

2014

A Monetary Analysis of Ghana: Examining the Relationship between Monetary Policy, Price Stabilization, and the Real Exchange Rate

Nana Quaicoe

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A Monetary Analysis of Ghana: Examining the Relationship between
Monetary Policy, Price Stabilization, and the Real Exchange Rate

(TITLE)

BY

Nana Quaicoe

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Arts in Economics

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

2014

YEAR

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**A Monetary Analysis of Ghana: Examining the Relationship
between Monetary Policy, Price Stabilization, and the Real
Exchange Rate**

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Eastern Illinois University

2014

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ACKNOWLEDGMENTS

Much thanks and gratitude goes to God, my family for their tremendous support, and the economics faculty at Eastern. Thank you.

ABSTRACT

The primary objective of this study involves evaluating the link between monetary policy, price levels, and the bilateral real exchange rate in Ghana. To make up for the sparse and inadequate monetary economics literature in Ghana, the study makes a substantial contribution by delineating between different monetary policy instruments. Using monthly data from 1992-2013, a Vector Error Correction Model (VECM) is developed for exploring and measuring the relationship between monetary policy, inflation rate, and the bilateral real exchange rate in Ghana. The growth of broad money supply (M2) and the Monetary Policy Rate are used as the principal monetary policy instruments. Changes in the world commodity price index acts as an exogenous supply shock. Using this framework enables the comparison of existing literature to current research and assists in determining which monetary policy tool is more influential in general price stabilization in Ghana. Also, by incorporating the world commodity price index, the study aims at solving the “price puzzle” effect associated with research of this nature. Results suggest that both financial market quantities and financial market prices have an effect on inflation and real exchange rate in Ghana. However, the Monetary Policy Rate has a larger impact on macroeconomic variables than the growth of money supply in Ghana. Supply shocks were found to have minimal effects on general prices in Ghana.

CHAPTER ONE

INTRODUCTION

Determining how monetary policy affects the economy is critically important both for distinguishing between competing theories of economic fluctuations and for conducting policy (Romer and Romer 2004). For this reason, understanding the relationship between monetary policy, the inflation rate, and the real exchange rate in Ghana is important for both economic stability and for developing policy. In evaluating this relationship, I first present a new model which builds on a Vector Error Correction Model (VECM) framework where monetary policy instruments are delineated into two categories: a financial market quantity category and a financial market price category. Furthermore, I use the world commodity price index as a proxy for external supply shocks and I also calculate the forecast error variance decomposition for each variable, a technique not utilized before in macroeconomic literature relative to Ghana. I then consider whether using monetary aggregates or interest rates are more effective in influencing both the price level and the real exchange rate in Ghana.

Since Ghana's political independence in 1957, the country has undergone financial sector development and various economic reforms. For instance, the Bank of Ghana, once politically dependent is now independent, banking competitiveness has improved, and credit to the private sector has grown over the last few years. Also, there have been capital market and money reforms, banking reforms, currency redenomination, and perhaps most importantly, rural banking reforms. How much impact these reforms coupled with different monetary policies have had on the economy in terms of economic growth and development, price level changes, and the exchange rates of Ghana is an important question that arises. Such a question demands an answer for a developing West African country like Ghana.

Seeing how monetary policy in the United States has been crucial and quite effective in mitigating the recent financial crisis and other crisis of note, it is ineluctable that the question of how fast the transmission of monetary policy occurs in a fairly developed country such as Ghana would arise. In other words, how long does it take for monetary policies enacted by Ghana's central bank to have an effect on the economy in relation to price and the real exchange rate? It is also appropriate and befitting to ask, what determinants may contribute to monetary policy lags. In addition, what are some of the policy implications of knowing and understanding the lags of monetary policy in Ghana? Can the monetary policy tool be regarded as an efficacious instrument in keeping inflation at an optimal level? What is the short run and long run relationship between prices and monetary policy? These are some of the issues and topics that have moved into the consciousness of analysts, policy makers, and researchers alike. In light of the huge costs associated with fiscal policy, and in light of the inadequate research covering the area of monetary economics in Ghana, it is only prudent that key relationships between money, price levels, and the bilateral exchange rate would be examined in spite of challenging and difficult issues. Such issues may be the unavailability and the non-dependable nature of data and the construction of a model that adequately represents the economy of Ghana. The object of this study is not only to enrich the sparse literature but also to provide an analytical framework that is designed to facilitate the understanding of Ghana's economy.

On the issue of monetary policy and monetary policy lags, Kourelis and Cottarelli (1994) looked at how financial structure affects the degree of stickiness of bank lending rates and the speed at which bank lending rates adjusted to their long run equilibrium value after a "shock" affecting money market rates. In doing this, they measured the speed of adjustment of bank lending rates in 31 industrial and developing countries by regressing the lending rate on a

distributed lag of money market rates (Cottarelli and Kourelis 1994). Schroder and van Kalckreuth (2002) evaluated the implications of higher depreciation rates for the speed of adjustment for financial stability and the strength of monetary transmission through the interest rate channel and exchange rate channel. To do this, they used a model known as the exchange rate-overshooting model attributed to the economist Dornbusch in 1976. Schroder and van Kalckreuth modified the model using an interest rate structure with the assumption of finite time to maturity and perfect foresight. Swoboda (1973) avers that economists would agree that money supply can be controlled in the medium run but not in the short run. In measuring the lag of monetary policy, he utilizes two major factors that may influence the speed of adjustment, namely, the degree of capital mobility and the proportion of traded to non-traded goods. Finally, Tucker (1968) uses a dynamic macroeconomic model with market clearing lags. He then studies the speed with which the system adjusts to reductions in money supply. Tucker (1968) asserts that the slower the interest rate adjusts, the more rapid the adjustment of income and employment.

The study concentrates on relationships involving monetary policy, price levels (inflation as an indicator) and the real exchange rate using a Vector Error Correction Model (VECM). As such, the hypotheses I seek to test are 1) the effectiveness of monetary policy in price stabilization, 2) the effect of external supply shocks such as commodity prices on price levels and the real exchange rate, 3) the duration of such shocks and monetary policy effects, and 4) what policy inferences could be drawn from both the effects and duration.

The research found that monetary policy whether using interest rates or monetary aggregates as the monetary policy tool has an effect on both price level and the real exchange rate in Ghana. However, interest rates had a more profound effect on price level and the real

exchange rate. External supply shocks had minimal effects on both price level and the real exchange rate in Ghana.

CHAPTER TWO

Literature Review

To adequately undertake a monetary analysis, a comprehensive mastery, appreciation, and knowledge of a country's financial/ banking structure needs to be undertaken first. Such a strong grasp of the financial sector may assist policymakers in conducting various efficacious policies and accurate decisions. As such, the literature review starts with a brief history and nature of Ghana's financial/banking structure. A good banking structure with strong financial institutions and banks helps in stabilizing the economy, a crucial necessity for any country.

2.1 Financial/Banking Structure

Ghana's former financial system was largely dominated by state-owned banks that enjoyed monopoly over the entire banking system. State-owned development banks such as the National Investment Bank (NIB), Agricultural Development Bank (ADB), and the Bank for Housing and Construction (BHC) were set up predominantly to fund and finance the agricultural and housing sectors. Using a mix of interest rates and selective credit controls, the Bank of Ghana controlled the flow of credit to these banks. Such seemingly authoritarian policies may have reduced the size of the financial market and may have further reduced competition in the financial system. The negative impact of repressive policies on financial sector development was seen most in the halving of the financial depth, measured by M2/GDP ratio, from over 25% in 1977 to only 12% in 1984. Between 1977 and 1984, most indicators of the development of the financial system declined in size. For instance, demand deposits fell from 11.6% to 4.6% while domestic credit declined from 38.8% to 15.6 % (Aryeetey and Fosu, 2002). By 1987, there were too many financial restrictions that were hampering financial transactions in Ghana. Coupled with corruption, indiscipline, and insufficient capital, banks in Ghana struggled to meet the needs of the people. High default rates, consistently high inflation rates, and weakened confidence in

the economy were also prevalent. The Broad Based Structural Adjustment Programme (BBSAP) introduced in 1986 and implemented in 1987 aimed at restoring monetary discipline in the banking sector. The principles of the Broad Based Structural Adjustment Programme (BBSAP) were to strengthen banking supervision; restructure financially distressed banks; increase efficiency in credit mobilization; and improve competition within the banking sector (Aboagye et al, 2008). However, most banks had become insolvent by the time the programme was enacted. The BBSAP was essentially in three parts. The first phase involved a review of legal and regulatory banking procedures and the deregulation of interest rates (an abolishment of maximum and minimum lending rates). The government then allowed more supervisory control to the Central Bank. Non-banking financial institutions were also brought under the control of the Bank of Ghana. Examples of such non-banking financial institutions are savings and loans institutions, credit unions, and agriculture development banks. In 1989, the new Banking Law enacted gave commercial banks the right to determine their own rates and display them in their banking halls. The second phase of financial reform also saw the establishment of the Ghana Stock Exchange (GSEC) in 1990 which had 12 listed companies and one government bond (Sowa and Acquaye, 1999). By 1993, total market capitalization was up by 120% and amounted to 95 billion Ghana Cedis. The third, and perhaps the most important phase, was in 2002 where the Central Bank Law was passed. The Central Bank Law guaranteed the complete independence of the Bank of Ghana. It also confirmed the Bank's principal objective to be the pursuit of price stability. At the beginning of BBSAP, 41% of bank credit was considered non-performing. By 2006, it was 14% and the number could be even smaller as of today (Aboagye et al, 2008). Currently, financial reforms are still ongoing. For example, the Credit Reporting Law passed recently, requires all banks to submit credit details to a reporting bureau and removes the

secondary reserve requirements in order to stimulate banking activities. The banking sector has seen appreciable growth and improvements in performance as a result of strategic financial reforms. Over the last two decades, mergers, liquidations, and the privatization of state owned banks and change of ownership have occurred. Technology such as ATMs and telephone banking has become common as well (Amidu and Hinson, 2006). Ghana's financial sector also consists of a large fragmented and informal sector. The informal sector consists of small scale credit groups and money lenders known as "susu groups". The formal sector involves the Ghana Stock Exchange (24 listed companies), 23 commercial banks and about 128 rural/community banks (Sowa and Acquaye, 1999). As of mid-2008, the number of commercial banks had increased to 24 with over 500 branches across the country. However, over 80% of the country's population does not have a basic bank deposit account and have little accessibility to financial institutions. A larger percentage of the 80% comes from the rural areas. In a research done by Osei-Asibey (2009) to determine why this is so, they observed that banks in Ghana (especially the commercial banks) are more responsive to areas where: the population is large in size; there is the availability of energy, communication, and developed transportation facilities; less crime, conflicts, and natural disasters occur and the evidence of urbanization can be found. People with a higher level of income and education may also demand more bank accounts.

Ghana's banking sector is mainly characterized by monopolistic competition. Comparing it with research done in prior years, Biekpe (2011) found that Ghana's financial sector has become increasingly more competitive. Specifically, the larger banks appear to be more competitive than smaller banks. Public banks were also found to be more competitive than privately owned banks. Amidu and Hinson (2006) discovered that larger banks in Ghana enjoy lower capital ratios and lending. Less than 1% of Ghanaian banks are exposed to credit risk

while most banks' lending rate is around 28%. Small banks on the other hand, have larger scale efficiencies than bigger banks in Ghana (Akoena et al, 2009).

An important component of any financial sector, the net interest rate spread is the difference between the average yield a financial institution (mainly banks) receives from loans and other interest-bearing activities and the average rate it pays on deposits and borrowings. Interest rates spreads do not only determine the profitability of a financial institution but also determine the efficiency of banks and assist in the crucial intermediation role banks play. Moreover, a wide gap may suggest low deposit rates and high borrowing rates or perhaps, both. If deposit rates are too low, banks are deprived of deposits and hence funds. Conversely, if borrowing rates are high, then borrowers are discouraged from taking out loans for profitable projects. Interest rates spread in Ghana have averaged 15.79% over the last decade and is one of the highest in Sub-Saharan Africa. In Ghana, it was determined that the banks' market power, staff and administrative costs, the extent of banks' risk aversion, and the inflation rate increase the net interest rate spread. Conversely, and contrary to theory, an increase in the Bank of Ghana's Monetary Policy Rate reduces the net interest rate spread. Upon careful analysis of the relationship between the Monetary Policy Rate and bank base rates (i.e. rates available to most credit worthy borrowers), it was found that banks *do not* pass on the full amount of changes in the central bank's Monetary Policy Rate to borrowers, especially in the short-run (Aboagye et al, 2008).

2.2 The Bank of Ghana

The Bank of Ghana first started as the Bank of the Gold Coast (BGC) during the colonial era. On 4th March 1957, just two days before the declaration of political independence, the Bank of Ghana was formally established by the Bank of Ghana Ordinance (No. 34) of 1954, passed by the then British Parliament. The principal objectives of the new central bank were: to maintain

price level stability; to issue and redeem bank notes and coins; to influence the credit market with the view of maintaining monetary stability in Ghana; to ensure the stability of the newly established currency, the cedi; and to serve as an institution that advised the government on monetary affairs. Following the Bank of Ghana Act in 2002, the Bank of Ghana became independent and void of any political interference.

The Monetary Policy Committee (MPC) is the branch of the Bank of Ghana responsible for formulating and implementing policy in the areas of money, credit, and banking with the main aim of price stabilization. The committee sets an interest rate, also known as the Monetary Policy Rate, they judge is consistent with an inflation target. Made up of seven members, the committee meets six times each year to deliberate on the economy.

The Bank of Ghana's medium-term objective is to sustain single digit inflation figures. The desired inflation target of below 10% is expressed in terms of an annual rate of inflation based on the Consumer Prices Index. The thinking and rationale that informs decisions of the MPC is made public through a press release on a periodic basis.

The history of monetary policy and management in Ghana could be categorized into two distinct phases: the period associated with tight monetary controls and the period under which monetary policy operated under a liberalized environment. Prior to 1983, when major reforms in the financial system began, the Bank of Ghana operated under a very controlled system of monetary management. The tight control involved the imposition of ceilings, both global and sectorial, on individual commercial banks' lending and had to be consistent with political and national macroeconomic targets such as inflation and external balance. The restrictive control proved to be ineffective and promulgated various inefficiencies in the economy and financial market. The direct control system of monetary management had to be abandoned with the advent

of liberalization of the economy in 1983. The liberalization process entailed progressive de-regulatory measures. These measures resulted in the use of indirect and market based instruments in the conduct of the Bank of Ghana's monetary policy and brought about a new dimension to the way monetary management was designed and implemented. In 2002, the Bank of Ghana Law, Act 2002, gave the central bank independence in the discharge of its monetary policy. The Bank could further use whatever tools available at its disposal in achieving its primary objective of price stability¹.

2.3 Economic Growth

In the 1960s and during the early stages of independence, there was a push for rapid industrialization in Ghana (Adu, 2013; Aryeetey and Fosu, 2002). The rapid industrialization was fueled by the country's determination in succeeding beyond its colonial history. The huge industrialization involved large physical capital accumulation. Due to the lack of funds to support the project, the country incurred large amounts of debt and registered three consecutive years of negative growth from 1963-1965. In 1966, due to a fall in living standards and deteriorating economic conditions, the military overthrew the government and adopted pro-private capital policies instead of the socialist policies of the previous government. The new government introduced monetary reforms, devalued the currency to boost exports, and liberalized the external sector. During the end of 1971, the economy went into a recession and the currency was devalued further to help with exports. Policies in the 1970s emphasized import substitution, underpinned by a restrictive foreign exchange regime, quantitative restrictions and imports, and price controls. At the beginning of 1983, inappropriate macroeconomic and institutional development policies, combined with various external shocks, led to severe

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¹ Information from Bank of Ghana

deterioration in economic performance. For instance, by the end of 1983 the inflation rate was 122%. Inadequate food supplies intensified the demand for foreign food imports. Between 1974 and 1983, the monetary base expanded by 93.9% to help finance government expenditure. Ghana gradually became a primary commodity exporter and a manufacturing goods importer. From 1984 onwards, fiscal and monetary policies underwent an overhaul and complete reform. Earnings from cocoa, the major export then, rose to a peak of \$495 million as a result (Aryeetey and Fosu, 2002).

In a research conducted by Adu (2013), it was found that factors such as private investment, skilled labor force, financial development, and terms of trade are significant drivers of economic growth in Ghana. He suggested an increase in savings and investment and the liberalization of the financial sector to ensure economic growth in the long-run. In a similar research done on economic growth in Ghana, Nketiah-Amponsah (2009) concluded that aggregated expenditure reduced economic growth because an increase in expenditure would increase taxation which then reduces consumption and growth. However, expenditure and infrastructural expansion promoted economic development in both the short and long-run.

2.4 Inflation

Inflation rates in Ghana have been volatile and often very high. It is important for policymakers to understand changes in the price level since high inflation could lead to low real wages, low savings, and goods and services becoming expensive. Over the large period of its history, Ghana has rarely experienced single digit annual inflation (Ocran, 2007). The inconsistency in inflation rates is mainly due to excessive money growth used to service the domestic purchase of cocoa (Adu and Marbuah, 2011). In 1957, and at the time of independence, inflation was at 8%. By 1964, Ghana had recorded its first double digit rate at 13.36%. In 1970, inflation had fallen to 1.8%. Ghana experienced high levels of inflation between 1972 and 1983

(Alnaa and Ahiapkor, 2011). Inflation levels shot up from 10% in 1972 to 123% in 1983.

Exchange rate adjustments announced at the time partly accounted for the surge in prices during this period. Oil prices in the 1970s may have contributed to the surge in prices as well. Things however improved somewhat as inflation dropped to 39.22% in 1984 and 11.29% in 1985.

Between 1995 and 1999, average inflation was at 25.4%. Inflation in Ghana has been found to be persistent in five main sectors namely: clothing and footwear; food and non-alcoholic beverages; furnishings and household; the housing sector; and miscellaneous goods and services (Coleman, 2012).

The determinants of inflation in Ghana have varied over the years. For example, Marbuah and Adu (2011) explain that real output is by far the most significant catalyst of inflation in the long-run mainly due to changes in money-supply. They discovered that a monetary expansion of 1% may raise the price level by 1.4% in the long run. Expectations were found to be very significant in explaining current and future inflation rates in Ghana too. Conversely, Ocran (2007) postulates that exchange rate, foreign prices, and to some extent, terms of trade are the major agents of inflation in Ghana in the long run instead of industrial output. In the short run, money growth, changes in Treasury bill rates, and the real exchange rate are important in determining the level of inflation, he avers further. Other studies suggest that rapid devaluation of the currency and general increases in import prices have been major causes of inflation in Ghana (Alnaa and Ahiapkor, 2011). The growth maximizing rate of inflation in Ghana is believed to lie somewhere between 22%-29.4% (Quartey, 2010).

2.5 Exchange Rate

High exchange rate volatility has been a major problem for Ghana. Since its independence in 1957, to around 1992, Ghana adopted a fixed exchange rate regime where the Ghana cedi was pegged to the British Pound and in later years, the US Dollar (Appiah and

Adetunde, 2011). In 1960, the Ghanaian cedi was pegged at 2 cedis to the British Pound. Due to the inheritance of huge foreign exchange reserves at \$270 million from the colonial era, Ghana exercised practically no control over the foreign exchange markets, which were in the hands of a few commercial banks (Sowa and Acquaye, 1999). The control of foreign exchange market led to an exchange rate overvaluation which weakened exports. Thus the balance of payments gradually worsened. Further large scale industrialization in the 60s had depleted external reserves and signs of foreign exchange constraint began to show. The Ghanaian cedi was first deliberately devalued in 1966 after the government accepted an IMF/ World Bank stabilization policy package to salvage the country from a foreign exchange and economic crisis. In 1978, Ghana introduced a flexible exchange rate system. However, this did not last long and the fixed exchange system was reintroduced later on in 1986 (Sowa and Acquaye, 1999). In 1983, reforms were set to induce the depreciation of the currency under the Economic Recovery Programme (Sanusi, 2010). The cedi was hugely devalued in stages from 2.75 cedis to 90 cedis by the third quarter of 1986 (Appiah and Adetunde, 2011). The Bank of Ghana allowed the exchange rate to be determined by supply and demand factors within the market. However, the Bank of Ghana intervened occasionally to stabilize the value of the currency when needed. From 1983 to 2005, the nominal exchange rate depreciated against the US dollar by around 35% per year, while the real exchange rate depreciated around 13% per annum. However, from 1983 to 1992, the nominal exchange rate had depreciated by 52% while the real exchange rate had depreciated by 27%. After reforms in 2006, the rate of depreciation has slowed.

Various studies have been conducted to understand what determines both short run and long run exchange rates relationships in Ghana. Results have differed as well. It has been suggested that there is a long-run relationship between prices, interest rates, and exchange rates

consistent with the unrestricted purchasing power parity and uncovered interest parity conditions in Ghana. Also, price and interest rate differentials play significant roles in exchange rate movements and, hence the cedi can be controlled by interest rate and price stability. However, the real exchange rate seems more responsive to the foreign interest rate dynamics than the domestic rates (Tweneboah, 2010). Using short term interest rates and broad money as monetary policy tools, Epstein and Hertz (2006) discovered that the real exchange rate initially depreciates when money supply goes up. This is because inflation rises leading to an initial depression of the nominal exchange rate associated with a transitory real depreciation till prices adjust. However, definitive conclusions cannot be drawn due to data limitations and structural uncertainties.

Exchange rate-pass through has to do with the impact of exchange rate movements on import and consumer prices over time (Loloh, 2014). In examining exchange rate pass-through to prices in Ghana, Sanusi(2010) asserts that the effect of an exchange rate shock on domestic prices is fairly gradual, taking about 6 years to reach full impact. Specifically, a 6.1% appreciation in the real exchange rate leads to a 0.7% decrease in the price level. Sanusi (2010) concluded that the exchange rate pass-through in Ghana is fairly large but incomplete and slow. Interestingly, it has been discovered that foreign aid inflows have led to a depreciation of the cedi as well (Arhenful, 2013). Lastly, Appiah and Adetunde (2011) using an ARIMA, predict that within the coming years, real exchange rate between the cedi and the dollar will experience a consistent upward trend (depreciation).

2.6 Lags of Monetary Policy

In measuring the lags of monetary policy, Bernanke and Mihov (1998) employed a “semi-structural” VAR model that left the relationship among macroeconomic variables in the system unrestricted but imposed contemporaneous identification restrictions on a set of variables relevant to the market for commercial bank reserves. Unlike Gruen et al (1997) who used short

term interest rates as the measure of monetary policy, Bernanke and Mihov (1998) used the fed funds rate, total bank reserves, and non-borrowed reserves as the measures of monetary policy in their analysis. Results from their research showed that expansionary monetary policy shock increases output relatively rapidly at twelve to eighteen months in the United States. However, they found that their results differed based on the monetary policy used. Cagan and Gandolfi (1969) found that after an expansionary monetary policy, interest rates decline continuously for about seven months. Monetary effects on aggregate expenditures are quite rapid roughly around a six-month period. It takes about eighteen months for aggregate expenditure to reach unity after a monetary policy (Cagan 1972).

Jovanoski and Muric (2012) and Kim and Douglas (2003) both assert that the lag structure of a VAR matters when assessing the quantitative effects of monetary policy shocks. Kim and Douglas (2003) in particular found that responses from symmetric lag structure in which all the variables have the same lag length and the asymmetric lag structure in which lag lengths differ across variables are significantly different using Monte Carlo simulations.

Deviations from VAR models, Gruen et al (1997) used OLS with lagged dependent variables (Australian non-farm output) to determine the lag of monetary policy in Australia. Although their results found similarities in the lags of monetary policy in Australia to the USA, Gruen et al (1997) warned that using OLS as a model may not “capture current and future developments in both inflation and output which are considered in the setting of monetary policy hence underestimating the strength of monetary policy’s impact on output or even prices.”

Cynicism as to how monetary policy lags are measured is found in the literature as well. Clark (1981) for instance, claims measuring monetary policy lags is highly controversial and

unreliable since the procedures used in estimating them tend to be highly subjective in nature and overly complex. He also averred that seasonal adjustment issues may also be a factor.

2.7 Monetary Policy in Ghana

Monetary policies must be generally coordinated with financial sector reforms in order to improve employment opportunities, reduce poverty, and support human development. The Bank of Ghana has focused its policy efforts on controlling inflation and maintaining price stability. Monetary policy in Ghana has been mainly limited by macroeconomic stabilization agreements with the IMF and World Bank. Such IMF conditionality has reduced the prospects for rapid economic growth and employment generation in Ghana.

In investigating monetary transmission mechanisms in Ghana, Kovanen (2011) asserts that interest rate channels are becoming increasingly relevant as central banks are finding it difficult to regulate or achieve quantitative targets with respect to monetary aggregates. This assertion may not be conclusive as a less developed financial sector may hamper the regulation of interest rates as well.

Ghanaian banks' lending behaviors are significantly affected by the country's economic activities and changes in money supply. For monetary policy to operate through a credit channel, monetary policy must fully affect banks' willingness to lend. The advancement of loan and credit of Ghanaian banks do not necessarily depend on the level of the central bank's monetary policy rate. Banks in Ghana are mainly affected more by credit and money supply than changes in the monetary policy rate (Amidu, 2006).

Bawumia et al (2003) using a structural vector error correction model, discovered that following an increase in interest rates, inflation initially rises in Ghana. This phenomenon happens for six months. After six months, or during the second quarter, prices begin to fall.

Counter to theory, exchange rates depreciate when interest rates rise while output dampens by 0.1% when there is an increase in the interest rates.

In a separate research conducted by Epstein and Heintz (2006) from the University of Massachusetts, they conclude that money supply (broad money) in Ghana has fairly standard effects on output, inflation, and exchange rates. For instance, an increase in money supply growth by 5%, leads to a quarter-percentage point increase in economic growth while raising inflation by only 1.5% points.

CHAPTER THREE

Data and Descriptive Statistics

The sample period for this study is from 1992-2013. Data for the inflation rate, the bilateral real exchange rate (cedi/ dollar), the Monetary Policy Rate, the growth of broad money (M2) and the World Commodity Price Index were collected over a monthly basis to derive monthly movements. The Monetary Policy Rate serves as a cap for all other interest rates in the economy and it is set by the Bank of Ghana to influence price levels. The World Commodity Price Index includes prices of metals, energy and agricultural products. Data was derived from the Bank of Ghana's Statistical Database and the IMF's International Financial Statistics Database. Table 1.a in Appendix A reveals key statistics of the variables being measured.

From Table 1.a, it can be inferred that over the sample period, the bilateral real exchange rate between the cedi and the dollar has a mean of 77 pesewas (0.77 cedis). Using a managed floating exchange rate, the cedi has shown less volatility and has been stable relative to the dollar as is evident by the low standard deviation of 0.57. Interestingly enough, the maximum exchange rate occurred recently, during the month of November in 2013. Table 1.a shows the extensive changes the inflation rate in Ghana has undergone since 1992. At some point in the country's history inflation hovered at 70.8% while in May of 2012, Ghana experienced its lowest inflation rate at 6.34%. The average inflation rate at 21.10% shows the country's inability to effectively stabilize prices over the years despite relatively high monetary policy rates. The Bank of Ghana's target inflation rate is 10% but as of late 2013, the inflation rate was 13.20%, falling short of even higher inflation expectations. The high drop in the world commodity price index, used as an indicator of supply shocks, occurred during 2008 at the onset of the Great Recession. Monthly changes in the commodity price index have averaged just 0.56% over the last 21 years.

Figure 1.a in Appendix A, graphically represents recent GDP growth in Ghana from 2006 to 2013 computed on a quarterly basis. From Figure 1 it is clear that GDP growth in Ghana is slightly volatile. From 2006 to 2008, GDP growth ranged from 0.1% to 5%, despite the irregularities in movements. During the Great Recession, the GDP growth rate in Ghana climbed steadily from the latter part of 2008 and almost reached a peak of 8% during the first quarter of 2010. It was not until after the first quarter of 2010 that the GDP growth of Ghana plummeted hugely and rapidly. Perhaps, it can be inferred that the aftershocks of the Great Recession in the USA which began during late 2008 was experienced in Ghana two years afterwards. The discovery and drilling of oil assisted in pushing Ghana's GDP growth back to acceptable and encouraging rates.

Evidence of volatile and high inflation rates since 1992 can be seen in Figure 2.a. After having a few years of steady irregular upward movements, Ghana's inflation rate climbed rapidly from 25.40% in 1994 to about 70.80% in December of 1995. Monetary policy rates during this period also increased from 30% to 45%, an increase of 15 percentage points. However, the hyperinflation or anomaly was short lived as inflation rate plunged rapidly to stable levels at 15 to 17% during late 1999. Sporadic increases in inflation rate were also evident from the four – year span of 2000-2005. After 2005, prices stabilized although the country still experienced a double digit inflation rate. It can be further inferred from Figure 2.a that the inflation rate is largely characterized by cyclical trends.

World commodity prices have grown at an average of 1% as depicted by Figure 3.a for the period 1992-2013. There has been a lot of irregular movements but a sharp drop can be seen during the period of 2008 due to the recent Great Recession where commodity prices plunged by over 20%. Figure 4.a depicts the actual world commodity price index and clearly shows an

upward trend with the average at 96.38. The index is based in 2005(average of 2005=100) and measured in nominal U.S. dollars. The index experienced a sharp increase during 2006 to 2008 but underwent a huge decline as well during the onset of the Great Recession. Commodity prices have climbed since then and average 178 .

Figure 5.a represents a step like graph depicting the Bank of Ghana's monetary policy since 1992. Steady increases in the earlier years were a response to the high inflationary periods experienced during 1995. The Monetary Policy Rate peaked at 45% during this period and plateaued till late 1998 when it began its steady descent. The policy rate has been relatively high and although it has dropped over the years, it still stands at around 16%.

M2 broad money) growth is characterized by irregular movements as seen in Figure 6.a. Changes are mainly between 2-10% although there was a sharp drop in early 2013.

Figure 7.a depicts the Lerner Index in the banking market for Ghana. The Lerner Index measures the market power in the banking market. It is defined as the difference between output prices and marginal costs (relative to prices). Prices are calculated as total bank revenue over assets, whereas marginal costs are obtained from an estimated translog cost function with respect to output. Higher values of the Lerner index indicate less bank competition. Bank competitiveness in Ghana from 1996-2010 has been slightly erratic. Ghanaian banks were the least competitive in 1997 with a Lerner Index of 0.44. Things improved in the next few years (in terms of competitiveness) but the success was short-lived. Banks became less competitive in 2002 again but competition levels began to peak afterwards. The election of a new government committed to financial liberalization and stabilization policies coupled with the new sovereignty of the Bank of Ghana attributed to the increase in competitiveness.

CHAPTER FOUR

Methodology

4.1 Vector Autoregression

To develop a comprehensive framework that would assist with the understanding of monetary policy and price stabilization in Ghana, a VAR model was used at first. A VAR-based approach is intrinsically important in determining the dynamics of an economy since it assists in tracing the response of the economy to a monetary policy shock and provides a means of observing the effects of policy changes under minimal assumptions (Bernanke and Mihov, 1998). Also, the VAR allows for a systematic way to capture good dynamics in multiple time periods (Stock and Watson, 2001). To make reading easier, a VAR is an n -equation, n -variable linear model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining $n-1$ variables.

It is assumed that the variables that represent the “true” structure of the Ghanaian economy, in terms of monetary policy and price stabilization, are the monetary policy rate, the growth of money supply, the inflation rate as an indicator of price level, and the bilateral real exchange rate which is an indicator of the price of the currency. To make the analysis simpler and to draw comparison based on research and policy-making purposes, the monetary policy tool is further distinguished as either a *financial market quantity* instrument or a *financial market price* instrument. Financial market prices include short-term interest rates, bond yields, and long term- interest rates. On the other hand, financial market quantities include money supply, bank credit, and the supply of government bonds. As such, a VAR model that includes money supply as the monetary policy tool assumes using a financial market quantity approach as a tool for measurement. Conversely, the Monetary Policy Rate assumes the financial market price tool approach.

The VAR model A with (p) lags goes as follows:

$$\pi_t = \alpha_1 + \beta_{11}\pi_{t-1} + \dots + \beta_{1p}\pi_{t-p} + \phi_{11}M_{t-1} + \dots + \phi_{1p}M_{t-p} + \theta_{11}W_{t-1} + \dots + \theta_{1p}W_{t-p} + \varepsilon_{1t} \quad (1)$$

$$M_t = \alpha_2 + \beta_{21}\pi_{t-1} + \dots + \beta_{2p}\pi_{t-p} + \phi_{21}M_{t-1} + \dots + \phi_{2p}M_{t-p} + \theta_{21}W_{t-1} + \dots + \theta_{2p}W_{t-p} + \varepsilon_{2t} \quad (2)$$

$$W_t = \alpha_3 + \beta_{31}\pi_{t-1} + \dots + \beta_{3p}\pi_{t-p} + \phi_{31}M_{t-1} + \dots + \phi_{3p}M_{t-p} + \theta_{31}W_{t-1} + \dots + \theta_{3p}W_{t-p} + \varepsilon_{3t} \quad (3)$$

Where α 's, β 's, ϕ 's, and θ 's are the coefficients to be estimated while the ε 's are the error terms. Model A indicates the growth of broad money supply as the monetary policy tool depicted by M . π_t represents the inflation rate at time t , while W represents the percentage change in world commodity price index at time t .

The VAR model B with (p) lags goes as follows:

$$\pi_t = \alpha_1 + \beta_{11}\pi_{t-1} + \dots + \beta_{1p}\pi_{t-p} + \phi_{11}R_{t-1} + \dots + \phi_{1p}R_{t-p} + \theta_{11}W_{t-1} + \dots + \theta_{1p}W_{t-p} + \varepsilon_{1t} \quad (4)$$

$$R_t = \alpha_2 + \beta_{21}\pi_{t-1} + \dots + \beta_{2p}\pi_{t-p} + \phi_{21}R_{t-1} + \dots + \phi_{2p}R_{t-p} + \theta_{21}W_{t-1} + \dots + \theta_{2p}W_{t-p} + \varepsilon_{2t} \quad (5)$$

$$W_t = \alpha_3 + \beta_{31}\pi_{t-1} + \dots + \beta_{3p}\pi_{t-p} + \phi_{31}R_{t-1} + \dots + \phi_{3p}R_{t-p} + \theta_{31}W_{t-1} + \dots + \theta_{3p}W_{t-p} + \varepsilon_{3t} \quad (6)$$

R depicts the Monetary Policy Rate at a time t . The Monetary Policy Rate is a signaling rate which is supposed to serve as a reference cap to all other rates in the economy. It is equivalent to the federal funds rate used by the Federal Reserve.

The VAR model C with (p) lags goes as follows:

$$X_t = \alpha_1 + \beta_{11}X_{t-1} + \dots + \beta_{1p}X_{t-p} + \phi_{11}M_{t-1} + \dots + \phi_{1p}M_{t-p} + \theta_{11}W_{t-1} + \dots + \theta_{1p}W_{t-p} + \varepsilon_{1t} \quad (7)$$

$$M_t = \alpha_2 + \beta_{21}X_{t-1} + \dots + \beta_{2p}X_{t-p} + \phi_{21}M_{t-1} + \dots + \phi_{2p}M_{t-p} + \theta_{21}W_{t-1} + \dots + \theta_{2p}W_{t-p} + \varepsilon_{2t} \quad (8)$$

$$W_t = \alpha_3 + \beta_{31}X_{t-1} + \dots + \beta_{3p}X_{t-p} + \phi_{31}M_{t-1} + \dots + \phi_{3p}M_{t-p} + \theta_{31}W_{t-1} + \dots + \theta_{3p}W_{t-p} + \varepsilon_{3t} \quad (9)$$

X represents the bilateral real exchange rate between the cedi and U.S. dollar at time t

The VAR model D with (p) lags goes as follows:

$$X_t = \alpha_1 + \beta_{11}X_{t-1} + \dots + \beta_{1p}X_{t-p} + \phi_{11}R_{t-1} + \dots + \phi_{1p}R_{t-p} + \theta_{11}W_{t-1} + \dots + \theta_{1p}W_{t-p} + \varepsilon_{1t} \quad (10)$$

$$R_t = \alpha_2 + \beta_{21}X_{t-1} + \dots + \beta_{2p}X_{t-p} + \phi_{21}R_{t-1} + \dots + \phi_{2p}R_{t-p} + \theta_{21}W_{t-1} + \dots + \theta_{2p}W_{t-p} + \varepsilon_{2t} \quad (11)$$

$$W_t = \alpha_3 + \beta_{31}X_{t-1} + \dots + \beta_{3p}X_{t-p} + \phi_{31}M_{t-1} + \dots + \phi_{3p}R_{t-1} + \theta_{31}W_{t-1} + \dots + \theta_{3p}W_{t-p} + \varepsilon_{3t} \quad (12)$$

Although the vast preponderance of literature use oil prices as an indicator of the supply shocks, the world commodity price index was preferred since it eliminates the “price puzzle” effect. The “price puzzle effect” is the scenario where for instance, a contractionary monetary policy causes an increase in price level. The “price puzzle effect” may usually occur when the researcher fails to capture anticipatory and future movements in the model. The models are further tested for co-integration. A Vector Error Correction Model is employed if the presence of cointegration is found.

4.2 Vector Error Correction Model

If the set of variables in the model are found to have one or more co-integrating vectors then a suitable technique known as the Vector Error Correction Model (VECM) is employed. The purpose of the VECM is to focus on the short run dynamics while making them consistent with a long run solution. If a number of variables are found to be cointegrated with at least one cointegrating vector, then there always exists a corresponding error-correction representation. This implies that changes in the dependent variable can be formulated as a function of the disequilibrium level in the cointegration relationship and fluctuations in other explanatory variables (Saluja et al, 2013). The VECM essentially adds error correction features to the VAR model.

CHAPTER FIVE

Scenario A- Financial Market Quantity Approach

For the sake of simplicity, Model A and Model C fall under this category.

5.1 Lag Selection Order Criteria

In order to determine the optimal number of lags to use, several lag selection criteria were used. The selection criteria focused on the three main measures used frequently in the literature. These are the Likelihood Ratio (LR), the Final Prediction Error Criterion (FPE), and the Akaike's Information Criterion (AIC). Table 1.b below presents the results for both the inflation rate and bilateral real exchange rate when the broad money supply growth was used as the monetary policy tool in a simplified form.

The results of the selection criteria in determining optimal lag length were consistent. The LR, FPE and the AIC suggested 12 lags as the optimal when modeling the inflation rate. Based on the results, the modeling approach would be to select 12 lags as the optimal lag length in order to ensure that the short run dynamics of the model for estimating the inflation rate are captured.

With the real exchange rate, the FPE and AIC select 7 lags as the optimal while the LR selected 6. Due to the recommendation, 7 lags were used as the appropriate lag length in estimating the model since a higher number of lags generally produce better results.

Table 1.b

Criteria for Selecting Lag Length (Inflation)

Lags	LR	FPE	AIC
1	746.92	5.079	4.463
2	59.62	4.037	4.233
3	12.657	3.869	4.191
4	11.428	3.727	4.153
5	.0793	3.755	4.161
6	9.460	3.645	4.131
7	0.005	3.657	4.139
8	0.046	3.703	4.147
9	3.570	3.680	4.140
10	1.751	3.684	4.141
11	2.315	3.679	4.140
12	9.460*	3.572*	4.110*

Criteria for Selecting Lag Length (Real Exchange Rate)

Lags	LR	FPE	AIC
1	907.49	0.0017	-3.5372
2	39.674	0.0014	-3.6873
3	2.0507	0.0014	-3.6875
4	470.32	0.0015	-3.6918
5	1.6368	0.0015	-3.3690
6	5.3191*	0.0014	-3.7035
7	2.3143	0.0014*	-3.7048*
8	0.2067	0.0015	-3.6976
9	0.1383	0.0014	-3.6902
10	1.4045	0.0014	-3.6878
11	0.2177	0.0015	-3.6807
12	0.0829	0.0015	-3.6731

Note: Optimal Lag Length selected by each criterion is marked with(*)

(LR): Likelihood-Ratio

(FPE): Final Prediction Error

(AIC): Akaike's Information Criterion

5.2 Unit Root Tests

Augmented Dickey Fuller

In determining whether the variables used in models A and C are stationary or not, the Augmented Dickey Fuller Test was carried out. The essence of the test is primarily aimed at determining the roots that characterize the data. In the Augmented Dickey Fuller Test, the test statistic is compared with the relevant critical values. The null hypothesis is the presence of a unit root while the alternative hypothesis is the absence of a unit root. If the critical value is less than the absolute value of the test statistic, the null is rejected and the variable is deemed as stationary. Conversely, if the absolute value of the test statistic is less than the critical value, then the null is not rejected and the variable is non-stationary. Table 2.b below displays the results.

Table 2.b

Augmented Dickey Fuller Unit Root Tests

Variable	Test Statistic
Inflation	-1.457
D.Inflation*	-5.157
M2(Growth)	-4.268
WCPI	-5.437

*D.Inflation indicates first difference

Critical Values : 1% (-3.460)

5% (-2.880)

10% (-2.570)

Variable	Test Statistic
Real Exchange Rate	-0.997
D.Real Exchange Rate*	-4.304
M2(Growth)	-8.624
WCPI	-6.667

*D.Real Exchange Rate indicates first difference

Critical Values: 1% (-3.460)

5% (-2.880)

10% (-2.570)

From Table 2.b, it is evident that the growth of money supply and the change in the world commodity price index are stationary since their test statistics are greater than the critical values. Inflation rate and the real exchange rate on the other hand were not stationary hence the need to carry out the first difference. Henceforth, both the inflation rate and the real exchange rate would be defined as *D.Inflation* and *D.Real Exchange Rate* for simplification purposes.

5.3 Cointegration Analysis

A variable is covariance stationary if its mean and all its autocovariances are finite and do not change over time. Cointegration analysis provides a framework for estimation, inference, and interpretation when the variables are not covariance stationary. The Johansen test for cointegration was carried out in determining the cointegration rank of the system and the number of common stochastic trends driving the entire system. Results are presented in Table 3.b.

Table 3.b

Johansen's Test for Cointegration

Inflation

Maximum Rank	Parameters	LL	Eigenvalue	Trace Statistic	5% Critical Value
0	102	-1864.6320	.	71.0644	29.68
1	107	-1845.8139	0.13924	33.4282	15.41
2	110	-1831.6408	0.10679	5.08220	3.76
3	111	-1829.0998	0.02004		

Real Exchange Rate

Maximum Rank	Parameters	LL	Eigenvalue	Trace Statistic	5% Critical Value
0	48	-988.7858	.	117.3036	29.68
1	53	-954.9798	0.2313	49.6916	15.41
2	56	-930.9796	0.1703	1.6911*	3.76
3	57	-930.1340	0.0065		

(*) number of cointegrating equations

The test statistics are based on a model with 12 lags and a constant trend. Johansen's testing procedure starts with the test for zero co-integrating equations (a maximum rank of zero) and then accepts the first null hypothesis that is not rejected. The null hypothesis is no cointegration while the alternative is the presence of cointegration. From the Table 3.b, the null hypothesis of no cointegration is not rejected when the inflation model is tested.

In relation to the real exchange rate, the null hypothesis of no cointegration is rejected and the null hypothesis of at least two cointegrating equations is not rejected. To ensure an exactly identified model, a Vector Error Correction Model (VECM) is utilized.

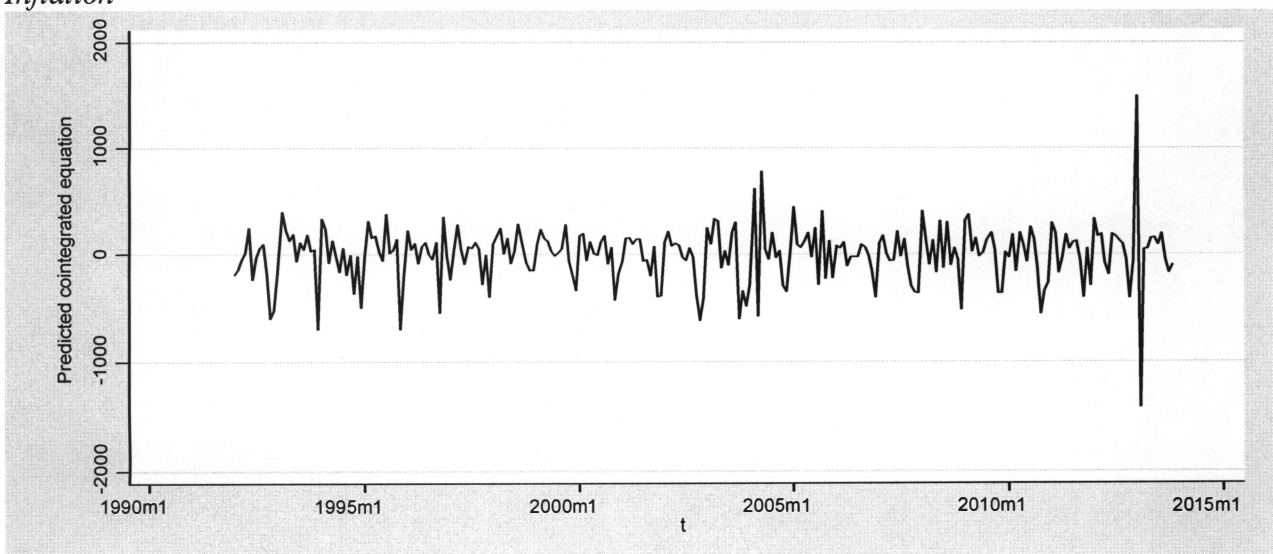
5.4 General Tests

Stationarity of Cointegrating Equations

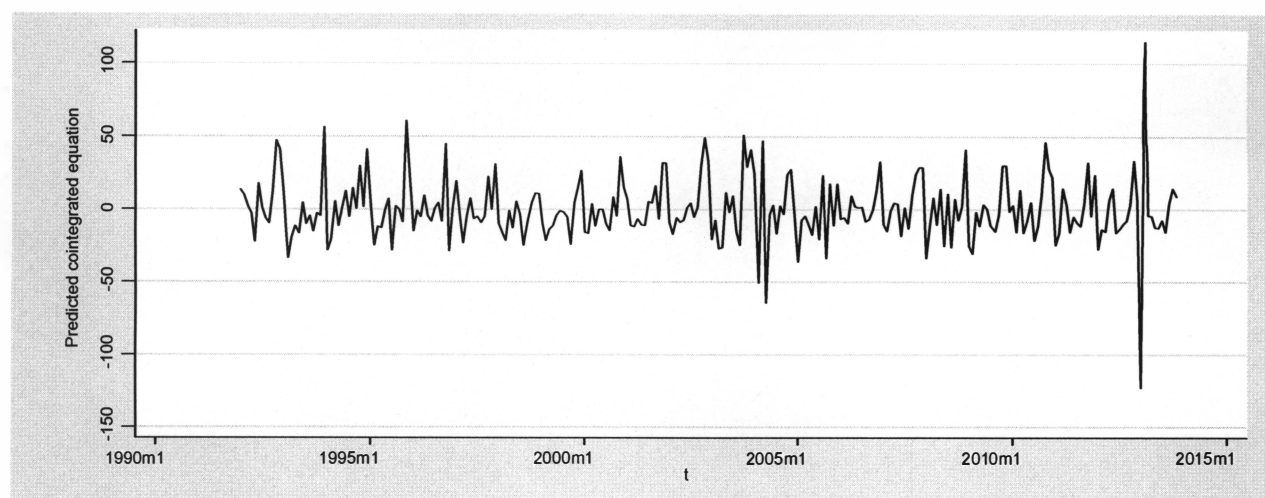
Inference on the parameters of the model depends on the stationarity of the cointegrating equations. The tests of stationarity for the cointegrating equations for inflation and the real exchange rate are displayed via graphs. Values of the cointegrating equations are predicted and graphed over time in Figure 1.b.

Figure 1.b

Inflation



Real Exchange Rate



*where t: 1992M1-2013M12

Both graphs signify stationarity in the cointegrating equations for both inflation and the real exchange rate models due to the absence of a trend.

Eigenvalue Stability Condition

To check whether the number of cointegrating equations has been correctly specified, the Eigenvalue Stability Test Condition is carried out. The companion matrix of a VECM with K endogenous variables and r cointegrating equations has $K-r$ unit eigenvalues. If the process is stable, the moduli of the remaining r eigenvalues are less than 1. Table 4.b and Figure 2.b present the eigenvalue stability condition tests for both model A and C.

Table 4.b

Inflation

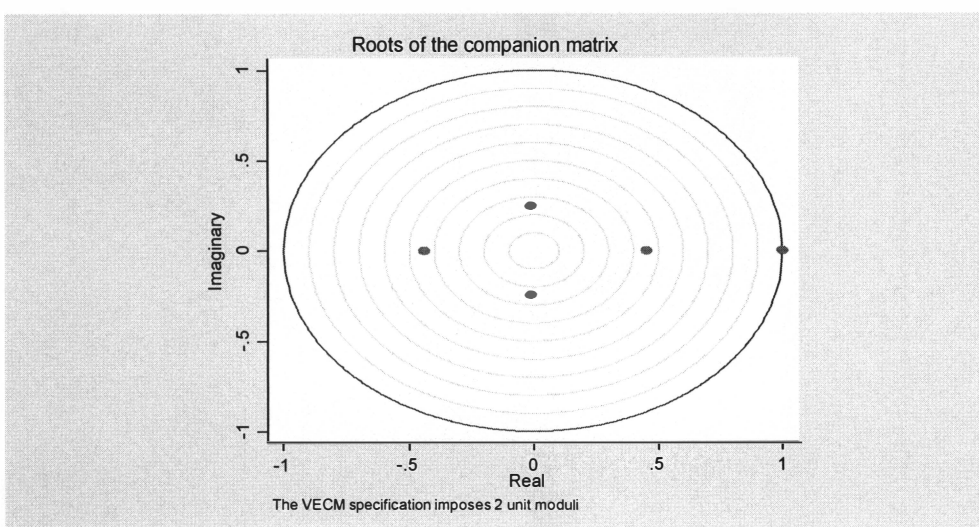
Eigenvalue	Modulus
-0.4187435 + 0.0855393i	0.514655
-0.4031015 - 0.0827393i	0.514655
-0.0198215 + 0.24101445i	0.341915
-0.0198212 - 0.2435445i	0.225515

Real Exchange Rate

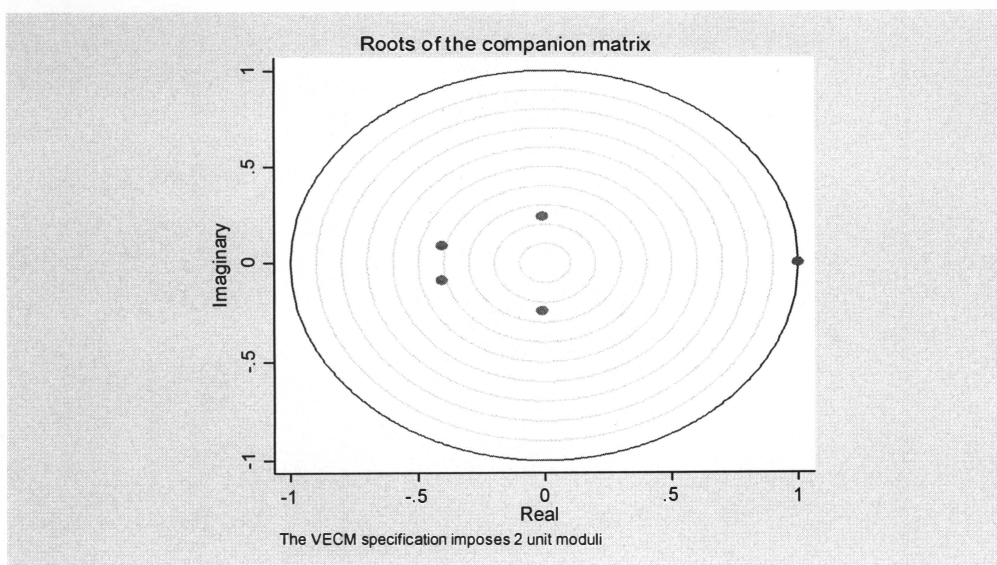
Eigenvalue	Modulus
-0.4073018 + 0.0887393i	0.416857
-0.4073018 - 0.0887393i	0.416857
-0.0134218 + 0.2415445i	0.241917
-0.0134218 - 0.2415445i	0.241917

Figure 2.b

Inflation



Real Exchange Rate



Since the modulus of each eigenvalue is less than one and since the eigenvalues are well within the unit circle, both models satisfy the eigenvalue stability condition.

Lagrange-Multiplier Test

To test for serial correlation in the residuals of each model, the Lagrange-Multiplier test is undertaken. Table 5.b below shows the results.

Table 5.b

Inflation

Lag	Chi-Square	P-Value
1	28.3378	0.00084
2	24.0068	0.00429
3	24.5944	0.00345
4	8.60400	0.47460
5	13.6421	0.13564
6	9.86710	0.36135
7	8.53150	0.48159
8	16.4025	0.05894
9	17.9259	0.03604
10	12.3286	0.01954
11	30.8725	0.00031
12	105.526	0.00000

Real Exchange Rate

Lag	Chi-Square	P-Value
1	17.5094	0.04131
2	21.2039	0.01178
3	17.8680	0.03674
4	8.98300	0.43884
5	12.5016	0.18649
6	11.8146	0.22397

With a null hypothesis of no autocorrelation, using 12 lags may produce autocorrelation in the inflation model. Hence, the model is refit with 7 instead of 12 since 10 or more lags may produce serial correlation. In relation to the real exchange rate model, the results indicate no

serial correlation when 5 or more lags are used. As such, 7 lags were chosen as the optimal lag length.

5.5 Results

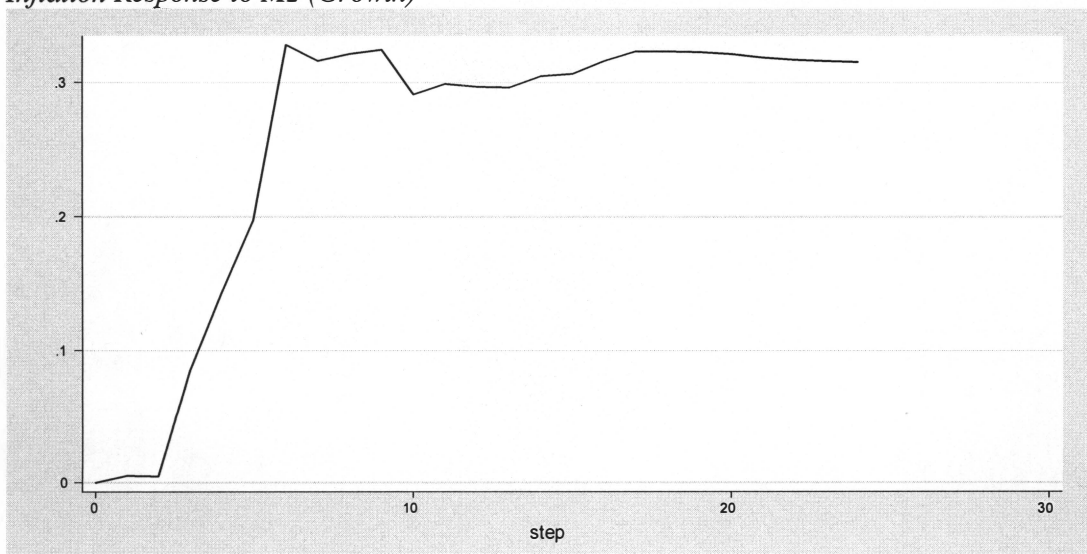
Impulse Response Functions (IRFs)

An Impulse Response Function ultimately measures the effect of a shock to an endogenous variable on itself or on another endogenous variable. It shows the effect of a unit increase in an exogenous variable on the endogenous variable over time. Hence IRFs serve as a useful tool for characterizing the dynamic responses implied by the estimated VAR models. The impulse response functions are presented in Figure 3.b below.

Money Supply Growth

Figure 3.b

Inflation Response to M2 (Growth)

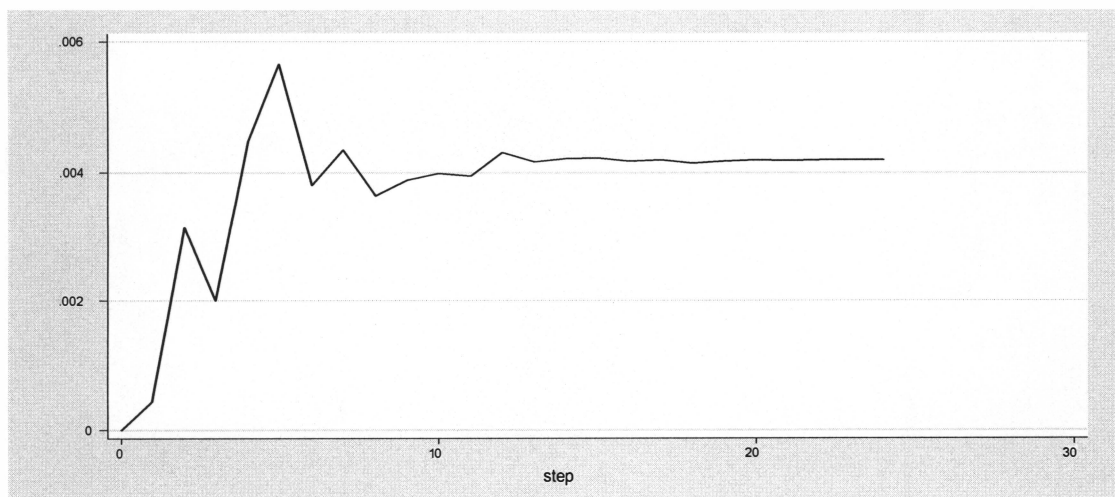


From Figure 3.b, an increase in the shock to the growth in broad money by 10 percentage points causes a sharp increase in inflation by 1 percentage points during the first few months in Ghana. After the 5th month, prices move rapidly than before. For example, a 10 percentage points increase in money supply leads to a 3 percentage points increase in inflation during the 6th

month. Price levels stay consistent afterwards and refuse to die out after a year signifying a permanent effect caused by the growth in money supply. The results are largely consistent with theory.

An increase in money supply lowers nominal interest rates since people would want to shift their wealth from money to assets that pay interest. The demand for these assets increases causing the price of the assets to increase as well. However, when the price of an asset increases, its interest rates decrease. The decrease in interest rates and the assumption of feeling wealthier (becoming wealthier) stimulates consumption. As people demand more goods and services due to increase in consumption, prices in the economy are driven up hence an increase in the inflation rate. Moreover, Figure 3.b points to the fact that the Bank of Ghana can effectively stabilize or influence prices by using monetary aggregates such as the broad money supply. The full effect of the increase in broad money supply is felt in the short run, during 1-4 months.

Figure 3.b
Exchange Rate Response to M2 (Growth)



An increase to the shock in money supply by 10 percentage points leads to a gradual depreciation of the cedi in relation to the U.S dollar. The reaction of the real exchange rate to the

increase in broad money is very minute and barely significant. For example, in the 2nd month, a 10 percentage points increase in the broad money supply would lead to a 0.03 percentage points depreciation of the cedi in relation to the U.S dollar. The shock in real exchange rate gradually plateaus after 10 months. There are various approaches and contrasting theories to why an increase in money supply leads to a depreciation of the currency in relation to another currency in this case the U.S. dollar. When the Bank of Ghana increases the money supply via open market operations, nominal interest rates decrease as well since people shift their money into asset based portfolios. Moreover, the increase in money supply makes consumers in Ghana feel wealthy. Holding all else equal, consumers demand more goods and consume more hence driving prices of domestic goods up. The increase in prices overtime forces consumers to demand or purchase goods from abroad since foreign goods become relatively cheaper hence demanding a foreign currency or in this case, the U.S dollar. The demand of the U.S dollar causes the dollar to appreciate hence depreciation in the cedi. In addition, the apparent increase in income likely leads to an increase in imports and the further depreciation of the currency. The decrease in interest rates also leads to large capital outflow. Ghanaians invest in foreign assets since the foreign interest rates are relatively higher. The higher demand in foreign assets leads to a higher demand of the foreign currency, in this case the US dollar and hence further depreciation in the cedi. The effect is fairly quickly as depicted in Figure 3.b above.

Supply Shocks

Supply shocks seem to have very minimal effects on inflation in Ghana. Theory suggests that a supply shock would lead to higher prices as a result of higher input costs and material shortages. From Figure 3.b below, a 10 percentage points increase in changes in the world commodity price index leads to a 0.61 percentage points increase in inflation during the 1st

month. Prices continue to increase till the 9th month where the effects become stable and permanent. A 10 percentage points shock then leads to 0.87 percentage points increase in prices.

Figure 3.b

Inflation Response to WCPI

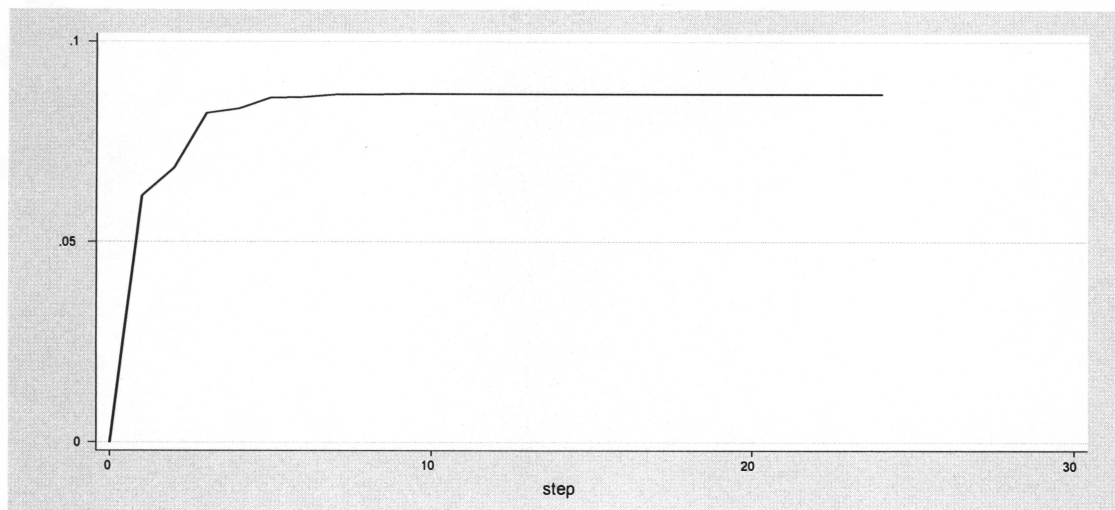
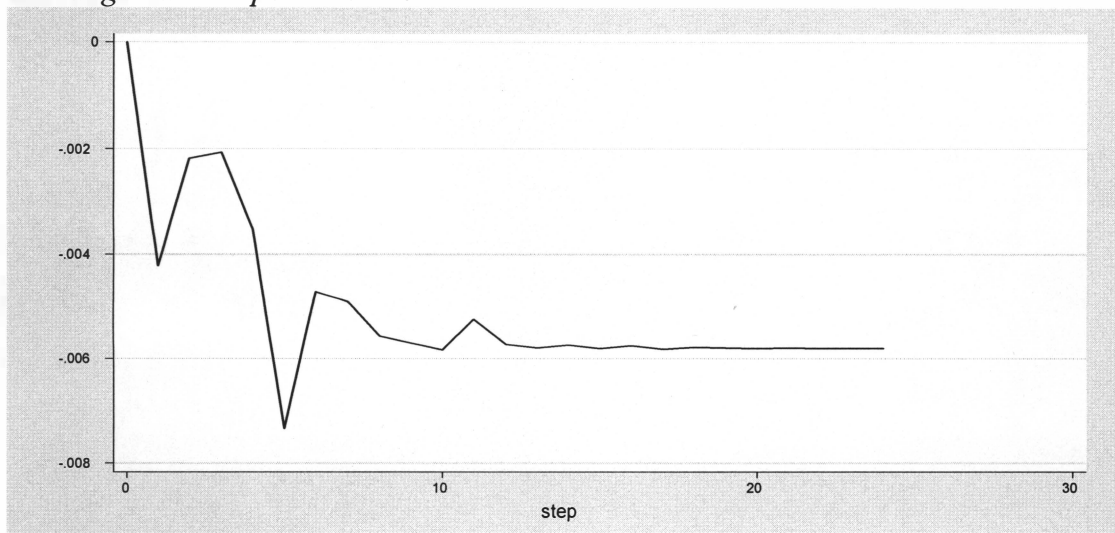


Figure 3.b

Exchange Rate Response to WCPI



*step indicates time horizon

A supply shock leads to an appreciation of the cedi for the first few months since consumers in Ghana may be forced to import less and consume more domestic goods and services as depicted in Figure 3.b above. The consumption of less foreign goods arises from the

increase in foreign prices relative to domestic prices. This theory holds if we assume that prices in Ghana rises slower relative to prices in the US when such a supply shock arises. In addition, when a supply shock occurs, producers tend to cut back on production since input costs rise. The decrease in production leads to less output and with time, less income. With income levels dropping, and everything held constant, consumers and producers may cut back on imports hence demanding less foreign currency(in this case, the US dollar) causing the domestic currency(cedi) to appreciate. Moreover, a supply shock may induce an adjustment among in Ghanaian investors who may want to decrease their foreign asset holdings in the USA due to market uncertainty. The decrease in holdings leads to less capital outflow and hence an appreciation of the cedi.

Table 6.b below shows a clearer picture over time.

Table 6.b

Inflation

M2(Growth)		WCPI	
Step	IRF	Step	IRF
1	0.005133	1	0.061396
2	0.004539	2	0.068517
3	0.085252	3	0.082242
4	0.143168	4	0.083396
5	0.197356	5	0.086061
6	0.328142	6	0.086352
7	0.316216	7	0.086889
8	0.321570	8	0.086951
9	0.324860	9	0.087059
10	0.291018	10	0.087072
11	0.299207	11	0.087094
12	0.297117	12	0.087097
13	0.296663	13	0.087101
14	0.305151	14	0.087102
15	0.306365	15	0.087103

Real Exchange Rate

M2(Growth)		WCPI	
Step	IRF	Step	IRF
1	0.000436	1	-0.004213
2	0.003146	2	-0.002187
3	0.002005	3	-0.002070
4	0.004474	4	-0.003520
5	0.005660	5	-0.007342
6	0.003810	6	-0.004704
7	0.004348	7	-0.004914
8	0.003653	8	-0.005568
9	0.003878	9	-0.005700
10	0.003987	10	-0.005827
11	0.003947	11	-0.005246
12	0.004310	12	-0.005734
13	0.004167	13	-0.005789
14	0.004216	14	-0.005740
15	0.004220	15	-0.005807

Forecast Error Variance Decomposition

The Forecast Error Variance Decomposition (FEVD) is the percentage of the variance of the error made in forecasting a variable due to a specific shock at a given time period. Thus, the forecast error variance decomposition is like a partial R-square for the forecast error, by forecast horizon (Stock and Watson, 2001). Table 7.b below shows the results.

Table 7.b

Forecast Horizon	Variance Decomposition (%)		
	Inflation	M2(Growth)	WCPI
2	99.992	0.006	0.002
4	99.511	0.022	0.467
8	98.584	0.240	1.176
12	98.171	0.312	1.517
24	97.901	0.346	1.753

Forecast Horizon	Variance Decomposition (%)		
	Real Exchange Rate	M2(Growth)	WCPI
2	99.023	0.010	0.967
4	98.845	0.398	0.757
8	97.139	1.192	1.669
12	96.908	1.164	1.928
24	95.974	1.214	2.812

During the first four months, M2 (Growth) contributes about only 0.022% to the change in inflation in Ghana while the WCPI contributes 0.467%. Most of the changes in inflation in Ghana, is largely influenced by shocks in price changes and supply shocks. Perhaps, Ghana's poorly structured and under developed financial structure may be responsible.

The WCPI contributes about 1.93% to movements in in Ghana's real exchange rate during the first 12 months. Ghana's limited exposure to world trade may perhaps be a reason for the narrow impact world commodity prices have on inflation and the real exchange rate. For instance, in 2009, Ghana's trade in both commercial services and merchandise to the world accounted for about 0.1% in total world trade. In 2012, the number had risen to only 0.2%.

With time however, the impact from both the growth in money supply and the prices of commodities on the inflation rate and the bilateral real exchange rate increases.

CHAPTER SIX

Scenario B-Financial Market Price Approach

A contentious debate, analysts and researchers alike are usually at a conundrum as to which monetary policy instrument is useful in stabilizing prices in an economy. There are usually two broad categories of instruments: monetary or reserve aggregates and short-term and long term interest rates. These are further characterized as financial market quantities approach or financial market prices approach. Scenario A presented models where the monetary aggregate, specifically the growth of M2, falling under the financial market quantities approach were used. To draw comparisons and to determine which approach is more efficacious in terms of influencing prices in Ghana, another model that incorporates the financial market price approach is utilized. The Monetary Policy Rate set by the Bank of Ghana is used as the financial market price and the monetary policy instrument. The World Commodity Price Index (WCPI) would still be used as the supply shock. VAR model B and D illustrate further. It is important to stress that the central bank can usually choose only one instrument. Again, it is essential to understand that the choice of instruments depends on how well a particular instrument is related to the ultimate goals of the central bank and how well it protects the economy from unforeseen shocks. The Bank of Ghana's principal monetary policy tool is the Monetary Policy Rate. Again, both the inflation rate and the bilateral real exchange rate are examined.

6.1 Lag Selection Order Criteria

The LR, FPE, and AIC suggest using 12 lags as the optimal length when the inflation rate is treated as the endogenous variable being examined. As such, a maximum of 12 lags was selected.

In relation to modeling the real exchange rate, the LR, FPE, and AIC recommend using 7 lags as the optimal as shown in the table above. Therefore, 7 lags were chosen as the optimal number of lags. Results of the lag selection order criteria can be seen in Table 1.c below.

Table 1.c

Criteria for Selecting Lag Length (Inflation)

Lags	LR	FPE	AIC
1	911.18	5.0728	4.4617
2	59.602	4.0325	4.2322
3	10.996	3.8906	4.1964
4	9.2504	3.7798	4.1675
5	0.0045	3.8101	4.1755
6	6.3085	3.7453	4.1583
7	0.2637	3.7713	4.1652
8	0.0941	3.8001	4.1728
9	1.5540	3.8069	4.1746
10	3.5309	3.7839	4.1685
11	0.7161	3.8034	4.1736
12	12.885*	3.6421*	4.1302*

Criteria for Selecting Lag Length (Real Exchange Rate)

Lags	LR	FPE	AIC
1	1037.5	0.0017	-3.5373
2	39.434	0.0014	-3.6864
3	2.0926	0.0014	-3.6868
4	3.0097	0.0015	-3.6908
5	1.5374	0.0015	-3.6889
6	5.0738	0.0014	-3.7012
7	2.1274*	0.0014*	-3.7014*
8	0.1625	0.0015	-3.6944
9	0.1901	0.0014	-3.6872
10	1.5284	0.0015	-3.6853
11	0.2842	0.0016	-3.6785
12	0.1362	0.0015	-3.6710

Note: Optimal Lag Length selected by each criterion is marked with(*)

(LR): Likelihood-Ratio

(FPE): Final Prediction Error

(AIC): Akaike's Information Criterion

6.2 Unit Root Tests

Augmented Dickey Fuller Test

To determine stationarity amongst variables in models B and D, the Augmented Dickey

Fuller test was carried out. Table 2.c below presents the results.

Table 2.c

Augmented Dickey Fuller Unit Root Tests

Variable	Test Statistic
Inflation	-1.457
D.Inflation*	-5.157
MPR	-0.913
D.MPR*	-4.819
WCPI	-5.437

*D.Inflation and D.MPR indicates first difference

Critical Values : 1% (-3.460)

5% (-2.880)

10% (-2.570)

Variable	Test Statistic
Real Exchange Rate	-0.997
D.Real Exchange Rate*	-4.304
MPR	-1.306
D.MPR	-4.159
WCPI	-6.667

*D.Real Exchange Rate and D.MPR indicates first difference

Critical Values: 1% (-3.460)

5% (-2.880)

10% (-2.570)

The MPR (Monetary Policy Rate) and inflation rate were differenced to reduce non-stationarity as evidenced in Table 2.c. The rest of the variables are stationary.

With a low test statistic, the real exchange rate was not stationary. In order to achieve stationarity, the real exchange rate was differenced and is referred to as *D. Real Exchange Rate* to account for the differencing.

6.3 Cointegration Analysis

The test statistics are based on a model with 12 lags and a constant trend. Johansen's testing procedure starts with the test for zero co-integrating equations (a maximum rank of zero) and then accepts the first null hypothesis that is not rejected. The null hypothesis is no cointegration while the alternative is the presence of cointegration. From Table 3.c below, the null hypothesis of no cointegration is rejected and the null hypothesis of two cointegrating equations is not rejected when the inflation model was tested.

Table 3.c

Johansen's Test for Cointegration

Inflation

Maximum Rank	Parameters	LL	Eigenvalue	Trace Statistic	5% Critical Value
0	102	-1527.3804	.	49.9681	29.68
1	107	-1510.7203	0.12432	16.6481	15.41
2	110	-1502.7866	0.06126	0.7807*	3.76
3	111	-1502.3963	0.00311		

Real Exchange Rate

Maximum Rank	Parameters	LL	Eigenvalue	Trace Statistic	5% Critical Value
0	102	-547.91683	.	37.4361	29.68
1	107	-531.98711	0.11920	5.5766*	15.41
2	110	-529.96854	0.01596	1.5395	3.76
3	111	-529.19879	0.11920		

(*) number of cointegrating equations

In relation to the real exchange rate, the null hypothesis of no cointegration is rejected and the null hypothesis of at least one cointegrating equations is not rejected. To ensure an identified model, a Vector Error Correction Model (VECM) is employed.

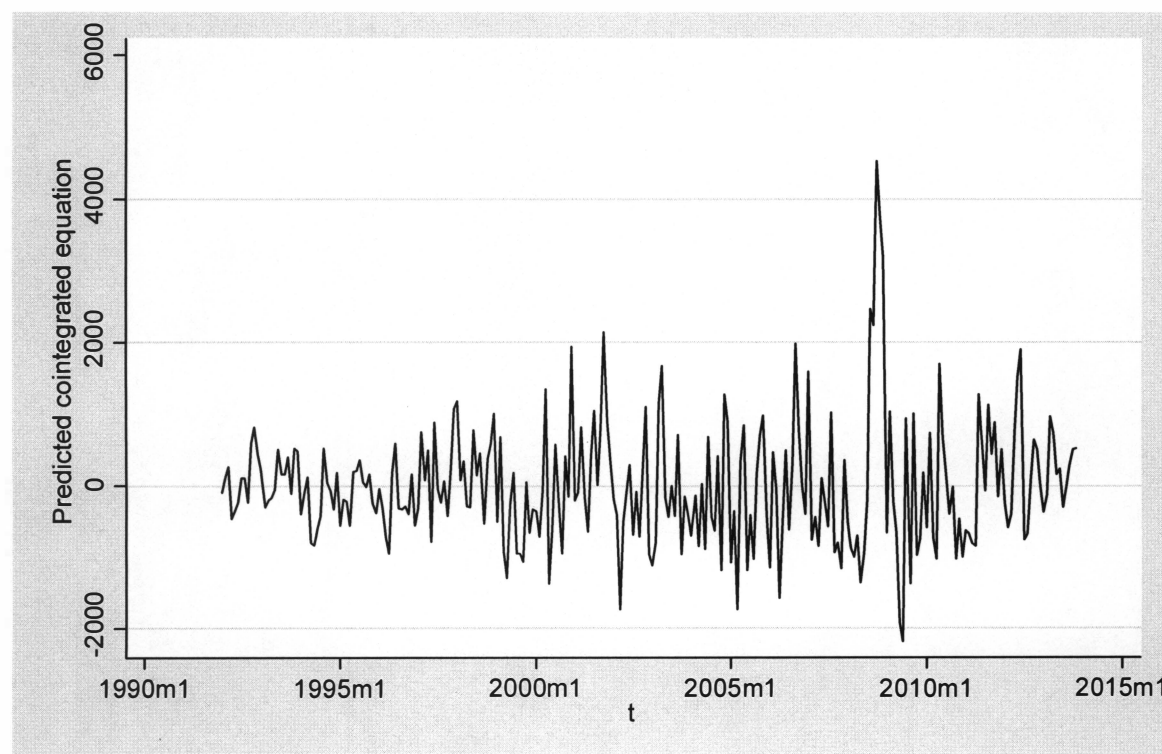
6.4 General Tests

Stationarity of Cointegrating Equations

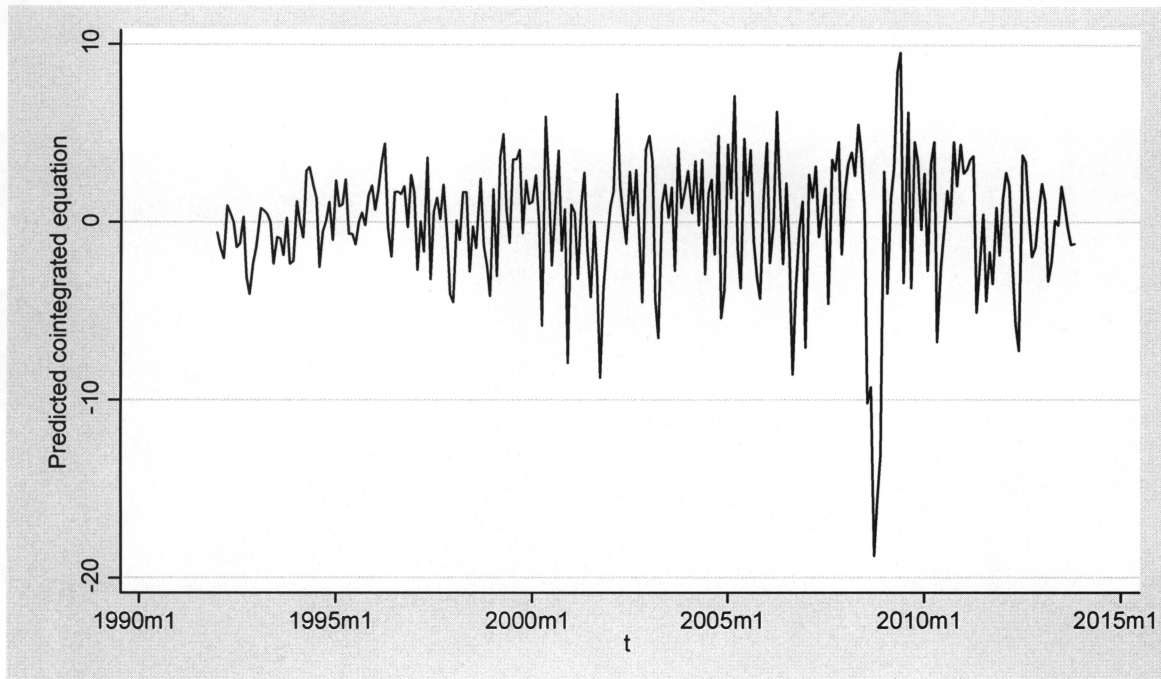
The tests of stationarity for the cointegrating equations for inflation and the real exchange rate are displayed in Figure 1.c. Values of the cointegrating equations are predicted and graphed over time.

Figure 1.c

Inflation



Real Exchange Rate



*where t: 1992M1-2013M12

Both graphs signify stationarity in the cointegrating equations for both inflation and the real exchange rate models.

Eigenvalue Stability Condition

Since the eigenvalues are well within the unit circle and since the modulus of each eigenvalue is less than one, both models satisfy the eigenvalue stability condition. Results are indicated in Table 4.c and Figure 2.c below.

Table 4.c

Inflation

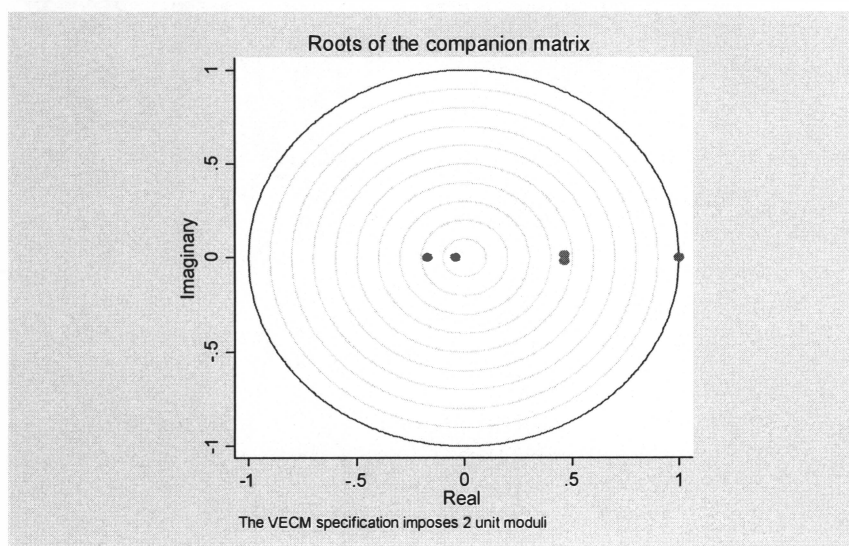
Eigenvalue	Modulus
0.4654389 + .01763219i	0.465773
0.4654389 - .01763219i	0.465773
-0.1707643	0.170764
-.04165803	0.041658

Real Exchange Rate

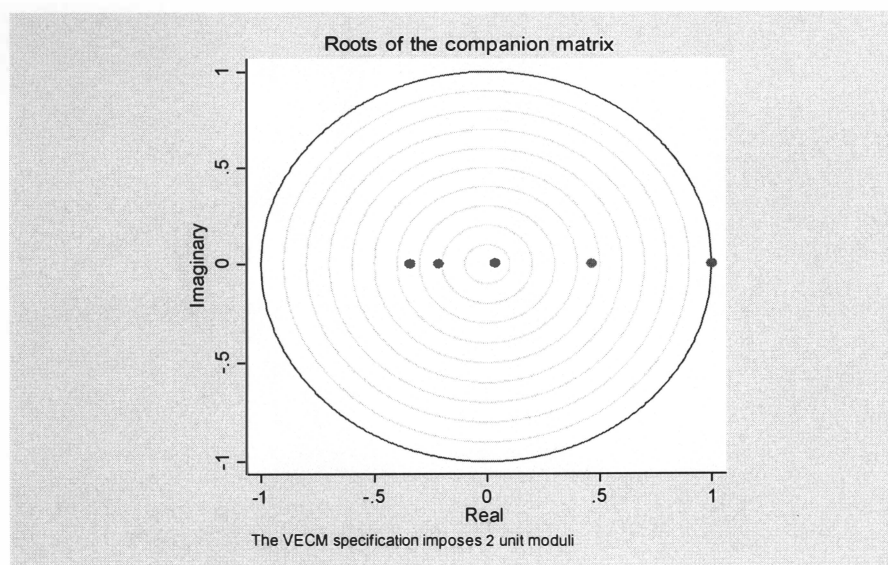
Eigenvalue	Modulus
0.4637066	0.463707
-0.3421056	0.342106
-0.2146257	0.214626
0.0346741	0.034674

Figure 2.c

Inflation



Real Exchange Rate



Lagrange-Multiplier Test

With a null hypothesis of no autocorrelation, using 12 lags may produce autocorrelation in the inflation model. Hence, the model is refit with 11 lags instead of 12. With regards to the real exchange rate model, the results indicate no serial correlation when 5 or more lags are used. As such, 7 lags were chosen as the optimal lag length. Table 5.c depicts the results.

*Table 5.c**Inflation*

Lag	Chi-Square	P-Value
1	18.5358	0.02944
2	10.2705	0.32904
3	29.6311	0.00051
4	5.67800	0.77166
5	16.9443	0.04960
6	8.53670	0.48109
7	4.43250	0.88071
8	23.4753	0.00521
9	14.1897	0.11574
10	8.74690	0.46095
11	12.3115	0.19631
12	66.5213	0.00000

Real Exchange Rate

Lag	Chi-Square	P-Value
1	10.8497	0.28615
2	10.0131	0.34943
3	27.9184	0.00098
4	6.66320	0.67214
5	15.7453	0.07239
6	9.11160	0.42704
7	10.0815	0.34393

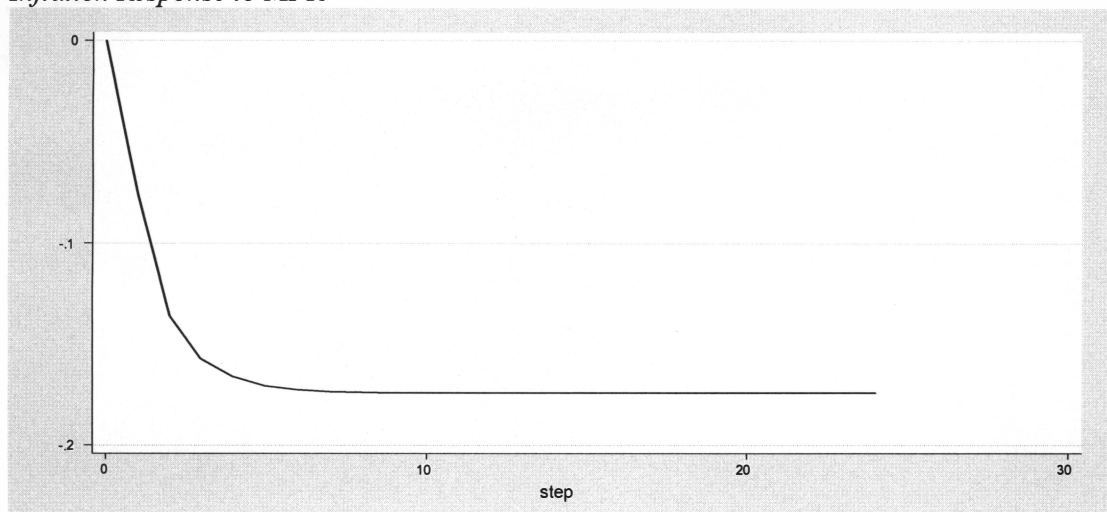
6.5 Results

Impulse Response Functions (IRFs)

Monetary Policy Rate

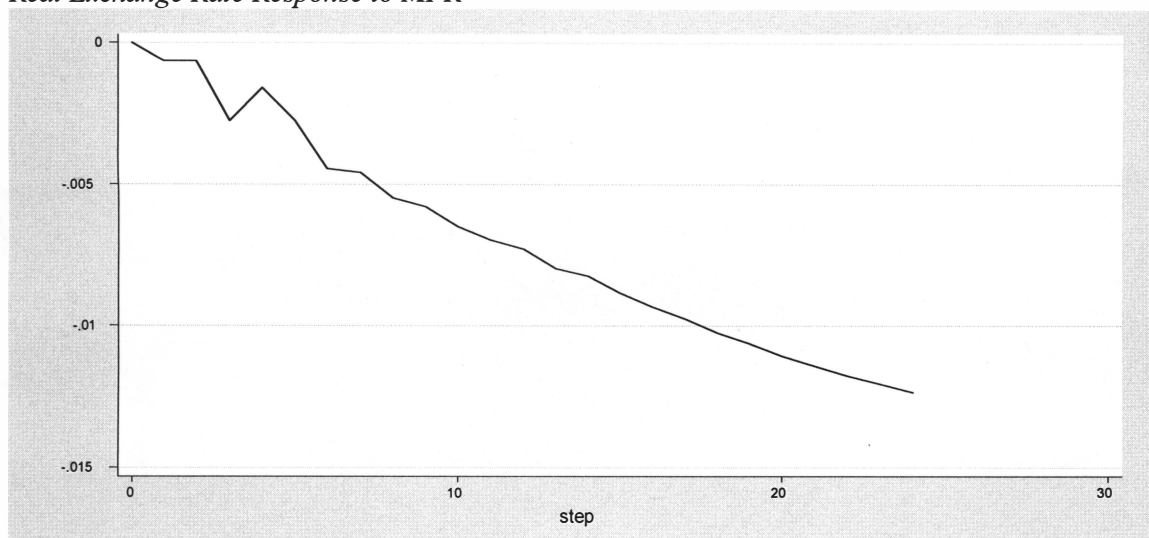
Figure 3.c

Inflation Response to MPR



A 1 percentage point increase in the Monetary Policy Rate (MPR) causes inflation in Ghana to decrease gradually as expected. When interest rates rise, people normally shift money or transactions they hold into demand deposits such as interest bearing checking accounts and savings account to benefit from the increase. As such, consumers hold less money, feel less wealthy, and demand less goods and services in the short run. The decrease in demand for goods and services forces prices to drop. Moreover, people holding assets make a loss since the value of their assets drop as interest rates rises. Such a drop induces consumers to feel less wealthy and hence lead to a decrease in investment and consumption triggering a further decrease in prices. From Figure 3.c, it can be concluded that the monetary policy rate set by the Bank of Ghana is a major determinant of inflation in Ghana. Inflation reduces rapidly till the 3rd and 4th month when the effects begin to die off after the 6th and 7th months.

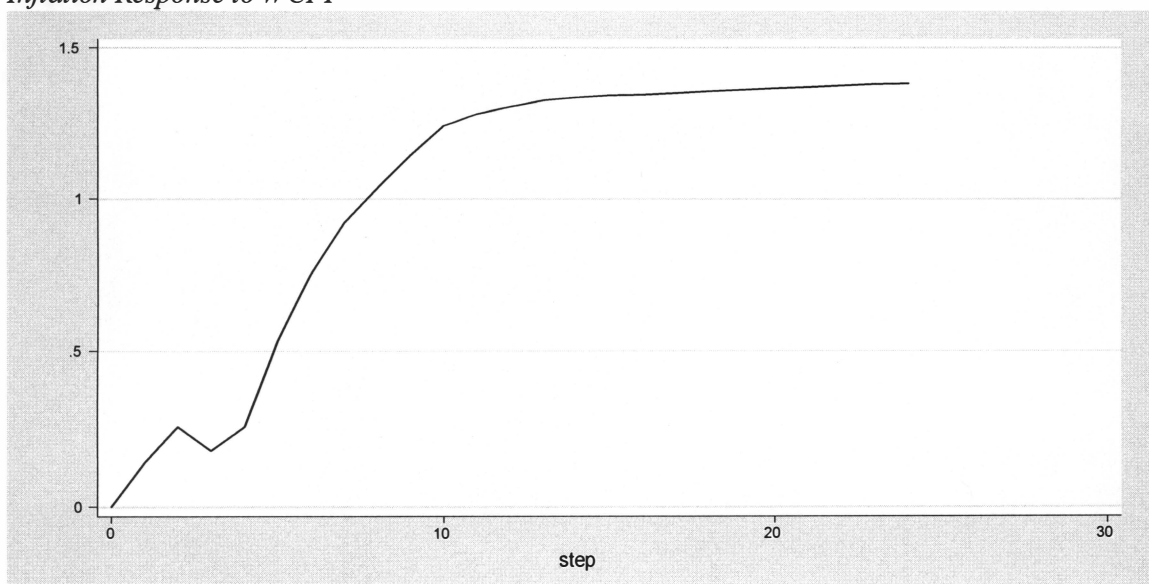
Real Exchange Rate Response to MPR



Impact of the MPR on real exchange rates is largely consistent. During the first few months, an increase in the monetary policy rate induces an appreciation of the cedi. The movements of the cedi are regular and the appreciation continues till the 24th month. However, the effects are very minimal. Imperfect capital mobility attributed to the Ghanaian economy is a reason behind the little impact the Monetary Policy Rate has on the bilateral real exchange rate.

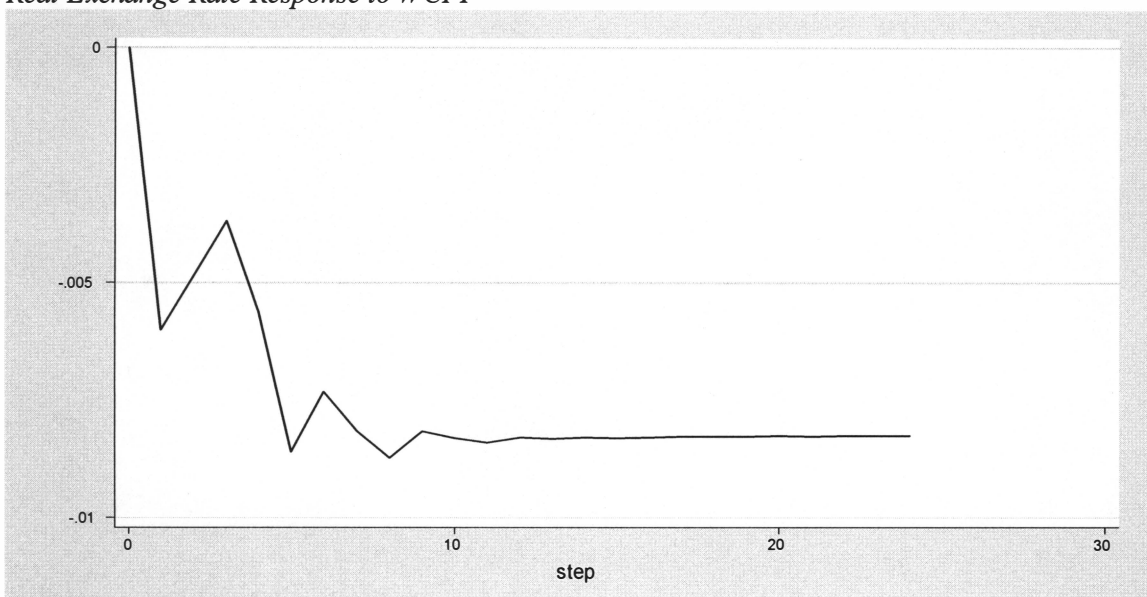
Supply Shocks

Inflation Response to WCPI



Quite similar to the results produced when Model A and C were used, shocks in the world commodity price index drive prices up in Ghana. In comparison to when the inflation rate was modeled with the monetary aggregates, changes in the world commodity price index have a slightly larger impact on inflation in Ghana. For instance, during the 10th month, a 10 percentage points shock in the prices of commodities causes inflation in Ghana to rise by 12 percentage points.

Real Exchange Rate Response to WCPI



*step indicates time horizon

From the onset, a shock in the world commodity price index leads to a gradual appreciation of the cedi in relation to the dollar. Consumers in Ghana quickly switch from consuming more foreign goods to consuming domestic goods which may be as a result of a decrease in real income or an increase in foreign prices holding all else equal. Table 6.c below gives a lucid picture.

Table 6.c
Inflation

MPR		WCPI	
Step	IRF	Step	IRF
1	-0.075958	1	0.141111
2	-0.136205	2	0.258466
3	-0.157341	3	0.179335
4	-0.165959	4	0.258571
5	-0.170540	5	0.531313
6	-0.172472	6	0.748251
7	-0.173382	7	0.919071
8	-0.173776	8	1.037410
9	-0.173965	9	1.145050
10	-0.174046	10	1.241910
11	-0.174085	11	1.280280
12	-0.174102	12	1.304580
13	-0.174110	13	1.325160
14	-0.174113	14	1.336530
15	-0.174115	15	1.342890

Real Exchange Rate

MPR		WCPI	
Step	IRF	Step	IRF
1	-0.000636	1	-0.006007
2	-0.000645	2	-0.004874
3	-0.002753	3	-0.003683
4	-0.001593	4	-0.005638
5	-0.002732	5	-0.008604
6	-0.004447	6	-0.007331
7	-0.004598	7	-0.008169
8	-0.005475	8	-0.008733
9	-0.005792	9	-0.008175
10	-0.006505	10	-0.008317
11	-0.006973	11	-0.008415
12	-0.007277	12	-0.008299
13	-0.007961	13	-0.008336
14	-0.008233	14	-0.008305
15	-0.008815	15	-0.008310

Forecast Error Variance Decomposition

Table 7.c

	Variance Decomposition (%)		
Forecast Horizon	Inflation	MPR	WCPI
2	99.7612	0.0400	0.1988
4	99.0415	0.5699	0.3886
8	94.9418	3.1658	1.8924
12	91.0779	5.1935	3.7286
24	87.4690	7.1981	5.3329

	Variance Decomposition (%)		
Forecast Horizon	Real Exchange Rate	MPR	WCPI
2	98.065	0.0115	1.923
4	97.963	0.0288	2.008
8	95.901	0.1738	3.925
12	94.660	0.4145	4.925
24	93.331	0.9563	5.712

From Table 7.c, during the first four months, MPR contributes about 0.57% to the change in the inflation rate in Ghana while the WCPI contributes a miniscule 0.39%. However in the long run, the MPR contributes more to the inflation rate in Ghana with 7.20% as opposed to the growth in money supply which contributes only 0.35%. However, as stated already, most of the change in inflation in Ghana, is largely influenced by shocks in price changes itself and other external factors. A comprehensive analysis on monetary transmission mechanism may be done to understand why this phenomenon occurs. The WCPI contributes about 5.71% to movements in Ghana's real exchange rate in the long run while in the short run the contributions are 1.93% and 2.00% in the first second and fourth months respectively.

CHAPTER SEVEN

CONCLUSION

The study aimed at examining the relationship between monetary policy, price levels, and the real exchange rate in Ghana. It also aimed at 1) evaluating whether monetary policy in Ghana is effective in influencing price levels, 2) the effect of external supply shocks such as commodity prices on prices and the real exchange rate, 3) the duration of such shocks and monetary policy effects and ,4) what policy inferences could be drawn from both the effects and duration.

A principle conclusion drawn from the period of study (1992-2013) is that monetary policy in Ghana, whether interest rates or monetary aggregates as the policy instrument, has an effect on price level and the real exchange rate. The full effect of the increase in broad money supply on inflation is felt in the short run, during 3-5 months while a shock in money supply by 1 percentage point leads to a gradual depreciation of the cedi in relation to the U.S dollar. The shock in real exchange rate gradually plateaus after 10 months. A 1 percentage point shock to the Monetary Policy Rate (MPR) causes inflation in Ghana to decrease rapidly until about the 5th month. On the other hand, commodity prices (supply shocks) when used with either monetary aggregates or the monetary policy rate, induces the price level to rise and the real exchange rate to appreciate.

The results are contrary to existing studies such as that of Bawumia et al (2003) where they found the Monetary Policy Rate for instance to have a positive effect on price level during the first 6 months In addition, Bawumia et al (2003) found an increase in the policy rate induced the cedi to depreciate yet the results proved otherwise. The movements of the cedi are regular and the appreciation continues till the 24th month when an increase in the monetary policy rate is undertaken. Other studies (Epstein and Hertz 2006) suggest that broad money supply have

minimal effects on inflation and real exchange rates. This might be so since a 10 percentage point increase in the broad money supply increases inflation by only 3 percentage points with a variance decomposition of about 0.022% during the 6th month.

In terms of key policy implications, the Bank of Ghana would be better off using the MPR (monetary policy rate) as the principle policy instrument instead of the broad money supply (M2) in stabilizing price levels due to the forecast error decomposition results. A higher percentage of changes in inflation can be attributed to changes in the MPR than changes in the M2. A refreshing novelty, the study primarily differs from other studies since it delineates between different monetary policy instruments. Moreover, unlike other research where oil prices are the proxy for external supply shocks, the study uses the world commodity price index as an indicator of external supply shocks thereby mitigating the “price puzzle effect”. In addition, and not found in other related studies, the forecast error variance decomposition is undertaken to determine how much of the price level or the exchange rate are caused by the various variables hence the research provides a more in-depth, analytical, and compendious framework for understanding price levels and the real exchange rate in Ghana. Financial market prices such as the interest rate are found to be more effective in influencing prices in Ghana. An area for further research include: constructing a price index from commodities imported and exported to the US by Ghana to comprehensively illustrate the impacts supply shocks may have on the key macroeconomic variables; including dummy variables such as a recessionary period or a change in government; using other financial market instruments T-Bills and bank reserves as the monetary policy variable; and including a growth variable in the model to examine the impact monetary policy has on economic growth and development.

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Appendix- A

Table 1.a (1992-2013)

Variable	Obs	Mean	Std. Dev	Minimum	Maximum
*Real Exchange Rate	263	0.77	0.571	0.04	2.08
**Monetary Policy Rate	263	25.00	10.73	12.50	45.00
**World Commodity Price Index(WCPI)(Growth)	263	0.56	4.23	-21.04	11.61
**Inflation Rate	263	21.10	13.62	6.34	70.80
**M2 (Growth)	263	2.57	4.05	-20.97	24.00

*Value of the dollar in terms of the cedi adjusted for the effects of inflation e.g 3cedis=1 dollar

** Measured in percentages

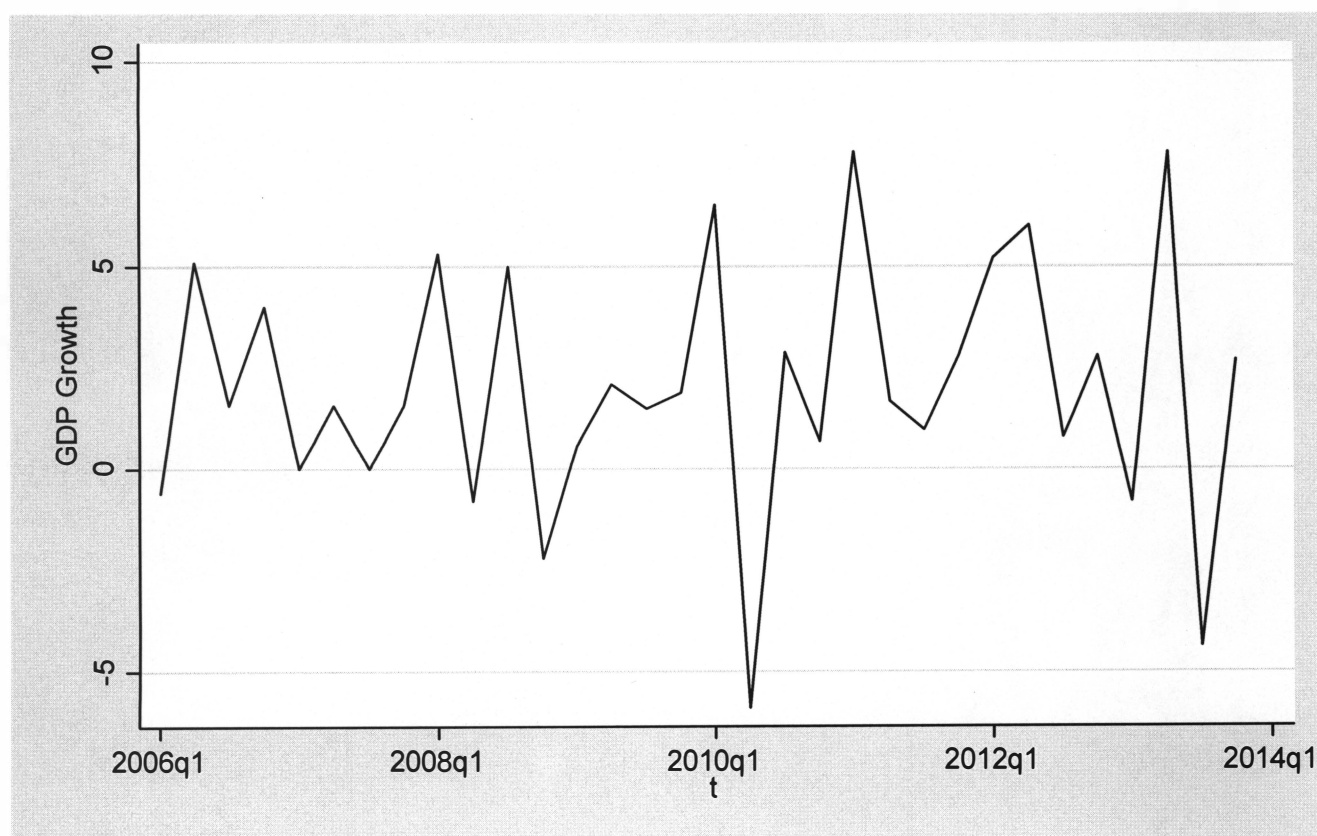


Figure 1.a-GDP Growth (2006Q1-2013Q4)

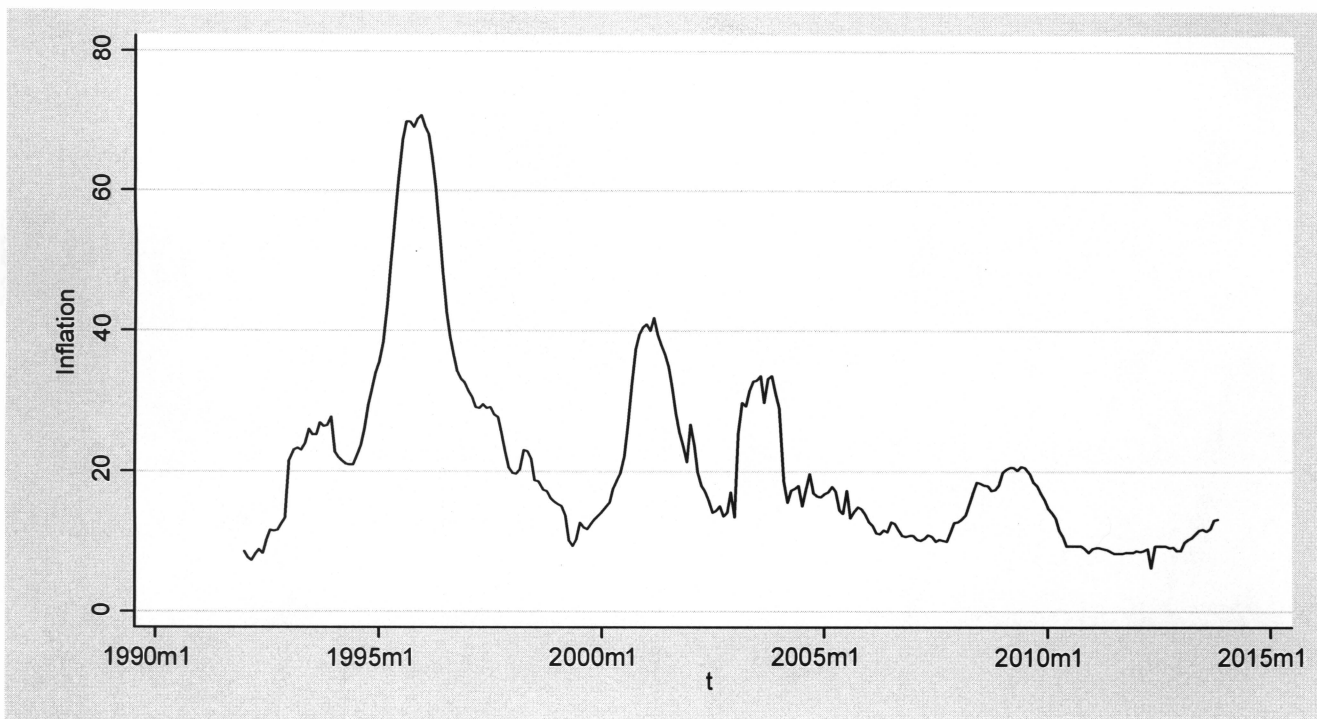


Figure 2.a-Inflation Rate (1992M1-2013M12)

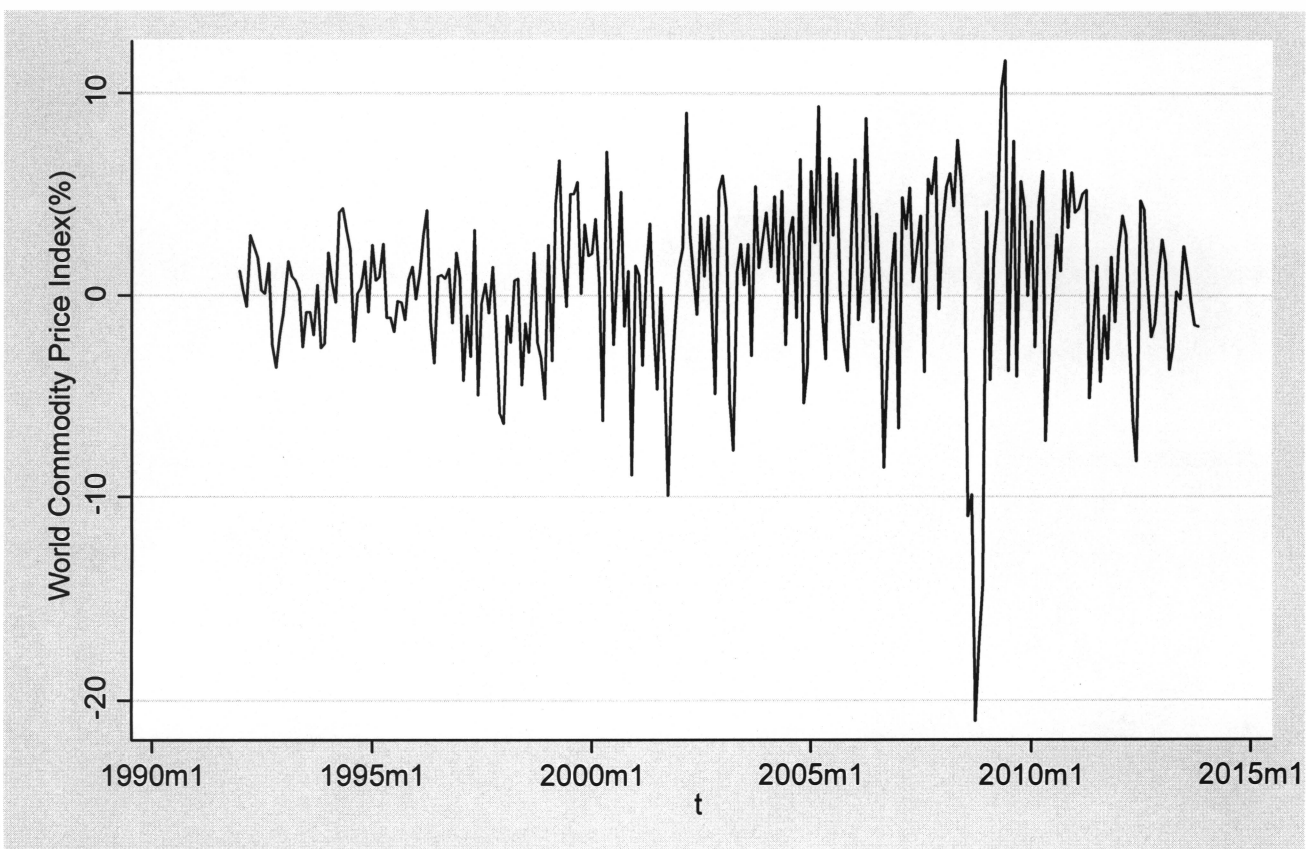


Figure 3.a -Changes in the World Commodity Price Index (1992M1-2013M12)

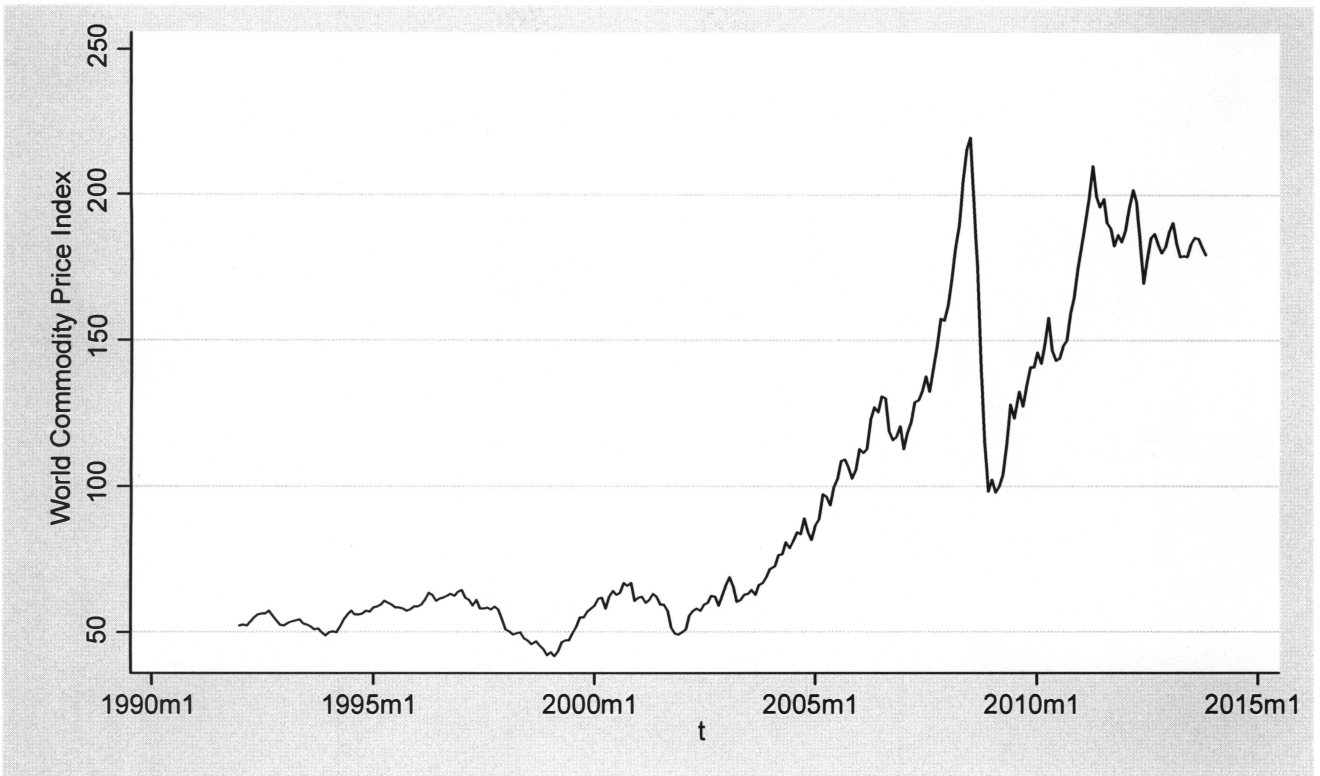


Figure 4.a-World Commodity Price Index (1992M1-2013M12)

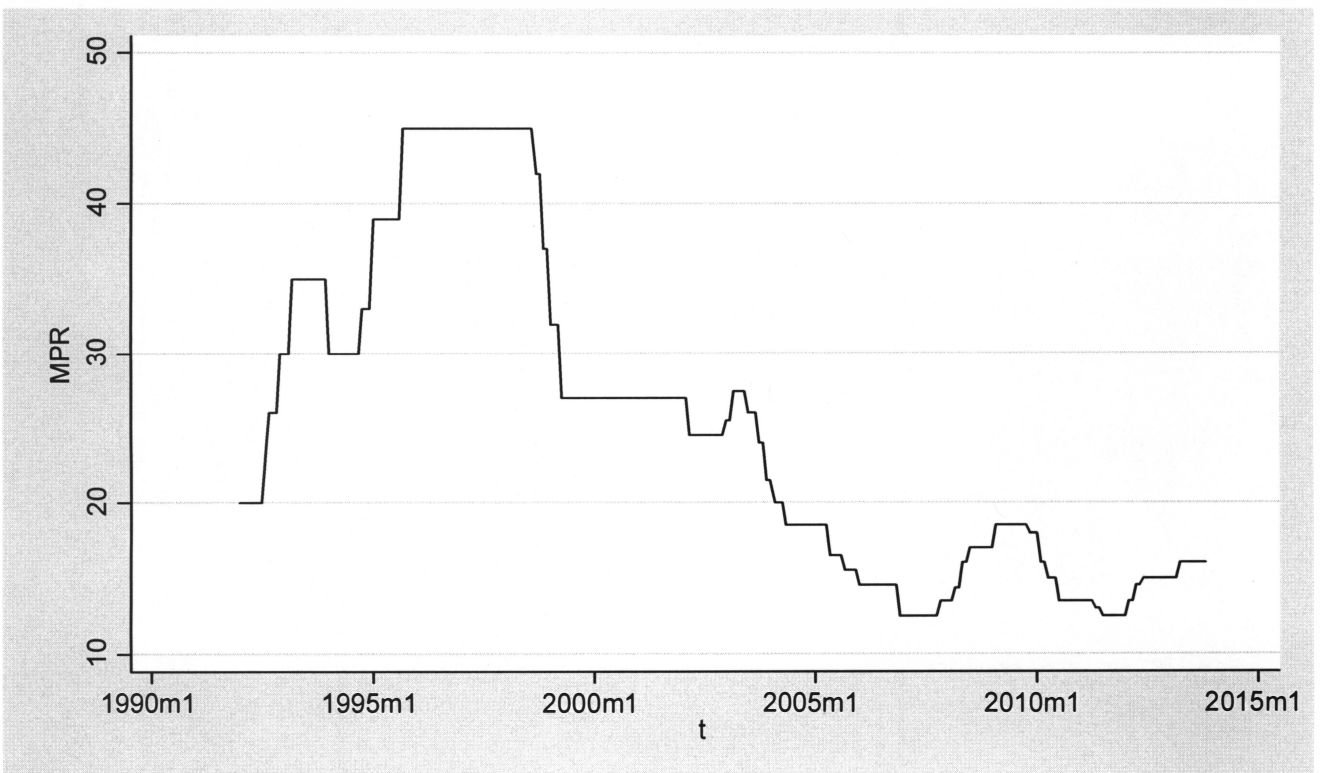


Figure 5.a- Monetary Policy Rate (1992M1-2013M12)

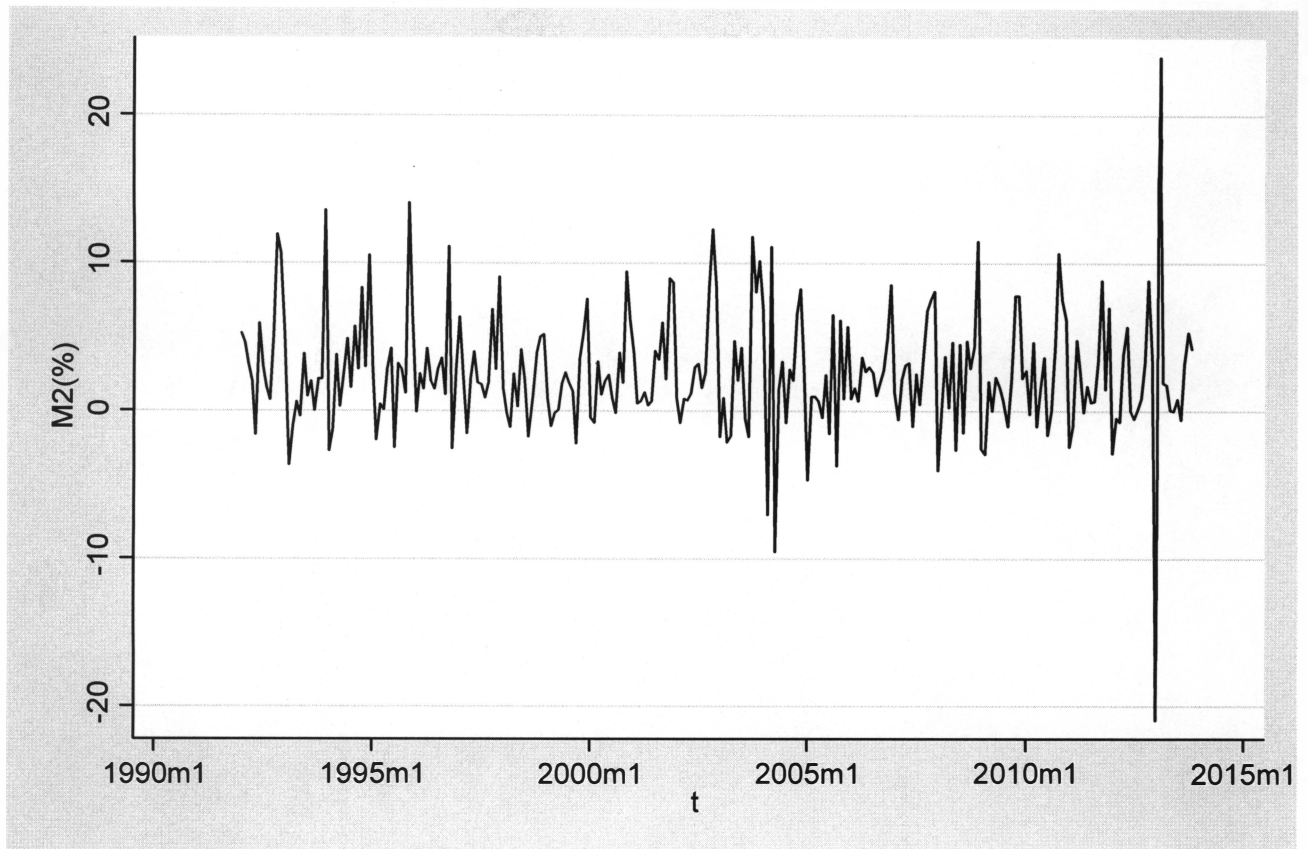


Figure 6.a- M2 Growth(1992M1-2013M12)

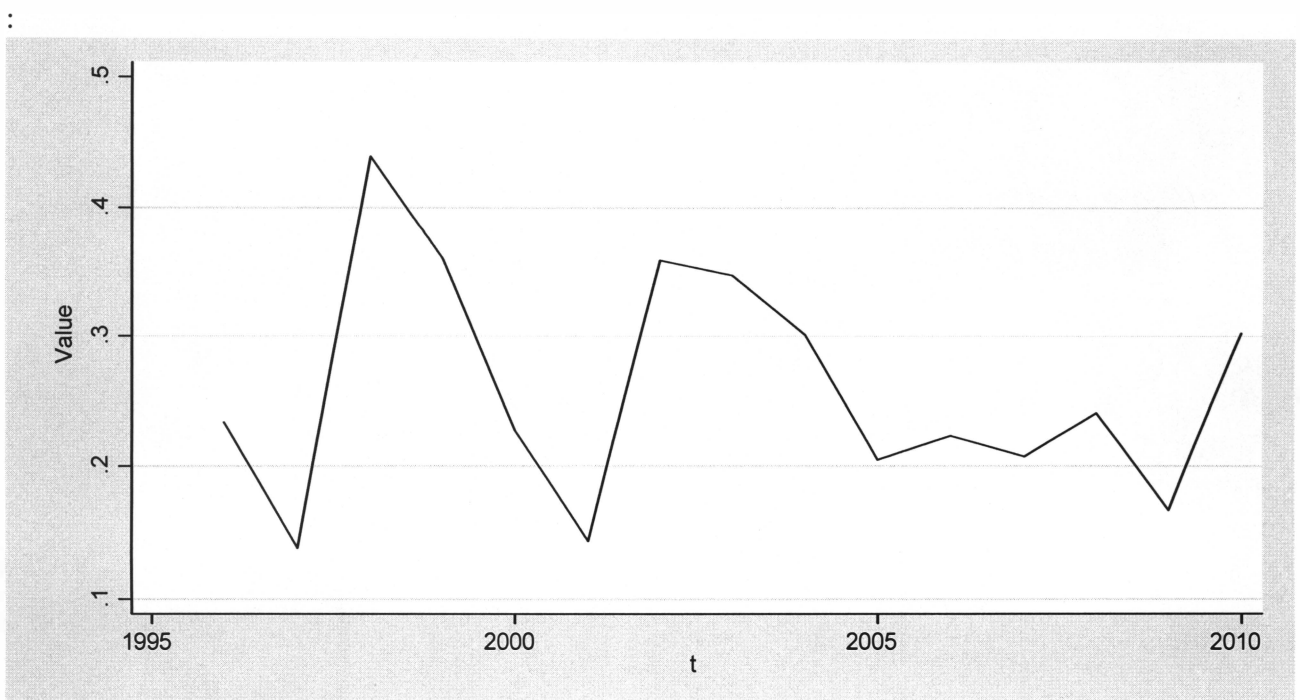


Figure 7.a-Lerner Index (1996-2010)