid that monetary policy in advanced economies may have significant impact on real economic activities in the short run and may significantly affect prices only in the long run.

Surprisingly, the effect of monetary policy though has been widely explored in most developing countries of which Ghana is no exception, the conclusions of the effectiveness of monetary policy on macroeconomic variables still remain uncertain. According to Agenor *et al*. (2000), there exist

a positive relationship between money and output in most developing countries which implies increasing money supply should be a major driving force for growth. Chuku (2009) also showed that money supply affects output and prices significantly in Nigeria but interest rate does not. On the other hand, Fasanya *et al*. (2003) found the relationship between money supply and prices in Nigeria to be insignificant.

In Ghana, Abradu - Otoo *et al*. (2003) proved that interest rate has a modest impact on output and prices but money supply impacts output and prices significantly but then Ahiador (2013), showed an insignificant relationship between money supply and inflation and also a negative relationship between interest rate and inflation in Ghana. It becomes obvious to ask if monetary policy has real effects in the Ghanaian economy.

Looking at the current state of the Ghanaian economy, it will be difficult to accept without further empirical research about the relative impact of monetary policy on real economic variables since the state of the economy raises a lot of questions about the effectiveness of monetary policy in Ghana. It is worth noting that in Ghana, studies on the effect of monetary policy on output and prices are scarce and the few ones are usually concerned about the transmission mechanism of monetary policies (Akosah, 2015 and Alhassan, 2014). One area that may be lacking is, which monetary policy instrument(s) provides better control over aggregate prices and output in Ghana.

This study therefore seeks to add to the pool of knowledge by exploring the linkages between monetary policy output and prices using time series data on Ghana from 1980 to 2012.

1.3 Objectives of the Study

The main objective of the study was to investigate the effect of monetary policy on output and prices in Ghana. To achieve this objective, the following specific objectives were explored; to

i. Establish empirically the responsiveness of output and prices to monetary shock in Ghana ii. Investigate which monetary policy variable is effective in boosting output and controlling prices in Ghana.

iii. Identify the variations in prices and output that is explained by monetary policy shocks.

1.4 Hypotheses

The following hypotheses were tested;

1. Changes in the MPR have no significant impact on output and prices.
2. There is no significant relationship between changes in money supply, growth in output and prices in Ghana.
3. Output and prices are not responsive to monetary shock in Ghana.
4. The MPR/ money supply/ Exchange rate is the most effective monetary policy variable in Ghana.

1.5 Significance of Study

Monetary policy has been an effective tool in influencing growth in any economy. Hence there is the need to study how effective monetary policy has been in Ghana. The study will provide an analysis and appraisal of the trends in money supply, interest rates (MPR), output and prices in the

economy. This information will inform appropriate and effective monetary policy designs by policymakers to achieve the targeted growth. The study will also show the responsiveness of output and prices to monetary policies. This will help monetary authorities to know the effectiveness of their policies and the various transmission mechanisms to achieve their target.

The study will contribute significantly to the pool of knowledge since the Structural Vector Autoregressive analysis will be employed. This captures complex dynamic interrelationships among macroeconomic variables very effectively and to the best of my knowledge, it is not a popular methodology used in studies like this in Ghana.

1.6 Organization of the study

The research work was organized in five chapters. The first chapter introduced the research work and provided the background to the study. It also identified the problem statement, the objectives of the study, hypothesis to be tested, and the scope of the study as well as the motivation for the study. The second chapter provided a review of both theoretical and empirical literatures on the subject matter of the research. The third chapter focused on the conceptual framework, research design and methodology used. The fourth chapter provided the data presentation, analysis and discussion of results. Finally, chapter five concluded the research by summarizing the key findings, provided policy implications and recommendations based on the findings.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter introduces related literature. The chapter is in two main parts. The first part looks at the theoretical review on how the conduct of monetary policy affects prices and output. The second part explores empirical evidence of monetary policy effects on output and prices.

2.2 Theories of the Relationship between Monetary Policy and Output and Prices

This section reviews theories that underpin the subject matter. In all, five theories were reviewed, that is, the dynamic stochastic general equilibrium model, the IS-LM model, The MundellFleming Model, the Quantity theory of money and Keynes theory of money and prices. The theories are discussed in the subsections below.

2.2.1 Dynamic Stochastic General Equilibrium (DSGE)

The DSGE model describes the behavior of the economy based on microeconomic foundations of the interactions of key agents in the economy; household, firm and the government, which interacts and clears at every point in time resulting in a general equilibrium. The model also considers the fact that the economy can be influenced by shocks. The equations that define the equilibrium of the model are in three components;

$$Y = f_y(Y_e, i, \varepsilon_e, \ldots\ldots\ldots) \quad (2.1)$$

$$\square\square\ f_{\square}\square^{\square}_{e},Y,.....\square \quad (2.2)$$

$$i\ \square\ f_{i}\ \square_{\square\square\square_{*}},Y.....\square \quad (2.3)$$

Where Y is aggregate demand, Y^e is future real economic activity, π, π^e and i denotes inflation, expected inflation and nominal interest rate respectively (Sbordone *et al*., 2010).

Equation 2.1 is the aggregate demand component which captures the idea that people are more likely to spend more when future economic activities are promising and also individuals and firms are likely to save or invest more when real interest rates are high. Equation 2.2 is the supply component which shows that in periods where economic activities are high, firms can increase wages to influence workers to increase output, which can eventually generate inflation.

Also, inflation in current period is influenced by peoples' expectations of future inflation. Equation 2.3 is the monetary policy component. It shows that the nominal interest rate set by the central bank is influenced by the inflation rate and the level of economic activities or aggregate output within the economy.

The central bank can adjust the interest rate to influence the level of economic activity in the economy. In periods of economic slack, there is the tendency for monetary authorities to lower short term interest rate or raise it when the economy is overheating. Monetary policy through changing the interest rate, affects real output (in equation 2.1) which further influences inflation (as in equation 2.2). The conduct of monetary policy has influence on aggregate output and prices. The theory therefore predicts that expectations about output and inflation have major implications on the conduct and effectiveness of monetary policy in the DSGE model.

2.2.2 The Investment Saving - Liquidity Preference (IS-LM) Model

The IS-LM model describes equilibrium relationship that exists between output and interest rate in the goods and money market. It was proposed by Hicks (1937) and was later polished by Hanses (1949). The IS curve shows equilibrium combinations of output and interest rate in the goods market (aggregate demand equals aggregate supply). The LM curve on the other hand shows equilibrium combinations of output and interest rate in the money market (real money demand equals money supply). Thus in equilibrium;

$$Y = C[Y - t(Y)] + I(r) + G + NX \quad (2.4)$$

$$\frac{M}{P} = L(r,Y) \quad (2.5)$$

Where Y denotes aggregate demand/ income, C is aggregate consumption, I is investment, G is government expenditure, NX is net exports and r is the rate of interest. $\frac{M}{P}$ represents real money balances. Equation 2.4 is the IS schedule, which shows that aggregate demand is the sum of consumption (income less taxes), investment, government expenditure and net export. An increase in any of these variables increases aggregate demand/ output and cause the IS curve to shift to the right. However, an increase in the interest rate will cause investments to fall and consequently output will also fall. The IS curve is downward sloping proving the inverse relationship between interest rate and output. Equation 2.5 shows the LM schedule which depends positively on output (Y) but inversely on the interest rate (r); which is the opportunity cost of holding money. The LM

curve is upward sloping in the sense that higher output means increase in the demand for money, because money supply is assumed fixed, interest rate will have to increase so that money demand can decrease to the real money supply level to restore equilibrium.

Changes in monetary policy can affect the equilibrium levels of output and the interest rate. If money supply increases, it means the LM curve will shift downwards to the left, which will cause interest rates to fall and increase output. Also, increase in prices can cause real money supply to fall which means the LM curve will shift to the left which will result in increased interest rates with decreased output.

2.2.3 The Mundell-Fleming Model

The model was first proposed by Robert Mundell (1963) and Marcus Fleming (1962). It is however an extension of the IS-LM model which introduces an open economy with perfect capital mobility unlike the closed economy in the IS-LM model and also shows the relationship that exist between interest rate, aggregate output and exchange rate. An important assumption of the model is that the local interest rate and the global interest rate are equal.

Under a flexible exchange rate regime, an expansionary monetary policy; an increase in money supply shifts the LM curve downwards causing the domestic interest rate to fall (below the global interest rate). The fall in interest rate encourages increase capital outflow, all things being equal, causing the domestic currency to depreciate. The depreciation of the currency makes domestic goods more competitive and hence increase net export. The increased net export on the other hand,

causes the IS curve to shift to the right causing domestic interest rate to equalize the global interest rate and eventually increasing output.

When there is a change in fiscal policy, say increased government expenditure, the IS curve shifts rightward which leads to a rise in the domestic interest rate (beyond the global interest rate). The increased domestic interest rate encourages increased capital inflows, makes imports cheaper and exports expensive and thence increase imports and decrease exports, which means lower net export. The reduction in the net export eventually causes the IS curve to shift back to its original level. In a flexible exchange rate regime, fiscal policy is less effective compared to monetary policy.

On the other hand, in a fixed exchange rate regime, monetary policy is less effective. Monetary authorities only influence the monetary aggregates to achieve some specific level of exchange rate. They either buy domestic currency with foreign currency when the supply of domestic currency exceeds its demand to avoid depreciation of the domestic currency or sell domestic currency when the demand exceeds supply. Fiscal policy proves to be more effective in a fixed exchange rate regime. Increases in government expenditure shift the IS curve to the right and hence interest rate rises which eventually leads to appreciation of the local currency. Since the exchange rate is fixed, monetary authorities will have to increase the domestic currency by buying the foreign currencies with local currency, thereby shifting the LM curve downwards. This reduces the interest rate and keeps the exchange rate at its initial level, however output increases.

2.2.4 The Quantity Theory of Money

The quantity theory of money evolved around the 16th century when gold and silver from America minted into coins in Europe increased, resulting in inflation by the classical economists. Money supply is directly proportional to the level of prices and any change in the amount of money in circulation will not necessarily increase output but it will result in equivalent increase in prices instead.

The theory is propounded further by Irving Fischer as

$$MV \equiv PY \qquad (2.6)$$

Where M is money supply, V is velocity of money/ the number of times money changes hands on the average, P is the general price level and Y denotes real output/ overall transactions of goods and services.

Equation 2.6 can also be referred to as the Fischer equation. It shows that the total value (monetary value) of output in the economy must equal the amount of money times the number of times that money changes hands in the economy. The theory assumes velocity of money (V) is constant over time, this is because the payment system is assumed to be constant over time since it is determined by institutional and technological factors and also peoples' spending pattern and individuals habit do not change quickly. Output (Y) in the long run, do not depend on the amount of money in the system, hence output is also considered to be constant. Thus any increase in money supply will result in a corresponding increase in prices.

Another approach to the quantity theory is the Cash Balance (Cambridge) approach. It determines prices from the demand and supply of money perspective. These were economists at the Cambridge University in England, and included Alfred Marshal, A.C. Pigou and the early writings of John Maynard Keynes. According to them, in equilibrium;

$$M = f(r^*)Py^e \qquad (2.7)$$

$$P = \frac{M}{f(r^*)y^e} \qquad (2.8)$$

Where M is money supply, P is price, r* is equilibrium rate of return on investment and y^e is real output at full employment level.

Equation 2.7 shows that money supply is a function of the equilibrium rate of return times prices and real output at full employment level. Pigou opines that the equilibrium rate of return (r*) was determined by the marginal productivity of capital, which is not influenced by money supply and prices. Also, prices and money supply has no effect on output at full employment level.

Therefore, equation 2.8 brings to bare that prices vary proportionately with money supply.

The quantity theory of money has however received several criticisms especially from Keynes, even though he was once a major contributor to the theory. He challenged the relevance of the

theory based on three reckons. He refuted the assumption of stable velocity, constant output and the motive behind people's demand for money balances.

Keynes argued that, available data showed the two assumption of stable velocity, that is, constant ratio of cash to deposit and constant ratio of reserves to deposit, are however unstable and thus velocity is unstable overtime. He also debunked the assumption that output is constant and that constant output is as a result of full employment but rather, it was equilibrium level of output that determines equilibrium level of employment. As such, a less than full level of employment is probable; hence output cannot be taken as constant. He finally addressed the assumption that people demand money only for transactionary purposes. He believed that money could be demanded for precautionary and speculative purposes as well (Johnson et al, 2001).

2.2.5 Keynes Theory of money and prices

The theory of money and prices by Keynes disagrees with the views of the Classical economists who postulated that there is a direct relationship between money supply and prices. According to Keynes, the assumption of constant velocity which is the basis for the Classical economists does not hold. Keynes however stated the relationship is an indirect one and is evident through the interest rate. That is, when there is an increase in money supply, it causes the rate of interest to fall, which leads to an increase in investment and thus aggregate demand and output and vice versa.

The theory argues that, when output is not at full employment level, increase in money supply causes output to increase in the same proportion as the increased in money but prices do not rise

with the increase in output. However, when output is at the full employment level, output does not respond to changes in money supply, hence any change in money supply translates in prices, by the same proportion.

2.3 Empirical Review

Ganev *et al*. (2002) did a study on the impact of monetary policy on 10 Central and Eastern European countries for the period between 1995 to 2000. The motivation of the study was to find out the relative impact of the interest rate and exchange rate channels of monetary policy in these transition economies. The study employed granger causality test and impulse response functions to analyze interest rate (the short term money market rate i.e. the 1-or 3-month interbank rate), the exchange rate (the local currency as against the Euro), the industrial output as a measure of output and core inflation, which is used as a measure for prices. The core inflation is used rather than CPI because they believe the former is less prone to short run supply shocks and could be a better estimator of general prices. The study showed little evidence of granger-causality from interest rate to industrial output. The impulse response functions proved that inflation is dampened by interest rate rise and increased by depreciation of the exchange rate and also, depreciation boosts output in majority of the countries.

Sims (1992), using the VAR framework also did a study on how monetary policy affect the economies of US, UK, France, Germany and Japan. The study employed monthly data series on all variables from 1957:1 to 1991: 12. The study showed that money supply has a positive effect on prices in all countries, but relatively small and unimportant in Germany and UK. Monetary innovations have a negative and also relatively small effect on output in all countries except

Germany. Though prices respond to interest rate positively, the effect is strong and persistent only in Japan and France. Output on the other hand responds negatively to interest rate in all countries.

Jaroncinski (2008) also did a study on how monetary policy shocks impact the Eastern and Western European countries. The paper compared the impulse response of countries in the Euro area before the adaptation of the monetary union and new member countries from the central and

Eastern Europe and to find out how countries' characteristics affect their economic activities. Using the VAR analysis, the study was conducted on five European area countries (Finland, France, Italy, Spain and Portugal) and four new member countries (Czech Republic, Poland, Slovenia and Hungary). The study found that monetary tightening leads to increase in prices but the impulse response of output and prices to monetary policy are not statistically significant and not different in both cases. Also, the Philips curve of the New Member countries was found to be steeper mainly because of higher inflation experienced in the 1990s in those countries. The study also could not find evidence to support the ineffectiveness of monetary policies in the new member countries but however, uncertainty band for these countries are wider than those in the Euro area, usually with lags longer than a year. When the study was done with subsamples, it showed that when inflation declines, price responses tend to be weaker whereas output responses are stronger and monetary transmission in both areas becomes similar. The paper concluded that, to compare the effectiveness of monetary policy in the Eastern and Western countries, there is the need to go beyond the usual assertion that monetary policy in less financially developed countries is ineffective.

Starr (2005) examined the real effects that monetary policy has on 4 CIS country using time series data. The study employed the Structural VAR analysis using three monetary policy variables; money supply, interest rate and exchange rate, with quarterly data from 1995 to 2003. The study proves that the impact of monetary policy variables on output in the CIS countries are relatively modest, except Russia. This shows money supply has not been a strong monetary policy instrument since there is low level of monetization and substitution of currency has been substantial in the CIS countries. However, their result showed no evidence that exchange rate granger-cause output in all four countries, but interestingly, interest rate has a significant impact on output in Russia but not for the other three countries; this shows that financial integration is making it difficult for small economies to set interest rates independent of the world market. There is however clear evidence that monetary policy variables have significant impact on prices. This result proves that monetary policy is more effective in large relatively closed economies than in small relatively open economies.

Borys and Horvath (2007) provided a VAR analysis of monetary policy effects in the Czech Republic using monthly data series from 1998:1 (period after the adoption of the inflation targeting framework) to 2006:5. The study used GDP and real-time output gap estimate as measures of economic growth, net price index (consumer price index excluding regulated prices) as measure for prices, the nominal Czech/Europe exchange rate and the three-month inter-bank interest rates. The study showed that prices and the level of output growth fall after contractionary monetary policy and the fall reaches its bottom after about a year or so. However, exchange rates appreciate after the policy tightening, lasting about 6 months and gradually depreciate afterwards. The study revealed that the real-time output gap gives an accurate estimate than the current GDP growth.

Further, Barth and Ramey (2001) provided evidence that the supply-side has also important mechanism through which monetary policy can affect the real sector of the economy, especially in the short run. Using quarterly data from 1959:1 to 2000:1 and VAR analysis with long run restriction, the study showed that contractionary monetary policies (increase in interest rate) increases the cost of production and hence decline in output. Again, industry wide evidence showed supply side channel is most evident between 1959 and 1976.

A simple recursive VAR analysis by Miyao (2002), using monthly data from January 1975 to April 1998 showed the effect of monetary policy on the Japanese economy. The study used four variables; the short term interest rate (the overnight call market rate), monetary aggregate (M2+CD), stock prices (as a measure for asset prices) and real output. The estimated result showed that monetary policy shocks had a significant and persistent effect on real output especially in the late 1980s. The study also argued that short term interest rate proves to be to a best monetary policy measure than money aggregate.

Kandil (2014) explored the effect of monetary policy on 105 developing countries using annual data from 1968 to 2008. The empirical time-series evidence shows that three factors need to be considered in allocating money growth between economic growth and inflation; price flexibility, demand elasticity and monetary uncertainty; the more prices are flexible, the less responsive output growth is to monetary changes. Expansionary monetary shocks prove to increase economic growth whereas fluctuations in monetary growth also increase price inflation across countries. The study

suggested that, to maximize the impact of monetary policy, the central bank should be credible to embark on its duties and it should also be independent of the government.

Agenor *et al*. (2000) employed quarterly data for twelve middle income countries from the first quarter of 1978 to the fourth quarter of 1995. Regardless of the definition of monetary aggregate used in the money-output correlation, the relationship between money and output though positive was not very strong. The study showed little evidence that money granger-causes output. And the relationship between output and inflation is not consistent. The paper argued that correlations among different variables could be minimal since it averages the impact of several types of shock, hence the need to separate the effects of the various variables.

A study by Chuku (2009) employed the structural VAR framework in analyzing the impacts of monetary shocks on output and prices in the Nigerian economy, using quarterly data from 1986:1 to 2008:4. The study used five variables in the model; interest rate measured by the Minimum Rediscounted Rate, money supply measured by M2, Real Effective Exchange Rate, prices measured by CPI and output measured by real GDP. The impulse response from the study showed that monetary policy innovations have effects on both real and nominal variables based on the policy variable used. Interest rate and exchange rates have no significant impact on prices and output and this could be attributed to the inefficiencies in the credit and industrial markets. The study argued that, since the money aggregate variable proves to be the most influential, policy makers should target money supply to manage the economy.

Fasanya *et al.* (2013) did a study on how monetary policy affects the Nigerian economy. The study using time series data spanning from 1975 to 2010 and the Error Correction model, found out that the relationship between money supply and inflation is insignificant. The study proves that exchange rates and interest rates are better monetary policy variables but monetary policy as a whole has not been an active policy option in influencing real variables. The study concluded that monetary policies have not been effective mainly to excessive fiscal dominance and underdeveloped financial institutions.

Ghosh (2009) did a study on how monetary policy affects industry value added in India using reduced form non-co integrated VAR based on a 2-digit level data from 1981 to 2004. The study used the lending rate as a proxy for policy which proved to have a significant impact on output. It proved that industries respond differently to monetary innovations; industries with higher short term financing needs show more output sensitivity and that larger industries are more able to guard themselves against monetary shocks.

Alam and Waheed (2006) investigated how various sectors respond to monetary policy innovations. The study employed the standard VAR framework using quarterly data from seven sectors. The study showed that though monetary tightening causes output of all sectors to decline, it affects the various sectors differently. The finance and insurance, manufacturing and wholesale and retail trade sectors are highly sensitive to interest rate changes than the agriculture, construction, mining and quarrying, ownership and dwellings sectors. The result remains stable when nominal exchange rate was included in the VAR, just that the decline of output is minimum in the 6^{th} quarter instead of the 8^{th} when nominal exchange rate was not included. The study

concluded that the different response of the various sectors is very important when formulating policies specially to stabilize the economy.

Studies on Ghana have shown interesting results. For example, Abradu-Otoo *et al.* (2003) did a study in Ghana on the transmission mechanism of monetary policy in Ghana using structural vector error correction model (SVECM). The study used quarterly data from the fourth quarter of 1969 (1969:4) to the fourth quarter of 2002 (2002:4). The inflation rate, real gross domestic product, credit to the private sector, interest rate which is equivalent to the 91-day treasury bill, real exchange rate and broad definition of money (M2+) were the endogenous variables used in the SVECM. The exogenous variable included in the study was international price of crude oil which served as a proxy for supply shocks. The study showed that interest rate has a positive effect on inflation and the maximum impact is felt in the short run. The study noted that, prices may begin to adjust to its initial stage in periods after the second quarter. The rate of interest, according to the study, has a negative effect on real GDP marginally in the short run and the adjustment period can last over 15 quarters. Again, increase in money supply caused prices to rise in the short run and prices could return to its initial level after the 7^{th} quarter. The short run impact of money supply on real GDP was uncertain but in the long run it caused output to decline, lasting for up to 4 quarters. Monetary policy instruments affected inflation and output strongly in the long run in the Ghanaian economy and the main medium was through the exchange rate.

Epstein and Heintz (2006), estimated two Vector Auto-Regressive models (VAR) on the impact of monetary policy and financial reform on Employment creation in Ghana based on quarterly analysis from first quarter of 1986 to the fourth quarter of 2004. The endogenous variables included

Treasury bill rate (T-bill), real economic growth, inflation and exchange rate, and the logarithm of oil price as an exogenous variable. The first VAR model used short term interest rate as a variable for monetary policy and the results showed that, the effect of policy change on output, inflation and exchange rates are fairly modest. Therefore, expansionary monetary policy may not lead to higher inflation and would have to be complemented with other policies to achieve considerable impact on economic growth. The second VAR on the other hand employed money supply (M2) as the monetary policy variable, the impulse response function reveled that money supply has relatively standard effects on output, inflation and exchange rate. The study indicated that a more expansionary policy has fairly modest positive impacts on economic growth without having a larger negative effect on inflation and exchange rate.

Balogun (2007) employed the Generalized least squares with cross section weights to find the impact of monetary policy on economic performance of five WAMZ countries; Gambia, Ghana, Guinea, Nigeria and Sierra Leone. The study used quarterly data for the period 1991:1 to 2004:4. The result for the pooled regression showed that, domestic monetary policy captured by aggregate money (M2) and credit to the government, has adverse effect on output rather than promote growth, with a two quarter lag, but however has a positive effect on prices. The simultaneous and single equation regression for Ghana showed that, the main impact of interest rate which is measured by the Minimum Rediscounted Rate has adverse effects mainly on output, whereas money supply has significant effect on both prices and output. Expansionary monetary innovations therefore boost output but at the expense of increased prices.

Ahiador (2013) did a study on how monetary policy affects prices in Ghana. The study employed the simple OLS with annual data from 1985 to 2009. The study showed evidence of long run relationship but statistically insignificant relationship between money supply and inflation and negative relationship between interest rate and inflation. The study argued that monetary policy in Ghana has not been effective in controlling prices and hence there is the need to implement price control with fiscal policy.

In conclusion, based on the theoretical review monetary innovations have positive influence on both output and prices. However, results based on the empirical review are inconclusive; whereas some works find a positive effect of monetary innovations on both output and prices, others also find a negative effect on either prices or output or both.

CHAPTER THREE METHODOLOGY

3.1 Introduction

This chapter provides a brief description of the sources of data and the econometric technique that was employed. There are four sections. The first section deals with the theoretical framework. This is followed by the model specification. The third section entails empirical strategy and finally the data collection and sources.

3.2 Theoretical framework

The study follows the Mundell-Fleming Model proposed by Robert Mundell (1963) and Marcus Fleming (1962). The model looks at how output responds to monetary policy in a small open economy with perfect capital mobility. Such that an increase in money supply increases output but lowers the exchange rate (Alhassan, 2014).

3.3 Model Specification

The study analyzed the variables using the SVAR methodology by imposing appropriate restrictions on the dynamic relationships of the variables. The VAR framework is a very valuable tool in identifying the dynamic impact of a shock on a variable of interest. It is able to explicitly allow for endogeneity of the variables included in the model and thereby accommodating the interdependence among the macroeconomic variables. The VAR framework also deals with the reduced form relationship and as such requires only a simple model with small number of variables to achieve efficiency.

Following Harvey and Cushing (2014) we consider the relationship among five macroeconomic variables. The output and price functions may be expressed as;

$$RGDP_t = f(M2_t, MPR_t, EXR_t) \quad (3.1)$$

$$CPI_t = f(M2_t, MPR_t, EXR_t) \quad (3.2)$$

Where RGDP represents real GDP, CPI represents prices (inflation), M2 represents money supply, MPR represents interest rate (the monetary policy rate) and EXR represents exchange

rate.

3.3.1 The SVAR Model

A basic SVAR model including three variables; real GDP, CPI and the MPR are estimated first, in order to determine the relative impact of the MPR on output and prices. This is because according to Akosah (2015), the MPR is the most frequent monetary policy used by the BoG, hence it will be appropriate to estimate the model with MPR first before other policy variables are added to determine their individual impact on output and prices.

The study orders the variables with Output coming first followed by prices and then money supply, interest rate and exchange rate. This arrangement follows Starr (2005), based on the assumption that non-policy variables are ordered first before the policy variables and also output is ordered first because it adjust slowly. The data of the variables are entered into the SVAR model depending on their order of integration, the variables which are stationary at levels enters the model at the

levels and the variables which are stationary at the first difference are entered in the first differenced form (Starr, 2005).

The SVAR presentation can be specified as

$$y_t = [RGDP_t, CPI_t, M2_t, MPR_t, EXR_t]' \quad (3.3)$$

Where y_t is a $k1$is a vector of observed variables

3.4 Empirical strategy

Preliminary tests are carried out on the variables to ensure that the parameters estimated from the above specified econometric model, using time series data are consistent. These includes, first we examine the stationarity of the variables to ensure that the estimated relationships are not spurious. And because the correct specification of most models depend on the optimal lag selected, the study used common criteria such as the Akaike Information Criterion (AIC), the

Final Prediction Error (FPE), the Schwartz-Bayesian Information Criterion (SBCI) and the Hanna-Quinn Information Criterion (HIC) to determine the optimal lags of the variables.

3.4.1 Unit Root Test

A test of stationarity has become very important when employing time series. This stems from the fact that many macroeconomic time series usually have the tendency to grow or fall at some rate and may be usually trended, thus the possibility for time series data to be non-stationary. It is

however important to test for the order of integration of the variables used because it is very helpful in econometric model specification to prevent the possibility of spurious regression in time series analysis. If the series is found to be stationary, that is, integrated of order zero; I~(0), then the Ordinary Least Square (OLS) method can be useful. However, if the series is nonstationary, integrated of an order greater than zero; I~(d), where d > 0. Then, the OLS will give biased estimates and as such other methods could be employed. The study will use the Augmented Dickey-Fuller and the Philip-Perron tests for unit root tests.

3.4.1.1 Augmented Dickey- Fuller (ADF) Test

In the traditional Dickey-Fuller test, the error terms are assumed to be uncorrelated and thus white noise. Dickey and Fuller further developed the "Augmented" version of the test for instances where the error terms are assumed to be correlated. Since the error terms of several macroeconomic variables are likely to be correlated mainly because the series are usually and more often trended as identified by Asteriou and Hall (2007), the ADF test is more useful in macroeconomic time series. The test adds extra lagged terms of the dependent variable to the equation (this is done to do away with autocorrelation). The ADF test may be expressed by the following equation:

$$\Delta Y_t = \alpha_1 + \alpha_2 t + \alpha_3 Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i} + \varepsilon_t \qquad (3.4)$$

Where Y_t represents the time series variable, t is the time/trend variable, α_1 and α_2 are the estimated parameters, Δ is the first difference operator, β_i denotes the various estimated parameters of the differenced values of the lagged variables and ε_t is the white noise error term.

Based on equation 3.4, we test for the hypothesis that there exist a unit root or the time series is non-stationary; $\alpha_3 = 0$. If the null hypothesis is rejected, then the series is stationary. If, however, we are unable to reject the null hypothesis then, the series is non-stationary and as such possess unit root. A stationary series has temporary shock effects whiles non – stationary series have permanent shock effects.

3.4.1.2 Philips-Perron (PP) Test

Philips and Perron in 1988 developed a more robust test for stationarity in time series variables. The PP test is a modification and advancement of the ADF test in that it makes non-parametric correction to the test statistics by correcting for autocorrelation and heteroscedasticity in the error terms. It is also able to make ways to deal with deviations for having white noise in the estimated regression. The PP test regression may be specified as;

$$\Delta Y_{t-1} = \beta_0 + \beta Y_{t-1} + \varepsilon_t \quad (3.5)$$

Based on equation 3.5, we test the null hypothesis that $\beta = 0$, which proves the existence of unit root as against the alternative hypothesis of the non-existence of unit root. If we do not reject the null hypothesis, then, the series is non - stationary and as such possess unit root. If, however, the null hypothesis is rejected, then the series is stationary.

3.5.1 SVAR Methodology

To build up a more robust and reliable model that can capture the complex relationship among macroeconomic variables we employ the Structural Vector Auto regression (SVAR) estimation technique (Bernanke and Mihov 1995). According to Kasa and Popper (1997), the SVAR technique is developed to interpret business cycle fluctuations and can help identify the effects of different economic policies. Hence, combines economic theory with time series analysis to determine the dynamic response of economic variables to various disturbances.

Equation 3.3 can thus be transformed into

$$y_t = u + \sum_j y_{t-j} + v_t \qquad (3.6)$$

Where

$$\begin{bmatrix} 1 & \alpha_{12} & \alpha_{13} & \alpha_{14} & \alpha_{15} \\ \alpha_{21} & 1 & \alpha_{23} & \alpha_{24} & \alpha_{25} \\ \alpha_{31} & \alpha_{32} & 1 & \alpha_{34} & \alpha_{35} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & 1 & \alpha_{45} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \alpha_{54} & 1 \end{bmatrix} \begin{bmatrix} GDP_t \\ IN_t \\ y_t \\ M2_t \\ Ex_t \end{bmatrix} = \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \\ u_5 \end{bmatrix}$$

$$\begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} & \beta_{25} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} & \beta_{35} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} & \beta_{45} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & \beta_{55} \end{bmatrix} \sum_j \begin{bmatrix} GDP_{t-i} \\ IN_{t-i} \\ y_{t-j} \\ M2_{t-i} \\ Ex_{t-i} \end{bmatrix} = \begin{bmatrix} v_1 \\ v_2 \\ v_t \\ v_4 \\ v_5 \end{bmatrix}$$

Where τ is the contemporaneous coefficients among the endogenous variables, u is a vector of constants, β_j is the matrix of structural coefficients and v_t is a matrix of the structural shocks such

that $\Omega_v = E(VV_t)$ $\Omega_t = I$

Equation 3.6 can be simplified as

$$y_t = u + \sum_{j=1}^{p} \beta_j y_{t-j} + v_t \quad (3.7)$$

From Blanchard and Quah (1989), Harvey and Cushing (2014) and Adu *et al*. (2015), the estimated moving average (MA) representation based on the estimation of the reduced form in equation 3.7 is given as

$$y_t = e_t + ce_{1\,t-1} + ce_{2\,t-2} + \ldots\ldots\ldots\ldots \quad (3.8)$$

The true MA representation of the data is thus

$$y_t = AV_{0\,t} + AV_{1\,t-1} + AV_{2\,t-2} + \ldots\ldots\ldots\ldots \quad (3.9)$$

$$\Omega_e = E(ee_{t\,t}) = AE_0(\Omega_{vv_{t\,t}})(A_0) = A_0A_0$$

This shows the relationship between the vector of structural shocks and the residuals of the reduced form. The variance matrix of the innovations v_t is expressed as

$$\Omega = A^{-1}{}_t B_t (A_t^{-1}) \quad (3.10)$$

Where A_t is the lower triangular matrix and B_t is the diagonal matrix.

Because there are 5 variables, this gives 15 equations, with 25 unknowns. Therefore, to make A_t exactly identified with each element having a unique value so that the structural shocks can be identified, there is the need to impose 10 restrictions.

3.5.2 Identification

Different types of restrictions can be imposed on the structural parameters of the VAR. Following Bernanke (1986) and Sims (1992), we impose restrictions on the VAR, as the VAR has been predominantly criticized for its lack of uniqueness, where different arrangement or ordering generates different results.

The identification of restrictions in this model follows Akosah (2015), which are based predominantly on real and nominal rigidities and the advantage of access to information by the Bank of Ghana over the private agents as well as forecast of inflation targets as Ghana is practicing the Inflation Targeting regime.

The Choleski decomposition method of identification giving a lower triangular matrix is employed, and assumes a shock to a variable does not contemporaneously affect the variable that precedes it in the arrangement but only affect it with a lag. We order the non-policy variables first with output first followed by prices then the policy variables with money supply coming first, and then the monetary policy rate and the exchange rate last, following Starr (2005) as stated earlier.

In the first place, output responds to all the other variables but only with a lag, this is because the decision of firms to expand or utilize its existing capacities take time and so the influences of the other variables may not take effect instantly. Also prices respond contemporaneously to only pressures from output. This is because of the delay in transmission mechanism; the monetary variables may affect prices only with a lag. According to Starr (2005), the policy variables are established depending on the knowledge of shocks to output and prices. And as such the policy variables are ordered based on the assumption of their possible degree of endogeneity to prevailing economic conditions. Exchange rate is ordered last based on the idea that exchange rate responds to output, prices and the other policy variables because of the high import content in Ghana's growth processes.

The lower triangular matrix which is the contemporaneous coefficient matrix and the diagonal matrix becomes

$$A_t = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ \square_{21} & 1 & \cdots & 0 \\ \square & \square_{32} & \cdots & \square \\ \square & \square & \cdots & \square \\ \square_{k1} & \square_{k2} & \cdots & 1 \end{bmatrix} \qquad B_t = \begin{bmatrix} \square_{11} & 0 & \cdots & 0 \\ 0 & \square_{22} & \cdots & 0 \\ \square & \square & \cdots & \square \\ \square & \square & \cdots & \square \\ 0 & 0 & \cdots & \square_{kt} \end{bmatrix}$$

Money supply and the monetary policy rate is ordered after output and prices in the Choleski composition because they describe the reaction function of the central bank. And it is assumed that Central banks (Bank of Ghana) respond instantly to output and inflationary influences (Akosah 2015).

The study seeks to identify the structural shocks and hence we separate the shocks into demand shocks, supply shocks and nominal shocks. Demand shocks capture those shocks that affect the demand side of the economy; aggregate demand. Supply shocks are those shocks that affect the supply side of the economy and nominal shocks refer to shocks to the monetary sector, which may be unexpected disturbances in the monetary system.

3.5.3 Impulse Response Functions and Forecast Error Variance Decomposition

Though the SVAR is a very reliable tool in econometric analysis, it is difficult to interpret the coefficients directly. Therefore, Stock and Watson (2001) proposed the impulse response functions and variance decomposition as more informative ways to understand the relationship among the variables than the coefficients and the R^2 statistic from the VAR regression.

The impulse response functions trace out the behavior of the dependent variables in response to shocks in the other variables in the VAR model. The Variance decomposition shows the amount of information each of the variables contribute in explaining other variables in the VAR model. It is able to separate the variation in the endogenous variable into separate shock components.

3.6 Data Collection and Sources

The study employed quarterly data series from the period 1980 to 2012. The data set was obtained from the World Development Indicators (WDI), the Bank of Ghana (BoG) and the International Financial Statistics (IFS) of the IMF. The analysis included five variables; money supply, interest rate, prices, output and exchange rate. Monetary Policy rate was used as a proxy for interest rate

(obtained from IFS), Consumer Price Index (CPI) – inflation as a measure for prices (obtained from IFS), real Gross Domestic Product as a measure for output (obtained from WDI), M2 as a measure for money supply (obtained from BoG) and real effective exchange rate for exchange rate (obtained from IFS). Money supply and interest rate are the monetary policy variables used. All variables were used in their natural logarithm so as to eliminate the possibility of outliers, reduce the presence of heteroscedasticity and autocorrelation and as such changes in the variables will indicate growth rates.

3.6.1 Variables Description

The variables are discussed below;

3.6.1.1 Money supply (M2)

Money supply is the total stock of money available in the economy at a given period of time. It includes currency, savings and checking accounts. Handa (2009) further defined money supply as the amount of money that is supplied at various levels of interest rate and income. The tendency for money supply to change usually rests with monetary authorities. M2 is considered as broad money which consists of currency in circulation, demand deposits, time deposits and savings deposits. The study employs M2 as a quantity based monetary policy as oppose to the other measures of money supply because M2 has proven to be more desirable in explaining monetary policy and output.

The study expects a positive relationship between money supply and output. When money supply increases, it leads to an increase in the amount of money available to individuals, which eventually increases output. Studies such as Mansor (2005) and Owoye and Onaforowa (2007) found a strong

evidence of increase in money supply resulting in increases in output. The study expects a positive relationship between money supply and prices. Following the quantity theory of money, because velocity and output is assumed to be constant in the long run as changes in money supply translates directly into prices.

3.6.1.2 Interest rate (MPR)

The Monetary Policy Rate (MPR) is used as a proxy for interest rate as it is the official monetary policy tool used predominantly by the Bank of Ghana and also as a priced based monetary policy variable. The MPR is the rate at which commercial banks can borrow from the Central Bank and thus expected to communicate the stance of monetary policy which serves as a guide for all other market interest rate. It is usually set at the level which is consistent with achieving the BOG's inflation target. This policy rate has evolved through different policy regimes (Bank of Ghana, 2015).

The study expects a negative relationship between interest rate and output. Following the Keynesians, an increase in the interest rate means an increase in the cost of borrowing (capital). This will cause investments to fall and thus causing output to fall eventually. The study expects a positive relationship between interest rate and prices. When interest rate rises, the cost of borrowing increases which means the cost of production increases. Producers pass on the higher prices to consumers (Akosah, 2015).

3.6.1.3 Prices (CPI)

Inflation refers to the persistent or sustained increase in the general price level in an economy over a period of time. Increasing prices reflect a fall in the purchasing power of the currency. The

Consumer Price Index (CPI) is used as it is the measure used mainly by the Ghana Statistical Service as a measure of inflation and it is also able to capture nominal price changes in the economy. The CPI is used with reference to price levels in 2010 as the base year (CPI 2010 =100) (Ghana Statistical Service, 2015).

3.6.1.4 Real Gross Domestic Product (rGDP)

The most common measure of output and growth in any economy is the GDP. GDP can be defined as the total amount of goods and services produced in an economy during a given period of time, usually a year. The GDP of any economy comprises of consumer spending, investments, expenditure by the government and exports less imports. The real GDP however, is the measure of the value of goods and services in an economy adjusted for inflation. Real GDP will be used as opposed to nominal GDP because adjusting GDP for price changes gives a more accurate measure of how much the economy really produced (Mankiw, 2006).

3.6.1.5 Exchange rate (EXR)

Exchange rate is the rate at which one currency is exchanged for another. It is thus the value of one currency in terms of another currency. The study employs real effective exchange rate as a measure of exchange rate. The Real Effective Exchange Rate (REER) describes the relative strength of a country's currency compared to a basket of other currencies. It describes the value a consumer actually pays for imported goods, which includes all tariffs and transaction costs. The BoG considers REER as the nominal effective exchange rate (NEER) divided by the price deflator or an index of cost. The REER is used mainly because it is more efficient when measuring the

currency's overall performance as it is able to incorporate differences in inflation between countries (Takaendes, 2006).

The study expects a positive relationship between exchange rate and output. When exchange rate falls (appreciation of the currency), it means the prices of domestic goods have increased relative to foreign goods. This may lead to increase in imports and fall in exports and eventually cause aggregate output to fall. The study also expects a negative relationship between exchange rate and prices.

CHAPTER FOUR
EMPIRICAL RESULTS AND DISCUSSION

4.1 Introduction

The chapter presents the results and analysis of the model in chapter three. The chapter is divided into six sections. The first section presents the trend analysis of the variables. The next sections also present and analysis the stationarity test. This is followed by the results and analysis from the SVAR model, impulse response functions and forecast error variance decomposition.

4.2 Trend Analysis of Variables

The graphical analysis of the variables helps to identify the behaviour of the series over time. This is important to the study as it provides the trends in the variables and also an informal view of the stationarity of the variables. The graphs in figure 4.1 shows the graphical analysis of the trends in the series from 1980 to 2012 in their levels and also in the first difference all in natural logarithm.

The graphs depict that the economy has been experiencing positive growth trends in all the variables over the research period except the MPR which had a downward turn after 1995.

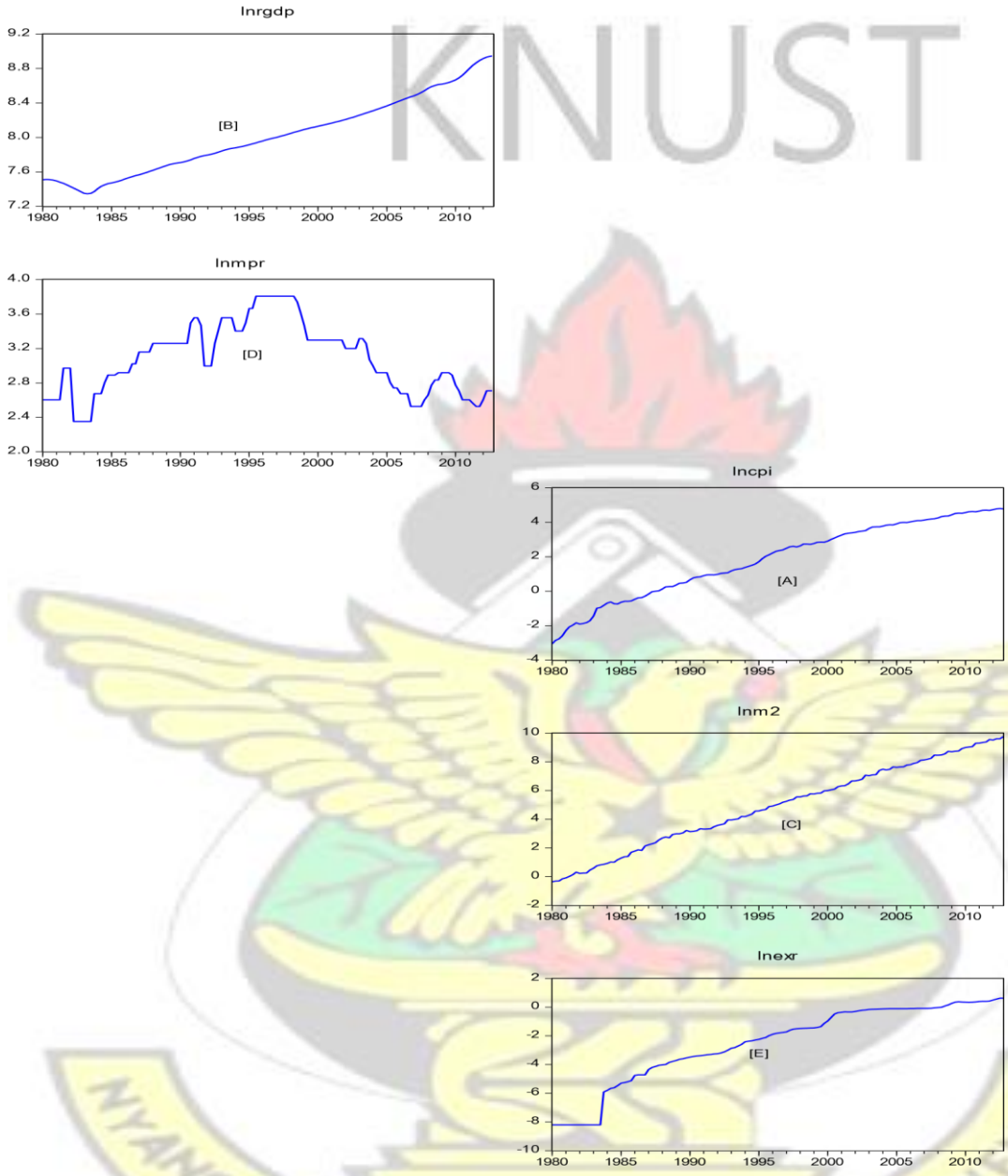


Figure 4.1: Graph of variables in levels

4.2.1 Trend Analysis of CPI

The CPI measures the overall price of goods and services in the economy and the rate of change of CPI gives the rate of inflation. Studies such as Kwakye (2012), ISSER (2001-2005) and several others have shown that increasing prices (inflation) has over the years been a hindrance to economic growth and development. From Figure 4.1A, CPI exhibits an upward trend over the sample period. Inflation in the early 1980s were attributed mainly to excessive borrowing and persistent budget deficit which were financed by loans from the BoG. Between 1982 and 2000, the Ghanaian economy was regarded as been in a very bad state, which was evident in lower per capita income, declining (and negative) growth rates, huge debt and higher inflationary trends. This period saw inflation attaining its highest record level of 123% in 1983. Many researchers attributed these economic difficulties to severe drought and bush fires that affected the economy coupled with the influx of several Ghanaians from Nigeria; putting pressure on the demand for goods and services which translated into higher prices (Alhassan, 2014).

However, the introduction of the ERP and SAP and increase in harvest in 1984 saw a decline in inflation. Inflation thereafter was controlled though it remained above the set target by the government. In the periods between 2001 and 2012, the Inflation Targeting framework was introduced. The single digit inflation of 8.7% and 8.8% were achieved only in 2006 and 2007 respectively, though monetary authorities struggled but could not achieve the set target during the other periods.

4.2.2 Trend Analysis of Real GDP

Figure 4.1B shows that the growth rate of output has been increasing over the entire period.

However, in the early 1980s the economy saw a downward trend, but with the introduction of the ERP and SAP, the economy bounced back to experience stability averaging between 4 – 5% between 1984 and 2000. Economic growth remained stagnant below 5% for almost two decades, this Alhassan (2014) attributed to factors such as weak state institutions that resulted in neglect and failure of the SAP reforms, low levels of investments due to low levels of savings and high interest rates, high levels of budget deficit and unfavorable terms of trade and foreign exchange depreciation.

The introduction of reforms such as the Highly Indebted Poor Countries (HIPC) and the Poverty Reduction Strategies (GPRS I and GPRS II) aided the economy in causing output to increase to 6.2% and 7.3% (its highest record level) by 2006 and 2008 respectively. Output grew averaging 10.2% between 2009 and 2012.

4.2.3 Trend Analysis of Money supply (M2)

Figure C shows the growth rate of money supply for the period between 1980 to 2012. The graph shows money supply has been increasing consistently over the sample period. According to Bawumia (2010) persistent growth in money supply may be as a result of government resorting to monetary financing of its budget deficit.

4.2.4 Trend Analysis of Monetary Policy rate (MPR)

Figure D shows the growth rate of the monetary policy rate for the study period. The MPR is decided by the Monetary Policy Committee (MPC) in their periodic meetings. The growth path of the MPR can be considered as unstable. In periods prior to 1995, the MPR witnessed consistent growth. Between 1995 and 2000 the MPR stabilized but saw a downward trend after

2000 till 2007. After 2008 there was a sharp increase to about 2.9% by 2009 and then fell sharply to 2.4% by 2011 though it shows signs of increasing in 2012.

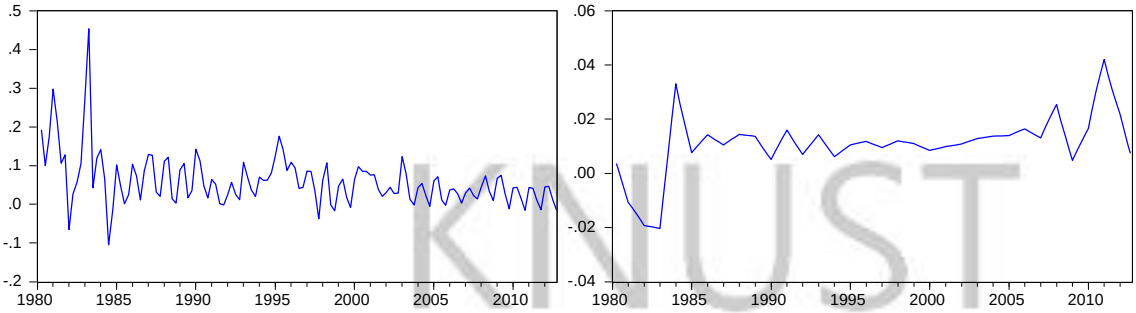
Bawumia (2010) advanced that for the period between 2002 and 2008 the MPC held about 30 meetings by the end of December 2008 out of which in 16 times the MPC did not change the policy rate, 9 times the policy rates were reduced and 5 times the rates were increased.

4.2.5 Trend Analysis of Exchange rate

Figure E shows the path of the exchange rate from 1980 to 2012. The graph suggested that the real effective exchange rate has been increasing over the sample period. The exchange rate in periods prior to 1983 was pegged to the US dollar. The implementation of the SAP and ERP in 1983 allowed for a liberalization of the market for exchange rate.

After the adoption of the flexible exchange rate, the rate has been increasing continuously. This continuous growth has been amidst fluctuations. In periods between 1999 and 2008, the exchange rate remained low which resulted in appreciation of the cedi during the period. However, the appreciation of the cedi between 2007 and 2008 was attributed mainly to the initial stages of the redenomination of the Ghanaian cedi. On the average, the upswings and downswings could be attributed to the adjustment to the flexible exchange rate regime, as well as the adjustment to the ERP and SAP as well as the redenomination of the cedi.

DLNCPI DLNRGDP



DLNM2 DLNMPR

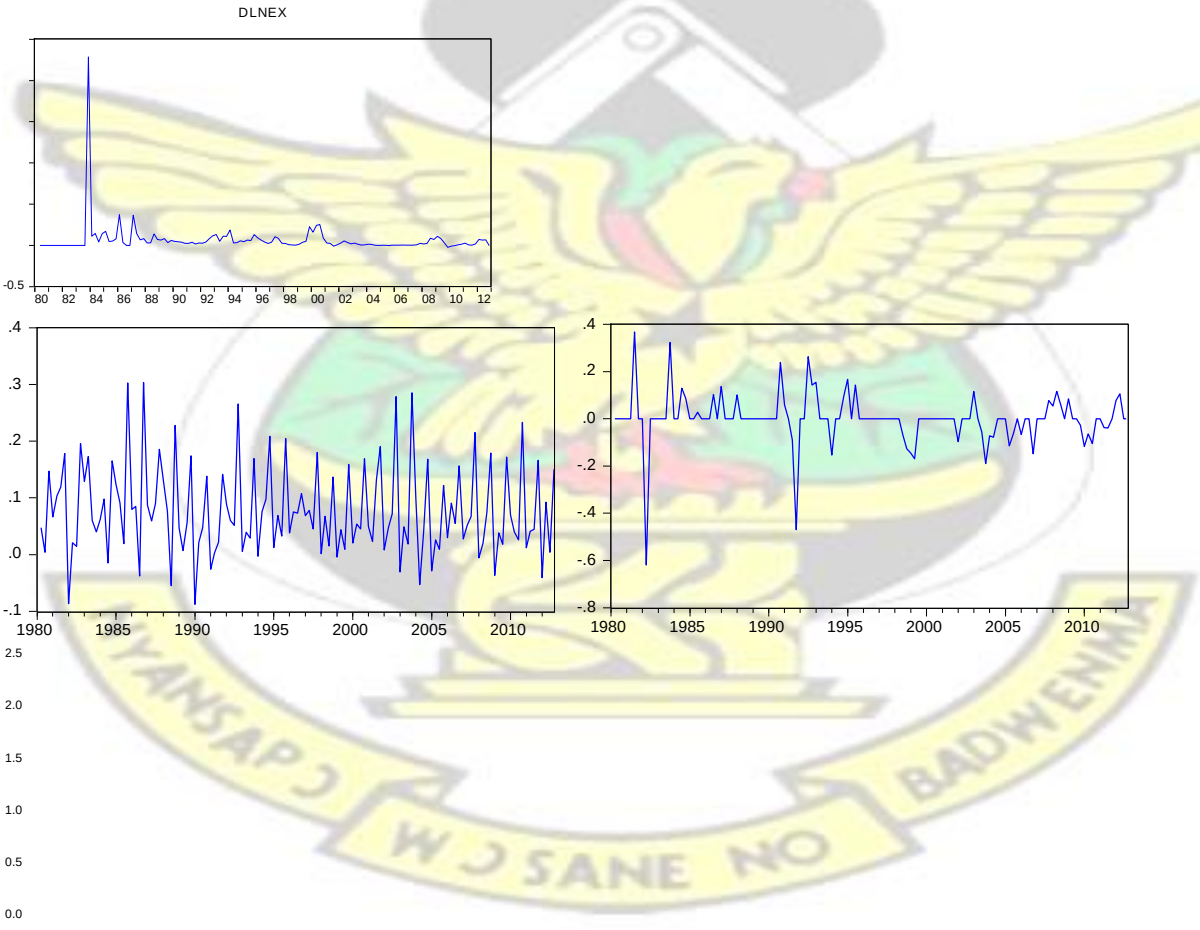


Figure 4.2: Graph of variables in first difference

The series tend to fluctuate around their mean after they were differenced once. This depicts that the series became stationary in first difference form.

4.3 Results of stationarity test

To identify the effects of monetary policy on output and prices using the SVAR methodology, stationarity properties of the variables are very important Starr (2005). This is because when the variables are not stationary, the regression is likely to produce spurious estimates. However, should any of the variables be non-stationary, there is the need to transform them to stationary series before incorporating them in the model. The study therefore tested the stationarity of the variables using the ADF and the Philip-Perron tests. The study tested a null hypothesis of the presence of unit root (non-stationary) against the alternative hypothesis of no unit root

(stationary). The results from the two tests are presented in table 4.1;

Table 4.1: Stationarity test results

Variable	ADF TAU test		PHILIP-	PERRON test	ORDER OF INTEGRATION
	CONST	CONST + T	CONST	CONST + T	
PANEL A: LEVELS					
MPR	-1.441	-1.535	-1.718	-1.743	

M2	-1.618	-2.526	-1.264	-2.574	
GDP	1.919	-2.612	3.380*	-2.328	
CPI	-2.687 *	-1.552	-4.473 *	-2.798	
Exr	-2.293	-1.483	-2.242	-1.392	
P ANEL B: FIRS T DIFFERENC E					
∆MPR	-5.471 ***	-5.681 ***	-9.220 ***	-9.263***	I(1)
∆M2	-4.656 ***	-4.939 ***	-15.799 ***	-16.099 ***	I(1)
∆rGDP	-3.695***	-4.097***	-2.999 ***	-3.394 ***	I(1)
∆CPI	-5.799 ***	-6.997***	-6.926 ***	-7.627***	I(1)
∆Exr	-7.528 ***	-7.851***	-10.849***	-11.110 ***	I(1)

Note: ***, ** and *means rejection of the null hypothesis at the 1% and 5%, 10% significant level Source: Author's estimation 2016

The result from Table 4.1, the study failed to reject the null hypothesis of the presence of unit root when estimated in levels for both the ADF and the Philip-Perron tests. The study however rejected the null hypothesis when the series were first differenced for both tests. This shows that all the variables follow the I~(I) process and thus the series are transformed by first differencing before implementing them in the model.

4.4 Lag Order Selection

The criteria for the selection of the optimal lag order of the variables included in the SVAR model is based on the four main frequently used measures according to literature. Thus according to Abradu-Otoo *et al.* (2003), an appropriate lag length is able to reduce the value of the determinant of the co-variance matrix. In view of this, the study employed the Final

Prediction Error (FPE), Akaike Information Criteria (AIC), Hannan-Quinn Criteria (HQ) and the Schwarz Criteria (SBIC). The result is presented in Appendix A. The result shows that the SBIC

supported a lag length of 3 whereas the FPE, AIC and HQ supported a lag length of 4, hence the study opts for a lag length of 4.

4.5 Results and Analysis from the SVAR base model

From the result of SVAR structural parameters presented in table 4.2, increase in output impacts significantly and negatively on prices, so that when output increases it will cause prices to fall. Monetary authorities respond appropriately to both prices and output innovations but the response were not statistically significant. The insignificant response of MPR to price and output changes is not surprising, this is because Ghana is a relatively small open economy with a very large informal sector (which makes record keeping difficult) and hence there is the likelihood that activities in the real sector may not have considerable relationship with the financial sector.

The Variance of the Structural shocks from Table 4.2 are all significant and thus time invariant, therefore proving the stability of the model and making it valid for statistical inference as well as possible for economic analysis (Lutkepohl, 2005).

Table 4.2:Contemporaneous coefficients from SVAR from base model

	Shocks		
	RGDP	CPI	M2
Contemporaneous Responses			
RGDP	1		
CPI	-4.108***	1	

	RGDP	CPI	M2
RGDP	.0002***		
CPI		.0046***	
MPR			0.033***

	MPR	3.001	-.2306	1

Structural Parameters
Variance of the Structural Shocks

Columns show impulses and rows show responses. With ** and *** represents 5 % and 1% significant level respectively. Source: Author's estimation 2016

Because of the difficulty in the economic interpretation of the coefficients of the SVAR (VAR system), emphasis is however focused on the Impulse Response Functions and the Forecast Error Variance Decomposition.

The SVAR model satisfied the stability condition such that all the eigenvalues are less than one and lie within the unit circle therefore making it possible to generate the Impulse Response Functions and the Forecast Error Variance Decomposition. The stability test is presented in Appendix B. The impulse response functions and the forecast error variance decomposition generated from the base SVAR model is presented in section 4.5.1 and 4.5.2.

4.5.1 Impulse Response Functions from the base model

The impulse response functions of the variables are done to provide an indication of how output and prices responds to a one standard deviation innovation (equivalent to a positive shock) in the monetary policy rate in Ghana over a period of 30 quarters (a little over 7 years). This provides information on the speed or time with which deviations from equilibrium due to shocks from the monetary policy variables are eliminated.

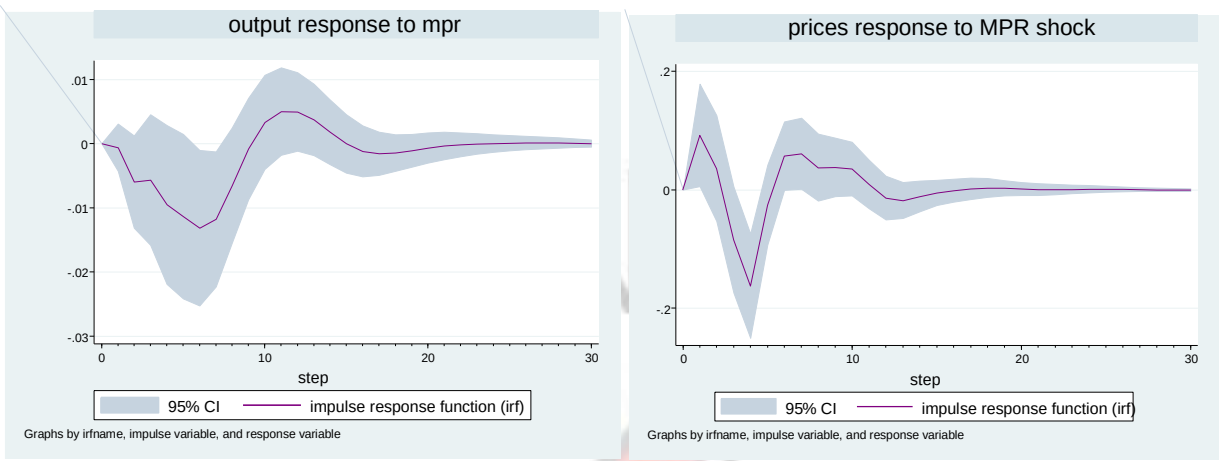


Figure 2.3:Output and prices response to MPR shocks

Figure 4.3 shows the responds of output and prices to the monetary policy rate shock.The Figure shows output responds negatively to a positive one standard deviation MPR shock (contractionary monetary policy). By the 10th quarter the effect becomes insignificant and mean revert thereafter. Output response to MPR shocks are relatively weak, ranging between 1% and 1.5%. According to Andinuur (2013), Foreign Direct Investments forms a larger fraction of investments in Ghana, this could mean that funds needed to expand most businesses are usually from foreign sources which may have little or no relationship with the prevailling monatary policy rate in the economy thus explaining the weak response of output to MPR shock. Also because of the large informal sector, with majority of Ghanaians unbanked and the thin nature of the credit market, which is mostly geared to those in the formal sector, the ability of monetary policy to influence economic activities is likely to be limited. This result is similar to the findings of Abradu-Otoo *et al.* (2003) for Ghana and Chuku (2009)for Nigeria.

Prices however, responds positively to a monetary policy rate shock (contractionary monetary policy) within the first two quarters. The responds howerver becomes negative between the 4th and 7th quarter and gradually disappears after the 11th quarter. The MPR shock is very significant in

prices as compared to output, this probably is the reason why monetary authourities target inflation rather than output.This is similar to the findings of Sims (1992) on Germany, U.K and the U.S. but contradicts the finding of Chuku (2009) on Nigeria who found a sustained increase in the response of prices though it was relatively insignificant.

Figure 4.4: output and prices response to output shocks

Figure 4.4 shows how output and prices response to output shocks. The positive response of output to a one standard deviation output shock declines after the 4th quarter. The impact of output shock on itself is temporal (not sustainable), though it is likely to stay up to the 10th quarter.

Prices on the other hand, responds negatively to an output shock, it remains negative and eventually dissipates after the 12th quarter. This shows that output shocks have a significant negative effect on prices, so that when output increases with demand unchanged, prices are likely to fall. This also confirms the contemporaneous coefficient of the structural parameter in table

4.2.

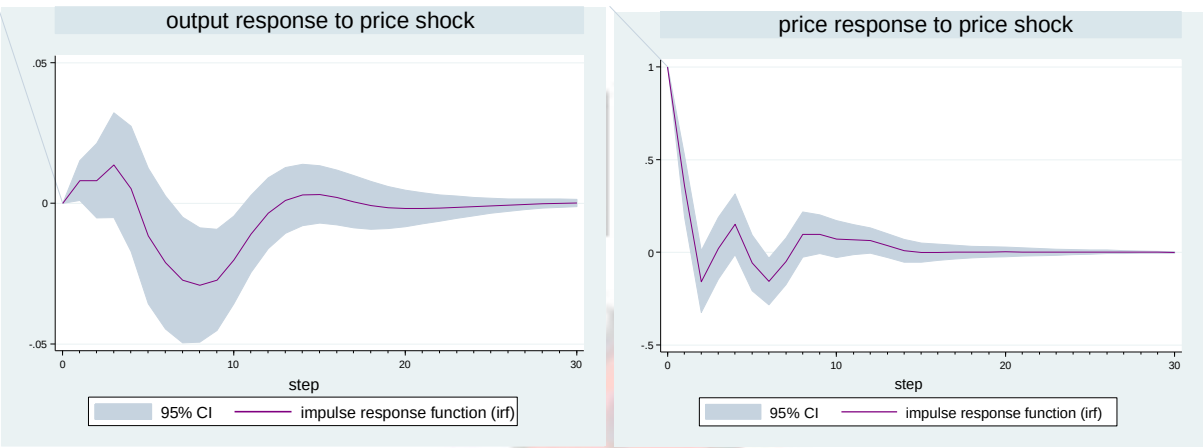


Figure 4.4: output and prices response to price shocks

A one standard deviation price shock causes output to respond positively in the first 4 quarters, the effect tends negative afterwards until it tapers off to zero by the 13th quarter. Output response to price shocks are relatively low (though the effect could stay for more than 2 years), suggesting that a price shock in the Ghanaian economy is likely to have adverse effect on demand for goods and services for over 2 years.

Prices also responds positively and significantly to price shocks, the effect declines sharply after the second quarter and becomes negative by the 3rd quarter. The effect oscillates ranging between -2% and 2% until it completely dies out after the 13th quarter. This is evident especially when citizens are losing confidence in the ability of the BoG to achieve its inflation targets because for over 3 years the BoG has failed to achieve its inflation target hence people resort to using previous inflation rates in Ghana to predict current inflation.

4.5.2 Forecast Error Variance Decomposition of the base model

The study decomposed the variance of the change in output and prices to assess the relative importance or contribution of monetary policy rate shock. The decomposition shows the variations in output and prices that is explained by the MPR at various time horizons. The result of the decomposition is presented in Table 4.3;

Table 4.3:Forecast Error Variance Decomposition of the base model

	Variations in RGDP explained by		Variations in CPI explained by	
Period	MPR	RGDP	MPR	CPI
1	0	1	0	.969325
2	.000192	.991242	.027027	.944302
7	.051232	.91847	.113535	.944302
15	.071068	.823429	.125076	.721079
29	.071468	.822732	.125103	.720617
30	.071469	.822731	.125103	.720618

From Table 4.3 in the first quarter MPR does not explain any of the variations in output and prices but output is able to explain 100% of its own variation, whereas prices explained about

97% of the variations in itself. In the second period, the variation in output that is explained by MPR is still weak (that is 0.02%) but it explains about 2.7% of the variation in prices. By the 15th

quarter the variations of output and prices explained by MPR increases to 7.1% and 12.5% respectively. Whereas the variations in output explained by output falls to about 82.3% and the variations in prices explained by prices also falls to about 72%.

From the 15th to the 30th quarter (a little over 7 years) MPR still explains on the average only 7.1% of the variations in output and output explains about 82.2% of the variations in itself. Also the variations in prices that is explained by MPR on the average is 12.5%, whereas prices explained about 72% of its own variations. MPR explained minimal variations in output and prices probably because of the structure of the Ghanaian economy. The economy is made up of a large informal sector, mostly evident in the agriculture and service sectors (ISSER, 2014), most of the people found in these sectors are not likely to have access to funds from the commercial banks and hence rely extensively on informal collective or rotary savings (susu groups) and private loan providers, this is likely to restrict the ability of MPR to influence output and prices effectively.

Based on the decomposition of the variance, MPR explains greater variations in prices than output. This makes targeting prices more effective and appropriate than targeting output. This also confirms the findings from the impulse response functions in Figure 4.3.

4.6 Results and Analysis from the SVAR extended model

Table 4.4:Contemporaneous coefficients from SVAR from the extended model

Structural parameters

	Shocks				
	RGDP	**CPI**	**M2**	**MPR**	**EXR**
Contemporaneous Responses					
RGDP	1				
CPI	-3.800***	1			
M2	-.8033	-.268	1		
MPR	7.0778***	-.1640	-.2417***	1	
EXR	-87360	-1.1583*	.5117**	.3350***	1

Variance of the Structural Shocks

	RGDP	CPI	M2	MPR	EXR
RGDP	.0001***				
CPI		.0025***			
M2			.0003***		
MPR				.0049***	
EXR					.008***

Columns show impulses and rows show responses. With *, ** and *** represents 10%, 5 % and 1% significant levels respectively. Source: Author's estimation 2016

The SVAR result after the model controlled for money supply and exchange rate as presented in Table 4.4 shows output has a positive and significant impact on prices similar to the base model in Table 4.2. The impact of output and prices on MPR remained the same; output has a positive relationship with MPR and prices has a negative relationship with MPR (similar in Table 4.2 in the base model). The relationship between output and the MPR however was statistically significant; this could be as a result of the introduction of money supply into the model through the influence of the activities of the commercial banks. MPR also showed a positive significant response to money supply innovations.

The result also shows a negative relationship between output and money supply as well as prices and money supply, though the relationships are statistically insignificant the inverse relationship between money supply and prices in the short run disputing the idea of the monetarist that inflation is everywhere a monetary phenomenon. This relation is however, similar to the findings of Kovanen (2011) and Osei (2014). The insignificant relationship between money supply and output as well as prices is likely to be as a result of the undeveloped nature of the Ghanaian economy, which means that an increase in money supply may not necessarily mean an increase in the amount of money available to the citizens to influence the level of economic activities. Also because of consistent fiscal deficits, governments are likely to crowd private investment even when money supply increases.

Exchange rate however responds appropriately and contemporaneously to price innovations, such that price increases may lead to a fall in the exchange rate. Also expansionary monetary policy (increase in money supply or decrease in MPR) causes the exchange rate to increase contemporaneously. This result is thus consistent to the findings of Akosah (2014).

The relationship between output and exchange rate is statistically insignificant, this could be as a result of the inelastic demand for imports in Ghana, showing that even when the rate of exchange changes, the demand for foreign goods do not change.

4.6.1 Impulse Response Functions from the extended model

The impulse response functions generated after the inclusion of money supply and exchange rate is presented to identify how output and prices response to a one standard deviation of the various monetary policy variables.

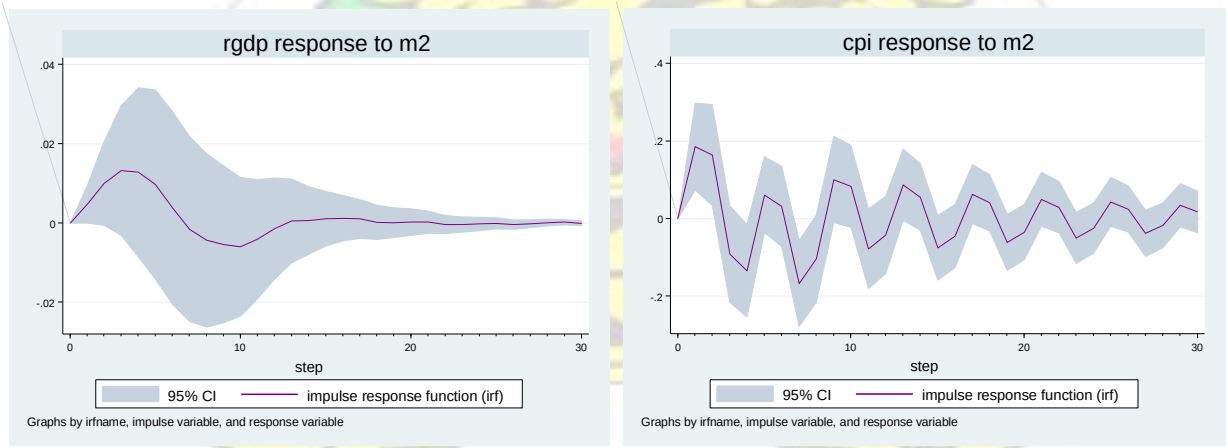


Figure 4.6: Money supply shocks

Figure 4.6 displays the graph of the responds of output and prices to money supply shock. Output responds positively to a positive monetary supply shock in the first 8 quarters before it becomes

negative and disspates after the 12th period. The effects are relatively minimal (averaging between 1.5% and 0.5%). Which proves the neutrality of money in the shortrun in the Ghanaian economyand perhaps confirms the underdeveloped financial system in the economy, which means that an increase in money supply may only incresse output moderately. The result is contrary to the hump-shaped response of output to money supply which last for over 3 quarters in the U.S. (Christiano *et al* 2002) but similar to the findings of Ghosh (1996) for Ukraine, Starr (2005) for Russia, Kazakhstan and Ukraine and Akosah (2015) for Ghana.

Prices also responds positively and significantly to initial money supply innovation and oscilliates consistently for over the 30 quarters which shows the effect is likely to prolong for over 7 years. This result is not consistent with the monetarist assertion that increasing money supply results in increasing prices and also contradicts the findings of Sims (1992) in 5 developed countries (U.S, Germany, France, U.K. and Japan).

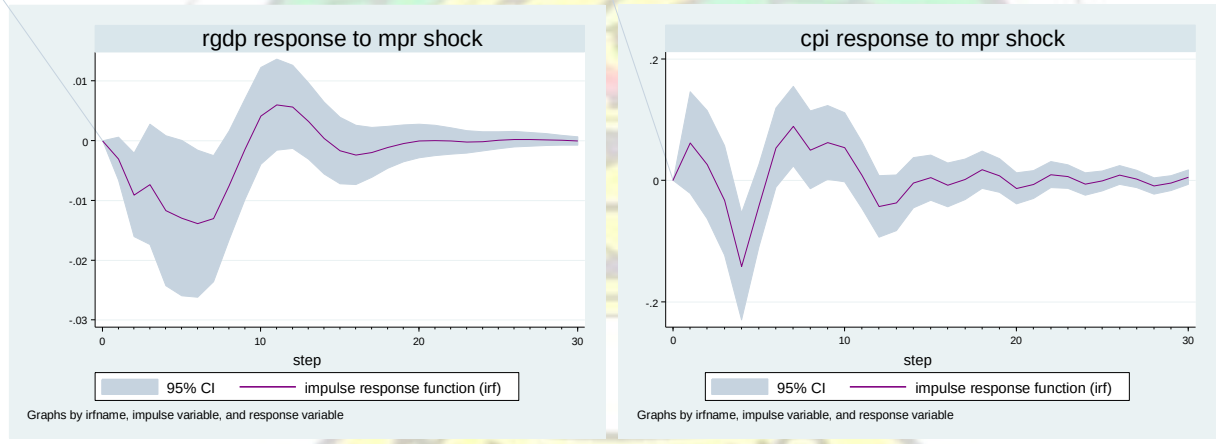
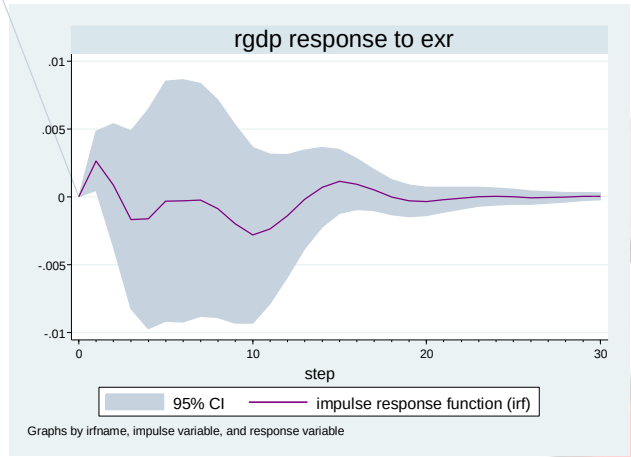


Figure 4.7: Monetary Policy Rate shocks



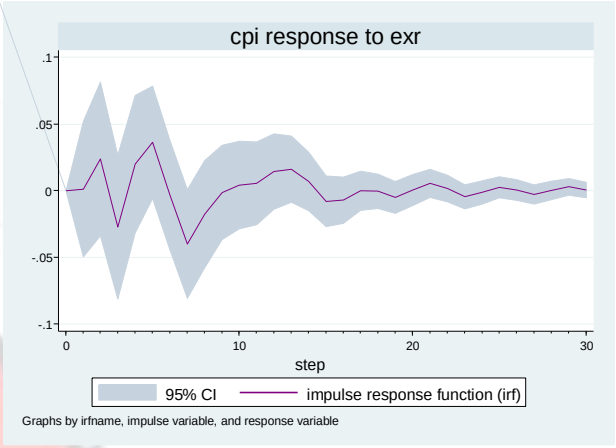


Figure 4.8: Exchange rate shocks

The results from figure 4.7 is similar to that of Figure 4.3 (with the base model). Even with the inclusion of the other monetary policy variables (money supply and exchange rate) the response of both output and prices to MPR shocks reamins the same. The response of output to MPR shocks remains relatively weak and slow over the entire period until petering out after the 15th quarter.Prices on the other hand responded positive to an MPR shock initially (in the first two quarters). The effect declines after the 2nd quarter and becomes negative after the 3rd quarter. It however tends positive by the 6th quarter and dies out after the 12th quarter.

Exchange rate shocks have a modest positive impact on output in the first2 quarters but tends negative after the 3rd quarter and revert to mean by the 15th quarter. The responds are relatively minimal and weak ranging between 0.1% to 0.3%. This is perhaps the Ghnaian economy is a small open economy with many trading partners and also has almost a perfectly inelastic demand for imports, therefore demand for goods and services respond little to changes in exchange rates.

Chuku (2009) also found similar finding for the Nigerian economy.

Prices also, responds positively to shocks from exchange rate only after the second quarter, it however becomes negative after the 3rd quarter. And by the fifth quarter, it picks up again but it dies out after the the 9th quarter. Though the impact is relatively weak, the response confirms the underlying situation in Ghana; the heavy dependence on imports and the large foreign capital inflows means increase in the exchange rate will relates directly into increase in prices (though the impacts fluctuates until it stabilizes at zero).

4.6.2 Forecast Error Variance Decomposition of the extended model

The FEVD in the extended model enables us to compare the roles of the various monetary policy variables in explaining the variations in output and prices at different time horizons.

Table 4.5:Variance decomposition of output and prices

Variations in RGDP explained by					Variations in CPI explained by			
Period	MPR	M2	EXR	RGDP	MPR	M2	EXR	CPI
1	0	0	0	1	0	0	0	.9734
2	.0022	.0030	.0090	.9781	.0112	.0325	.0000	.8954
7	.0585	.0318	.0031	.8786	.0594	.0564	.0166	.6937
15	.0745	.0296	.0069	.7746	.0813	.0964	.0257	.6205
29	.0750	.0296	.0075	.7734	.0810	.1119	.0260	.6071

30	.0750	.0296	.0075	.7734	.0810	.1126	.0260	.6065

Source: Author's estimation 2016

The result based on Table 4.3 shows that in the 2nd quarter exchange rate shocks are important source of variation in output accounting for about 0.9% whereas money supply and the MPR account for 0.3% and 0.2% respectively. However, by the 7th quarter through to the 30th quarter, the MPR accounts for the largest variation in output averaging over 7%, with exchange rate accounting for the least. Output accounted for most of the variations on itself, at the 2nd quarter, output own shocks accounted for 97.8% and by the 30th quarter it fell to about 77.3%.

This result shows that past values of output has more predictive of current output than the monetary policy variables, though MPR explains more of the variations in output than money supply and exchange. This outcome is however not surprising, due to the nature of the Ghanaian economy; inelastic demand for imports, heavy reliance on remittances, large informal sector coupled with the underdeveloped financial sector, monetary policy variables are not able to explain effectively the variations in output.

With reference to prices, the result from the variance decomposition shows that money supply explains the largest variations in prices for over 30 quarters, followed by the MPR and then exchange rate. Explanation of money supply to variations in prices increased from about 3.3% in the 2nd quarter to about 9.6% and 11.2% in the 15th and 30th quarters respectively. Relative to the MPR which explains only about 1.1% of the variation in prices in the second quarter and then increase to 8.1%from the 15th quarter through to the 30th quarter. Exchange rate which explains the

least of the variations in prices, in the second quarter could not account for a significant variation in in prices but by the 15th through to the 30th quarter it accounted for only about 2.6%.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides summary of the findings and the conclusion of the study. The chapter further provides possible recommendations based on the findings.

5.2 Summary of Findings

The study first employed the SVAR methodology with three macroeconomic variables; that is real GDP, CPI inflation and the MPR (the MPR is the most frequent monetary policy variable used by the BoG) as the base model. The three variables-model was modified by controlling for money supply and exchange rate to analyze the relative impact of the various policy variables on output and prices. Impulse response functions were estimated to identify the response of output and prices to one standard deviation of the monetary policy variables and forecast error variance decompositions to identify the variations in output and prices that were explained by the various monetary policy variables.

The findings of the study are as follows:

1. The impulse response functions from the base model shows a relatively weak negative response of output to MPR over a period of 30 quarters. However, prices increase in

response to MPR shock initially but become negative after the second quarter. The MPR shock is very significant in prices relative to output making it appropriate for a small- open Ghanaian economy which is targeting inflation rather than output.

2. The impulse response funtions also shows a strong negative respond of prices to output shock. The effect is however transitory and dissipates after 2 years. Output on the otherhand responds positively initially to price shocks but tends negative after the 4th quarter. The response of output to price shocks were largely insignificant over the entire period.

3. Consistent with the Impulse response , the variance decomposition of the base model shows that MPR explains more of the variations in prices than output. This confirms that

   MPR has been relatively important in explaining the variations in prices than output in Ghana.Previous values of output and prices however expalins more of the variation in current output and prices respectively, with output accounting for about 99% of its own shocks and prices also accounting for 96.9% of its own shock. Though the values reduces in the extended model, output and prices expains most of the variations in themselves.

4. The impulse response functions of the extended model also showed that, though output responds positively to monetary aggregate innovations, the impact is relatively insignificant. This result may be as a result of the under developed nature of the financial sector in Ghana and also confirming the neutrality of money in the short run. Price's response to money supply over the entire period was oscillating which was an indication

that increasing in money supply may not generally result in inflation. Also, the responds of prices and output to exchange rate shocks were relatively insignificant over the entire study period.

5. The variance decomposition of the extended model shows that, in the initial periods money supply explains more of the variations in output followed by MPR with exchange rate explaining the least. However, by the end of the 2nd year MPR picks up explaining more of the variation in output than money supply and exchange rate. However, the variation in prices is explained most by money supply over the entire 30 quarter period followed MPR and exchange rate respectively.

5.3 Conclusion

Generally, the contemporaneous coefficients, the impulse response functions and the forecast error variance decomposition shows that output and prices response to monetary policy shocks are usually weak and\or slow.

Monetary and fiscal policies are considered as complements (and not substitutes) in all economies. It is usually the interaction of these two policies that comes to play in periods such as the financing of budgets so that one policy may not be implemented in isolation. However, many challenges with the implementation of monetary policy has been governments exploiting the trade-off between output and inflation by usually running large budget deficit with the hope of financing it with borrowings from the central bank mainly for political reasons. There is however the need to

reduce large deficits which has the tendency to dominate monetary policy and limits its ability to achieve macroeconomic stability in the economy.

These findings were achieved amidst some challenges, the availability of quarterly time series data for periods after 2012 were not readily available to make the study up to date. The study further proposes further studies with data series extended after 2012 to check for any significant differences.

5.4 Recommendations

The analysis of the study based on the impulse responses brought to bear the weak and \or slow responses of output and prices to the various monetary policy variables. The study recommends for a more expansionary monetary policy in order to boost output without necessarily having a significant adverse impact on prices.

From the study, money supply proved to have the most influential impact on prices, therefore, monetary authorities should place more emphasis on quantity–based monetary policy. For example, focusing on instruments such as, reserve ratios, liquidity ratios amongst others, which influence monetary aggregates directly to enable it achieve the set inflation targets.

From the FEVD, the variations in prices and output that is explained by monetary policy variables are relatively small suggesting the large informal sector and the underdeveloped nature of the financial sector because financial services are not accessible to majority of the people. The study

recommends policies to help develop the financial sector of the Ghanaian economy such as emphasizing on technologies such as encouraging the use of the E-zwich smartcards, credit and debit cards and encouraging the commercial banks to extend their branches and providing mobile banking services to the informal and rural folks who are likely to be excluded.

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APPENDIX

APPENDIX A: LAG LENGTH SELECTION

```
Selection-order criteria
  Sample:  5 - 132                              Number of obs    =   128
 +---------------------------------------------------------------------------
 |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC
```

```
  |----+-------------------------------------------------------------------------
|  0 | -198.719                        .000017   3.18311   3.22837   3.29452
|  1 |  938.783    2275   25  0.000  4.7e-13  -14.1997  -13.9281  -13.5313
|  2 |   1123.9  370.24   25  0.000  3.8e-14  -16.7016  -16.2037  -15.4761
|  3 |  1199.68  151.55   25  0.000  1.7e-14   -17.495  -16.7707  -15.7124*
|  4 |  1240.24  81.128*  25  0.000  1.4e-14* -17.7382* -16.7876* -15.3986
  +-------------------------------------------------------------------------
   Endogenous:  lncpilnmpr lnm2 lnrgdplnexr
    Exogenous:  _cons
```

APPENDIX B: STABILITY TEST

Eigenvalue stability condition

Eigenvalue	Modulus
-.00794297 + .9436843i	.943718
-.00794297 - .9436843i	.943718
-.9429477	.942948
.5992883 + .5878529i	.839475
.5992883 - .5878529i	.839475
.7360075 + .3608467i	.819706
.7360075 - .3608467i	.819706
.7873328 + .00679093i	.787362
.7873328 - .00679093i	.787362
-.2850941 + .7114387i	.766436
-.2850941 - .7114387i	.766436
.1317987 + .7010753i	.713357
.1317987 - .7010753i	.713357
-.6326654 + .3101977i	.704619
-.6326654 - .3101977i	.704619
-.7002712	.700271
.3429345 + .167795i	.381784
.3429345 - .167795i	.381784
.2212562 + .2862035i	.361755
.2212562 - .2862035i	.361755

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

APPENDIX C: Contemporaneous coefficients from SVAR from base model

Estimating short-run parameters

```
Iteration 0:   log likelihood = -400.51649

Iteration 1:   log likelihood =  505.54179

Iteration 2:   log likelihood =  856.52422

Iteration 3:   log likelihood =  937.62554

Iteration 4:   log likelihood =  947.87517

Iteration 5:   log likelihood =  948.03602

Iteration 6:   log likelihood =  948.03614

Iteration 7:   log likelihood =  948.03614
```

Structural vector autoregression

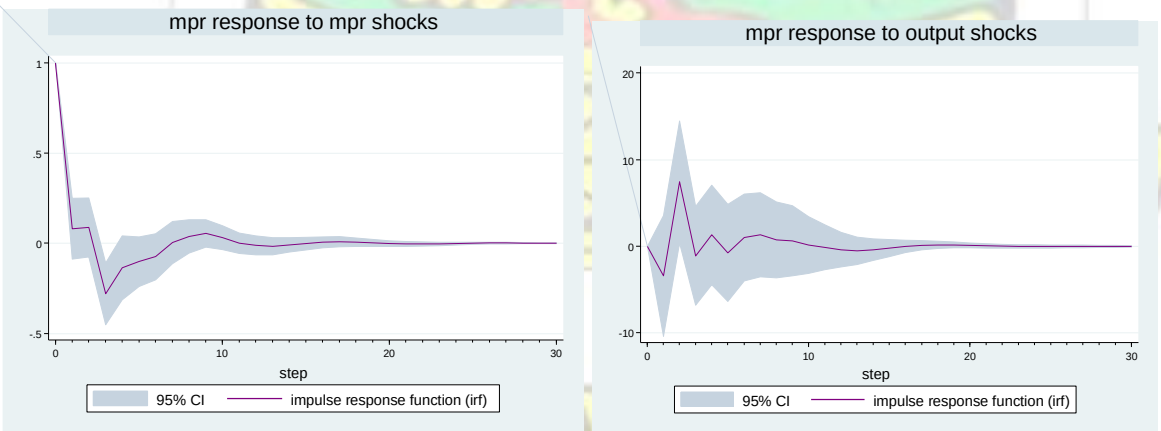
```
( 1)  [a_1_1]_cons = 1

( 2)  [a_1_2]_cons = 0

( 3)  [a_1_3]_cons = 0

( 4)  [a_2_2]_cons = 1

( 5)  [a_2_3]_cons = 0

( 6)  [a_3_3]_cons = 1

( 7)  [b_1_2]_cons = 0

( 8)  [b_1_3]_cons = 0

( 9)  [b_2_1]_cons = 0
(10)  [b_2_3]_cons = 0

(11)  [b_3_1]_cons = 0
```

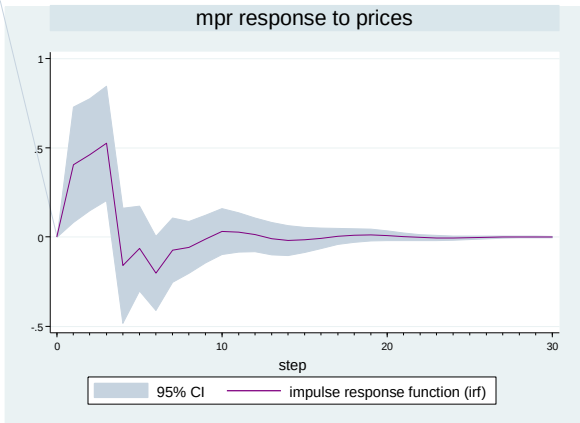
```
(12)  [b_3_2]_cons = 0


Sample:  6 - 132                                        No. of obs      =    >
127

Exactly identified model                                Log likelihood  =  9 >
48.0361

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|   [95% Conf. Interval]
      /a_1_1 |          1  (constrained)
      /a_2_1 |  -4.107784   2.049043    -2.00   0.045    -8.123834 -.> 091734
/a_3_1 |   3.001261   4.092698     0.73   0.463    -5.020281  > 11.0228

      /a_1_2 |          0  (omitted)
      /a_2_2 |          1  (constrained)
      /a_3_2 |  -.2305758   .1744985    -1.32   0.186    -.5725866  > 1114349
      /a_1_3 |          0  (omitted)
      /a_2_3 |          0  (omitted)
      /a_3_3 |          1  (constrained)
-------------+----------------------------------------------------------------
```

/b_1_1	.0019781	.0001241	15.94	0.000	.0017348 .> 0022214
/b_2_1	0	(omitted)			
/b_3_1	0	(omitted)			
/b_1_2	0	(omitted)			
/b_2_2	.0456774	.0028661	15.94	0.000	.04006 .> 0512948
/b_3_2	0	(omitted)			
/b_1_3	0	(omitted)			
/b_2_3	0	(omitted)			
/b_3_3	.0898245	.0056361	15.94	0.000	.078778 .>.100871

APPENDIX D: IMPULSE RESPONSE FUNCTIONS

MPR RESPONSE TO MPR, OUTPUT AND PRICE SHOKS





APPENDIX E: FORCAST ERROR VARIANCE DECOMPOSITION FOR THREE VARIABLES

TABLE E1: VARIATIONS IN OUTPUT

0	0	0
1	0	1
2	.000192	.991242
3	.009087	.983815
4	.011296	.977466
5	.021315	.96932
6	.034362	.951028
7	.051232	.91847
8	.063471	.882934
9	.065963	.857151
10	.064721	.840252
11	.065112	.831266
12	.067287	.827212
13	.06955	.825081
14	.070816	.823884

|15 | .071068 | .823429 |

|16 | .071008 | .823322 |
|17 | .071075 | .823271 |

|18 | .071247 | .823199 |

|19 | .071391 | .82311 |

|20 | .071462 | .823024 |

|21 | .07148 | .822948 |

|22 | .071477 | .822883 |

|23 | .071471 | .822829 |

|24 | .071467 | .822788 |

|25 | .071465 | .822761 |

|26 | .071464 | .822745 |

|27 | .071465 | .822737 |

|28 | .071466 | .822733 |

|29 | .071468 | .822732 | |30

| .071469 | .822731 |

TABLE E2: VARIATIONS IN PRICES

|PERIOD | MPR | CPI |

|0 | 0 | 0 |

|1 | 0 | .969325 |

|2 | .027027 | .944302 |

|3 | .029601 | .914259 |

|4 | .049636 | .882733 |

|5 | .115202 | .810128 |

|6 | .112666 | .7829 |

|7 | .113535 | .747253 |

|8 | .119359 | .729111 |

|9 | .120924 | .725549 |

|10 | .1227 | .723346 |

|11 | .124466 | .721157 | |12 | .124195 | .721448 |

|13 | .12429 | .721709 |

|14 | .124839 | .721339 |

|15 | .125076 | .721079 |

|16 | .125117 | .720991 |

|17 | .125117 | .720961 |

|18 | .125116 | .720932 |

|19 | .125127 | .720874 |

|20 | .125133 | .720808 |

|21 | .125126 | .720751 |

|22 | .125116 | .720702 |

|23 | .125109 | .720661 |

|24 | .125105 | .720634 |

|25 | .125104 | .720621 |

|26 | .125104 | .720616 |

|27 | .125104 | .720615 |

|28 | .125104 | .720616 |

|29 | .125103 | .720617 | |30

| .125103 | .720618 |

APPENDIX F:Contemporaneous coefficients from SVAR from Extended Model

Estimating short-run parameters

```
Iteration 0:   log likelihood = -788.58642   Iteration
1:   log likelihood =  617.12553

Iteration 2:   log likelihood =   1005.278

Iteration 3:   log likelihood =  1010.1153

Iteration 4:   log likelihood =  1082.7541

Iteration 5:   log likelihood =  1152.3062

Iteration 6:   log likelihood =  1250.8859

Iteration 7:   log likelihood =  1270.0833
Iteration 8:   log likelihood =  1274.0143

Iteration 9:   log likelihood =  1274.0338 Iteration
10:  log likelihood =  1274.0338



Structural vector autoregression


( 1)  [a_1_1]_cons = 1

( 2)  [a_1_2]_cons = 0

( 3)  [a_1_3]_cons = 0

( 4)  [a_1_4]_cons = 0

( 5)  [a_1_5]_cons = 0

( 6)  [a_2_2]_cons = 1

( 7)  [a_2_3]_cons = 0

( 8)  [a_2_4]_cons = 0

( 9)  [a_2_5]_cons = 0

(10)  [a_3_3]_cons = 1

(11)  [a_3_4]_cons = 0

(12)  [a_3_5]_cons = 0

(13)  [a_4_4]_cons = 1
```

```
(14)  [a_4_5]_cons = 0

(15)  [a_5_5]_cons = 1

(16)  [b_1_2]_cons = 0

(17)  [b_1_3]_cons = 0

(18)  [b_1_4]_cons = 0

(19)  [b_1_5]_cons = 0

(20)  [b_2_1]_cons = 0

(21)  [b_2_3]_cons = 0

(22)  [b_2_4]_cons = 0

(23)  [b_2_5]_cons = 0

(24)  [b_3_1]_cons = 0
(25)  [b_3_2]_cons = 0

(26)  [b_3_4]_cons = 0

(27)  [b_3_5]_cons = 0

(28)  [b_4_1]_cons = 0

(29)  [b_4_2]_cons = 0

(30)  [b_4_3]_cons = 0

(31)  [b_4_5]_cons = 0

(32)  [b_5_1]_cons = 0

(33)  [b_5_2]_cons = 0

(34)  [b_5_3]_cons = 0

(35)  [b_5_4]_cons = 0


Sample:  6 - 132                                  No. of obs      =>127

Exactly identified model                          Log likelihood  =1>274.03

------------------------------------------------------------------------------

             |      Coef.   Std. Err.      z    P>|z|     [95% Conf.Interval]

-------------+----------------------------------------------------------------
```

```
> -------

      /a_1_1 |          1  (constrained)

      /a_2_1 |  -3.798252   2.043084    -1.86   0.063    -7.802622  .>2061183

      /a_3_1 |  -.7928862   2.525555    -0.31   0.754    -5.742883  4>.157111

      /a_4_1 |   7.049805   4.036621     1.75   0.081    -.8618278  1>4.96144

    /a_5_1 |   -8.64742   6.595987    -1.31   0.190    -21.57532  4>.280476

      /a_1_2 |          0  (omitted)

      /a_2_2 |          1  (constrained)

      /a_3_2 |  -.0266023   .1082277    -0.25   0.806    -.2387247   >.18552

      /a_4_2 |  -.1624906   .1729555    -0.94   0.347    -.5014771   >.17649

/a_5_2 |  -1.148195   .2802506    -4.10   0.000    -1.697476  .>5989142

      /a_1_3 |          0  (omitted)

      /a_2_3 |          0  (omitted)
      /a_3_3 |          1  (constrained)

      /a_4_3 |   .2421227   .1417721     1.71   0.088    -.0357456  >.519991

/a_5_3 |   .5079493   .2315419     2.19   0.028     .0541355  .>9617632

      /a_1_4 |          0  (omitted)

      /a_2_4 |          0  (omitted)

      /a_3_4 |          0  (omitted)

      /a_4_4 |          1  (constrained)

      /a_5_4 |  -.3328617   .1432869    -2.32   0.020    -.6136987 -.>0520246

      /a_1_5 |          0  (omitted)

      /a_2_5 |          0  (omitted)

      /a_3_5 |          0  (omitted)

      /a_4_5 |          0  (omitted)

      /a_5_5 |          1  (constrained)

-------------+------------------------------------------------------------
```

/b_1_1	.0017697	.000111	15.94	0.000	.0015521	.>00198
/b_2_1	0	(omitted)				
/b_3_1	0	(omitted)				
/b_4_1	0	(omitted)				
/b_5_1	0	(omitted)				
/b_1_2	0	(omitted)				
/b_2_2	.0407464	.0025567	15.94	0.000	.0357355	.>04575
/b_3_2	0	(omitted)				
/b_4_2	0	(omitted)				
/b_5_2	0	(omitted)				
/b_1_3	0	(omitted)				
/b_2_3	0	(omitted)				
/b_3_3	.049697	.0031183	15.94	0.000	.0435853	.>05580
/b_4_3	0	(omitted)				
/b_5_3	0	(omitted)				
/b_1_4	0	(omitted)				
/b_2_4	0	(omitted)				
/b_3_4	0	(omitted)				
/b_4_4	.0794004	.004982	15.94	0.000	.0696358	>.089165
/b_5_4	0	(omitted)				
/b_1_5	0	(omitted)				
/b_2_5	0	(omitted)				
/b_3_5	0	(omitted)				
/b_4_5	0	(omitted)				
/b_5_5	.1282127	.0080448	15.94	0.000	.1124452	.>1439801

APPENDIX F: FORCAST ERROR VARIANCE DECOMPOSITION FOR FIVE VARIABLES

TABLE F1: VARIATIONS IN OUTPUT

PERIOD	MPR	M2	EXR	RGDP
0	0	0	0	0
1	0	0	0	1
2	.002212	.003008	.009041	.978171
3	.018165	.01332	.004544	.958151
4	.019909	.022307	.003881	.945405
5	.032096	.029469	.003833	.927487
6	.044482	.032323	.003391	.90785
7	.058511	.031838	.003159	.878692
8	.069666	.030166	.002994	.843169
9	.071769	.029082	.003039	.811437
10	.070407	.028844	.0038	.792264
11	.070323	.029325	.005396	.782453
12	.072013	.029653	.006507	.778232
13	.073895	.029678	.006898	.776239
14	.074577	.029639	.006896	.775213
15	.074539	.029611	.006992	.774636
16	.074574	.029597	.007243	.774178
17	.074813	.029611	.007409	.773846
18	.074994	.029635	.007452	.773692
19	.075052	.029628	.007448	.773655
20	.075054	.029625	.007464	.773631
21	.075045	.029628	.007487	.773588

|22 | .075041 | .029631 | .007496 | .773548 |

|23 | .075038 | .029631 | .007499 | .773519 |

|24 | .075039 | .029633 | .007498 | .773495 |

|25 | .075038 | .029633 | .007498 | .773476 |

|26 | .075037 | .029632 | .007498 | .773466 |

|27 | .07504 | .029636 | .007499 | .773459 |

|28 | .075042 | .029636 | .0075 | .773454 |

|29 | .075044 | .029636 | .0075 | .773449 | |30

| .075045 | .029638 | .0075 | .773445 |

TABLE F2: VARIATIONS IN PRICES

| PERIOD | MPR | M2 | EXR | RGDP |

|0 | 0 | 0 | 0 | 0 |

|1 | 0 | 0 | 0 | .973499 |

|2 | .011287 | .032586 | .000012 | .895468 |

|3 | .013926 | .05317 | .004145 | .852405 |

|4 | .018344 | .056895 | .009291 | .835298 |

|5 | .062347 | .065055 | .011217 | .778015 |

|6 | .057407 | .060042 | .017717 | .723981 | |7 | .059465
| .056497 | .016631 | .693748 |

|8 | .067745 | .074771 | .024002 | .657488 |

|9 | .069928 | .081343 | .024963 | .646975 |

|10 | .075201 | .084565 | .024287 | .635639 |

|11 | .079427 | .086108 | .023894 | .629967 |

|12 | .078796 | .090148 | .023792 | .628524 |

|13 | .080588 | .090461 | .024547 | .62666 |

|14 | .081639 | .094901 | .025569 | .621641 |

|15 | .081399 | .096496 | .025717 | .620502 |

|16 | .081068 | .099697 | .025899 | .618036 |

|17 | .081072 | .100556 | .026072 | .617052 |

|18 | .080841 | .102906 | .025995 | .615242 |

|19 | .081194 | .103581 | .025935 | .614115 |

|20 | .081043 | .105792 | .02598 | .61248 |

|21 | .08122 | .106365 | .025947 | .61195 |

|22 | .081097 | .107705 | .02604 | .610747 |

|23 | .081179 | .108031 | .026021 | .610308 |

|24 | .081074 | .109488 | .026066 | .609205 |

|25 | .081082 | .109757 | .026052 | .608984 |

|26 | .08098 | .110777 | .026052 | .608223 |

|27 | .081072 | .111037 | .026039 | .607916 |

|28 | .08099 | .111872 | .026044 | .607294 |

|29 | .081085 | .111983 | .026032 | .607106 | |30 | .081033 | .112634 | .026052 | .606599 |