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 analyzed the relative importance of real and nominal shocks in explaining inflation dynamics in the Ghanaian economy using the Structural Vector Autoregressive (SVAR) model. Specifically the study sought to analyze the response of inflation to output and money supply shocks in Ghana which are proxies for the real and nominal shocks respectively. The analysis and the reported findings of the study were based on quarterly data spanning the period 1980Q1 to 2012Q4. The complete annual nature of the real GDP was disaggregated into quarterly frequencies through the use of Ecotrim software. With the imposition of short run restrictions, the study confirmed the increasing importance of inflation being a structural rather than a monetary phenomenon since inflation tend to be more responsive to real rather than nominal shocks in the short run. Inflation remained relatively stable in response to money supply and exchange rate shocks whiles it declined by a greater magnitude in response to a positive output (real) shock. It was also found that, the dominant importance of inflation inertia, inflation responded positively between 0% and 100% to inflation persistence. This was further buttressed from the variance decomposition as inflation persistence explained more than 60% of the variations in inflation while the combined effect of output and money explained less than 40% in the short run. It is worth noting that other policy meted out which have real effects on the economy would be advantageous to reducing inflation, however inflation targeting policy tools which have real effects on the economy would only be successful after the 11^{th} quarter period as inflation becomes insensitive to real shocks after this period.

Key Words: Inflation, Real Shock, Nominal Shock, Inflation Inertia, SVAR, Ghana

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DEDICATION

I dedicate this project to GOD ALMIGHTY, for favoring me with wisdom to apply the knowledge and understanding he has bestowed on me. This journey would have been impossible without his divine and timely assistance.

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CHAPTER ONE INTRODUCTION

1.1 Background of the Study

Inflation, defined as the sustained increase in the general price level, does not only diminish individual's purchasing ability but also has a destructive spiral effect on an economy. The effects of inflation tend to worsen when it becomes prone to continuous fluctuations, thus inducing a volatile macroeconomic environment. Macroeconomic volatility emanating from high and volatile inflation exposes economic agents - households, firms, and the government – to high degree of uncertainties and thus hinders efficient allocation of resources. The benefit of price stability for efficient allocation of resources (temporally and inter-temporally) cannot be overemphasized (Adu and Marbuah, 2011).

Two main culprits are found to be associated with substantial fluctuations in the rates of inflation: (1) forces associated with financial market disturbances (nominal shocks) such as money supply, the nominal interest rates, oil prices and the foreign exchange rate and (2) real economy forces (real shocks) such as demand and supply factors including output. Fluctuations in inflation caused by these forces tend to disrupt the smooth operation of an economy (Kempa, 2005).

Shocks are unpredictable changes in external forces that tend to affect an endogenous economic variable either negatively or positively. An unexpected change in money supply, nominal exchange rate target or commodity (e.g. gold, cocoa, crude oil) prices are seen to be pure instances of nominal shocks which can significantly have an impact on inflation. It is important to note that different kinds of nominal shocks that buffets the economy at irregular intervals can and do transmit to the real sector of the economy through cost of

production, real relative prices (such as real interest rate, real exchange rate, real commodity prices) to aggregate demand, output, and employment which are seen as real shocks (Gordon *et al*., 2014). These shocks, either real or nominal have some implications for inflation expectations and ultimately, on inflation dynamics.

To quantify the significance of these real and nominal shocks in the determination of inflation dynamics is motivated by the traditional demand driven Keynesian model where monetary shocks have real effects due to the presence of imperfections due to nominal rigidities (such as wage and prices stickiness).

A major prerequisite for the Ghanaian economy joining the West Africa Monetary zone is to achieve a single digit inflation (Adu and Marbuah, 2011). This single digit inflation headache called for the implementation of a policy framework that is Inflation Targeting (IT) in 2007. Nevertheless to ensure a successful IT framework requires a clear assessment and insight into how fast monetary policy variables transpires to other sectors of the economy and its accompanying effects (Harvey and Cushing, 2014). This further increases the necessity to delve into the sources of inflation dynamics and to assess the relative importance of nominal shocks in accounting for inflation dynamics.

In the light of this, there have been arguments about whether or not inflation targeting has been successful in the separation of nominal from real shocks. Gordon *et al*. (2014) argued on the failure of monetary policy which is inflation targeting in this respect. They are of the view that a successful inflation targeting should be able to separate real shocks from nominal shocks such that a nominal shock to inflation should not spiral down to have real shocks as well. This raises questions about the direction which should be targeted in order

to ensure the successful policy implementation across the globe, whether policy think tanks should be targeting real or nominal macroeconomic forces as policy tools. This lies in the relative importance of either force in the explanation of inflation dynamics as well as the response of inflation to these shocks. The relevance of finding the importance of nominal and real shocks is a worthy course.

Furthermore, influential papers like Osorio and Unsal (2011) have found the declining importance of nominal shocks in the explanation of inflation fluctuations in Asia over the years. The same can be said about Bloch *et al*. (2012) as they found increasing importance of real shocks compared to nominal shocks in the determination of worldwide general price level. With the declining importance of nominal shocks in the explanation of inflation across the globe in recent years, it becomes a necessity to determine its importance in Ghana's inflation experience as it could be country specific.

The study considers the relative importance of shocks to money supply and real output growth in inflation dynamics in Ghana. From Monetarist point of view, inflation is identified as a purely monetary phenomenon. This view is enshrined in Friedman's proposition that "inflation is always and everywhere a monetary phenomenon". If this is the correct view of inflation dynamics, then the prudent monetary management will successfully contain inflationary pressures. This contradicts the Keynesian theory which argues in favor of the real shocks where supply and demand factors are of greater importance in inflation dynamics.

1.2 Statement of the Problem

A brief look at the developments in the trends of Ghana's inflation in Figure 1.1, it could be observed, Ghana recorded much lower inflation rates but steady increased to an alltime high from about 22% in 1982 to 123% in 1983. Inflation again however dropped to about 18% by 1991 and further to about 12% by 1999 (Ghana Statistical Service, 2015).

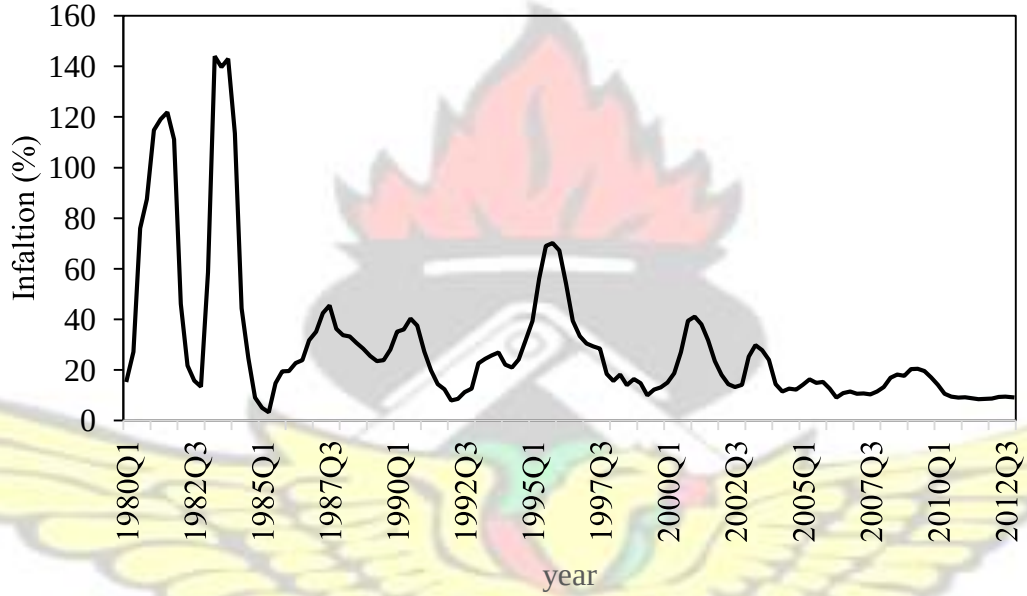

Figure 1: Inflation Trends (1980Q1-2012Q4)

Source: Author's own construct, 2015

After the formal adoption of the Inflation Targeting Framework in May 2007, the only periods where Ghana's inflation experience drummed up a remarkable decline was between June 2010 and January 2013 where there was achievement of consecutive single-digit inflation (Akosa, 2014). This short lived single digit experience remains a wonder as the rest of the periods after took a reverse turn.

Policymakers over the years have attempted to tackle this problem of chronic volatility in inflation rates using a combination of monetary and fiscal measures. Despite the various policies meted out to mitigate the continuous upswings and downswings in inflation, inflation in Ghana has persistently remained high and above policy targets.

Earlier studies conducted on the determinants of key drivers of inflation dynamics in Ghana (see Sowa and Kwakye, 1993: Bawumia and Abradu-Otoo, 2003: Ocran, 2007: Almounsor, 2010: Gyebi and Boafo, 2013: Adu and Marbuah, 2011) indicates that inflation is at least influenced by monetary expansion, exchange rate depreciation, fiscal deficit and real income. Bawumia and Abradu-Otoo (2003) and Adu and Marbuah (2011) confirm the existence of long run relationship between inflation, money supply and exchange rate depreciation and the responsiveness of inflation to these variables. Though these influential studies have broadened our understanding and recommended interesting policy options, the Ghanaian economy is still bedeviled with a plethora of wobbling inflation rates.

Despite the good amount of research on inflation dynamics in Ghana, there are still gaps in our understanding of inflation dynamics in Ghana. In particular, the relative importance of nominal shocks and real shocks in accounting for the variance of inflation and how inflation responds to different kinds of shocks are not well understood in the Ghanaian context. This study fills this knowledge gap by providing empirical assessment of relative importance of nominal and real shocks in inflation dynamics in Ghana using quarterly data spanning the period 1980Q1 to 2012Q4. The study also provides an assessment of the degree of inflation

persistence (inertia) by examining how inflation responds to its own shock and how much of the variance of inflation is attributable to previous shocks to inflation.

Knowing that inflation moves in tandem with these macroeconomic variables is not enough to ensure a successful policy implementation. The study thus attempts to find the response of inflation to money supply which is the proxy for nominal shocks and output which is the real shock per the study via the Structural Vector Autoregressive framework which is useful for analyzing the importance of shocks.

1.3 Objectives of the Study

The main objective of the study was to empirically analyze the importance of nominal and real shocks in Ghana's inflation dynamics. To achieve this, the study sought to specifically:

i. Analyze the response of inflation to money supply (nominal) shocks in Ghana.

ii. Evaluate the response of inflation to output (real) shocks in Ghana. iii. Assess the variation in inflation that is explained by money supply shocks.

iv. Analyze the variation in inflation rate that is explained by output shocks.

1.4 Hypothesis Statement

The study seeks to test the following hypotheses:

i. Shocks from money supply do not cause dynamics in inflation in Ghana.

ii. Shocks from output do not cause inflation dynamics in Ghana. iii. Monetary shocks do not explain variations in inflation dynamics iv. Output shocks do not cause variations in inflation dynamics in Ghana.

1.5 Justification of the Study

One of the most important issues in Ghana's policy arena over the past years has been that of inflation rate stabilization as demonstrated by successive budget and policy statements. Again, it is worth noting that a successful policy option is one that is able to separate real shocks from nominal shocks, the study fulfils this intermediate goal. The study would bring afore evidence on the relative importance of nominal and real shocks in the short run when it comes to inflation dynamics to enable successful policy implementation.

Another major contribution of this study is in the use of a broad up-to-date data spanning the period 1980Q1 to 2012Q4, to capture the various economic policy regimes particularly the Inflation Targeting regime adopted in 2007 when it comes to inflation dynamics. Furthermore, the study adds to the existing knowledge by identifying the macroeconomic variables as real or nominal variables and attempt to specifically explain the relative importance of nominal and real shocks on inflation dynamics in Ghana given its reduction in explaining inflation in developing countries with evidence from Ghana.

1.6 Organization of the Study

The study is organized into five chapters. The rest of the study is organized as follows: Chapter two discusses the theoretical and empirical literature on inflation dynamics. Chapter three describes the data sources and econometric techniques applied to the data set; while Chapter four presents the empirical results and discussions. Chapter five concludes the study with summary of findings and policy recommendations.

CHAPTER TWO LITERATURE REVIEW

2.1 Introduction

This chapter presents various theoretical and empirical literatures on inflation. The theoretical review brings to bare vast theories and arguments about the causes of inflation whereas the empirical review puts forward varied works by scholars pertaining to the relationship between inflation and other macroeconomic forces whether real or nominal significant to the study.

2.2 Theories of Inflation

Various theories have sprung dating as far back from the eighteenth centuries all in an attempt to explain the causes of inflation. The most prominent ones are the arguments between the Keynesians and the Monetarist. Whiles the monetarists are of the view that inflation stems from monetary expansion, the Keynesians deem inflation to be as a result of changes in aggregate demand. Notwithstanding this, the common types of inflation postulated by Keynes are the cost-push, demand-pull and the built-in inflation.

According to the cost-push theory of inflation, it is a situation when the cost associated with the production of goods and services tend to increase and thus drives prices up. Negative supply shocks that hit producers such as workers attempt to increase their wages, increase in prices of raw materials and inputs as well as the increase in interest rates and depreciation of the domestic currency all constrains supply leading to inflationary pressures.

Also, the demand-pull theory of inflation on the other hand highlights more on the demand side. Inflation is seen to occurring when demand for goods and services outweigh its

supply. A situation when more cash tend to chase fewer goods, phrased differently, when the quantity demanded increases and therefore causes shortage of goods and services which in turn leads to the increase in prices. This increase in demand is as a result of both expansionary fiscal and monetary policy such as increase in government expenditure and money supply.

Furthermore, built-in theory of inflation also known as *inflation inertia* postulates that, inflation occurs as a result of an inflation which occurred in the past and further persists in the current period. When inflationary pressures tend to be chronic with no policy options to mitigate, it would lead to its persistence and further inflation being compounded into the economy.

Inflation theories have confirmed not a single cause of inflation but a combination of real factors from the structuralists and nominal factors from the monetarists. But the monetarist view about inflation being "everywhere a monetary phenomenon" which has gained prominence employs the quantity theory of money (Friedman, 1963).

2.2.1 The Quantity Theory of Money (QTM)

The monetarist deemed inflation to exist if the growth rates of money supply tend to outweigh the growth rate in the national income.

The quantity theory of money is an argument put forward by the Classicals or the Monetarist concerning inflation. Inflation in this case is viewed and seen to be "always and everywhere a monetary phenomenon" (Friedman, 1963). An increase in the quantity of nominal money supply would lead to a corresponding increase in the general level of prices.

Therefore monetary expansion is seen as the culprit when it comes to inflationary pressures per this theory.

The quantity equation by Irving Fisher (1867-1947) was formulated by the equation of the total payments to the total good and services. Thus given by;

$$MV = PY \tag{2.1}$$

Where M= money supply, V= velocity of circulation of money, P= price level and Y= output. The left hand side (MV) represents the total transfer of money and the right hand side (PY) represents the total nominal value of payments or transfer of goods and services (Eatwell et al, 1987).

Since the general price level is the main focus, making P the subject gives

$$P = \frac{MV}{P} \tag{2.2}$$

$$LogP = LogM + LogV - Log\ P \tag{2.3}$$

The velocity of money supply (V) is viewed in this case to be fixed. This is because the circulation of money is believed to be influenced by other institutional factors which do not change much. V is thus assumed per the theory to be equal to 1. Also, output (Y) in the long run is assumed to be constant, thus

$$LogM = LogM \tag{2.4}$$

Differentiating with respect to time to derive the corresponding growth rates

$$\frac{dp}{dt} * 1/p = dm/dt * 1/m \tag{2.5}$$

$$gm = gp \tag{2.6}$$

It becomes evident from (2.6) that, the growth rate of price is independent on output and the velocity of circulation of money but rather it is dependent on growth rate of money supply. In the long run therefore, money supply and price level have a direct positive relationship with no effect on output.

John Maynard Keynes challenged the relevance of the QTM even though he was a major contributor to this theory. He disputed the relevance of the theory by challenging it on three counts. He refuted the assumption upon which the constant Velocity of circulation of money rest and argument on the constant nature of output and the reason or the purpose for which money is demanded.

First, he did not agree with the constant velocity of money circulation where money is exchanged once and thus equating V to 1. He found out through a research and found velocity to be highly instable and would passively adapt to changes independently in the stock of money.

He refuted the long run equilibrium position of full employment of an economy thus a constant output. He believed unemployment goes beyond just a reflection of price and wage disturbances but could be a deep-seated feature of an economy and that it was equilibrium output that determined equilibrium employment not the other way round.

Thus once there is a possible less than full employment, output cannot be constant.

He further contended that individuals hold money also for speculative and precautionary reasons not just transactionary purposes. Money is not demanded just for the purchasing of goods and services but also household would demand money for unforeseen

circumstances or emergencies as well as to avoid the loss in the capital gain from holding financial assets.

2.2.2 Milton Friedman's Restatement of the Quantity Theory of Money

Various seasoned authors have made efforts to modify the QTM, Milton Friedman is one of such pioneers who would never go unmentioned. This was first presented in this work "Quantity Theory of Money-A Restatement" in 1956. Freidman argued that Keynes challenge of the QTM was more empirical than theoretical.

Friedman in his restatement succinctly regarded the QTM in the first instance to be a theory of demand for money rather than a theory of price level, output or money income. This he justified based on the premise that any statement about these theories requires combining the QTM with some other specifications about the conditions about money supply and the other variables (Friedman, 1956). In the QTM, there was no possibility of substitution between money and non-money assets. The QTM equation was thus seen to be crude in that it failed to make the QTM behavioral rather than just a mere mechanical relationship between M and Y.

He argued from a point where he opined economic agent including individuals, firms and the government would rather want to hold quantity of real as opposed to nominal real money balances. The premise being that if inflation erodes the purchasing ability, economic agents would prefer holding more nominal balances in order to ensure the constant state of their real balances. Friedman argued, the real money demand was a function of permanent income (the present discounted value of all expected future income), the relative expected return on bonds and stocks versus money, and expected inflation.

$$\frac{M_d}{P} = f(Y_p < +>, r_b - r_m, r_s - r_m < ->, \pi_e - r_m < ->)$$

Where $\frac{M_d}{P}$ is the demand for real money balances and Y_p is the permanent income, $r_b - r_m$ is the expected return on bonds less return on real expected money, $r_s - r_m$ also is the expected return on stocks minus the return on money and $\pi_e - r_m$ indicates the expected inflation less the expected return on money. $< +>$ and $< ->$ are the increases in and decrease in notation respectively.

To Friedman therefore, demand for real money balances is a function of income, wealth, return on money, bonds and expected inflation. As shown below.

$$\frac{M_d}{P} = f(y, w, r_m, r_b, r_e, p_e, u)$$

According to Friedman, demand for real money balances increases with permanent income and declines when expected return on bonds, stocks or other goods appreciates.

The movement in Price is thus related with the movement in the stock of money per unit of output rather than just money supply. "Inflation can be prevented if and only if the stock of money per unit of output can be kept from increasing appreciably" (Friedman, 1956).

2.2.3 Keynesian Theory of Inflation

John Maynard Keynes, a major contributor of the quantity theory of money's skepticism about the theory became evident through the publication of his famous "The General Theory of Employment, Interest and Money".

He opines fiscal rather than monetary forces to be the chief cause influencing of events. He heightened the relevance of investment and the stability of consumption rather than the stock of money and the stability of the demand for money in the QTM (Eatwell *et al*, 1987). To Keynes therefore, inflation which results from excess demand stems from an increase in aggregate demand in an economy rather than an increase in money supply.

Thus according to Keynes Money does not matter when it comes to economic events.

2.2.4 The Theory of Price Determination

The appreciable increase in the general price level defines inflation; the annual change in the general price level serves as a measurement for inflation. The Consumer Price Index (CPI) is a proxy used for the inflation measurement and it consists of the basket of goods and services. These baskets of goods and services consist of tradable and non-tradable goods. The general price level therefore becomes the weighted average of these tradable and non-tradable goods and services.

$$P = P_N^q P_T^{(1-q)} \tag{2.7}$$

Where P denotes the general price level whereas, P_N and P_T represents prices for nontradable and tradable goods and services respectively.

$$LogP = qLogP_N + (1-q)LogP_T \tag{2.8}$$

As the name of tradable good implies, it is determined in the international market and thus it is dependent on the exchange rate (E) and foreign price (P^f).

$$P_T = E_T P^f \tag{2.9}$$

$$LogP_T = LogE_T + LogP^f \quad (2.10)$$

It is thus evident from (2.10) that general price level moves in tandem with exchange rate and price of foreign goods. Thus inflation can be said to be positively associated with depreciation of the cedi and foreign price through importation of goods and services**.**

Furthermore, prices of the non-tradables are assumed to be determined domestically in the money market. The equality between real money demand and real supply of money market determines the equilibrium in the money market which is given by

$$m^d = \frac{M^S}{P}$$

$$P_N = \gamma(LogM^s - Logm^d)$$

Where γ, is the scale factor that illustrates the relationship between non-tradable goods and the economy-wide demand. Furthermore real money balances is assumed to be dependent on wealth which is measured by GDP, expected inflation and interest rates.

$$m^d = f(y, P^e, r)$$

Expected inflation (P^e) here per the study is assumed to be dependent on previous inflation, thus

$$P^e = \emptyset(LogP_{t-1})$$

$$P = f(y, E, r, M, P_{t-1})$$

$$lnP = \partial + \gamma_1 lny + \gamma_2 lnE + \gamma_3 lnr + \gamma_4 lnM + \gamma_5 lnP_{t-1} + \varepsilon_t$$

ε_t Takes into account other factor not explained in the model above best known as the disturbance term. The general price level of goods and services is postulated to be inversely related to real income but positively related to money supply and the nominal exchange rate. With a rise in real income, real money balances would also increase leading to a decrease in the prices of non-tradable goods and thus a fall in the general price level given the prices of tradable goods. γ_1 is thus expected to be negative.

Also, monetary expansion would lead to corresponding increase in the demand for nontradable goods which transpires into increase in general prices of goods and services. Furthermore, an increase in the rate of exchange is an indication of the depreciation of the domestic currency would lead to an increase the price of tradable goods which pass through to general price level.

2.3 Empirical Review

Volumes of literature have sprouted over the years in an attempt to explore the causes of inflation globally. On one hand, inflation is seen as strictly a monetary phenomenon and on the other hand the monetary phenomenon is relegated and inflation is seen as a structural phenomenon. Nevertheless other works also found mixture of both phenomena to be culprits of inflation. Monetary expansion, exchange rate depreciation, output and inflation relationships have received much attention in the process, however, the exact extent of the impact and relationship between these macroeconomic forces still remains inconclusive with mixed outcomes using different econometric modeling.

2.3.1 Inflation in Africa

A brief look at the cross-country culprits of inflation fluctuations can be seen in the works of Loungani and Swagel (2001), Blavy (2004), Parisa and Hassan (2012), Moriyama (2008), Almounsor (2010), Osorio and Unsal (2011), Egwaikhide *et al* (1994), Canetti and Greene (1991) amongst a host of others.

Using a sample of ten different African countries, Canetti and Greene (1991) examined monetary growth and exchange rate depreciation as causes of inflation in African countries. By the application of the Vector Autoregressive (VAR) model, the study found a positive relationship between inflation, monetary expansion and exchange rate depreciation.

Loungani and Swagel (2001) also applied the Vector Autoregression (VAR) model based on evidences from 53 developing countries between 1964 and 1998, found monetary expansion and exchange rate depreciation to be important determinants of inflation in countries under the flexible floating exchange rate regimes whiles inflation inertia is relatively important source inflation under the fixed exchange rate regimes.

Also, Blavy (2004) confirmed the existence of a long run increasing impact of monetary shock on inflation variability in Guinea using the vector error correction model on quarterly data from 1992 to 2003. It was also evident that short term variations in inflation tend to influence its long run impacts from monetary shocks which stabilize at a much higher rate. Blavy's study thus confirmed inflation being a monetary phenomenon.

Parisa and Hassan (2012)'s work further supported the monetary phenomena of inflation as they investigated inflation and money in Iran using a bounds test approach to co

integration. The study establishes a long run and stable relationship between money and inflation using quarterly data between 1989Q1 to 2007Q4.

Furthermore, Moriyama (2008) investigating inflation dynamics in Sudan made use of three separate models including a single equation, the recursive structural VAR and the vector error correction model (VECM) to ensure robustness due to the limitations associated with available data quality. The study based on using quarterly dataset from 1995Q1 to 2007Q2, confirmed in all instances that, monetary expansion and nominal exchange rate were forces behind inflation variations in Sudan and lasted between 18 to 24 months. However, the nominal exchange rate had a greater impact on inflation variations compared to money supply.

Gottschalk, *et al* (2008) applying the Structural Vector Auto-regressive model (SVAR) on dataset of monthly frequencies between 2000 and 2007 in Sierra Leone found the increasing importance of monetary expansion and the nominal exchange rate depreciation in inflation dynamics. The only limitations to this study was the shortcomings of the dataset as economic recovery from the civil war started in 2001 making availability of data from the onset impossible.

Almounsor (2010) also in an International Monetary Fund (IMF) working paper employed the same three models including the single equation model, the SVAR and the Vector Error Correction Model (VECM) to analyze drivers of inflation in Yemen. With similar quarterly time periods between 1995 and 2007, the results showed that international prices, exchange rate depreciation, money supply and domestic demand were the major drivers of inflation in Yemen. Nevertheless, Almounsor noted per the study that

international prices and exchange rate mattered just in the short run and dies out after two years whiles domestic shocks including money supply and demand had significant impact on inflation in the medium term.

However, the works of Osorio and Unsal (2011) has disputed inflation being monetary phenomenon with structural factors gaining more prominence. Osorio and Unsal (2011) using quarterly data from 1986Q1 to 2010Q1 examined inflation drivers in Asia with spillover from China. With the application of the Global Vector Autoregressive model (GVAR) as well as the Structural Vector Autoregressive (SVAR) model, the study found the increasing impact of demand factors in driving inflation in recent years. However, over the past years inflation was mainly driven by monetary and supply shocks but their impacts in explaining inflation has gradually dwindled with time. It became evident also from the study that economies in the Asian regions are exposed to notable spillovers form China as inflationary pressures from China quickly disseminate through commodity prices into the other Asian economies.

Nasr-Esfahani and Yavari (2003) assessed the effects of nominal and real variables on inflation in Iran. Using liquidity growth, exchange rate growth, inflation and expected inflation as nominal and real output gap as the real variable, they employed the Vector Autoregressive (VAR) on seasonally adjusted quarterly data from 1971to 2001. The results found chronic inflation to be related to the actual variables. In the short term inflation shocks, liquidity and exchange rate were effective variables and in the medium term also, stable inflation largely depends to expected inflation but in long term actual sector shocks have important impact on inflation.

The likes of Egwaikhide *et al* (1994), Durevall and Sjo (2012), Akinbobola (2012), Alavinasab (2014), Ashwani (2014) and Onour (2015) found support for the mixture of both phenomena.

Egwaikhide *et al* (1994) drawing on the co-integration and the error correction model found both the official and parallel exchange rate, real output and domestic money supply to be significant causes of inflation in Nigeria. The official exchange rate turns to affect price inflation with a lag period of one year.

Durevall and Sjo (2012) using monthly dataset between 2000 and 2010 employed a single error correction model and found similar factors which drive inflation in both Kenya and Ethiopia. Exchange rate and world food prices had a long run impact whiles excess money growth and agricultural supply shocks has only short term effects.

Akinbobola (2012) used the Vector Error Correction Model (VECM) on quarterly frequencies between 1986Q1 and 2008Q4 to examine money supply and exchange rate dynamics on inflation in Nigeria. He found money supply to have a major short run inverse effect on inflation in Nigeria. However, exchange rate had very minute or even no significant effect on inflationary pressures. This he attributed to the strong nature of the Naira. He further found increasing supply side factors to also play a role in curbing Nigeria's inflation as real output also had an inverse effect on inflation.

Alavinasab (2014) also using annual dataset from 1965 to 2012 with evidence from Iran and by employing the co integration and the vector error correction model found a long run relationship between inflation and money supply, gross domestic product and oil prices.

Money supply and oil price were found to have a positive relationship with inflation whiles GDP had an inverse relation with inflation in Iran.

Ashwani (2014) did a study using a co integration approach and the error correction model to establish the long run and short run determinants of inflation in India based on the premise that inflation has increased due to economic growth and development in India which has resulted in the increasing purchasing power of the citizens. The study made use of annual data between 1981 and 2011 and found money supply, exchange rate and private final consumption to significantly influence inflation both in the long and short run.

Onour (2015) in an attempt to model inflation dynamics in a conflict economy with evidence from Sudan, found inflation to be a monetary phenomenon as monetary growth was Sudanese's main cause of inflation. The study also found Sudan to be exposed to external shocks as evident with the increasing role of foreign exchange in the black market as well as imported inflation in recent years. His findings were based on his application of the ARDL model to monthly dataset from January 2008 to December 2013 in Sudan. He thus recommends the control of monetary expansion coupled with the adoption of a more flexible official exchange rate system.

2.3.2 Empirical literature on Ghana's Inflation Experience

Influential papers on inflation dynamics in the Ghanaian front have found the declining importance of money supply on inflation dynamics. This is evident in the works of Sowah and Kwakye (1993), Ocran (2007), Kovanen (2011), Harvey and Cushing (2014) and Osei (2014).

Sowah and Kwakye (1993) in their study found inflationary pressures from Ghana to be mainly driven by supply factors compared to the forces from monetary factors. The study found exchange rate to be a potential source of inflation in the future though it turned out to be statistically insignificant. The application of the Ordinary Least Squares (OLS) concluded a mixture of real and monetary factors should be targeted in an attempt to curb inflation in Ghana.

Ocran (2007) observes in his study of finding the causes of inflation in Ghana between 1960 and 2003 that inflation inertia, money supply, exchange rate and Treasury bill rates were the short run determinants of inflation in Ghana. This was made possible with the employment of the Johansen Co integration and the Error Correction Model.
Nevertheless inflation inertia was the dominant cause of inflation in Ghana.

Also, Kovanen (2011) in his study begs the question whether money mattered when it came to inflation dynamics in Ghana. As inflation is seen to be a monetary phenomenon by the monetarists, Kovanen found not only weak support but also declining importance of monetary expansion in Ghana's future inflation arena. Nevertheless exchange rate depreciation and output were the important predictors of inflation in Ghana.

Osei (2014) modeled inflation in Ghana using the VAR on dataset from January 2000 to December 2013. The study found monetary expansion to be insignificant determinant of inflation in Ghana, this he supported with the Bank of Ghana's adoption of the Inflation Targeting rather than the monetary targeting policy framework. The study however found exchange rate, price expectation, domestic food prices and petroleum prices to be the forces behind Ghana's inflation volatility.

Furthermore, using the SVAR approach in Ghana is Harvey and Cushing (2014) in an attempt to explore inflation dynamics by separating its monetary and structural causes. They used data from Ghana on monthly frequencies from January 1980 to December 2010 and found that, structural factors such as real output explained more of Ghana's inflation dynamics as opposed to monetary factors such as money supply and exchange rate. The structural shocks also took a longer time before dying out compared to the monetary shocks which died out more quickly. They thus concluded per their findings that inflation dynamics was more a structural rather than monetary phenomena in Ghana.

Other studies in Ghana however also had outcomes that supported the relevance of money supply in explaining Ghana's inflation. Bawumia and Abradu-Otoo (2003) has explored the relationship between money supply, exchange rate and inflation in Ghana with the use of the error correction model. The results confirmed a long run relation with inflation being positively related to money supply and exchange rate. Nevertheless the rate of adjustment of inflation toward its equilibrium was fairly fast. This was made possible with the use of annual data from 1983 to 1999.

Also, Adu and Marbuah (2011) used the ARDL to co integration to find the factors accounting for inflation in Ghana between 1960 and 2009. The study also confirmed the relative importance of nominal exchange rate, real output, nominal interest rate and fiscal deficit in inflation dynamics. Monetary expansion was found to be a key driver of inflation in Ghana both in the long and short run however real output growth accounted for the greater variations in inflation compared to the money supply. The study found inflation to be a mixture of structural and monetary phenomena.

Gyebi and Boafo (2013) modeled inflation variations in Ghana between 1990 and 2009 using the Ordinary Least Squares (OLS). The study confirmed money supply, exchange rate and real output as main forces behind the volatility in inflation levels in Ghana. Exchange rate depreciation was found to be relatively important as per the study it tends to reduce inflation to an appreciable level whiles monetary expansion and growth in real output increases the general price level of goods and services.

Adom *et al* (2015) using time series data between 1960 and 2012 and the application of the fully modified ordinary Least Squares (FMOLS) and the bounds test to co integration, their study found a long run relationship between inflation and money supply, crude oil prices and interest rate. The study thus confirmed inflation in Ghana being a monetary phenomenon with intra-continental transfer of inflation between Ghana and Ivory Coast as inflation in both countries can extend beyond their own boundaries per the study.

It is thus obvious that the sources of the chronic- inflation trends in Ghana is inconclusive despite the growing interest of various researchers in the area of study.

CHAPTER THREE METHODOLOGY

3.1 Introduction

This chapter brings afore the methodology adopted for the study's analysis. To this effect, this chapter is subdivided into three sections. Section 3.2 presents the specification of the econometric model to be used. Section 3.3 presents the various sources of the data used coupled with the definition and measurements of each variable included in the study. Finally, the section gives the estimation strategy for the analysis.

3.2 Theoretical Model Specification

To uncover a robust and reliable model that captures the relationship between inflation and monetary disturbances, the researcher follows the Quantity theory of Money framework as a baseline model. Inflation is seen to be everywhere a monetary phenomenon according to this theory. Growth in prices (Inflation) is seen to be function of growth in money supply, velocity of money and growth in real income.

The study, however, includes real GDP (output) following the likes of Kwakye and Sowah (1993), Bawumia and Abradu-Otoo (2003) and Adu and Marbuah (2011) who have found the importance of supply factors in the explanation of inflation over the years.

In an attempt therefore to analyze the relative importance of real and nominal shocks in explaining the dynamics of inflation in Ghana, a baseline VAR model was specified in three different endogenous macroeconomic variables – consumer price index- Inflation (CPI), money supply (MS) and real GDP (RGDP). The three dimensional vector of endogenous variables in our baseline specification is given in equation (3.1).

$$y_t = (CPI\ MS\ RGDP_t, \quad t, \quad t)' \tag{3.1}$$

However, in accordance with the United Nations Economic Commission of Africa (UNECA) in its Structural Adjustment Program, exchange rate depreciation is postulated to be major determinant of inflation in developing Countries (Canetti & Greene, 1991), I modified the model to control for this nominal shock;

$$y_t = (CPI\ MS\ RGDP\ EXR_t, \quad t, \quad t, \quad t)' \tag{3.2}$$

Where, all the variables have been previously defined except EXR which is the nominal exchange rate of the Ghana cedi to the US dollar. All endogenous variables are in their natural log forms. The study's K-dimensional stationary, stable VAR (p) process is specified as;

$$y_t = \alpha_1 y_{t-1} + \ldots\ldots + \alpha_p y_{t-p} + e_t \tag{3.3}$$

Where y_t is a ($kx1$) vector of observable time series variables (CPI, MS, RGDP and EXR), $\alpha_i (i = 1, \ldots\ldots)p$ are (kxk)coefficient matrices and e_t is a K-dimensional white noise with zero mean and a constant variance.

The domestic inflation in the Ghanaian economy is thus subject to four structural shocks $\varepsilon_t (e\ e\ e\ e_t^i, \ t^m, \ t^e, \ t^y)$. These structural shocks is further disentangled into real and nominal shocks; one real shock, that is, output shock e_t^y and three nominal shocks made up of shocks to inflation e_t^i , money supply e_t^m and nominal exchange rate e_t^e .

3.3 Data Sources and Type

Strictly secondary sources of dataset are employed in this study. The study attempts to use quarterly frequencies of inflation, money supply, the nominal exchange rate, real GDP and oil prices covering the period 1980Q1 to 2012Q4 which were extracted from two major sources. All data on the specified macroeconomic variables were obtained from the International Financial Statistics (IFS) of the IMF with the exception of the nominal exchange rate which was obtained from the monthly Bulletin from the research department of the Bank of Ghana (BOG). Owing to the complete annual nature of the real GDP, it's disaggregation into quarterly frequencies was made possible through the use of Ecotrim software. The use of the quarterly frequency is justified due to its high frequency which is appropriate with regard to analyzing responses quarter to quarter variations in macroeconomic variables.

3.4 Variable Definition and Expected Signs

Inflation (CPI)

Inflation is the increase in the general prices of goods and services over a period of time. The study uses the Consumer Price Index as a proxy for the measurement of inflation in the study. The study is compelled to using the CPI inflation as opposed to the year on year inflation because; the YOY inflation has its roots in the actual CPI. Inflation in the model of the study is noted by CPI.

Money supply (MS)

The proxy for the money supply is the M2+. M2+ is preferable for this study due to its composition of the major components of the monetary base. Its components comprise of M2 plus foreign currency deposits (FCD). The M2 is the detailed amount of M1 plus travelers cheques of non-bankers and demand deposits. The most liquid monetary base is the M1 which is the amount of money in the hands of the general public in the form of coins and notes including all savings deposits in the commercial banks. According to theory monetary expansion is expected to be positively related to inflation rates, increasing money supply would cause demand for goods and services to outweigh the supply of goods and services leading to increasing prices (Adu and Marbuah, 2011).

Nominal Exchange Rate (EXR)

The nominal exchange rate is the actual rate or established rate of exchange on the foreign currency market such that its increase becomes a signal of depreciation whiles a decrease indicates appreciation of the currency. The study uses the cedi/US$ as a measure for the exchange rate given the recent depreciation of the cedi against the US Dollar coupled with it being one of the major international trading currencies across the globe. The depreciation of the domestic currency is expected to causing increasing rates of inflation since Ghana tends to be more import dependent (Adu and Marbuah, 2011).

Gross Domestic Product (RGDP)

The real gross domestic product (RGDP) is an inflation adjusted measure of the total amount of goods and services produced in a country over a period of time specifically one year. It is usually expressed in a base-year. The real GDP is used as a measure of the output

per the study. Inflation and output level is postulated by the study to be inversely related in that increasing output level should have a positive impact on inflation thus causing it to decline (Adu and Marbuah, 2011).

3.5. Estimation Strategy

To ensure accuracy in the outcome of the SVAR model, it was necessary to give succinct procedures to be undertaken which would enable the achievement of the required estimates.

3.5.1 Unit Root Test

In order to avoid spurious results, it becomes imperative to assess the time series properties of the macroeconomic variables. In order to ensure the successful use of the SVAR model, the endogenous variables first should assume stationarity. A dataset is deemed stationary when their joint probability distribution does not change over time. This process spells out the order of integration of the variables whether Integrated of order zero (i.e., I(0)) or order one (I(1)). The study thus implements the Augmented Dickey-Fuller (ADF) and the Philip Peron test for stationarity. Two separate tests are preferable to ensure accuracy and consistency of the stationarity outcomes. Though the PP unit root test is a modified version of the ADF test, the primary difference is in how the tests each manage serial correlation. Whiles the PP test ignores any serial correlation, the ADF uses a parametric auto-regression to approximate the structure of errors. In other words, the P-Perron test corrects for both serial autocorrelation and heteroscedasticity by employing the Newey-West heteroscedasticity and autocorrelation (Smith & McAleer, 1994). The test regression for the PP test and the ADF model is specified below in equations (3.4) and (3.5) respectively;

$$\Delta y_t = \beta_0 + \gamma y_{t-1} + \mu_t \quad (3.4)$$

$$\square\square\square\square y\square\square\square_1 \qquad {}_2t \qquad {}_3y_{t\square 1}\square\square(A\, y_i\square\ {}_{t\square 1})\square u_t \quad (3.5)$$

Where Δ is the first difference operator.

From both equations, we test the null hypothesis of existence of unit root against the alternative hypothesis of non-existence of unit root. Failure to reject the null hypothesis imply unit root and thus the variable is integrated of order one or a higher order. If the null hypothesis is rejected, then the variable is stationary, hence integrated of order zero at the levels i.e. I(0).

3.5.2 The Structural Vector Autoregressive (SVAR) Model

The empirical analysis of inflation dynamics in this study is based on SVAR technique, which was first proposed by Sims (1980) and popularized by Blanchard and Quah (1989) in documentation of the relative importance of demand and supply shocks on business cycle, Clarida and Gali (1994) in finding the relative importance of nominal shocks in the exchange rate dynamics, Sims and Zha (2004) in enquiring the effects of output and money and Adu *et al*. (2015) works on the exchange rate dynamics and pass through effect on domestic prices. It was purposely introduced to overcome the shortfalls of the standard VAR model where the coefficients do not have any economic implication. The SVAR, however, is guided by imposing appropriate restrictions on the variables based on economic theory. The shocks are thus seen to be structural shocks rather in contrast to the normal shocks in the standard VAR framework. Form equation (3.3) , its matrix

representation is specified in the form;

$$\Gamma_0 y_t = \Gamma_0 + \sum_{i=1}^{p} \Gamma_i y_{t-i} + \varepsilon_t \quad (3.6)$$

Where Γ_0 is a *kXk* matrix of contemporaneous coefficients which is a representation, Γ_0 is the vector of constants, Γ_i represents a *kXk* matrix of structural coefficients, ε_t is a vector of orthogonal structural shocks. The structural shocks are assumed to be independent and identically distributed (i.i.d) with zero mean and constant variance.

The reduced form of equation (3.3) becomes:

$$y_t = \Phi_0 + \sum_{i=1}^{p} \Phi_i y_{t-i} + e_t \quad (3.7)$$

where Φ_0, Φ_i *and* e_t are representations of $\Gamma_0^{-1}\Gamma_0$, $\Gamma_0^{-1}\Gamma_i$ *and* $\Gamma_0^{-1}\varepsilon_t$ respectively.

The actual presentation of the Wold Moving Average (MA) of the data for the study is;

$$y_t = AE_0 + AE_1\varepsilon_{t-1} + AE_2\varepsilon_{t-2} + \ldots\ldots\ldots \quad (3.8)$$

Where A_i is representation of responses to E_t shocks. The covariance of the innovations (error terms) e_t can be expressed as $\Gamma_0^{-1}B(\Gamma_0^{-1})'$, and the assumption of a diagonal B matrix, we get $n(n-1)/2$ independent equations. In other words all $n(n-1)/2$ off- diagonal elements of $\Gamma_0^{-1}B(\Gamma_0^{-1})'$ are all equal to zero.

Ordering the variables based on the Choleski decomposition gives an outcome where connotes the lower triangular matrix. The inclusion of three different endogenous variables confirms the imposition of 3 restrictions in order to recover all the structural parameters found by $n\ n(\ 1)/\ 2$. This gives a lower triangular matrix as depicted in matrix below.

$$\begin{bmatrix} 1 & 0 & \cdots & 0 \\ \square & 1 & \cdots & 0 \\ \square\square & \square & \cdots & \square \\ \square\square\square_{21} & \square_{k1}\square & \cdots & 1\square\square \end{bmatrix}$$

The above lower triangular matrix after the imposition of the restrictions ensures that the innovations and the corresponding impulse response are just-identified.

Matrix B on the other hand connotes the diagonal matrix as represented below

$$B\square\square\square = \begin{bmatrix} \square\square_{211} & 0 & \cdots & 0\ \square \\ 0\ \square_{22} & & & \\ 2 & 0 & 0\ \square\square & \\ \square\ . & . & . & .\ \square \\ \square\ 0 & 0 & 0\ \square_{2kk}\ \square\square\square & \\ \square\square & & & \end{bmatrix}$$

A diagonal matrix represents the structural shocks which depicts that the shocks are orthogonal i.e. the independence of the error terms in the model. Thus pure structural shocks have covariances equal to zero.

3.5.3 Choleski Identification Restrictions

The Choleski identification strategy is the most common approach to identifying orthogonal disturbances amidst other approaches. Its ordering process is based on the premise that a shock to a particular variable does not contemporaneously affect the variable that precedes it in the ordering but however affects it with a lag. Following Almounsor (2010), Ayubu (2013) and Akosah (2014) where Cholesky decomposition of the variance-covariance matrix have the policy variables being ranked last and the nonpolicy variables coming first in the ordering criterion gives the monetary policy shocks to be estimated (Bernanke & Blinder, 1992). Per the study we order output (RGDP) first since it is less volatile and a non-policy variable, followed by money supply and thirdly the nominal exchange rate in that order. Finally inflation is ordered last since it is a target policy variable for achieving single digit inflation in the Ghanaian economy.

Following the likes of influential authors such as Gali (1992), I impose short run (contemporaneous) restrictions in order to recover all the coefficients of the structural equations into nominal and real shocks. The justification for the imposition of the short run restrictions is based on the premise that in the long run all shocks to inflation are assumed to die out thus given the short run more prominence.

First, output shock is assumed to contemporaneously affect all variables (money supply, exchange rate and inflation) in model (Ayubu, 2013). Secondly like Gali (1992) money

supply is projected to have no contemporaneous impact on output. Output is seen not to respond to changes in money supply in such a short periods given the quarterly series. This is supported by the works of Shapiro (1986). Money supply thus affects only exchange rate and inflation. Lastly, exchange rate does not have any contemporaneous impact on output and money supply given money supply being controlled by the central bank. Thus exchange rate impacts just on inflation in the short run.

3.5.4 Optimal Lag Selection

The inference of the VAR depend on the correct specification of the model, hence the choice of the optimal lag becomes an important issue of concern (Gutierrez et al, 2007). Diverse criteria are available to aid in the optimal selection of lags for various analysis using different methodologies. The most commonly used information criteria are the Akaike Information Criterion (AIC), the Schwartz-Bayesian Information Criterion (SBC) and the Hannan-Quinn Information Criterion (HIC).

Lutkepohl (1993) stressed the fact that if lag selected are high or lower than the true lag length, it would lead to the increase in the mean squares forecast of the errors and autocorrelation respectively. Also, Braun & Mittnik (1993) indicated the inconsistency in the derivation of the impulse response functions (IRFs) when the optimal lag is not selected. To ensure that the model is devoid of all these time series anomalies we make use of the AIC for the optimal lag selection which is appropriate due to the small sample size of the data under observation.

3.5.5 Forecast Error Variance Decomposition (FEVD)

The variance decomposition tells the feedback of the various endogenous variables on each other. It spells out the relative share of variance that one structural shock contributed to the entire variation in the other variables. In this manner the possibility of ascertaining the relative contribution of each shock in the explanation of the each other is made visible.

3.5.6 Impulse response functions

The impulse response function (IRF) traces the effect of a shock to an innovation and how an endogenous variables response to such a shock both in the current and future period. It thus gives a visual presentation of the behavior of the various endogenous variables in response to other shocks whether positive or negative. The coefficients of the innovations (error terms) are plotted against the time horizons, where a shock does not only affect the variable directly but also the shock is transmitted to the remaining endogenous variables through the lag structure of the VAR.

CHAPTER FOUR EMPIRICAL RESULTS AND ANALYSIS

4.1 Introduction

This chapter presents and discusses the estimated empirical results as specified in chapter three. To begin with, analysis and discussion on the trends of the various variables are presented and further, tests for stationarity are carried out. Finally the outcome of the exact response of inflation to shocks from real and nominal macroeconomic variables are discussed and interpreted thereof.

4.2 Descriptive Analysis

The purpose of the descriptive analysis is to uncover the basic features and general overview of the dataset under study. This comprises their respective means, maximum and minimum values as well as their standard deviations. The results are presented in table 1 below.

Table 1: Summary of Descriptive Statistics

	lnRGDP	LnM2+	LnEXR	lnCPI
Mean	8.014596	5.075595	-2.506760	1.863896
Maximum	8.947176	10.02653	0.634741	4.798407
Minimum	7.343855	-0.364015	-8.199277	-3.057608
Standard Dev.	0.444350	3.051292	2.717282	2.184579
Observations	132	132	132	132

Source: Author's Estimation, 2015

From the period 1980Q1 to 2012Q4 constituting 132 observations, real GDP recorded a mean value of 8.0145 which is considered moderate for a developing country like Ghana and ranged between 7.343 and 8.9471. Its standard deviation was about 0.44435 which is an indication of a lower tendency to deviate from its actual mean and thus less volatile.

Also, inflation rate also averaged 1.86 and ranged between -3.057 and 4.798 with a standard deviation of approximately 2.2 which depicts a much higher volatile nature. Furthermore, the nominal exchange rate also had -2.50 as its average value with a maximum value of -8.199 and a minimum of 0.634. It further recorded a standard deviation of 2.717. The broad money supply experienced a maximum value of 10.02 and a minimum of -0.3640, and recorded the highest standard deviation of 3.051 and characterized by a mean of about 5.0.

The above description of the dataset uncovers real GDP to be the most stable macroeconomic variable followed by the rates of inflation then the nominal exchange rate with money supply being the most volatile.

4.3 Inflation and Macroeconomic Variables in Ghana

This section presents an illustration depicting the trends and relationship between inflation and the real (real GDP) and nominal (money supply and exchange rate) macroeconomic variables.

4.3.1 Inflation and output

Figure 2 illustrates the trends taken by both inflation and real GDP series between 1980Q1 and 2012Q4. On the average, the Ghanaian economy's real GDP has been on the rise over the 132 period under observation. Two distinct phases of the two series can be identified that is the period between 1980-1983 and 1984 to 2012. The first phase was characterized by relatively low and stable real output of not more than 2,000 million USD amidst outrageous fluctuations in the rates of inflation which ranged between as low as 5% to about 123% rates. This relatively low output and highly volatile rates of inflation could be attributed to series of coup d'état and poor economic management at the time. The second phase which encompasses the periods after the implementation of the Economic Recovery Program (ERP) which saw the level of output to be on the continuous increase whiles inflation rates although amidst fluctuations is relatively stables compared the proceeding years.

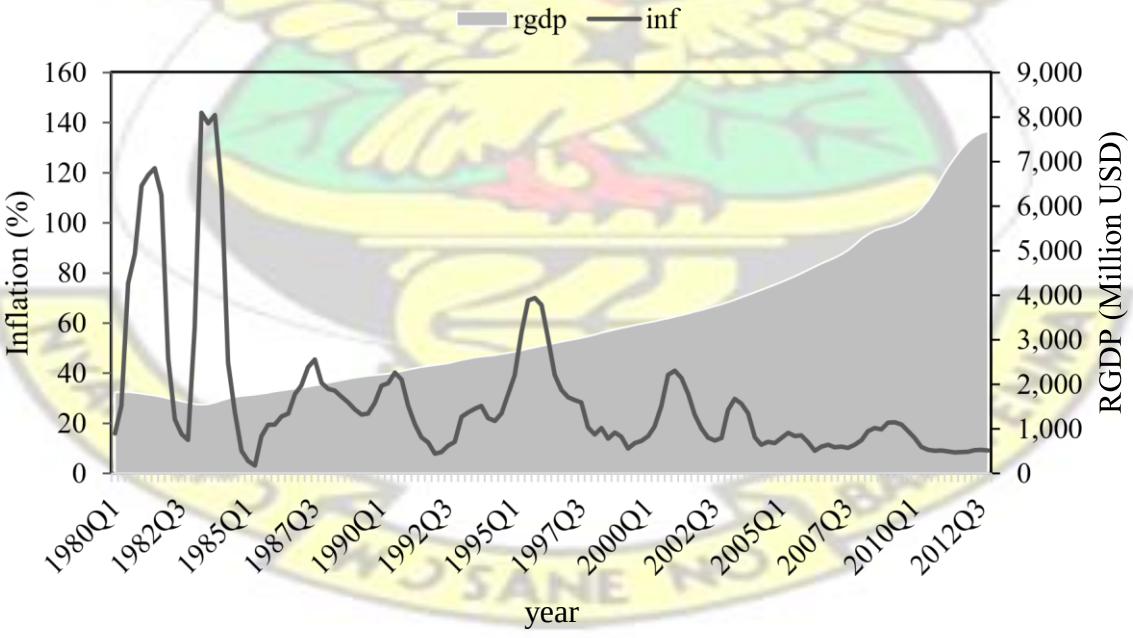

Figure 2: Inflation and Real GDP trends (1980Q1-2012Q4)

Source: Author's own construct, 2015

The calm rates of inflation and increasing level of output is associated with the stringent fiscal, monetary and trade policies implemented during the ERP aimed at increasing productivity and reducing inflation rates.

It can thus be visualized that there is an inverse relationship between inflation and output. In other words an increasing output would be marked by relatively low rates of inflation whiles a high rates of inflation rates is mainly characterized by low level of output.

4.3.2 Inflation and Broad Money Supply

The broad money supply generally is seen in Figure 3 to be significantly increasing over the years. Though monetary expansion and inflation are found to move in the same direction, the illustration in figure 3 confirms almost otherwise. Between 1980 and 1983 where due to poor economic management budget deficit was financed by printing more domestic currencies, inflation was amidst serious fluctuations and reaching its highest peak of about 123% thus confirming the positive relationship. However after the ERP between 1984 and 2012, inflation rates has been more stable compared to the pre-ERP reforms whiles money supply continues to be on the rise (see Figure 3).

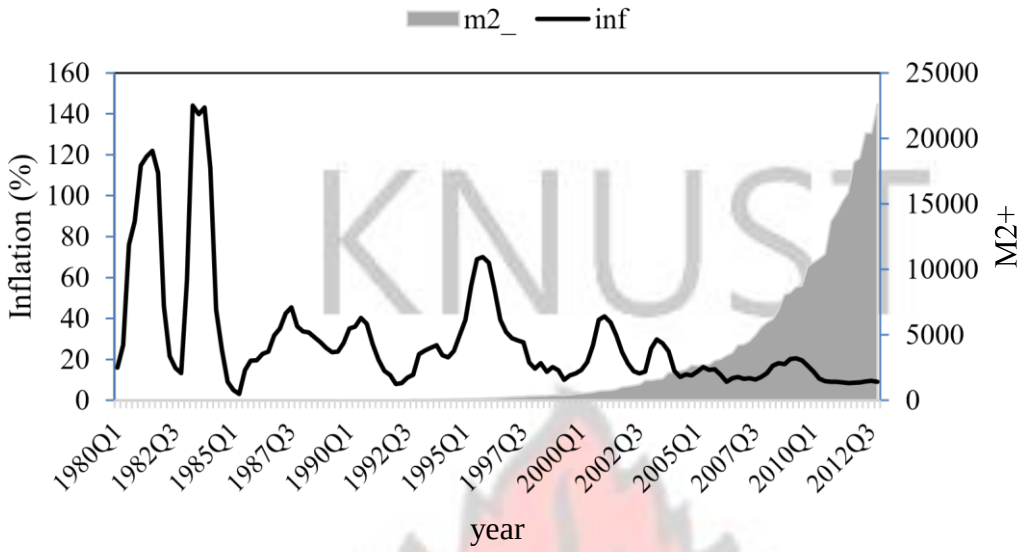

Figure 3: Inflation and Money Supply Trends (1980Q1-2012Q4)

Source: Author's own construct, 2015

After the introduction of the Inflation Targeting framework in 2007, Ghana has achieved relatively calm and low rates of inflation to even single digit inflation between June 2010 and January 2013, however money supply was highest between these periods compared to the past years (see Figure 3).

Mostly, the management of money supply has been the target to bringing inflation under control. A critical look at the relationship between these two series in recent years is suggestive of how monetary authorities poorly manage the supply of money to bring inflation rates under control, it however shows the importance of targeting monetary expansion as a tool for bringing inflation under control. **4.3.3 Inflation and the Nominal Exchange rate**

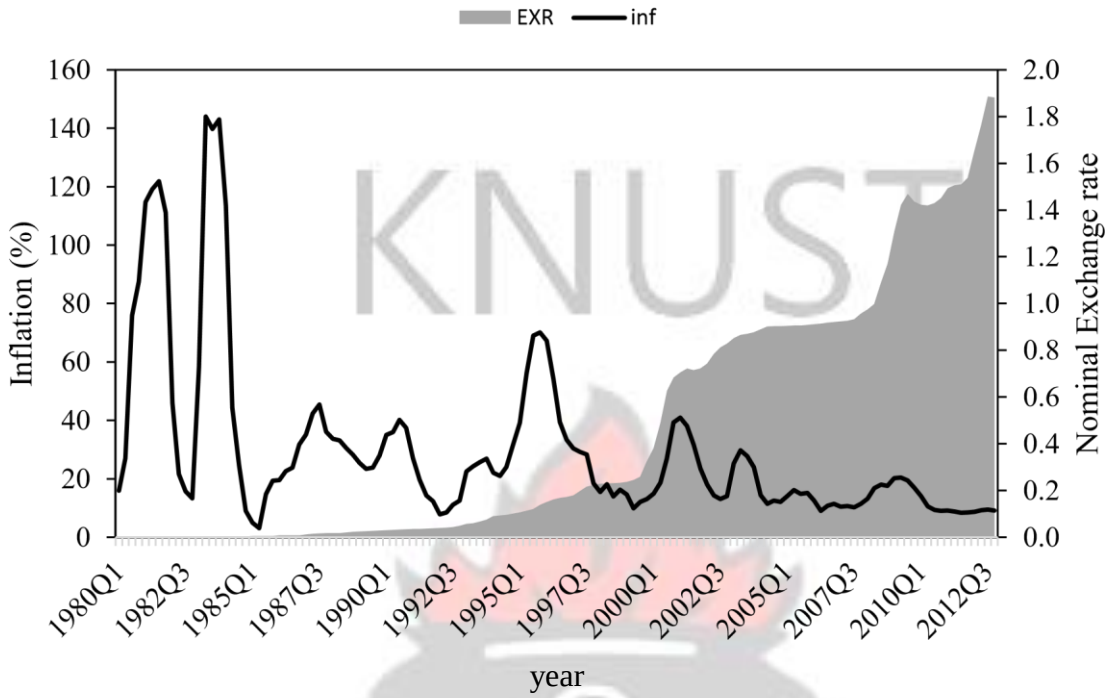

Figure 4: Inflation and Nominal Exchange rate Trends (1980Q1-2012Q4)

Source: Author's own construct, 2015

On the average the nominal exchange rate has been on the increase except for certain parts of the period which took a different turn such as in 2007 when there was redenomination of the domestic currency which led to the appreciation of the cedi and at the same time inflation being more stable averaging about 10% annually. The depreciation of the domestic currency could be attributed to the increasing demand for foreign exchange in order to support the economic activities. Also the election years (2000, 2008 and 2012) have been a major cause of increasing rate of exchange and rates of inflation. The general interpretation of relationship between these two trends in the Figure 4 is that they move in the same direction.

4.4 Results and Analysis of Stationarity Properties

This section is dedicated to the stationarity results of the respective variables under study which comprise inflation, money supply, real GDP and the nominal exchange rate. The results are based on the ADF and Philip Perron Tests using both the constant and the constant plus trend terms. From Table 2, the test of unit root using both the ADF and the PP test is presented. It is evident that testing for the presence of unit root with intercept and trend, all the variables proved to be non-stationary except for inflation and the real GDP. The two variables were rendered non-stationary with the inclusion of the trend term but without a trend they were both stationary at 5% level of significance using both tests. Nevertheless, null hypothesis of unit root is not rejected for inflation and real GDP at levels and hence integrated of order one [I(1)]. This is justified because stationarity should be with both constant and constant with trends.

With the acceptance of the null hypothesis of unit root in all the variables, a further testing for the absence of unit root at their first difference, the study found the all variables including inflation, money supply, exchange rate and real GDP to be stationary at 1% level of significance with both intercept and addition of the trend term.

Table 2: ADF and Philips Perron Test for Unit Root

Variables	**ADF tau Test**		**Philips Perron Test**		**Order of Int**
	Intercept	Intercept +T	Intercept	Intercept + T	
			PANEL A: LEVELS		
lnCPI	-2.687*	-1.552	-4.473**	-2.798	?
lnM2+	-0.384	-1.521	-0.123	-2.036	?

lnEXR	-0.685	-1.273	-0.649	-1.341	?
lnRGDP	1.919*	-2.612	3.380**	-2.238	?
PANEL B: FIRST DIFFERENCE					
d.lnCPI	-5.799***	-6.997***	-6.926***	-7.627***	I(1)
d.lnM2+	-9.234***	-9.221***	-15.175***	-15.134***	I(1)
d.lnEXR	-8.483***	-8.473***	-12.040***	-12.015***	I(1)
d.lnRGDP	-3.615***	-4.097***	-2.999**	-3.394*	I(1)

NB: *, ** and *** indicates significance at 10%, 5% and 1% respectively

Source: Author's Estimation, 2015

The null hypothesis is thus rejected confirming non stationarity at their first difference irrespective of using the ADF or PP test and hence integrated of order one [I(1)]. The study thus makes use of only [I(1)] series for the respective macroeconomic variables in the analysis.

4.5 Lag Order Selection

The Akaike and the Hannan-Quinn Information Criteria gave an optimal lag of four (4) for the use of both criteria whiles the Swartz-Bayesian information Criterion (SBIC) gave lag two (2) as its optimal lag. The study however, in the attempt to select the optimal lag appropriate for the study's analysis makes use of the AIC of four lag to aid in the SVAR modeling. This is because the AIC is useful when it comes to small sample sizes as in the case of the study.

Table 3: Optimal Lag Selection

Lag	Df	P-value	AIC	HQIC	SBIC
0	16	0.000	-12.3114	-12.275	-12.2218
1	16	0.000	-14.7989	-14.617	-14.351
2	16	0.000	-16.1459	-15.8184	-15.3397*

3	16	0.000	-16.2362	-15.7631	-15.0717
4	16	0.000	-16.697*	-16.0783*	-15.1741

Source: Author's Estimation, 2015

4.6 Results from the SVAR

Given the imposition of the short run restrictions, the first model of interest comprised only money supply a nominal shock and output a real shock as focus variables which affect inflation in the Ghanaian economy. All structural shocks tend to be highly significant at 1%. Pertaining to the structural parameters, the outcome was output impacting positive on money supply, at the same time the results confirmed output inversely affecting the rates of inflation and further uncovered money supply to also negatively affect inflation rates in the short run (See Table 4).

Table 4: Estimates of the Structural Parameters

Parameters	Values
$\square_{21}$	1.499258
$\square_{31}$	-3.264389*
$\square_{32}$	-3.264389
Variances of the Structural Shocks	
$\square^2_{11}$	0.0021139***
$\square_{22}{}^2$	0.0435673 ***
$\square^2_{33}$	0.0465071 ***

Note: *, **, *** indicates 10%, 5% and 1% level of significance respectively. Parameters without * indicate statistical insignificance.

Source: Author's Estimation, 2015

Nevertheless, all relationships turned out to be statistically insignificant with the exception of the negative short run impact of output on inflation. This relation met a priori expectation at a 10% level of statistical significance. This significance re-echoes inflation in the Ghanaian economy being a structural rather than a monetary phenomenon since money supply could neither meet the positive relation postulated by the monetarists nor assumed statistical significance.

Controlling for exchange rate as another major nominal shock, the outcome was not different from the first model since the variables maintained their respective signs except for the impact of output on money supply which turned out negative after controlling for exchange rate shocks. Output negatively affected exchange rate, money supply also positively impacts on exchange rate whiles exchange rate also affects inflation rates negatively in the short run. Exchange rate though inversely related to inflation was found to be a significant determinant of inflation together with output at 5% and 10% significance level respectively contrary to money supply which remained insignificant
(see appendix B). All structural shocks turned out to be statistically significant at 1%. Per the study's results, it is worth nothing that care should be taken in the explanation of the relationship amongst variables from the short run through to the long run periods. The negative relationship between exchange rate shocks and inflation as well as between money supply and inflation implies that monetary expansion and depreciation of the domestic currency per the study does not immediately cause increasing inflation but could do so in the long run. This disputes the relationship established by Bawumia & Abradu-Otoo (2003), Adu & Marbuah (2011) and Canetti & Greene (1992).

The argument on the ground here is that, contemporaneously, monetary expansion would not lead to demand-pull inflation. Demand does not immediately outweigh the supply of goods and services when there is expansionary monetary policy. Also, the depreciating domestic currency and coupled with the high level of importation by the Ghanaian economy does not instantaneously imply importation of inflation into the country.

Due largely to the difficulty in the economic interpretation of the coefficients from the VAR system, much focus is placed on the Impulse response Functions (IRFs). We thus focus on the responses of inflation to shocks from output (real), money supply and exchange rate shocks (nominal). The graphing of the IRFs is made possible because the VAR system satisfied the stability condition as all the eigenvalues lie within the unit circle and were less than one (see appendix A).

4.6 Impulse Response Function

Figures 5, 6 and 7 are the results of the impulse response from the SVAR model. The solid black lines represent the respective responses whiles the blue shadow areas are the 95% confidence intervals.

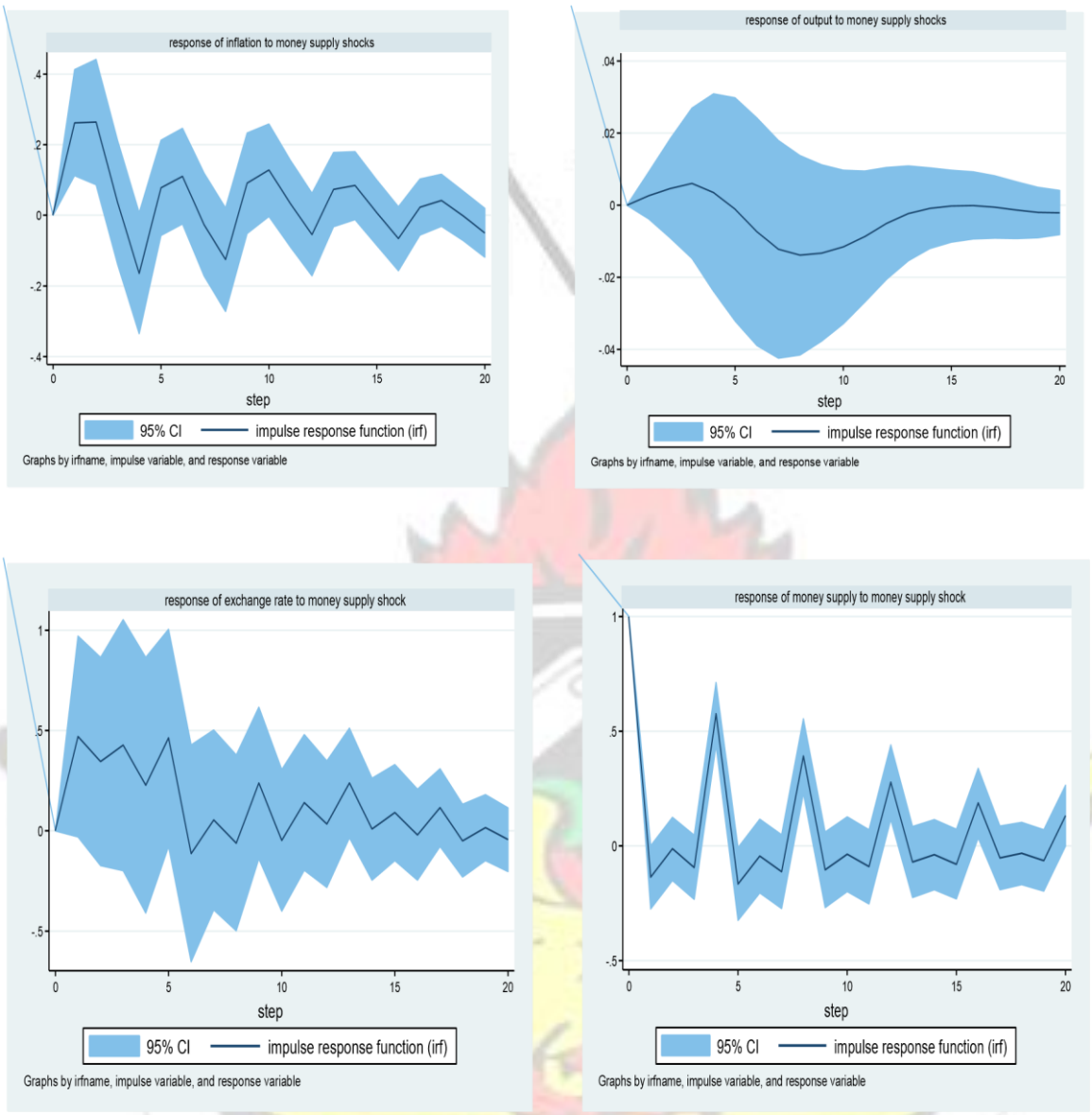

Figure 5: Response to Money Supply (nominal) Shock

Source: Author's own construct, 2015

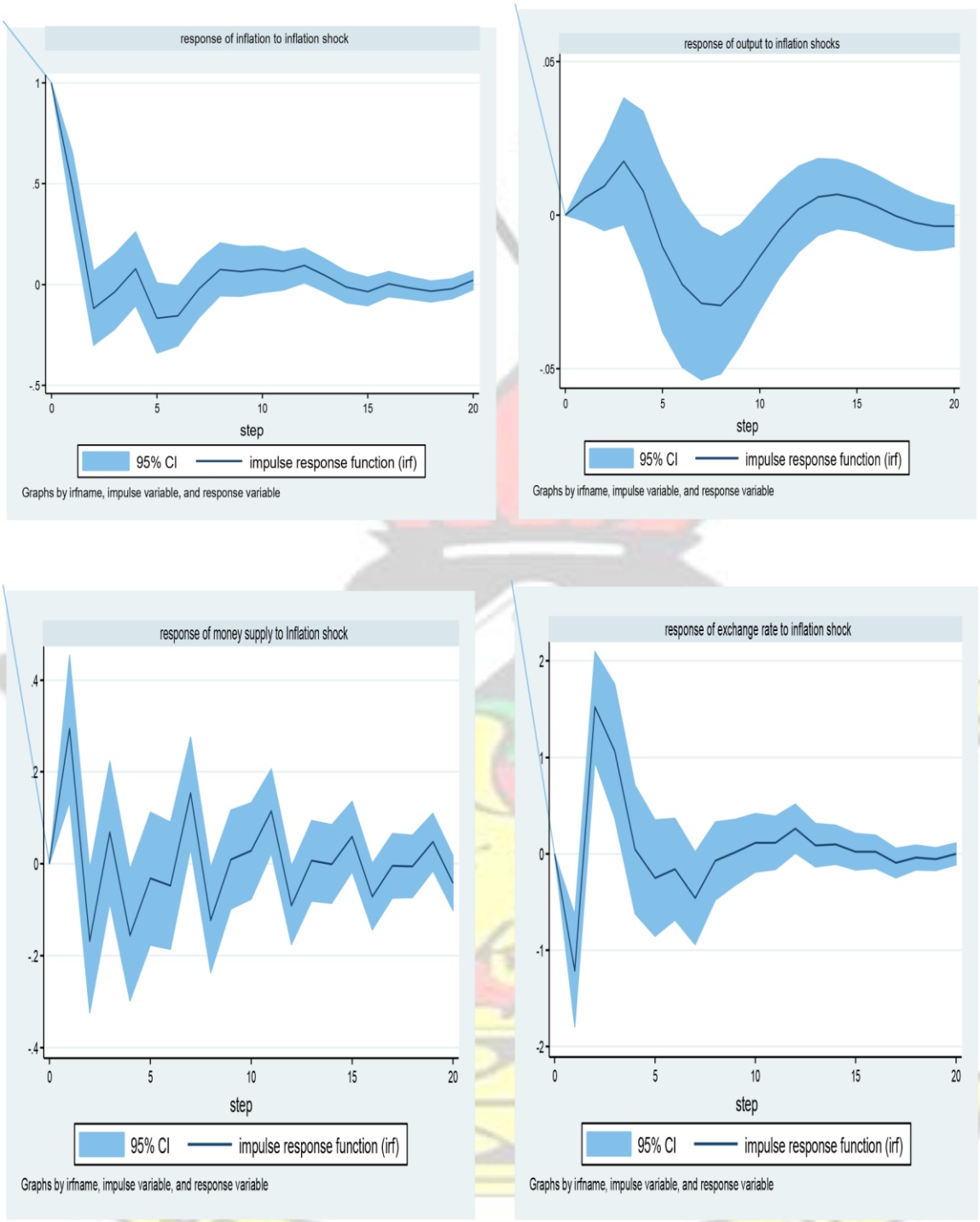

Figure 6: Response to Inflation (Nominal) Shock

Source: Author's own construct, 2015

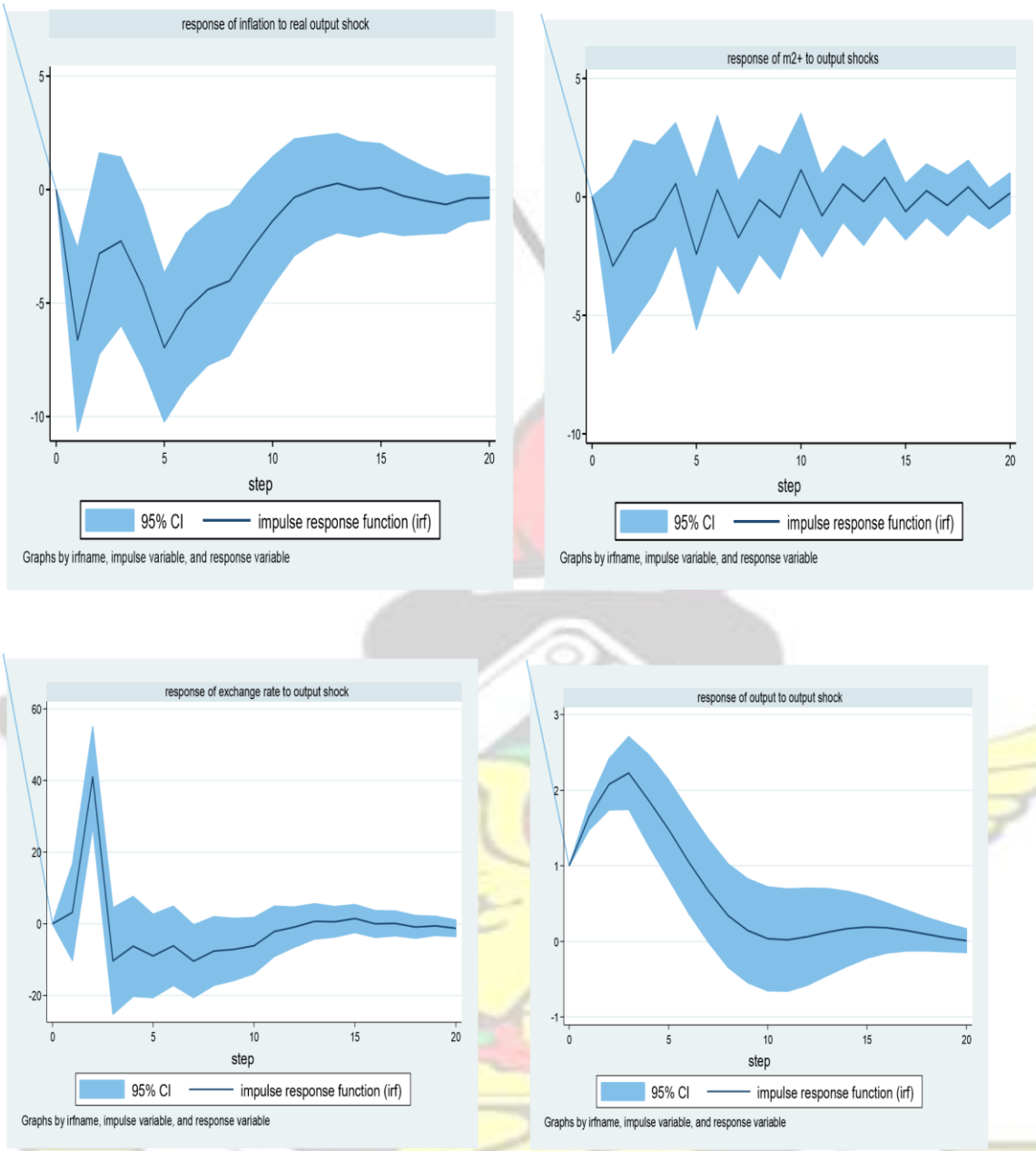

Figure 7: Response to Output (real) Shock

Source: Author's own construct, 2015

With reference to money supply shocks from Figure 5, Inflation starts by positively responding to a positive money supply shock of about 23% till the 2nd quarter period but quickly drops to about negative 19% after one year period (4th quarter period). In the fifth

quarter period however, the response of inflation increases to almost 10% with a further decline in to about negative 18% in the 8th period, this negative and positive swings in the response of inflation to money supply shocks gradually declines when it merely dies out by the 20th period (see figure 5). Although the response of inflation to money supply shocks lasted longer, it is worth nothing that these fluctuations of inflation were quite stable as it hovered around the zero origin before eventually dissipating. This implies that the general prices remains stabilized in the presence of monetary expansion or contraction.

The persistence of inflation, that is inflation inertia had a declining but positive impact on current inflation, however, this effect lasts for only two quarters period (see figure 6). Its initial impact was about 100% but suddenly spiral down to negative 1% in the second quarter period following the shock. Inflation however picked up with an increasing response to about 1% in the fourth quarter with a brief decline of about negative 1.5% in the fifth quarter period. After this period, the response of inflation to inflation inertia remained positive although insignificant after the 8^{th} quarter period. This confirms that Ghana's inflation has some degree of inertia, an implication that current prices keep rising because of failure to contain past level of increasing prices. However, it fades out by the 8^{th} quarter period. This inertial inflation could be attributed to efforts by governments to adjust the wages of the labor force based on past level of inflation. Also, when investors tend to be backward looking such that past rates of inflation becomes a deciding factor of their investment.

The outcome of the IRF also reveals inflation responding negatively to a positive real shock, and stayed negative throughout the quarters (see figure 7). Nevertheless, this

negative response was amidst fluctuations within the first five quarters, after which the negative response declined gradually from about -7% to about 0% in the 11th quarter period after which the shock died out completely. The implication of this negative relationship further stresses the point that a sudden positive shock to output (fall in cost of production such as subsidies, fall in interest rates etc.) would cause producers to increase the supply of goods and services. This increasing supply if outweighs demand would ensue in surpluses leading to a decline in the general prices. But this inverse relation between output and inflation becomes more visible within the first eleven quarter periods.

Exchange rate shocks had a negative and significant impact on inflation in the 3rd quarter of 0.3% with a peak in the fifth quarter to about 0.3% which is quite also stable. However, the impact quickly dies out and becomes very insignificant just after the sixth quarter. Inflation on the average was also stable when there is a shock to the nominal exchange rate. Rates of inflation in response to the nominal exchange rate just like the money supply is on the average zero (see appendix B).

The other macroeconomic variables which served as the independent variables of focus (money supply and output) responded differently to the real and nominal shocks compared to the response from the inflation rates. Output responded negatively to positive exchange rate shock and money supply shock after the first quarter but however responded positively to a positive real shock after the 4th quarter and eventually died out after the 10^{th} quarter. The size of the output response to real shocks ranges significantly from about 2.1% to 0%. A positive real shock signals an increasing level of the GDP of Ghana. Money supply on

the other hand fluctuated significantly in response to both output and exchange rate shocks as well as shocks from itself.

The response of inflation to monetary shock lasted significantly till the 20th quarter compared to its response to the nominal exchange shock which become insignificant after the 6th quarter. Further the response of inflation to real shocks lasted till the 11th quarter before dissipating. Comparing the significance of the inflation's response over the quarters, though inflation responds to monetary shocks till the 20th quarter relative to the 11th quarter period of output shock, the magnitude of inflation's response to output shocks outweighed money supply and exchange rate. Inflation was more stable in response to money supply and exchange rate shocks compared with shocks to output. Thus within the first 11 quarters, output shocks becomes the major culprit that threatens the stability of inflation after which it becomes irrelevant to inflation dynamics. Structural factors and thus real shocks (output, real income, fiscal deficits etc.) are of great significance in influencing inflation dynamics which can threaten the successful implementation of the Inflation Targeting policy framework within the first 11 quarters. Nominal shocks (monetary expansion and exchange rate depreciation) per the study have a more declining and stable impact on inflation over the years.

A prominent feature of the responses to real and the nominal shocks as presented above in figure 5, 6 and 7 is that, majority of the impacts last for quite a number of quarters before eventually dying out or not dissipating at all.

4.7 Forecast Error Variance Decomposition

Table 5: Variance Decomposition of Inflation

Inflation variation due to				
Horizon	Real GDP shock	Money supply	Exchange rate	Inflation
1	.039351	.001058	.07662	.882972
2	.054999	.038499	.075652	.83085
4	.071889	.076529	.07736	.774222
6	.145972	.08412	.068832	.701076
10	.203258	.092497	.065631	.638614
12	.201365	.098835	.065216	.634583
17	.198700	.106349	.064815	.630137
20	.199155	.107075	.064682	.629088

Source: Author's Estimation, 2015

Further analysis of inflation dynamics is the decomposition of the variance of inflation to assess the contribution of the varied shocks. Table 5 presents the outcomes of the forecast error variance decomposition of inflation. From the results, it is visible that the variation in inflation dynamics is explained more by inflation persistence (inflation inertia) followed by output shocks, monetary shocks and exchange rate shocks in that order. Averagely, more than 60% of the variation in inflation is explained by past rates of inflation (inflation inertia) over the 20 quarter horizon such that the combined effects of shocks to money supply, output and exchange rate account for less than 40% of the variance of inflation in Ghana contemporaneously. Inflation persistence in a country like Ghana would be hard to defeat due to the mechanism surrounding how the economy works. The economic agents (individual, firms and government) in the economy are more backward looking pertaining to inflationary expectations. Individual's decision to investment is dependent on past inflation rates; producers on the other hand tend to adjust relative prices of goods and services in accordance to past rates. The government, also in most cases adjusts the current wage levels base on inflation over the past six or one year period which in the long run

leads to the persistence of inflation. This high degree of inflation persistence could be responsible for the inability of policy makers to control current rates of inflation.

Whiles inflation inertia tend to be declining over time, both shocks to output and money supply tend to have an increasing impact on the variations in inflation within the 20 quarters period with output having the highest increasing explanation of inflation variations. For instance between the 10th and the 20th quarter period averagely, 20% of a change in inflation dynamics is explained by output shocks whiles about just 10% is explained by monetary shocks. Percentage of the variations in inflation dynamics was least explained by the nominal exchange rate shocks which albeit exhibited a declining importance to changes in inflation rates.

In the absence of inflation inertia, real factors explain more of inflation variations. This further stresses the highest importance of real shocks as main culprits of inflation variations with nominal shocks being the least important forces behind inflation dynamics.

Furthermore, considering the variations in output that is explained by the varied variables (see appendix B), money supply and exchange rate least explained the variations in output following inflation rates. Nevertheless output shocks explained more of the variations in output, 98% of the variations in output was explained by output shock in the 2nd quarter even till the 20th quarter period. This emphasizes the importance of the premise that supply factors tend to be the main factors that affects output changes.

Money supply and exchange rate contributed less than 2% over the 20 quarters. Inflation on the other hand between the 1st six quarters explained less than 2% but jumped to averagely 7% between the 10th and 20th period.

On the variations in the money supply front (see appendix B) a major variable that explained its variation in the absence of itself is the rates of inflation followed by the nominal exchange rate and then output.

Inflation from the above analysis plays a major role in explaining the macroeconomic environment of Ghana including itself thus the need to bring it under control. The estimates found inflation to have a negative impact on output, money supply and exchange rate. The implication is that high rates of inflation could be detrimental to output growth, affects the level of monetary growth and cause the depreciation of the domestic currency.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

In this chapter, a general overview of the proceeding chapters is presented. It includes the major summary of findings, the conclusion as well as the policy implications of the outcome of the study.

5.2 Summary of Key Findings

After analyzing the response of inflation to both real and nominal shocks using the SVAR econometric model based on short run restrictions, the following outcome was uncovered;

First, the study found an inverse relationship between inflation and all the structural parameters used in the study that is real GDP, money supply and the nominal exchange rate in the short run. This empirical estimation disputes the premise that monetary expansion contemporaneously causes increasing price level and further, the depreciation of the domestic currency does not contemporaneously imply importation of inflation into the country.

Secondly, the estimated results based on the IRF further found a weak support for money supply and exchange rate (nominal shocks) in Ghana's inflation experience as a more stable response of inflation to these variables were traced over the 20 quarter periods.

However, the response of inflation to real shocks showed a significantly strong response of over the first 11 quarter period (1 year and 3quarters). A positive shock to output causes a strict decline in the rates of inflation although at varying magnitudes such that an increase in the Gross Domestic Product would cause the general prices of goods and services to decline with magnitude of impact on inflation dynamics between 0% and -7%.

Furthermore, inflation was found in the first eight quarter periods to respond positively to the persistence of inflation (inflation inertia) between 0% and 100% in magnitude.

Inflation's response to money supply and exchange rate (nominal) shocks appeared to persist over the 20 quarters and six quarter periods respectively nevertheless was quite stable averaging zero compared to its response to real shocks.

Lastly, another key finding of this study was based on the variance decomposition. Inflation inertia, again was found to explain more than 60% of the variations in current inflation dynamics although its significance declined over time. Output was the next culprit in the absence of inflation inertia which explained about 20% of the variations in inflation but was on the ascendency contrary to inflation inertia which declined over time. Money supply also explained about 10% of inflation variations which also increased over time whiles the nominal exchange rate explained the least of about 0.7% with a declining significance.

Whiles output and money supply had an increasing importance in the variations of Ghana's inflation fluctuations. Inflation inertia and the nominal exchange rate on the other hand were found to have a reducing impact in the explanation of the variations in inflation dynamics. The study thus underscores the declining importance of nominal shocks especially exchange rate in Ghana's inflation experience.

On the variations in the other focus variables, inflation played the major part in explaining the variations in money supply, exchange rate and output with an increasing importance. It negatively affected these variables thus high rates of inflation becomes detrimental to macroeconomic stability. Since it would lead to a decline in output level as well as reduce the value of the domestic currency.

5.3 Conclusions

The study analyzed the relative importance of real and nominal shocks in the explanation of inflation dynamics in the Ghanaian economy based on the fixed coefficient Structural Vector Autoregressive (SVAR) model. Specifically the study sought to analyze the response of inflation to real and nominal shocks in Ghana. The study focused on output

and money supply as the proxies for real and nominal shocks respectively and controlling for the nominal exchange rate as another prominent nominal shock in Ghana. The analysis and the reported findings of the study were based on quarterly data spanning the period 1980Q1 to 2012Q4. Owing to the complete annual nature of the real GDP, it's disaggregation into quarterly frequencies was made possible through the use of Ecotrim software.

With the imposition of short run restrictions, the study confirmed the increasing importance of inflation being a structural rather than a monetary phenomenon since inflation tend to be more responsive to real rather than nominal shocks in the short run. Inflation remained relatively stable in response to money supply and exchange rate shock whiles it declined by a greater magnitude in response to a positive output (real) shock.

The study underscores the importance of inflation inertia, inflation responded positively between 0% and 100% to inflation persistence. This was further buttressed from the variance decomposition as inflation persistence explaining more than 60% of the variation in inflation whiles the combined effect of output and money explained less than 40% in the short run. Thus money per the study no longer becomes a reliable indicator of monetary policy and therefore should not be given significant weight in policy deliberations for inflation stabilization.

The estimation results confirmed high rates of inflation having negative repercussions on macroeconomic environment via declining output and depreciation of the domestic currency.

5.4 Policy Recommendations

First, any attempt to reduce the rates of inflation by policy makers, the usual monetary policy tools (money supply) and the appreciation of the domestic currency if used as main policy targets could render the policy options impotent in the short run due to the declining importance of nominal shocks in explaining inflation.

Moreover, positive supply shock causes inflation to fall implying that measures should be meted out to increase the supply side of the economy. Policy makers should ensure the reforming labor markets through the reduction in income tax which would act as incentives for more unemployed into the labor market would increase output.

Further, policy makers should introduce subsidies for research and development which can spur innovations and increase factor productivity. This would spur up the supply side of the economy thus reducing inflation.

Additionally, with inflation inertia being a dominant factor which explained the variations in inflation and current inflation responding largely to it, inflation expectations should be well anchored by policy makers to ensure economic agents are forward-looking and base their expectations on monetary authorities' inflation objective. Policy makers should ensure that the adjustment of wages and salaries by the government should not be based on past level of inflation rates whiles motivating investors to be more forward looking.

It is worth emphasizing that other policy meted out which have real effects on the economy would be advantageous to reducing inflation. However, since real shocks are the major culprits for inflation rates in Ghana, inflation targeting policy tools which have real effects

on the economy would be successful only after the 11th quarter (1 year, 3quarter period) as inflation becomes insensitive to real shocks after this period.

5.5 Limitations of the Study and Issues for further Research

First and foremost, one major limitation is the inadequacy of broad-up-to-date and quality of data. The study made use of dataset up to 2012 which is quite a number of years back relative to the present year and could have a significant impact on the outcome of the presented results.

Secondly due to the limitations on the number of variables to be incorporated in the SVAR to ensure appropriate and correct restrictions are imposed, the study failed to disaggregate the real shocks into both demand and supply shocks as much emphasis was on the supply shocks only. This was due to the weak real sector of the economy where all relevant data in high frequencies (quarterly) are non-available.

For further and future research, the researcher recommends an increase in the time period under study and the incorporation of a demand shock.

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APPENDICES

Appendix 1

Descriptive Statistics

```
sum lnrgdp lnm2 lnexr lncpi

    Variable |       Obs        Mean    Std. Dev.       Min        Max ----
---------+--------------------------------------------------------
lnrgdp |       132    8.014596    .4443501   7.343853   8.947177
lnm2 |       132    4.914748    2.949935  -.3538218   9.770059        lnexr
```

```
|       132   -2.508747    2.721516  -8.217089   .6347392        lncpi |
132    1.863896    2.184579  -3.057608   4.798407
```

Lag Selection Criterion

```
varsoc d.lnrgdp d.lnm2_ d.lnexr d.lncpi

   Selection-order criteria
   Sample:  1981q2 - 2012q4                        Number of obs      =       127
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 |  785.773                        5.3e-11  -12.3114   -12.275  -12.2218  |
  |  1 |  959.732  347.92   16  0.000  4.4e-12  -14.7989   -14.617   -14.351  |
  |  2 |  1061.27  203.07   16  0.000  1.1e-12  -16.1459  -15.8184  -15.3397* |
  |  3 |     1083  43.469   16  0.000  1.0e-12  -16.2362  -15.7631  -15.0717  |
  |  4 |  1128.26  90.518*  16  0.000  6.6e-13*  -16.697* -16.0783* -15.1741  |
  +---------------------------------------------------------------------------+
```

varstable

```
   Eigenvalue stability condition
  +--------------------------------------+
  |        Eigenvalue          |  Modulus  |
  |----------------------------+-----------|
  |   .9970266 + .00875087i    |   .997065 |
  |   .9970266 - .00875087i    |   .997065 |
  |   .7685243 +  .4409202i    |   .886025 |
  |   .7685243 -  .4409202i    |   .886025 |
  |   .7000301 +  .2546633i    |   .744913 |
  |   .7000301 -  .2546633i    |   .744913 |
  |  -.6232382                 |   .623238 |
  |   .1786271 +  .5704649i    |   .597777 |
  |   .1786271 -  .5704649i    |   .597777 |
  |  -.1132515 +  .3059121i    |   .326203 |
  |  -.1132515 -  .3059121i    |   .326203 |
  |  -.1452882                 |   .145288 |
  +--------------------------------------+
   All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.
```

Appendix 2

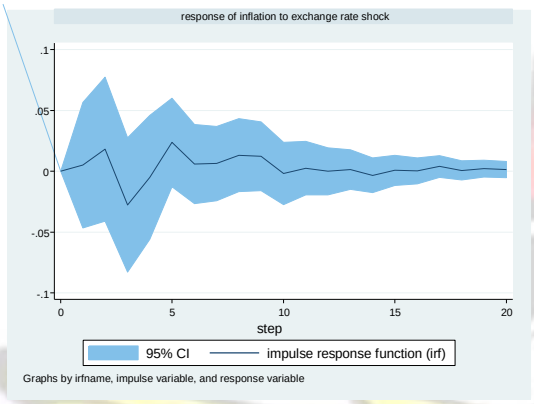
Estimation of structural Parameters and Structural Shocks

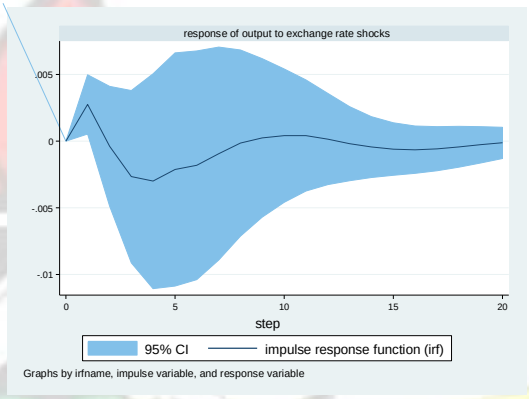
```
Estimating short-run parameters
Sample:  1981q2 - 2012q4                        No. of obs      =       127
Exactly identified model                        Log likelihood  =  1029.207
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

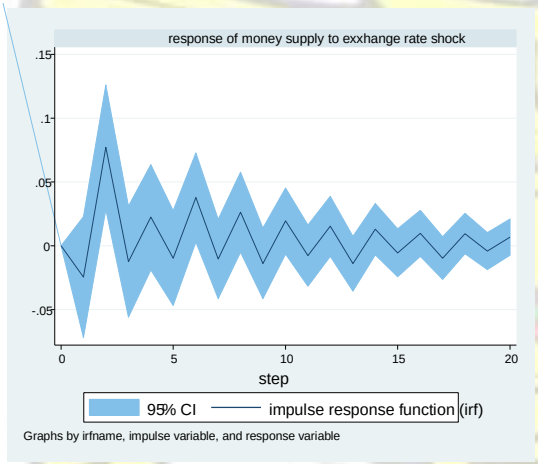
```
-------------+----------------------------------------------------------------
/a_1_1 |          1  (constrained)
      /a_2_1 |   1.499258   1.828806     0.82   0.412    -2.085137    5.083652
      /a_3_1 |  -3.264389    1.95737    -1.67   0.095    -7.100764    .5719847
      /a_1_2 |          0  (omitted)
      /a_2_2 |          1  (constrained)
      /a_3_2 |   -.068746   .0947234    -0.73   0.468    -.2544004    .1169084
      /a_1_3 |          0  (omitted)
      /a_2_3 |          0  (omitted)
      /a_3_3 |          1  (constrained)
-------------+----------------------------------------------------------------
      /b_1_1 |   .0021139   .0001326    15.94   0.000      .001854    .0023739
      /b_2_1 |          0  (omitted)
      /b_3_1 |          0  (omitted)
      /b_1_2 |          0  (omitted)
      /b_2_2 |   .0435673   .0027337    15.94   0.000     .0382094    .0489251
      /b_3_2 |          0  (omitted)
      /b_1_3 |          0  (omitted)
      /b_2_3 |          0  (omitted)
      /b_3_3 |   .0465071   .0029181    15.94   0.000     .0407877    .0522265
------------------------------------------------------------------------------


svar d.lnrgdp d.lnm2_ d.lnexr d.lncpi, lags(1/4) aeq(A) beq(B)
Estimating short-run parameters
Sample:  1981q2 - 2012q4                        No. of obs      =       127
Exactly identified model                        Log likelihood  =  1128.259
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
/a_1_1 |          1  (constrained)
      /a_2_1 |  -.5378318    1.89298    -0.28   0.776    -4.248004    3.172341
      /a_3_1 |  -8.761471   6.795704    -1.29   0.197     -22.0808    4.557864
      /a_4_1 |  -3.901702   1.955409    -2.00   0.046    -7.734233   -.0691703
      /a_1_2 |          0  (omitted)
      /a_2_2 |          1  (constrained)
      /a_3_2 |   .5237684   .3184554     1.64   0.100    -.1003927    1.147929
      /a_4_2 |  -.0086005   .0920036    -0.09   0.926    -.1889242    .1717233
      /a_1_3 |          0  (omitted)
      /a_2_3 |          0  (omitted)
      /a_3_3 |          1  (constrained)
      /a_4_3 |  -.0842125   .0253675    -3.32   0.001    -.1339319   -.0344931
      /a_1_4 |          0  (omitted)
      /a_2_4 |          0  (omitted)
      /a_3_4 |          0  (omitted)
      /a_4_4 |          1  (constrained)
-------------+----------------------------------------------------------------
      /b_1_1 |   .0019094   .0001198    15.94   0.000     .0016746    .0021442
      /b_2_1 |          0  (omitted)
      /b_3_1 |          0  (omitted)
      /b_4_1 |          0  (omitted)
      /b_1_2 |          0  (omitted)
      /b_2_2 |   .0407328   .0025558    15.94   0.000     .0357235    .0457421
      /b_3_2 |          0  (omitted)
      /b_4_2 |          0  (omitted)
```

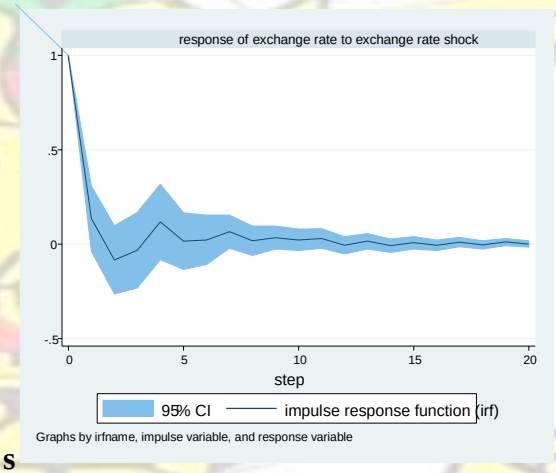
```
      /b_1_3 |          0   (omitted)
      /b_2_3 |          0   (omitted)
      /b_3_3 |   .1461822    .0091723    15.94   0.000     .1282048    .1641595
      /b_4_3 |          0   (omitted)
      /b_1_4 |          0   (omitted)
      /b_2_4 |          0   (omitted)
      /b_3_4 |          0   (omitted)
      /b_4_4 |   .0417902    .0026221    15.94   0.000     .0366508    .0469295
------------------------------------------------------------------------------
```


IMPULSE RESPONSE FUNCTIONS Response to Exchange rate (nominal) Shocks









S

Variance Decomposition

	Inflation variation due to			
Horizon	Real GDP shock	Money supply	Exchange rate	Inflation
1	.039351	.001058	.07662	.882972
2	.054999	.038499	.075652	.83085

3	.063957	.076369	.071504	.78817
4	.071889	.076529	.07736	.774222
5	.089325	.088808	.074347	.74752
6	.145972	.08412	.068832	.701076
7	.175482	.085638	.065246	.673635
8	.192629	.084172	.06396	.659239
9	.200869	.090435	.06452	.644176
10	.203258	.092497	.065631	.638614
11	.201954	.098731	.065023	.634292
12	.201365	.098835	.065216	.634583
13	.200293	.099739	.065169	.6348
14	.199854	.101634	.06508	.633432
15	.199148	.104629	. 06496	.631263
16	.199029	. 104596	. 064947	.631429
17	.198700	.106349	.064815	.630137
18	.198835	.106489	.064809	.629867
19	.199039	.107117	.064708	.629137
20	.199155	.107075	.064682	.629088

	*GDP*variation due to			
Horizon	Real GDP	Money supply	Exchange rate	Inflation
1	0.0000	0.0000	0.0000	0.0000
2	.980808	.000121	.015357	.003714
3	.984781	.001161	.007268	.00679
4	.977935	.002245	.005030	.014790
5	.978315	. 002391	. 005818	.013476
6	.975421	.002138	.007849	.014593
7	.960662	.002701	. 011254	.025383
8	.938466	.005018	. 013874	.042642
9	.916370	. 008224	.015321	.060085
10	.902553	.011293	.015827	.070327
11	.896686	.013771	.01586	.073683
12	.894886	.015263	.015828	.074023
13	.894337	.015783	.01584	.07404
14	.893637	.015864	.015835	.074664
15	.892918	.015836	. 015798	.075448
16	.892561	.015796	.015763	.07588
17	.892537	.015770	.015778	.075915

18	.892544	.015757	.015851	.075848
19	.892354	. 015771	.015944	.075932
20	.892008	.015823	.016019	.076151

Source: Author's Estimation, 2015

	Fraction of □*MS* variance due to			
Horizon	Real GDP	Money supply	Exchange rate	Inflation
1	.000635	.999365	0.0000	0.0000
2	.007185	.911243	5.8e-07	.081571
3	.011086	.846122	.042580	.100212
4	.01198	.842455	.042537	.103028
5	.009460	.860801	.033725	.096014
6	.019399	.852598	.034001	.094002
7	.019337	.843899	.042521	.094243
8	.020605	.830964	.041548	.106883
9	.018824	.835748	.039605	.105824
10	.019810	.834619	.040478	.105093
11	.022023	.829741	.04345	.104786

12	.021922	.824252	.042963	.110862
13	.021173	.826832	.041521	.110475
14	.021220	.826088	.042561	.110131
15	.022080	.824582	.043536	.109801
16	.022171	.823446	.043315	.111068
17	.021754	.824132	.042563	.111552
18	.021973	.82358	.043105	.111342
19	.022164	.823075	.043566	.111195
20	.022215	.822352	.043427	.112006

Source: Author's Estimation, 2015