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DEPARTMENT OF ECONOMICS

FISCAL DEFICIT, MONEY GROWTH AND INFLATION DYNAMICS IN GHANA

A THESIS SUBMITTED TO THE DEPARTMENT OF ECONOMICS, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN ECONOMICS

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DECLARATION

I hereby declare that this submission is my own work towards the Master of Philosophy and that, to the best of my knowledge, it contains no material previously published by another person or material which has been presented for the award of any degree University, except where due acknowledgement has been made in the text.

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ABSTRACT

The issue of inflation has attracted a great deal of attention over the past two decades, as reflected in substantial academic literature. The objective of the study was to investigate the causal relationship between fiscal deficits, money growth and inflation, having controlled for macroeconomic variables such as interest rate, exchange rate and real GDP in the Ghanaian economy for the period 1960-2012 and to test whether the Sargent Wallace Hypothesis holds for the Ghanaian economy. The time series properties of the underlying series were examined using the Argumented Dickey Fuller and the Philip Perron unit root tests and the result reveals that the interaction between fiscal deficit and money supply, fiscal deficit, money supply, were all stationary at the levels, while other incorporated variables in the empirical analysis- real income and the nominal exchange rate -were stationary at first difference. Using the autoregressive distributive lag model the long and short run models were estimated, and the Granger Causality test was employed to test for causality among the variables. The results suggest a positive relationship between fiscal deficits and inflation in the Ghanaian economy occurs only in the short run; however the money supply shows a consistent positive relationship with inflation, both in the short and long run. This supports the position that in the long run, inflation is mainly driven by monetary expansion. The Granger causality test supported a unidirectional causality from fiscal deficit to inflation and money supply; and a bi-directional causality existing between money supply and inflation. The results indicated that the best approach to understand the causal relationship between fiscal deficit, money supply and inflation in the Ghanaian economy in the long run is given by the SW-H. The study suggested policies which aimed at properly formulating and implementing good monetary and fiscal policies.

DEDICATION

This thesis is dedicated to God and my mother, Juliana C. Serwah.

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LIST OF ABBREVIATIONS

ADF Test: Augmented Dickey-Fuller test statistic

ARDL: Autoregressive Distributed Lag

CPI: Consumer Price Index

FTPL: Fiscal Theory of the Price Level

GDP: Gross Domestic Product

IMF: International Monetary Fund

PP Test: Philip Perron Test

SW-H: Sargent Wallace Hypothesis

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Inflation is a key macroeconomic variable that exerts significant influence on macroeconomic stability and is the focal point of macroeconomic policy aimed at achieving sustainable rates of economic growth and development in many countries. Inflation is defined as a sustained or persistent increase in the general price level of goods and services in an economy over time. In an inflationary economy, it is difficult for money to act as a medium of exchange and store of value, with adverse effects on output, employment and real income.

There is, however, no consensus both in theoretical and empirical literature regarding the factors that drive the inflationary process of many economies, especially in the developing world. While in the monetarist theory aggregate excess demand resulting from an excess supply of money is regarded as the only cause of inflation, the structuralist theory accredits inflation to the composition of demand for products and services accompanied by inflexibilities in the productive structure (Fischer and Mayer, 1980).

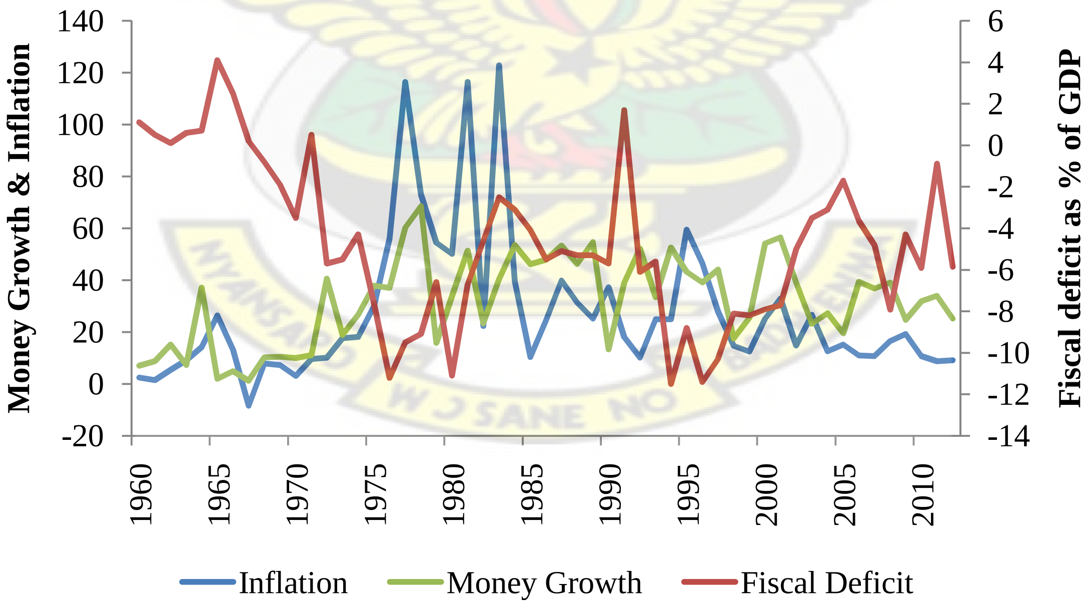
One of the core culprits of money growth, especially in the developing world, is the monetization of deficits. The monetization of deficits leads to increases in the monetary base in an economy which implies increases in the money supply which in turn stimulate aggregate demand and expectations of higher inflation forcing the authorities to accommodate the resulting price increases. With Friedman (1963) arguing that high inflation in any economy is due to a monetary expansion, some researchers and policy makers argue that government budget deficits are also inflationary. These arguments (see Sargent and Wallace, 1981; Leeper and Walker, 2012) stem from the method by which governments finance their deficits. That is, either by borrowing from domestic or foreign sources, or by printing money. This is because, deficits financed by monetization would directly expand the money supply (creating inflation) while borrowing (particularly from domestic sources) tend to crowd out investment of the private sector and reduces economic growth and aggregate supply, which also has inflationary consequences on the economy. Historically, highly inflationary economies, especially those in the developing world, also tend to have large fiscal deficits; suggesting a link between fiscal deficits and inflation.

The Ghanaian economy for more than three decades has experienced high and persistent inflation, and several policies and programs like the Economic Recovery Program (in 1983), the Structural Adjustment Program (in 1986) that were aimed at curtailing it proved infertile. Sowa and Kwakye (1993), Atta-Mensah and Bawumia (2003), Ocran (2007), Adu and Marbuah (2011) among other empirical studies on the causes of the inflationary process in the Ghanaian economy have arguably pointed out that the high and persistent inflation rates since the late 1970s has been "nurtured" by: monetization of the fiscal deficits, monetary expansion, depreciation of the Ghanaian currency, cyclical food deficits amongst other.

After Ghana attained independence in 1957, the country experienced relative price stability as the inflation rate floated around a single digit. However, the 1970s and early 1980s, saw very high inflationary episodes been recorded. The yearly inflation rates recorded exceeded 100% on four occasions between July 1977 and March 1983. The 1970s in particular was characterized by an upward trend in inflation. Inflation levels remained generally high from 1972 with rates ranging between 10% in 1972 and 123% in 1983, with growth in money supply being 41% and 40% respectively in both years. Whiles the figures for fiscal deficits in that period were 5.7% in 1972 and 2.7% in 1983. The surge in inflation during this period (1972-1983) could be as a result of the excess growth in money supply due to the monetization of the fiscal deficits. The inflation rate then dropped in 1984 to 39% while growth in money supply was 53% and a deficit-GDP ratio of 1.8%. After moderating somewhat during the latter parts of the 1980's and early 90s; government expenditure increases in 1992 which was an election year contributed massively to inflation rates surging from 10.1% in 1992 to 24.81% in 1993 and 59.9% by the end of 1995.

Of recent times the inflation rate has been of relatively low when compared with the 1970's and 80's. In the 2000s, the inflation rate has been between 11% and 34%, with 2001 and 2011 having the highest and the lowest figures of 32.9% and 8.7% respectively. During this same period fiscal deficit as a percentage of GDP was 7.7% (2001) and 4.26% (2011) while growth in money supply was 56.53% for 2001 and 34.04% for 2011.

Figure 1: Trends in growth in money supply, fiscal deficit and inflation in Ghana, 1960-2012



Source: Word Development Indicators, World Bank. Accessed in May 2013

Looking at the trend in inflation rate, growth in money supply and fiscal deficit in Ghana over the period 1960 to 2012 as depicted in Figure 1 above, it is observed that the level of inflation fluctuates above growth in money supply over the period 1974-1984; the inflation rate persistently lied below money supply growth after 1984. This suggests a possible co-movement between inflation and money growth. In other words, the rate of inflation can generally be associated with monetary expansion. This trend in Ghana's inflationary experience, with respect to its close association with growth in money supply, seem to suggest that a rise in the general price level can most often be traced to money supply growth. The growth in money supply in the 1980s was attributed to the high foreign exchange inflows that were monetized by the central bank, and in the 1990s it was due primarily to government deficits (Adu and Marbuah 2011).

Ghana's budget statement from the 1970's up to the 2000's has mostly been in the deficit zone except for 1971 and 1991 which actually saw the economy record surpluses of 0.50% and 1.70% respectively. Of recent times the deficits as a percentage of GDP figures recorded in the economy has been 7.92% for 2008, 5.91% for 2010 and 12.1% for 2012. The persistence increase in the deficits of the public sector is depicted in Figure 1 by its downward trend.

This has led to the belief that Ghana's high inflationary situation could also be attributed to the method employed by the government in financing its debt. In the course of the 1980s, real interest rates were more often than not negative, and the rate of growth in money supply of over 40% was quite common. To finance the deficit, governments over this period relied mostly on monetizing its debt and borrowing internally from the banks and from the public through the issue of debt instruments, which resulted in the high inflationary episodes in the 1980's.

1.2 Problem Statement

The importance of stable prices in attaining macroeconomic stability and providing the congenial environment for achieving sustainable growth in employment and output cannot be overemphasized. As such, ensuring price stability, in the form of low inflation, so as to anchor government's objectives of achieving higher rates of employment and economic growth remains the focal point and the cornerstone of Bank of Ghana's monetary policy. Over the past three decades, Ghana has succeeded in reducing inflation rates from historically high levels to a single digit, of 9.52 percent in June, 2010 and 8.80 percent in January, 2013 (Ghana Statistical Service, Quarterly Statistical Bulletin). However, over the past one-and half years, the country seems to be losing the battle against inflation, as the general price level has steadily edged up to 14.8 percent in May, 2014. The economy is showing signs of deterioration, and the stability of the macroeconomic environment is being threatened as the Cedi is losing its external value against major currencies (i.e. depreciating by 15.8 percent against the US dollar), with public debt to GDP reaching 47.2 percent in 2013 (IMF Country Report, 2013). Furthermore, whereas, ardent monetary policy operations by the central bank has slowed money supply growth in recent years (i.e. dropping from 33.3 percent in 2010 to 20.4 percent in 2013), the country continues to experience rising fiscal deficits and current account deficits (reaching 10.8 and 12.30 percent in 2013 respectively) with detrimental effects on the price stability, economic activities and economic growth in general.

Whereas government is consolidating its fiscal stance by cutting down fuel and utility subsidies and trimming down public sector wages, in order to stabilize the price level and the economy as a whole, the question remains whether we can rely on fiscal prudence alone to curtail the inflationary pressures in the economy. Again, how is the price level jointly affected by both fiscal deficits and expansion in aggregate money supply? Is there a uni-directional, two-way or three-way causal link between fiscal deficits, money supply and inflation rate in Ghana? Finding empirical answers to these questions is what this thesis set out to achieve. The current study differs from existing studies by exploring the extent to which both fiscal and monetary policy interacts to influence the price level in Ghana.

As Ghana continues to combat inflation through the framework of inflation targeting and also achieving its aim in meeting the requirement of joining the West African Monetary Zone (i.e. single-digit inflation rate), understanding the forces that actually explain the dynamics of inflation cannot be overstressed. This study therefore explores the relationship among fiscal deficit, money growth and inflation in Ghana. Specifically, it seeks to find a possible three way relationship from fiscal deficit to money supply growth and then to inflation in Ghana.

1.3 Objectives of Study

The general objective of this study is to empirically analyze the relationship among fiscal deficit, money growth and inflation. Specifically, it seeks to

i. Examine the causal linkage between fiscal deficit and money growth.

ii. Examine the nexus between money growth and inflation.

iii. Examine the causal nexus between fiscal deficit and inflation.

iv. To estimate the effect of fiscal deficit and money growth as well as their interaction on inflation in Ghana.

1.4 Hypothesis

In the empirical analysis of this study, the following hypotheses are tested for their long-run and short-run effects:

A. fiscal deficit has a positive effect on the price level.

B. growth in money supply has a positive effect on the price level.

C. fiscal deficit and money supply has a positive effect on the price level.

1.5 Justification of the Study

It is believed that developing economies such as Ghana tend to experience high inflation when faced with huge and persistent deficits that are monetized. According Lozano (2008) inflation "emerges as a fiscal driven monetary phenomenon", but the question is what if the occurrence of inflation is not as a result of the monetization of deficits? Yet, part of the budget deficits ends up being determined by the inflationary process. Due to this most, empirical studies in Ghana are done using either just the growth in money supply or the fiscal deficit to determine the root cause of inflation with the exception of Adu and Marbuah (2011); however they did not seek to find out the causal linkage among the variables. The study would therefore help bridge the gap in empirical studies by determining the causal relationship between fiscal deficit, money growth and inflation. Apart from bridging the research gap with respect to whether inflation in Ghana is fiscal or monetary driven, the conclusion of the study will be very useful for policy purposes as Ghana seeks to reduce its deficit and inflation rates to stimulate economic growth and also accelerate the improvement in its status from lower middle income to an upper middle income country. The conclusion will also enable policy makers and stakeholders to know the effect of fiscal deficit and money growth on inflation in Ghana. The study will also provide useful information for further studies. The information provided by the study will serve as a reference and guidance material for researchers in the field of public sector macroeconomics and will contribute to the stock of literature.

1.6 Organization

The rest of the study is organized as follows: Chapter two concentrates on the review of relevant theoretical and empirical literature on the interactions (on the causal linkages) between fiscal deficit, money growth and inflation. Chapter three focuses on the methodology, main econometric issues and data sample used in the estimation of the linkages of Ghana's inflation. Chapter four analyses the empirical results of the estimated equations. Finally, chapter five presents a summary of the major findings of the study, recommendation for policy considerations and conclusion of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of theoretical and empirical literature on the interactions of fiscal deficits, money supply and inflation, the chapter is organized in two main sections. The first section is devoted to the review of theoretical literature on inflation. Presented in this section include classical and contemporary theories on inflation. Existing empirical literature on the inflation, fiscal deficit and money supply nexus is reviewed in the second sub-section of the chapter.

2.2 Theoretical Review

This section is devoted to shedding lights on the meaning of the three main concepts under study, followed by a brief survey of theoretical literature on four main opposing views on the linkage between budget deficits, money supply growth and inflation from a theoretical perspective. The main theories of inflation presented in this chapter are: the monetarists' theory, the fiscal theory of the price level, the structuralists theory, and the new Keynesian theory of inflation.

2.2.1 The Concepts of Fiscal Deficit, Money Growth and Inflation

Inflation is an economy-wide phenomenon that concerns, first and foremost, the value of the economy's medium of exchange. When there is an increase in prices, people have to pay more for goods and services. Alternatively, the price level can be viewed as a measure of the value of money. This implies that an increase in the price level means a less significant value of money that is the quantity of goods and services a given amount of money can buy decreases.

Inflation is a continuous and sustained increase in the general prices of goods and services, thus a one-time increase in the general price level cannot be classified as inflation. Because the general price level is expected to stabilize after their one-time jump. Without a continuing increase in the quantity of money, there can be no inflation. This is what Milton Friedman (1963) meant by his memorable aphorism "inflation is everywhere a monetary phenomenon."

Several items have been used to constitute the money supply at different times in economic history. In the 21st century money supply is defined as the amount of money within an economy available for purchasing goods or services at a particular point in time. There are varying conceptions of what is money supply but there are some basic acceptable versions M1 – known as the narrow definition, it looks at money supply in terms of currency in circulation in form of paper currency and coins (c) plus demand deposit. This definition is associated with J.M. Keynes. M2 and M2+ known as broad money – some economists have included to M1 amount held in savings and time deposits. The argument is that even though holders of these accounts do not issue cheques payable on demands, they can easily go to the bank and make immediate cash withdrawals. Even for fixed deposits, they can terminate their fixed deposits by paying some penalties and collect cash ahead of expiry. The central bank which serves as a banker to the government is responsible for controlling the amount of money supply in an economy. When the Central Bank expands money supply, inflation occurs and when it reduces money supply deflation occurs. Growth in money supply implies an increase in the amount of money in circulation at an existing point in time. In most cases, the growth in money supply is attributed to credits extended by the deposit money banks to the private sector.

Governments, all over the world, use fiscal policy, composed of government revenue collection (taxation) and expenditure (spending), to influence the economy towards the achievement of its macroeconomic goals. When governments' spending for a particular budget period or year is more than the revenue it accrues through taxes, donors, foreign aides etc., it is said that the government has a negative or deficit balance or budget. Worded differently, fiscal deficits are defined as the difference between the total government revenue and expenditure during a single budget period, usually a year.

These three macroeconomic variables are closely linked to one another customarily, fiscal deficit on its own does not cause inflationary pressures, but rather it affects prices through its impact on money aggregates and public expectations, which in turn generate movements in prices. Conferring to the classical view, which is rooted in the quantity theory of money (QTM), fiscal deficits cause inflation since governments that run persistent fiscal deficits over time, tend to resort to printing more currency to finance the deficits. Tiwari et al (2012), Prusty (2012), and Hossain (1987), among others arrived at the same conclusion that fiscal deficits cause's inflation.

The link of causality from growth in money supply to inflation rests on Milton Friedman (1963)'s famous theory of money, which dictates that "inflation is always and everywhere a monetary phenomenon." This is concurred by Nelson (2008) in his study when he concludes by saying "By contrast, the proposition that inflation, in the long run, is determined by money growth, goes beneath those high-level assumptions and provides an underpinning for the conviction that the central bank can deliver the long-run inflation rate at its target value". Nikolic (2003) shares the same sentiment, when he concludes in his paper that "we want to reiterate the notion that monetization of the deficit, rather than the deficit themselves has been affecting the price level in Russia."

2.2.2 Theories of Inflation

Various theories have been proposed by various economists in explaining the incidence of inflationary situations in an economy. This section concisely reviews literature from four (4) major theories of inflation. These include the monetarist theory of inflation, the fiscal theory of the price level, the structuralist theory of inflation and the new Keynesian approach.

2.2.2.1 The Monetarist Theory of Inflation

Monetarism suggests that the factors causing inflation in an economy, like Ghana are similar to those causing inflation elsewhere in the world and are primarily a matter of excessive aggregate demand. Thus, monetarists view situations of excess aggregate demand for goods and services over and above the aggregate supply in an economy as the ultimate source of inflationary tendencies. The monetarists' view of inflation relied on the quantity theory of money to provide an explanation of movements in the price level. The quantity theory of money posits that a change in the growth rate of money induces an equal change in the rate of price inflation (Lucas, 1980 cited in Walsh, 2003). Thus from the monetarists' perspective, movements in the price level are solely driven by changes in the quantity of money (Mishkin, 2004).

According to Lozano (2008), given the nominal money supply – being exogenously determined by the monetary authority – the price level is determined as the unique level of prices that will make the purchasing power of the money supply equal to the desired level of real balances. From an operational point of view, it means the central bank seeks to ensure the quantity of money agents want for their transactions. Hence given a price level, if the nominal money supply differs from the desired real balances, it will translate into changes in that price level.

Mishkin (2004) noted that in monetarist analysis, money supply is viewed as the sole source of shifts in the aggregate demand curve. Using aggregate demand and aggregate supply curves, the author showed that if monetary policy is accommodative such that money supply is always rising in response to increasing aggregate demand (usually for the purposes of financing persistent budget deficits), output rises initially above the natural level but after some time the economy returns to its potential level of output. However, this occurs at the expense of permanent higher prices, which results in inflation. This is because the resulting unemployment below the natural rate level will cause wages to rise, and the aggregate supply curve to quickly fall. It will stop shifting only when it reaches the level at which the economy has returned to the natural rate level of output on the long run aggregate supply curve. At the new equilibrium, the price level will increase. As long as the money supply grows, this process will continue, and inflation will occur. That is according to the monetarist, inflation will only occur if the central back monetizes the government debt.

By this approach, a higher budget deficit increases deficit financing, which allows the central bank to allocate more money to the government through various sources to funding its deficit. It increases high-powered money and the nation's money supply, thereby increasing the price level of the economy. An extensive literature has examined the relationship between the budget deficit and inflation. At a theoretical level, Sargent and Wallace (1981) showed that under certain conditions, if the time paths of government spending and taxes are exogenous, bond-financed deficits are not sustainable, and the central bank should eventually monetize the deficit, this will increase the money supply and inflation in the long run. Thus, budget deficits can lead to inflation, but only to the extent that they are monetized. Given that inflation rate is determined exclusively by the change in money supply relative to the change in output, the monetarists' view of inflation implies that price stability can be achieved by ensuring that the central bank is unwaveringly committed to curtailing the growth in money supply.

However, a rethinking of the foundations of the monetarists' doctrine has given rise to an unorthodox view that a tough, independent central bank does not suffice for price stability. As Kocherlakota and Phelan (1999) argued "there is a large hole in this simple, static reasoning. How much money a household wants to hold today depends crucially on that household's beliefs about future inflation. As it turns out, this dependence of current money on beliefs about future inflation creates a possibility of a large number of equilibrium paths of inflation rates. Thus, control of the money supply alone is not sufficient to pin down the time path of inflation rate (Kocherlakota and Phelan). In other words, since there are many paths of the price level, the equilibrium price level is not uniquely determined by the famous equation of exchange underlining the monetarists' view there are many paths of that satisfy it as well as all the other equilibrium requirements.

2.2.2.2 The Fiscal Theory of the Price Level

The fiscal policy of the price level, developed by Leeper (1991), Sims (1994), and Woodford (1994, 1995, 2001), traces its origins to this incompleteness in the monetarist view of inflation (i.e. the equilibrium price level is not to be uniquely determined, by monetary policies).

The fiscal theory of the price level (FTPL) describes policy rules such that the price level is determined by government debt and the present and future tax and spending plans, with no direct reference to monetary policy. The main point behind the FTPL is indeed the idea that the price level is determined through the inter-temporal government budget constraint. That is, the price level adjusts in order to ensure that the value of nominal government debt, divided by the price level, equals the real present value of future budget surpluses.

In other words, the price level equals the ratio of nominal government liabilities to the present value of future budget surpluses in real terms. The main point emphasized by proponents of, the FTPL is that, the present value government budget constraint and fiscal policy play a crucial role in the determination of the price level. Where the present value of government budget constraint is given as

$\frac{B}{P}$ = discounted sum of expected primary surpluses…………………………………… (2.1)

Where B is the nominal debt and P is the price level.

The FTPL theory holds that it is fiscal, but not monetary, policy that determines the price level and becomes the nominal anchor. The principles of fiscal theory of price level require that it is necessary to have appropriate fiscal policy and also an adequate monetary policy to achieve price stability. According to the fiscal theory, the government can instead target directly the price level using fiscal variables alone, such as the present value of future surpluses and the current level of nominal debt. The role of money is so minor that it is sometimes neglected altogether (Bassetto, 2001).

FTPL basically demonstrates that fiscal policy plays a crucial role in the determination of the price level. To Sargent and Wallace (1981), the money authorities are the sole determinant of the price level and fiscal policy is assumed to passively adjust primary surpluses to guarantee credit worthiness of the government for any price level. This is what is referred to as Ricardian price determination as noted by Woodford (1995). FTPL however purports the idea that fiscal authority should be free to choose primary surpluses independently of government debt, leaving the price level to adjust to satisfy the present value of government budget constraint; this Woodford (1995) refers to as the Non – Ricardian fiscal regime.

Under FTPL the price level or inflation is determined by the need to impose fiscal solvency; thus it is set at the value necessary for the government inter-temporal budget constraint to hold at the market value of outstanding debt. Given this determinate price level, money supply growth, interest rates and output are determined recursively as the values required by the rest of the model to permit this price level.

2.2.2.3 The Structuralist Theory of Inflation

The structuralist school of thought stresses structural rigidities as the principal cause of inflation in developing countries. Structuralism holds the view that inflation is a necessary condition for growth. They are of the idea that inflation is a purely non-monetary phenomenon, it is driven by "cost-push" factors, and these factors dominate the conduct of inflation regardless of what course monetary policy takes. Thus cost-push causes of inflation result when cost in production increases independently of aggregate demand. To them inflation is not triggered merely by the excess of demand over supply but built into an economy due to the government's monetary policy. In the words of Sunkel (1969:6) cited in Khabo (2002), "the structuralist position on inflation is a reaction to the stabilization policies pursued by the Latin American governments on the advice of the International Monetary Fund (IMF), these policies were considered harmful rather than merely austere and growth promoting."

One important argument of the structuralist school is that the roots of inflation can be found in bottlenecks of "inelastic supply" in the agricultural sector. This is emphasized by Boianovsky

(2010) "according to the structuralist, the basic factor behind chronic inflation in underdeveloped countries such as Brazil was that the pace of diversification of aggregate demand was much quicker than that of corresponding changes in the composition of aggregate supply that is a "particularly inelastic supply function." Latin American structuralist will grant that the money supply may increase along with the price level. Unlike monetarists, however, they believe that the money stock is responding to inflation rather than initiating it.

2.2.2.4 The New Keynesian Approach

Keynesian economists argued that, generally, budget deficit per se does not cause inflationary pressures, but rather affects the price level through the impact on money aggregates and public expectations, which in turn trigger movements in prices. In the Keynesian view, a one-shot increase in government expenditure leads to only a temporary increase in the inflation rate, not to an inflation in which the price level is continually rising. If, however, government spending increased continually, we could get a continuing rise in the price level.

It appears, then, that Keynesian analysis could reject Friedman's proposition that inflation is always the result of money growth. The problem with this argument is that a continually increasing level of government expenditure is not a feasible policy. There is a limit on the total amount of possible government expenditure; the government cannot spend more than 100% of GDP. In fact, well before this limit is reached, the political process would stop the increases in government spending (Mishkin, 2004).

Keynesians argued that, money supply is only one of the components of aggregate demand and therefore cannot solely be responsible for increases in the general price level rather it is aggregate demand that entirely influences inflationary situations in a country. Keynesians believe that, factors that influence aggregate demand in the economy (money supply inclusive) are responsible for the persistent rise in price levels in an economy.

Ackay et al (1996) pointed out that there are two other possible channels through which higher deficits lead to higher inflation. Firstly, the government's borrowing requirements normally increase the net credit demands in the economy, driving up the interest rates and crowding out private investment. The resulting reduction in the growth rate of the economy will lead to a decrease in the amount of goods available for a given level of cash balances and hence the increase in the price level. Secondly, deficits can also lead to higher inflation even when Central Banks do not monetize the debt when the private sector monetizes the deficits. This occurs when the high interest rates induce the financial sector to develop new interest bearing assets that are almost as liquid as money and are risk free. Thus, the government debt not monetized by the Central Bank is monetized by the private sector and the inflationary effects of higher deficit policies prevail.

In the New Keynesian framework, the relationship between money growth, inflation and budget deficit can be derived from two equations; the aggregate supply (inflation equation) and the aggregate demand. That is given an output gap and inflation expectations, if agents expect government expenditure to rise in the next period, it is reasonable to expect a slowdown in private consumption in the next period, hence lowering output and inflation. Hence individual expectations about fiscal actions could affect inflation directly and induce money expansion through a higher price level.

2.3 Empirical Review

In empirical literature, numerous models have been developed to analyze the long-run relationship among inflation, money supply and budget deficit. However, evidence from the empirical literature is mixed.

In a cross-country study involving four developing countries, namely, Brazil, Colombia, the Dominican Republic and Thailand, Aghevli and Khan (1978) investigated the money supply growth - inflation relationship using time series data over the period 1964-1974 for Brazil and 1961-1974 for the others. Aghevli and Khan (1978) using the three-stage least squares (3SLS) and other econometrics procedures confirmed their hypothesis that financing a deficit incurred in an economy that is experiencing inflation would lead to increase in the money supply which would further aggravate the inflation situation in that economy. They established that there was a two -way causal relationship between increases in money supply and inflation.

Ackay et al (1996) investigated the long-run relationship between budget deficits, money and inflation, and the short-run changing aspects of the inflationary process using annual data for the period 1948-1994 and quarterly data for 1987Q1-1995Q4 in their study of the Turkish economy. Employing the vector autoregression (VAR) and vector error correction (VEC) models, they found that increases in the budget deficit had positive effects on inflation in Turkey. However, they also found using the unrestricted VAR that both budget deficits and money supply did not influence inflation in any significant way.

In studying the Turkish economy using data 1950-1987, Metin (1998) argued that while the monetization of deficits and budget deficits increases inflation, the rate at which the former increases inflation is slower than the latter which increases inflation with immediate effect.

Using cointegration analysis, he concluded that budget deficit, real income growth and monetization of debt have effects on the level of inflation in Turkey.

Solomon and de Wet (2004) examined the deficit-inflation relationship in the Tanzanian economy and established the causal link that ran from the budget deficit to the inflation rate using vector autoregressive model (VAR), and Johansen co-integration analysis over the period 1967-2001. They found that there exist a stable long run relationship between the budget deficit, exchange rate, GDP and inflation, the present study goes beyond the impact of fiscal deficit on inflation, to account for the influence of monetary factors, as postulated in theoretical literature on inflation

Vuyyuri and Seshaiah (2004), by applying the well-known cointegration approach and Vector Error Correction Model (VECM) for the period 1970-2002, explored the long run relationship between budget deficits and other macroeconomic variables (i.e. nominal effective exchange rate, GDP, consumer price index and money supply (M3)) in India. Their estimates provided evidence of a long run relationship among the variables under study. However, they found no significant relationship between budget deficit and GDP, money supply and consumer price index in India.

Hossain (2005) studied the inflationary dynamics in the Indonesian economy using an annual data, spanning from 1952-2002 but breaking them into two sub-samples together with co-integration and other econometrics model. He established that the CPI, the stock of narrow (M1) or broad money (M2) and real permanent income form a (feebly) co-integral relationship for the whole sample period.

Another study conducted by Nachega (2005) examined the fiscal dominance hypothesis in the Democratic Republic of the Congo (DRC) during 1981-2003. The author established that in the long-run, there exist a strong and statistically significant relationship between budget deficits and seigniorage, and between money creation and inflation. He also found that deviations of real money balances from their long-run equilibrium level and changes in output growth through the money supply impacted directly or indirectly, on the short-run dynamics of inflation.

Using a multivariate cointegration analysis and data from 1875 – 1991, Hendry (2006) in his study on modeling inflation in the United Kingdom (UK), established that the determinants of UK's inflation included excess demand for goods and services, world price inflation, the short-long term interest – rate spread, the markup, nominal money growth, community price inflation and interest changes. However he found that excess money, excess debt and excess labour demand were statistically insignificant in determining inflation in the UK. He established that no single variable could explain the cause of inflation. He concluded his study by writing "the results remain tentative, but are consistent with the basic framework that inflation is the resultant of the many excess demands and supplies in the economy."

Narayan, Narayan and Prasad (2006), and also modeled the relationship between fiscal deficits, money supply and inflation in Fiji using annual data for the period 1970-2004, with the framework of the ARDL and Granger causality test. They found that fiscal deficits and changes in money supply generally induce inflation in Fiji. They also found deficits, money supply and inflation to be cointegrated, and that in the long run both money supply and deficits 'Granger-cause' inflation.

Vizek and Broz (2007) explores the inflationary dynamics in Croatia using a series of econometrics approaches and quarterly data from 1995 - 2006. They established that the relationship between mark-up and excess money is a dominant factor in influencing the short run dynamics of inflation, as well as output gap and nominal effective exchange rate, import prices, interest rates and narrow money. Based on the results they conclude that inflation in the short-run is more reactive to changes in the supply side conditions and exchange rate than to monetary conditions.

Lozano (2008) also looked at the causal long-term relationship between budget deficits, money growth and inflation in Colombia, considering the standard (M1), the narrowest (M0-Base) and the broadest (M3) definitions of money supply, using a vector error correction (VEC) model with quarterly data from 1982-2007. He found that there exist positive relationship between inflation and money growth on one hand, and between money growth and fiscal deficit, on the other. He came to the conclusion, after running several statistical tests, that the Sargent and Wallace hypothesis would be the most appropriate approach to understanding the dynamics of these variables that is fiscal deficits, money growth and inflation.

Using cointegration and other econometric models to study the linkages among budget deficits, money and inflation in Ethiopia for 1964–2003 Wolde-Rufael (2008), established that the relationship between budget deficit and inflation is of a long run phenomenon and not short run. Hence to him short run inflation was not as a result of budget deficit but could be as a result of structural rigidities. He established that other than money growth, budget deficits also had a significant role in the occurrence of inflation in the Ethiopian economy. However, Wolde-Rufael failed to examine whether there was a link from budget deficit to money supply in the Ethiopian economy.

A cross-country macroeconomic analysis of growth in money supply and its effect on other macroeconomic variables in the West African Monetary Zone, using variables such as money supply, interest rate, exchange rates, fiscal deficits and gross domestic product, found that the occurrence of inflation in each of the selected country depended on certain peculiar circumstances pertaining to that country in question (Freetown, 2009).With regards to Ghana they found that there exist a positive relationship between inflation and money supply, which they concluded by saying was linked to the expansionary monetary policy that had been undertaken by Ghana from 2000 to 2008 (Freetown, 2009).

Sahan and Bektasoglu (2010) in their study found out that in developed countries like Austria, Belgium, Denmark, France, Germany, Italy etc. there was no co-integration between budget deficits and inflation. But in developing countries like Czech Republic, Greece, and Turkey etc. they showed that there was cointegration between budget deficit and inflation implying that there exist a long run relationship between budget deficit and inflation. Hence their result showed that even though budget deficit and inflation has long run positive relationship in some of the countries, it has a negative relationship in other countries. The overall inference drawn from the paper is that there is no identical or homogeneous relationship between budget deficit and inflation in the long run for all countries, as this relationship evolves with the structural changes and overall economic development of the economies understudy.

Using quarterly data over the period 1963Q1-2009Q4, Amisano and Fagan (2010) modeled the inflationary experience of Canada, the Euro Area, UK and USA, within the framework of a Markov switching model. In this framework, inflation is model as a regime-switching process. By employing Bayesian techniques, they found that that money growth serves as a vital early cautionary indicator for risks to price stability. They concluded their work by saying "These caveats notwithstanding, we believe that the results are sufficiently robust to support the claim that money growth is a leading indicator of shifts in inflation regime. Thus it would be unwise of central banks to neglect the information contained in money because of recent evidence on the limited forecasting performance of money for inflation in the recent low-inflation period."

Mukhtar and Zakaria (2010) examined empirically the link between deficits, money supply and inflation in the Pakistan with quarterly data for the period 1960-2007. The estimation results, using the Johansen (1998) and Johansen and Juselius (1990) maximum likelihood cointegration technique and Granger causality test, suggested that monetary growth significantly influenced inflation. In particular, they found that increases in money supply were the main determinant of inflation in the Pakistani economy. However they did not find any long run relationship between deficits and inflation. Worded differently, the authors did not find any evidence in support for the accommodation hypothesis which suggests that changes in budget deficit lead to changes in monetary expansion in Pakistan.

Using the Johansen co-integration approach and annual data running from 1980-2005, Makochekanwa (2011), in his study of the Zimbabwean economy found a causal relationship running from budget deficit to inflation. He also confirmed the existence of a long run relationship between exchange rate, GDP and inflation in the Zimbabwean economy. The author concluded that higher levels of inflation and its impact on the economy where experience when budget deficits were immensely monetized.

In analyzing the relationship between budget deficits and inflation in the Iranian economy, Mehdi and Reza (2011), came to the conclusion using the ARDL technique and data from 1975 – 2006 that changes in the budget deficit lead to changes in inflation.

Habibullah, Chee-Kok, and Baharom (2011) surveyed the long run relationship between budget deficits and inflation for thirteen selected Asian developing countries which are namely; Indonesia, Malaysia, the Philippines, Myanmar, Singapore, Thailand, India, South Korea, Pakistan, Sri Lanka, Taiwan, Nepal and Bangladesh by annual data for the period 1950-1999. Using co-integration and an error- correction model (ECM) they established that there exist a long run relationship between budget deficit, inflation and money supply. They found that budget deficits lead to the occurrence of inflation in the short run in three (Sri Lanka, Bangladesh and South Korea) out of the thirteen counties under study. In sum, they concluded that inflation in the thirteen Asian developing countries were as a results of the existence of budget deficits.

In the case of Sri Lanka, Ekanayake (2012), investigated validity of the hypothesis that there is a link between fiscal deficits and inflation in developing countries and further explores this link in the absence of public sector wage expenditure. An ARDL model is employed in the analysis, using annual data from 1959 to 2008. The results suggest that, in the long run, a 1 percentage point increase in the ratio of the fiscal deficit to narrow money is associated with about an 11 percentage point increase in inflation. This link becomes weaker in the absence of the public sector wage expenditure. The overall inference is that inflation is not only a monetary phenomenon in Sri Lanka and public sector wage expenditure is a key factor in explaining the deficit-inflation relationship.

Examining whether budget deficit in Nigeria for the year 1980-2009 was inflationary or not, Awe and Shina (2012), concluded using time series data and vector error correction Mechanism (VECM) that there exists a causal relationship from budget deficit to inflation while the reverse did not hold. They found that so far as there was increase in the money supply, budget deficits had direct or indirect impact on inflation.

In using an ARDL model to empirically investigate the relationship between budget deficit and inflation in Nigeria covering the period 1970-2009, Anayochukwu (2012) found that inflation in Nigeria is contingent on the performance of the budget deficit and that there is a unidirectional causality running from fiscal deficits to inflation.

Tharaka and Ichihashi (2012) employed the vector autoregressive (VAR) model in analyzing the relationship and the causal linkages between government budget deficits, source of financing deficits and inflation for Sri Lanka. Using time series data from 1950 to 2010, they established that budget deficit causes inflation, and that there exist a positive relationship between budget deficit and inflation. The causality test also showed that there was bidirectional causality between budget deficits and inflation. In other words, budget deficits granger causes' inflation and inflation also granger causes budget deficits.

2.3.1 Empirical Literature on Ghana's Inflationary Experience

Sowa and Kwakye (1993) investigated all the possible causes of inflation in the Ghanaian economy for the period 1962-1982 using a Cochrane-Orcutt technique and the OLS estimator. The sources identified were growth in money and output, the rate of exchange and anticipated prices; they discovered that most of the factors individually were significant in impacting on inflation with supply constraint emerging as the strongest driver of the inflationary process over the period. Exchange rate devaluation was also found to be a cause of inflation in Ghana, which to the authors is a result of their extended data. Sowa and Kwakye (1993) demonstrated in their paper that real factors rather than monetary elements are culprits of inflation in Ghana.

Using an error-correction model (ECM), Sowa (1996) estimated an inflation equation for Ghana during the ERP era. He established that in the long run the influences of output and money on the inflationary spiral in Ghana were of equal magnitude while in the short run the effect of output on inflation was more pronounced than that of money. This implies that changes in output have more impact on the inflationary process in Ghana either in the short or long run. Explaining why monetary pressures could not explain the short run price increase during the ERP era, Sowa noted that every reform instituted under the ERP in the financial sector had little difference as before the program started with it maintaining the same high average of around 40%, this probably had given the illusion that inflation was simply a monetary phenomenon. However, it was noticed that the primary growth of money under the adjustment program was from external inflows and these was enough to alleviate supply pressures. Working on the hypothesis that "an unsustainable fiscal policy would make government miss some macroeconomic targets" he was of the view that whenever the set target for inflation was not achieved it meant that government was not able to sustain consistent fiscal deficits as was the case 1986-1988, periods in which inflation was well above the set target and that the vice versa was true, as it happened in 1985 and 1989 which was during the EPR era.

Bawumia and Abradu-Otoo (2003), examined the relationship between monetary growth, exchange rates and inflation in Ghana using co-integration and an error correction mechanism. The empirical results confirm the existence of a long-run equilibrium relationship between inflation, money supply, the exchange rate, and real income. Their findings depicted that in the long-run, inflation in Ghana is positively related to the money supply and the exchange rate, while it is negatively related to real income.

In exploring the poor performance of the Ghanaian economy in the 1990s, and aiming to provide a quantitative analysis of both the macro and sectoral behavior of the economy, Kraev (2004), accumulating a yearly time series of Social Accounting Matrices and a monthly series of financial stocks, arranged in Financial Accounting Matrices, for the 1990-2001, and using an Autoregressive Integrated Moving Average with eXogenous variables (ARIMA-X) technique came to a few conclusion. Some of the conclusion arrived at were that the pace at which the agricultural sector was growing was determined by supply while that of the industrial sector was driven by demand and that there was a positive relationship between growth in broad money and inflation. The CPI inflation was determined by growth in broad money, wholesale price of food crops and price of fuel, with growth in broad money being the main determinant of CPI inflation.

Ghartey (2001), using a class of vector correction models, granger causality, impulse response functions and data from 1972-1992 concluded that fiscal deficit was inflationary in Ghana between that period. Ghartey opined that this outcome was as a result of the increase in money supply which was due to the government printing more money to finance its budget deficit and leading to a stunted economic growth.

Using the Johansen cointegration test and an error correction model Ocran (2007) also, studied the causes of inflation in Ghana between 1960 and 2003. He found that the determinants of inflation in the short run included inflation inertia, changes in money supply, changes in Government of Ghana Treasury bill rates and changes in exchange rate. With regards to the long run, he found the principal determinants of inflation in Ghana to be inflation inertia, which was followed by growth in money supply. He also found that excess money supply did not have any influence on inflation in the long run.

Adu and Marbuah (2011) provided an empirical analysis of the factors accounting for inflation dynamics in Ghana using the bounds test and other econometric approaches. In consensus with previous studies, they found that a combination of structural and monetary factors explain Ghana's inflationary experience. In particular, they found that real output, nominal exchange rate, broad money supply, nominal interest rate and fiscal deficit play a dominant role in the inflationary process in Ghana. Their findings that, output growth by far had the strongest impact on inflation revealed that, targeting supply-side constraints will help moderate price inflation.

Insah and Ofori-Boateng (2012) for the Ghanaian economy employed the use of a static error correction model (ECM) and the Stock-Watson dynamic OLS (DOLS) model to study the dynamic relationship among fiscal deficits, money supply, and inflation with annual data from 1980 to 2010. They established that while money supply and inflation has a positive relationship, the opposite was for fiscal deficit and inflation. They found out that, money supply and fiscal deficits had substantial influence on the inflationary process in Ghana and they also established that both the current and past values of money supply had influences in the dynamics of the inflationary process in Ghana.

Agreeing with other studies that growth rate of real GDP and the increases in money supply are the main factors that cause the dynamics inflation in Ghana, with money supply being the key determinant. Gyebi and Boafo (2013) in their study using the OLS estimator established that growth in money supply and the exchange rate are the main determinants of inflation in Ghana.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Data Source

All data used are solely secondary annual time series data for the period 1960 – 2012, the data used were compiled from two main sources. While the main variables being studied were money supply, fiscal deficits and inflation, other variables known to influence the general price level such as interest rate, exchange rate and real income have been controlled for. Data on real gross domestic product (Y) and money supply (MS) as a percentage of GDP (M1, M2 and $M2^{+}$) were obtained from the World Development Indicators (WDI) available online at The World Bank's database. Data on fiscal deficits (FD), exchange rate (EX), consumer price index (CPI) or the price level (P), as well as the interest rate (IR) were obtained from the annual reports of the Bank of Ghana. The choice of the sample period and the variables in this study was influenced by the availability of data on all the variables used in the study and the relative importance of each variable.

3.2. Specification of the model

A simple theoretical model explaining the determinants of inflation in a developing country like Ghana is presented below. The study adapts the framework presented by Adu and Marbuah (2011) with a little modification. The baseline model is specified as

$$P_t = f(Y_t, IR_t, EX_t, M_t^s, FD_t, P_{t-1}) \qquad (1)$$

Equation (1) then becomes estimable in a log linear form as

$$\ln P_t = \sim_0 + \sim_1 \ln Y_t + \sim_2 \ln IR_t + \sim_3 \ln EX_t + \sim_4 \ln M_t^s + \sim_5 \ln FD_t + \sim_6 \ln P_{t-1} + \pounds_t \text{......................}(2)$$

Empirically evidence on the direction of causality between fiscal deficits, money supply and inflation remains unresolved or inconclusive. However Sargent and Wallace (1981) proved theoretically that under certain conditions, if the time paths of government spending and taxes are exogenous, issuing of debt (bond) financing deficit becomes unsustainable, and the central bank would eventually monetize the deficit; which would increase money supply in the long run. Hence basing on the Sargent Wallace Hypothesis (SW-H) an interaction between money growth and fiscal deficit is introduced into equation (2), to test for the direction of causality between fiscal deficit, money supply and inflation in the Ghanaian economy.

Therefore, in testing for our fourth hypothesis we incorporate the interactive term M^sFD into equation (2), which then becomes our long-run equilibrium relationship for the general price level for the Ghanaian economy. This is modeled as:

$$\ln P_t = \sim_0 + \sim_1 \ln Y_t + \sim_2 \ln IR_t + \sim_3 \ln EX_t + \sim_4 \ln M_t^s + \sim_5 \ln FD + \sim_6 \ln M_t^s FD_t + \sim_7 P_{t-1} + \pounds_t \text{......................}(3)$$

$\sim_0$, is the general intercept and $\sim_1 .... \sim_6$ are all elasticity coefficients. $\pounds_t$ is the white noise error term, (i.e. it is assumed to identically and independently distributed with zero mean and a homoscedastic variance) and not correlated with the independent variables. Depreciation of the domestic currency (an increase in the nominal exchange rate (EX)) and nominal interest rate (IR) are expected to be positively related with domestic inflation. The average of annual 90-day Treasury bill rate is used as a proxy for the interest rate. To explain why the response of the price level with respect to the exchange rate is positive, we observe that changes in the exchange rate can contribute to the general price level either directly through their impact on the costs of imported consumer goods or indirectly through their impact on the costs of intermediate goods. Real income (Y) is expected to have a negative marginal effect with the general price level. In this study the real GDP is use as a proxy for real income. Economic theory predicts that the partial derivatives of price with respect to money supply be positive. All other things being equal, the monetary theory of inflation predicts a positive response of the general price level with respect to money supply. This is due to the quantity theory of money which assumes a constant velocity of money when the economy is operating under full capacity. During such a state, any persistent increase in money supply will lead to an increase in the general price level and thus spark off inflationary pressure (Laryea & Sumaila 2001). The study uses three monetary aggregates (M1, M2 and M2+) to model the impact of monetary expansion on inflation in Ghana. Fiscal deficit and the interacted variable (M^SFD) are also expected to be positively correlated with the rate of inflation.

3.3 Estimation Strategy

In this section we briefly discuss the time series modeling strategies employed to estimate the parameters in the model specified in equation (3) in order to accomplish the objectives of the study. Modern econometric analysis of time series data follows three sequential steps. First, the order of integration of the underlying time series needs to be determined using a standard unit root testing procedures. Once the order of integration has been determined, the existence of long run equilibrium relationship is established, as a second step, using a standard cointegrating testing procedure. These first two steps provide a guide on the appropriate data transformation and choice of estimator that ensures efficient and consistent identification of model parameter. As a final step, the long and short run parameters of the model are estimated and inference performed. This is the approach taken in this study.

3.3.1 Unit Root Tests

Given that most macroeconomic time series, such as money supply, fiscal deficits, inflation rates, exchange rates, interest rates and income exhibit nonstationary over time, using the conventional ordinary least squares estimator to estimate regression models involving these nonstationary variables will produce biased and spurious results. Moreover, as Gujarati (2004) noted, if the underlying time series are nonstationary, we can study their behavior only for the time period under consideration and as a consequence, it is not possible to generalize it to other time periods, and for that matter, utilizing the results for the purpose of forecasting will be misleading.

Hence to ensure the reliability of our analysis, we first examine the stationarity of the underlying variables using the Augmented Dickey-Fuller (ADF) unit root test proposed by Dickey and Fuller (1979) as well as the Phillips-Perron (PP) unit root test developed by Phillips (1987) and Phillips and Perron (1988). In both the *PP* and *ADF* unit root tests the null hypothesis is that the series is non-stationary and this is either accepted or rejected by examination of the t-ratio of the lagged term compared with the tabulated values. If the t-ratio is less than the critical value the null hypothesis of a unit root (i.e. the series is non-stationary) is accepted. If so the first difference of the series is evaluated by the equation and if the null hypothesis is rejected the series is considered stationary and the assumption is that the series is integrated of order one I(1). Critical values for this t-statistic are given by the one-sided Mackinnon (1996). Details of the rigorous computational procedures of the test statistics can be gleaned from Greene (2008), and Phillips-Perron (1988).

3.3.2 The ARDL Cointegration Framework

The Johansen cointegration technique has being employed by a significant number of past studies in determining the long-term relationships between variables of interest. In fact, this remains the technique of choice for many researchers who argue that this is the most accurate method to apply for *I*(1) variables. Recently, however, a series of studies by Pesaran and Shin (1996); Pesaran and Pesaran (1997); Pesaran and Smith (1998) and Pesaran *et al*. (2001) have introduced an alternative cointegration technique known as the 'Autoregressive Distributed Lag (*ARDL*)' bound test. This technique has a number of advantages over Johansen cointegration techniques.

To begin with, the ARDL cointegration procedure is relatively more efficient in small sample data sizes as is the case in this study. This study covers the period 1960–2012 inclusive. Thus, the total observation for the study is 52 which is relatively small. Again the ARDL enables the cointegration to be estimated by the ordinary least square (OLS) method once the lag of the model is identified. This is however, not the case of other multivariate cointegration techniques such as the Johansen Cointegration Test developed by Johansen (1990). This makes the ARDL procedure very simple. Finally the ARDL procedure does not require the pretesting of the variables included in the model for unit roots compared with other techniques such as the Johansen approach. It is applicable regardless of whether the repressors' in the model are purely I(0), purely I(1) or a combination of I(0) and I(1).

According to Pesaran and Pesaran (1997), the *ARDL* approach requires the following two steps. In the first step, the existence of any long-run relationship among the variables of interest is determined using an F-test. The second step of the analysis is to estimate the coefficients of the long-run relationship, followed by the estimation of the short-run coefficients of the variables in the error correction representation of the *ARDL* model. By applying the *ECM* version of *ARDL*, the speed of adjustment to equilibrium will be determined.

In order to implement the bounds test procedure for cointegration, the following restricted (conditional) version of the *ARDL* model is estimated to test the long-run relationship between the price level and its determinants:

$$\Delta \ln P_t = \ _0 + \sum_{i=1}^{p} ¡_i \Delta \ln P_{t-i} + \sum_{i=1}^{p} ¢_i \Delta \ln Y_{t-i} + \sum_{i=1}^{p} ¬_i \Delta \ln IR_{t-i} + \sum_{i=1}^{p} ¤_i \Delta \ln EX_{t-i} + \sum_{i=1}^{p} ¯_i \Delta \ln M^s_{t-i} + \sum_{i=1}^{p} ¦_i \Delta \ln FD_{t-i} +$$
$$+ \sum_{i=1}^{p} °_i \Delta \ln M^s_{t-i} FD_{t-i} + \sum_{i=1}^{p} ±_i \Delta \ln P_{t-1} + ¥_0 \ln P_{t-i} + ¥_1 \ln Y_{t-i} + ¥_2 \ln IR_{t-i} + ¥_3 \ln EX_{t-i} + ¥_4 \ln M^s_{t-i}$$
$$+ ¥_5 \ln FD_{t-i} + ¥_6 \ln M^s_{t-i} FD_{t-i} + ¥_7 \ln P_{t-1} + « \text{...} (4)$$

Where all variables have been previously defined and Δ is the first difference operator, $«_t$ is the white noise error term and $\ _0$ is the constant term. The parameters ¡, ¢, ¬, ¤, ¯, ¦, °, ± on the difference of the independent variables represent the short-run dynamics of the model to be estimated through the error correction framework and $¥_i$ are the long run multipliers, in the *ARDL* model.

3.3.3 ARDL Bounds Testing Procedure

The ARDL Bounds testing procedure is done in two steps. The first step is to estimate equation (4) by the ordinary least square (OLS) estimator in order to test for the long-run relationship among the variables. This is done by conducting an F-test for the joint significance of the coefficients of lagged levels of the variables.

The hypothesis would be:

$$H_0 : ¥_0 = ¥_1 = ¥_2 = ¥_3 = ¥_4 = ¥_5 = ¥_6 = ¥_7$$
$$H_1 : ¥_0 \neq ¥_1 \neq ¥_2 \neq ¥_3 \neq ¥_4 \neq ¥_5 \neq ¥_6 \neq ¥_7$$

The test which normalizes on price (P) is denoted by

$$F_P\left(P \middle| Y, IR\ ,\ EX, M^s,\ FD, M^s FD\right)$$

Two asymptotic critical values bounds provide a test for cointegration when the independent variables are I(d) (where 0 ≤ d ≤1).The lower bound values assumed that the explanatory variables are integrated of order zero, or I(0), while the upper bound values assumed that they are integrated of order one [I(1)]. Therefore, if computed F-statistic falls below the lower bound value, I(0), the null hypothesis of no cointegration cannot be rejected. On the other hand, if the computed F-statistic exceeds the upper bound value, I(1) it is concluded that inflation and its determinants are cointegrated and approach a long-run equilibrium. However, if the test statistic lies between these two bounds, the result is inconclusive.

In order to implement the bounds test procedure for cointegration, the following restricted (conditional) version of the *ARDL* model is estimated to test the long-run relationship between the general price level and its determinants:

$$\ln P_t = ¬_0 + \sum_{i=1}^{p} ¥_1 \ln P_{t-i} + \sum_{i=0}^{q} ¥_2 \ln Y_{t-i} + \sum_{i=0}^{r} ¥_3 \ln IR_{t-i} + \sum_{i=0}^{s} ¥_4 \ln EX_{t-i} + \sum_{i=0}^{t} ¥_5 \ln M^s_{t-i} + \sum_{i=0}^{u} ¥_6 \ln FD_{t-i} +$$
$$\sum_{i=0}^{v} ¥_6 \ln M^s_{t-i} FD_{t-i} + µ_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The estimation of equation (5) involves selecting the orders of the ARDL$(p,\ q, r, s, t, u, v)$ long-run model using the Schwarz Bayesian Criterion (*SIC*). SIC was chosen over the AIC because it is a consistent estimator.

Finally, we obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as:

$$\Delta \ln P_t = \ _0 + \sum_{i=1}^{n} \text{¡}_i \Delta \ln P_{t-i} + \sum_{i=1}^{n} \text{¢}_i \Delta \ln Y_{t-i} + \sum_{i=1}^{n} \text{¬}_i \Delta \ln IR_{t-i} + \sum_{i=1}^{n} \text{¤}_i \Delta \ln EX_{t-i} + \sum_{i=1}^{n} \text{¯}_i \Delta \ln M_{t-i}^{s} +$$

$$\sum_{i=1}^{n} \text{¦}_i \Delta \ln FD_{t-i} + \sum_{i=1}^{n} \text{°}_i \Delta \ln M_{t-i}^{s} FD_{t-i} + \cdot\ ecm_{t-1} + \text{²}_t \text{...(6)}$$

From equation (6), the coefficients represent the short-run dynamics coefficients of the model's convergence to equilibrium. ECM_{t-1} is the Error Correction Model. The coefficient of the Error Correction Model, · measures the speed of adjustment to obtain equilibrium in the event of shocks to the system.

3.4 Tests for Causality

The next step after establishing the presence of cointegration is to determine the causal relationship between our three variables of interest being money supply, fiscal deficits and inflation. This is accomplished by employing the Granger causality test due to Granger (1969). The main idea of the Granger causality test is to examine whether the past values of one variable contains information relevant to the prediction of another variable. Therefore, in a regression of Y on other variables (including its own past values) if we include past or lagged values of X and it significantly improves the prediction of Y, then we can say that X (Granger) causes Y. A similar definition applies if Y (Granger) causes X. In this study, the Granger causality test is specified as;

$$P_t = \sim_{10} + \sum_{i=1}^{p} \sim_{11}^{i} P_{t-i} + \sim_{12}^{0} MS_t + \sum_{i=1}^{p} \sim_{12}^{i} MS_{t-i} + \sim_{13}^{0} FD_t + \sum_{i=1}^{p} \sim_{13}^{i} FD_{t-i} + \pounds_{1t}$$

$$MS_t = \sim_{20} + \sim_{22}^{0} P_t + \sum_{i=1}^{p} \sim_{21}^{i} P_{t-i} + \sum_{i=1}^{p} \sim_{22}^{i} MS_{t-i} + \sim_{23}^{0} FD_t + \sum_{i=1}^{p} \sim_{23}^{i} FD_{t-i} + \pounds_{2t}$$

$$FD_t = \sim_{30} + \sim_{33}^{0} P_t + \sum_{i=1}^{p} \sim_{31}^{i} P_{t-i} + \sim_{32}^{0} MS_t + \sum_{i=1}^{p} \sim_{32}^{i} MS_{t-i} + \sum_{i=1}^{p} \sim_{33}^{i} FD_{t-i} + \pounds_{3t}$$

In this equation, non-causality from money supply to inflation implies $\sim_{12}^{1} = \sim_{12}^{2} = \dots = \sim_{12}^{p} = 0$ while non-causality from budget deficits to inflation implies $\sim_{13}^{1} = \sim_{13}^{2} = \dots = \sim_{13}^{p} = 0$. Similarly, non-causality from inflation to money supply implies $\sim_{21}^{1} = \sim_{21}^{2} = \dots = \sim_{21}^{p} = 0$ while non-causality from deficits to money supply implies $\sim_{23}^{1} = \sim_{23}^{2} = \dots = \sim_{23}^{p} = 0$. Finally, non-causality from inflation to budget deficits implies $\sim_{31}^{1} = \sim_{31}^{2} = \dots = \sim_{31}^{p} = 0$ while non- causality from money supply to budget deficits implies $\sim_{32}^{1} = \sim_{32}^{2} = \dots = \sim_{32}^{p} = 0$. In sum, a three-way causality is suggested when the sets of P, MS and FD coefficients are statistically significantly different from zero in the three regressions.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

4.1 Introduction

This chapter presents a thorough analysis and discussion of the results of the study. The chapter is divided into four sections. Section one examines the time series properties of the data. It presents the unit root test and the bound test for cointegration. The second section presents and discusses the results of the estimated long run growth equation using the ARDL approach. The results of the Error Correction Model for the selected ARDL model were also presented and analyzed in the second section. The third section analyses the results of the estimated correlation coefficients between inflation and the explanatory variables and among the explanatory themselves. The last section looks at the direction of causality. All estimations were obtained with the help of Eviews 7 and Microfit 5.0.

4.2 Results of Unit Root Test

Prior to estimating the long-run relationship between inflation and its determinants in Ghana, the stationarity status of all the variables in the model specified for the study were determined. The results of the unit root test based on the Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) unit root test approach are presented in Table 4.1.

Table 4.1: Results of Unit Root Test

Data Period	Level		First Differences	
	ADF	PP	ADF	PP
Variables	Constant & Trend	Constant & Trend	Constant	Constant
$\ln P$	3.13	7.65	-2.60**	-2.36**
$\ln Y$	0.75	0.50	-4.67***	-4.63***
$\ln IR$	-1.29	-0.95	-8.63***	-8.75***
$\ln EX$	-2.18	-1.97	-3.99***	-3.95***
$\ln M1$	-3.29*	-3.10		
$\ln M2$	-3.55**	-3.30*		
$\ln M2^{+}$	-3.05	-3.40*		
$\ln FD$	-3.24*	-3.18*		
$\ln M1FD$	-2.87	-3.69**		
$\ln M2FD$	-3.03	-3.83**		
$\ln M2^{+}FD$	-3.04	-3.79**		

The null hypothesis is that the series is non-stationary, or contains a unit. The rejection of null hypothesis for both the ADF and the PP test is based on the Mackinnon (1996) critical values. ***, **, and * indicate the rejection of the null hypothesis of the existence of a unit at 1%, 5% and 10% significant level, respectively

Both ADF and PP tests show that, at the log levels with a drift and trend, the price level, real income, interest rate and exchange rate are nonstationary, as we fail to reject the null hypothesis of unit root at any of the error levels. However, after the first differencing, these variables achieved stationarity, for both tests and the null hypothesis that they pose unit root is rejected at 1 percent. This implies they are integrated of order one ($I(1)$). In contrast, fiscal deficit, monetary aggregates and their interactive terms, are found to be stationary at their log levels, with a drift and trend. This suggests they are integrated of order zero ($I(0)$). Since we have confirmed the absence of $I(2)$ variables, and a case of a mixed order of integration we are justified to apply the *ARDL* methodology to test for the existence of long-run equilibrium relationship between the price level and its covariates.

4.3 Results of Bound Test for Cointegration

We now turn our attention to establishing the existence of a long run cointegration relationship among the variables of the model in equation (3) by means of the bounds test. The results of the bounds test for cointegration are presented in Table 4.2. The null hypothesis of no cointegration is consistently rejected at the 5% significance level. This implies that there exists a long run relationship among the variables of our model, when the equation is normalized on inflation (i.e. with inflation being the dependent variable).

Table 4.2: Results of Bound Test for Cointegration

Testing for the existence of a level relationship among the variables in the ARDL model				
Without Interaction (MFD)				
K	**95% Lower Bound**	**95% Upper Bound**	**90% Lower Bound**	**90% Upper Bound**
5	2.9195	4.2353	2.4601	3.6291
With Interaction				
K	**95% Lower Bound**	**95% Upper Bound**	**90% Lower Bound**	**90% Upper Bound**
6	2.7139	4.0524	2.3193	3.4991

Model	**Calculated F-statistic**	**Inference**
$\ln P(\ln Y, \ln IR, \ln EX, \ln M1, FD)$	15.5480**	Cointegration
$\ln P(\ln Y, \ln IR, \ln EX, \ln M2, FD)$	18.7059**	Cointegration
$\ln P(\ln Y, \ln IR, \ln EX, \ln M2^{+}, FD)$	23.3757**	Cointegration
$\ln P(\ln Y, \ln IR, \ln EX, \ln M1, FD, \ln M1FD)$	13.3074**	Cointegration
$\ln P(\ln Y, \ln IR, \ln EX, \ln M2, FD, \ln M2FD)$	13.3713**	Cointegration
$\ln P(\ln Y, \ln IR, \ln EX, \ln M2^{+}, FD, \ln M2^{+}FD)$	12.3400**	Cointegration

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations using 20000 replications.k is the number of regressors

The computed F-statistic exceeds the upper critical values at 95% confidence level for all the equations. Hence, there exists a long run relationship among inflation and its covariates. Having arrived at this conclusion, the next step is to estimate the long run parameters of the model.

4.4 Results of the Long-run Inflation Model

The results of the long run relationship between inflation and its determinants estimated by the ARDL approach are reported in Table 4.3 below. The coefficients of the variables represent the long run elasticities.

Table 4.3: Estimated Long-Run Model using the ARDL Approach

Dependent variable: $\ln P$						
Regressors	**Autoregressive Distributed Lag Model**					
	Without Interaction			**With Interaction**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$\ln Y$	-2.473	-3.630	-3.177	-2.454	-2.890	-2.919
	(-8.674)***	(-5.586)***	(-5.828)***	(-9.274)***	(-10.04)***	(-11.32)***
$\ln IR$	0.399	0.178	0.403	0.381	0.377	0.436
	(3.387)***	(0.834)	(2.086)***	(3.487)***	(3.331)***	(4.332)***
$\ln EX$	-0.239	-0.263	-0.311	-0.186	-0.191	-0.195
	(-3.706)***	(-2.977)***	(-3.550)***	(-3.027)***	(-2.973)***	(-3.414)***
$\ln M1$	1.322	-	-	1.287	-	-
	(21.222)***	-	-	(22.430)***	-	-
$\ln M2$	-	1.459	-	-	1.315	-
	-	(12.204)***	-	-	(21.538)***	-
$\ln M2^{+}$	-	-	1.3898	-	-	1.299
	-	-	(13.761)***	-	-	(24.244)***
FD	-0.034	-0.056	-0.019	-0.039	-0.028	-0.016
	(-2.244)***	(-1.770)**	(-.753)	(-2.69)***	(-1.838)**	(-1.188)
$M1FD$	-	-	-	0.0031	-	-
	-	-	-	(1.275)	-	-
$M2FD$	-	-	-	-	0.002	-
	-	-	-	-	(0.826)	-
$M2^{+}FD$	-	-	-	-	-	0.004
	-	-	-	-	-	(2.043)**
CONSTANT	18.026	28.491	23.309	18.266	21.791	21.818
	(6.436)***	(4.606)***	(4.502)***	(7.024)***	(7.832)***	(8.781)***

Note: ***, **, * denote significance at 1% 5% and 10% respectively. Values in parenthesis are t-statistics. ARDL (1,0,0,1,2,1), ARDL (1,0,1,1,2,1), ARDL(1,0,2,1,0,1) selected for models (1), (2) and (3) respectively and ARDL(1,0,0,1,2,1,1) selected for models (4) - (6) are all based on Schwarz Bayesian Criterion

The results from the table indicate that the coefficient on real income assumed a negative sign and is also statistically significant at 1% error level. Real income is the covariate that exerts the largest impact on the price level in the long-run. The size of its coefficient implies that, conditioned on the other factors included in the model, a percentage rise in real income (total output) will cause the general price level to fall by approximately between 2.5% to 3.6%. On the average, the models estimated without the interaction terms had a larger effect on the price level than the models estimated with the interaction (due to possible correlation between the MS, FD and their interactions). The negative sign on the coefficient is consistent with supply-side theoretical expectation, which intimates that an increase in aggregate supply (total output), eases the demand pressures, and puts a downward pressure on the general price level in the economy. In addition, real income seems to have greater effect on the price level through broad money (M2 and $M2^+$) than narrow money (M1). For instance, whereas a percentage point increase in real income, all other things being equal, would reduce inflation by about 2.4% when M1 is used to proxy money supply; it would reduce inflation by approximately 3%, when the broader monetary aggregates (M2 and $M2^+$) are used instead. This result is consistent with that obtained by Adu and Marbuah (2011).

In coherence with economic theory, nominal interest rate is found to be positively and statistically significantly associated with the price level for all the alternative specifications, with the exception of model (2) which is not statistically significant. The magnitude of the impact of interest rate on the price level is very low compared to the other variables in the long run, as a percentage rise in the nominal interest rate will lead to an increase in the general price level by 0.178 to 0.436%. The plausible reason for this may be that that producers and investors in Ghana allow changes in the nominal interest rate to affect their investment decisions, such that an increase in the interest rate (lending), dampens the desire to borrow by the private sector, as the cost of borrowing investible fund rises. This may curtail the ability of the firm, investors, and the private sector as a whole to expand their production capacity. Not only will the higher cost of borrowing translate into higher prices (Podkaminer 1998), but its adverse impact on expansion, will also cause aggregate supply to fall short of overall demand in the economy, thereby, fuelling inflationary pressures in the long run.

Theoretically the depreciation of the Ghanaian cedi relative to the dollar makes Ghanaian commodities relatively cheaper and more competitive on the foreign markets as well as makes imports more expensive in the domestic markets. This is expected to cause both cost-push (imported) and demand-pull inflation as firms push the higher cost of imported inputs to consumers and as the aggregate demand rises in response to the falling relative price of domestic goods. Contrary to theoretical expectation, the results show that depreciation in the external value of the cedi against the US dollar (i.e. increase in EX) is beneficial for price stability in the economy, as the exchange rate is inversely related to the price level. The estimated elasticity coefficients of inflation with respect to nominal exchange rate remain consistently negative and statistically significant at 1% across the various specifications. Whereas the size of its effect (i.e. the coefficient of exchange rate) declined as we controlled for the various interactions between money supply and fiscal deficits, its inverse correlation with the price level and statistical significance is maintained throughout. For instance, while a percentage increase in the nominal exchange rate results in a 0.23% fall in the general price level (in model 1), it however led to a 0.18% fall in the price level for model 4. Even though this may be surprising, the results suggest that in an economy where the aggregate supply is more elastic than aggregate demand (and if the Marshall-Lerner condition holds), depreciation in the currency can lead to a reduction in the general price level. This result confirms the findings of Adu and Marbuah (2011), but contrary to the findings of Ocran (2007).

The powerful effect of expansion in money supply in intensifying inflationary tendencies is confirmed in our results, as the coefficient of money supply is unswervingly positive and highly statistically significant at 1 percent level, irrespective of which monetary aggregate is employed. Money supply showed up to be the second most important determinant of the general price after real income, with its elasticity coefficients ranging a little above 1 percent. In comparison, all the coefficients in the specifications without the interaction are marginally lower than those with the interaction. Policy wise, the use of $M2^+$ as a measure of monetary aggregate by the Central bank implies that, a percentage increase in $M2^+$ will result in an approximately 1.3% or 1.4% increase in the price level in the long run, ceteris paribus (see models (3) and (6) respectively). Hence, increases in the money supply in the Ghanaian economy without corresponding increases in the level of productivity will eventually lead to an increase in the general price level. Implying that in the long run, increases in money supply is a dominant factor in fostering increases in inflation in Ghana. In other words, the monetary policy can be relied on as an effective long term policy tool to influence the rate of inflation in Ghana. The result corresponds with the results obtained by Marbuah and Adu (2011), Ocran (2007) and Sowa and Kwakye (1993).

Interestingly, fiscal deficit turned out to exert negative impact on the price level in the long-run. This reversed relationship between fiscal deficit and the price level is statistically significant at 1% for M1 (model 1 and 4), 5% for M2 (model 2 and 5) but not significant for $M2^+$. Whereas, fiscal deficit seems to be the third most important determinant of the price level in the long-run, its impact (in terms of the size of its coefficient) is relatively small, compared to the other determinants in the long run. Other things being equal, a percentage increase in fiscal deficit will cause the general price level to fall by about 0.03% on the average. This means that the price level in Ghana is less influenced by the fiscal dominance of government in the long run. In line with Keynesian economics, this result suggests that running fiscal deficits may be beneficial in stabilizing prices in the long run, given that the government is directed towards more productive sectors, and removing supply-side constraints by ensuring sustainable supply of energy, investing in productive infrastructure and other physical capital necessary to stimulate employment and output.

Lastly, the composite impact of money supply and fiscal deficit on the price level is found to be positive and only statistically significant at 5 percent when $M2^{+}$ is interacted with FD (see model 6). The positive sign is consistent with the SW-H hypothesis. Given that the Bank of Ghana uses $M2^{+}$ as a measure of monetary aggregate in implementing its policies, this outcome beholds an important implication for the conduct of monetary policy in Ghana. The import of this result and for that matter the Sargent and Wallace hypothesis is that fiscal and monetary policy are interdependent, and must be aligned or coordinated in order to achieve price stability in the long-run.

4.5 Results of the Short Run Dynamic Model

The Error Correction Model (ECM) provides the means of reconciling the short run behavior of an economic variable with its long-run behavior. The existence of cointegration relationships among the variables requires the estimation of ECM to understand the short-run dynamic behavior of the inflation model. Thus, the ECM captures the short run dynamics of the system and its coefficient measures the speed of adjustment to equilibrium in the event of shocks to the system. The model uses the first difference of the variables (capture short run changes). The estimated results are presented in Table 4.4 below.

Table 4.4: Estimated Short-Run Error Correction Model using the ARDL Approach

Dependent variable: $\ln P$						
Regressors	**Autoregressive Distributed Lag Model**					
	Without Interaction			**With Interaction**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$\Delta \ln Y$	-1.018	-1.183	-1.058	-1.029	-1.210	-1.315
	(-6.138)***	(-6.282)***	(-6.202)***	(-6.580)***	(-6.756)***	(-7.386)***
$\Delta \ln IR$	0.164	0.209	0.199	0.1599	0.15771	0.197
	(3.156)***	(3.565)***	(3.419)***	(3.236)***	(3.090)***	(3.895)***
$\Delta \ln EX$	0.10398	0.069	0.048	0.132	0.125	0.115
	(2.0637)**	(1.265)	(0.906)	(2.664)**	(2.448)**	(2.322)**
$\Delta \ln M1$	0.458	-	-	0.420	-	-
	(5.056)***	-	-	(4.725)***	-	-
$\Delta \ln M2$	-	0.343	-	-	0.447	-
	-	(2.738)***	-	-	(4.299)***	-
$\Delta \ln M2^{+}$	-	-	0.463	-	-	0.500
	-	-	(6.051)***	-	-	(4.291)***
ΔFD	0.0138	0.010	0.013	0.018	0.022	0.025
	(2.7973)***	(1.8737)**	(2.481)**	(3.653)***	(4.058)***	(4.639)***
$\Delta \ln MIFD$	-	-	-	-0.0013	-	-
	-	-	-	(-1.512)	-	-
$\Delta \ln M2FD$	-	-	-	-	-0.002	-
	-	-	-	-	(-2.292)	-
$\Delta \ln M2^{+}FD$	-	-	-	-	-	-0.002
	-	-	-	-	-	(-2.152)**
ecm_{t-1}	-0.411	-0.326	-0.333	-0.419	-0.419	-0.451
	(-6.790)***	(-4.357)***	(-4.571)***	(-7.305)***	(-7.048)***	(-7.721)***

Note: ***, **, * denote significance at 1% 5% and 10% respectively. Values in parenthesis are t-statistics. ARDL (1,0,0,1,2,1), ARDL (1,0,1,1,2,1), ARDL(1,0,2,1,0,1) selected for models (1), (2) and (3) respectively and ARDL(1,0,0,1,2,1,1) selected for models (4) - (6) all based on Schwarz Bayesian Criterion.

From Table 4.4 above, all our short-run models show convergence to equilibrium in the long-run, after a temporary shock. Theoretically, the dynamic stability of the path of inflation requires that the coefficient on the error correction term be negative and statistically significant. This is confirmed in all of our short-run specifications, the coefficients of lagged *ecm* both negative and highly significant at 1% level. With regard to model (6), the estimated coefficient of the ECM is -0.45. This implies that the about 45% of the disequilibrium in the previous year following shocks to the system converge back to the long run equilibrium in the current year. The coefficient is quite large, indicating that there is a greater rate of convergence toward equilibrium. By this finding, it is concluded that any disequilibrium within the inflation dynamics of Ghana in the short run is quickly adjusted and converged back to equilibrium in the long run.

Real income is inversely related to inflation in the short-run. The coefficients remain negative and are statistically significant at 1% in the short-run. Substantially, real income is still the most significant determinant of inflation even in the short-run. However, the magnitude of the coefficient in the short-run is lesser than that of the long-run. This confirms our expectation based on the Samuelson's Le Châtelier principle, that the long-run elasticity of money demand with respect to real income is at least as large as its short-run elasticity; implying that the higher the elasticity of money demand with respect to income, the stronger the effect of income on inflation. A percentage rise in the real income will reduce inflation by 1% to 1.3% in the short run, all things being equal. In essence in the short run, when real income increases as a result of increased productivity, it leads to a reduction in the level of inflation in the Ghanaian economy. This is consistent with Adu and Marbuah (2011) findings.

The short run results also indicate that the coefficients of interest rate maintained their positive sign and are statistically significant at 1% conventional level. This is consistent with economic theory. Compared to the long run, the magnitude of its effect on inflation is slightly reduced, as a percentage change in the nominal interest rate will increase inflation by approximately 0.2% in the short run for all the models, as against 0.4% in the long run. This indicates that even in the short run interest rate still affects investment decision (reduction in productivity levels); implying that interest rate spurs the inflationary process in the Ghanaian economy. This results support that obtained by Ocran (2007).

Unlike the long run estimates, the impact of exchange rate depreciation on inflation is found to be consistent with theoretical expectations in the short run. Without the interaction terms, depreciation in the nominal exchange rate significantly puts upward pressure on the price level only when the narrow definition of money (M1) is used. However, this positive correlation turns to be statistically significant at 5 percent level across M1, M2 and $M2^+$ when the combined effects of monetary and fiscal policy are accounted for. The intuition is that, while depreciation in the external value of the cedi may aggravate inflationary expectations and force prices upwards in the short-run, the resultant increase in aggregate supply in response to the rising demand for domestic goods and services, will eventually cause prices to stabilize at lower levels in the long run. This requires the removal of supply-side constraints and diversifying away from the production of primary products, so as to make aggregate supply more elastic. This is consistent with Adu and Marbuah (2011) but contrary to Gyebi and Boafo (2013).

Money supply, regardless of its definition, continues to be an important driver of the price level in the short run. Though relatively smaller, compared to its long run estimates, its coefficients remain positive and statistically significant at 1 percent level. The short run estimates show that, all things being equal, a 1 percentage expansion in the money supply will cause inflation to rise by an average of 0.3% to 0.5% in the short run (as against 1.3 percent in the long run). Thus, whereas growth in money supply appears to marginally affect the price level in short-run; its impact is fully manifested in the long run with a disproportionate rise in price level. Sowa (1996) attributes "the low coefficients on money supply to the absence of scale economies in the use of monetary policy to fight inflation in the short run". Juxtaposing the two specifications, we observed that accounting for the joint impact of money supply and fiscal deficits leads to a minuscule improvement in the size of the coefficients. In essence, our results show that conduction of expansionary monetary policy must be accompanied by supply-side policies to stimulate employment and productivity. Sowa (1996), Ocran (2007), Adu and Marbuah (2011) and Ayubu (2013) also arrived at similar conclusions in their respective studies.

In contrast with our long run estimates, expansionary fiscal policy is found to significantly drive inflation in the short-run. The size of the estimated coefficients for the models with the interactions is marginally larger than those without interactions. All the short-run coefficients are statistically significant at 1 percent with the exception of model 2 which is significant at 5 percent. Inferentially, the reversal in the impact of fiscal expansion on inflation in the short run suggests that whereas running fiscal deficits may be inimical in the short-run (since productivity or aggregate supply is inelastic in the short run), it will be instrumental in reducing inflationary pressures and stabilizing the price level in the long-run. This result also implies that fiscal policy in Ghana can significantly reduce inflation in the short run; specifically lowering deficits per GDP can effectively reduce the price level in the Ghanaian economy. Metin (1998) found similar results for the Turkish economy.

Incongruous with the long run estimates, the short run coefficients on the interaction terms (M1FD, M2FD and $M2^{+}$FD) did not assume the expected positive signs. That is the short-run; coefficients portray a negative relationship between the interacted variables and inflation. Like the long run, the short run coefficients are insignificant except for model 6, which is significant at 5%. Given that the Central Bank usually targets $M2^{+}$ in the conduct of its monetary policy, the coefficient of $M2^{+}$FD in column 6 implies that both expansionary monetary and fiscal policies (especially financing budget deficits by printing money) can be advantageous for price stability in the short run. However, monetization of deficits will be detrimental to the economy as the price level will shoot up when the fundamentals of the economy fully adjust in the long run.

Thus, while there is evidence that the Sargent and Wallace hypothesis holds in the long-run, it does not hold in the short- run.

4.6 Results of Model Diagnostic Tests

Various diagnostic tests were also applied to examine the validity of the model. Table 4.5 below summarizes the results.

Table 4.5 Regression and diagnostic statistics

Statistics	(1)	(2)	(3)	(4)	(5)	(6)
$\overline{R}^2$	.85310	.84393	.84724	.86947	.86004	.87054
$F-stats$	42.9092***	40.1945***	41.0432***	43.1305***	39.9062***	43.5278***
$DW-stats$	2.1854	2.0785	2.3157	2.1960	2.0872	2.2665
AIC	57.2932	55.3944	56.2954	59.6136	57.8358	59.8243
SIC	46.6682	43.8034	45.6703	47.0567	45.2790	47.2674
$\chi^2_{Auto}(1)$	0.57375[.453]	0.20426[.654]	1.7756[.190]	0.57775 [.452]	0.11698 [.734]	1.2320[.274]
$\chi^2_{Reset}(1)$	0.30182[.586]	0.18194[.672]	0.20098[.656]	1.0628 [.309]	2.3942[.130]	0.43691[.513]
$\chi^2_{Norm}(2)$	1.7584[.415]	.64938[.723]	.45139[.798]	3.8664 [.145]	2.5585[.278]	1.0697[.586]
$\chi^2_{White}(1)$	1.0050[.321]	.84348[.363]	1.4312 [.237]	0.20154[.655]	.01885 [.891]	0.008415[.927]

χ^2_{Auto}, χ^2_{Reset}, χ^2_{Norm}, χ^2_{White} are Lagrange multiplier statistics for test of serial correlation, functional form misspecification, non-normal errors and heteroscedasticity, respectively. These statistics are distributed as Chi-square values with degree of freedom in parentheses. Values in parentheses [ ] are probability values.

The results from Table 4.5 show that the overall regression is significant at the 1% level. Again, the adjusted R-squared value of approximately 0.85 to 0.87 indicate that about 85% to 87% of the variation in the general price level can be accounted for by the changes in interest rate, exchange rate, the monetary aggregates, fiscal deficits and the interacted variable (MFD). A DW statistic of 2.3 indicates that there is no strong serial correlation in the residuals. Moreover, an F-statistic value of approximately 43 suggests the joint significance of the determinants in the ECM. Also, all the models pass the white test for heteroscedasticity as well as the RESET test for correct specification of the model. Hence it can be conclude from the above analysis that the model has passed all the essential diagnostic tests. Therefore, the results presented in this study are unbiased and are valid for policy analysis.

4.7 Results of the Granger Causality Test

For this sub-section, the study conducts Granger-causality test to investigate the causal relationship between inflation and the variables of interest, in this case; money supply and fiscal deficit. However, it must be emphasized that the existence of Granger-causality does not literally imply that the occurrence of one variable is as a result of the other. It is more of prediction test than the mere meaning of causation. It proposes that while the past can predict the future, the future cannot predict the past.

The results from the unit root tests show that the price level, money supply and fiscal deficits are integrated of order one (i.e. $I(1)$, we use the first log difference of the variables in this analysis. The results of the Granger Causality test are presented in Table 4.6 below.

Table 4.6: Results Of The Granger Causality Test

Null Hypothesis	F-Stats	Prob
FD does not Granger Cause P	5.50498	0.0231
P does not Granger Cause FD	0.00029	0.9865
LNM1 does not Granger Cause P	11.6275	0.0013
P does not Granger Cause LNM1	3.20142	0.0798
LNM2 does not Granger Cause P	11.6750	0.0013
P does not Granger Cause LNM2	5.46824	0.0235
$LNM2^+$ does not Granger Cause P	12.0955	0.0011
P does not Granger Cause $LNM2^+$	8.57618	0.0052
LNM1 does not Granger Cause FD	0.50693	0.4798
FD does not Granger Cause LNM1	7.61104	0.0081
LNM2 does not Granger Cause FD	0.55225	0.4609
FD does not Granger Cause LNM2	8.30173	0.0059
$LNM2^+$ does not Granger Cause FD	0.18703	0.6673
FD does not Granger Cause $LNM2^+$	2.10722	0.1530

The results from Table 4.6 above indicate that the null hypothesis that fiscal deficit (FD) does not Granger-cause inflation (P) could be rejected at the 5% significant level. On the other hand, the null hypothesis that inflation does not Granger-cause fiscal deficit could not be rejected at the 5% significance level. The implication therefore is that, there is unidirectional causality running from fiscal deficits to the inflation with no feedback effect, which supports Ahking and Miller (1985), Solomon and Wet (2004) and Lozano (2008) findings in his study of the Colombian economy. Hence, past and present values of fiscal deficits provide important information to forecast the future values of inflation in Ghana.

The results also indicate that the null hypothesis that the monetary aggregates (M1, M2, $M2^+$) do not Granger-cause inflation (P) is rejected at the 1% significance level. On the other hand, the null hypothesis that inflation (P) does not Granger Cause any of the monetary aggregates is also rejected at 10% level for M1, 5% level for M2 and 1% level for $M2^+$.Hence, there is reverse (or bi-directional) causality running from inflation to the monetary aggregates especially with $M2^+$ and vice versa consistent with Lozano (2008) findings.

Moreover, the null hypothesis that neither of the monetary aggregates (M1, M2, $M2^+$) Granger Cause fiscal deficit could not be rejected at the 5% significance level. On the other hand, the null hypothesis that fiscal deficit (FD) does not Granger-cause any of the monetary aggregates (M1, M2, $M2^+$) is rejected at the 5% significance level except for $M2^+$ which could not be rejected. Yet, we can conclude that there is a unidirectional causality running from fiscal deficit to the monetary aggregates with no feedback effect.

To sum it all up, we find evidence that, first of all, fiscal deficit Granger-cause money supply growth (which is consistent with SW-H) and, secondly, money supply growth granger-cause inflation (although the opposite is also true; that is, inflation granger-cause money supply growth); hence we can conclude that the best approach to understanding the relationship between fiscal deficit, money supply and inflation in Ghana is given by the SW-H.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter concludes the study. It summarizes the major findings obtained from the study as well as their policy implications. It further provides recommendations based on the findings of the study.

5.2 Summary of Findings

The belief that inflation is a major threat to every economy especially the less developed economies has pervaded much thinking among international development cooperation throughout the past decades. In Ghana, achieving price stability remains the main objective of the Central Bank. While, in the past few years, the Bank has been able to lower inflation rates from historically high levels to single-digits, it seems to be losing the fight again, as inflation rates have begun to pick up again, with inimical consequences on macroeconomic stability. Empirical evidence is, however, inconclusive regarding the factors that drive Ghana's inflationary process. Therefore drawing on existing literature, especially from developing countries, this study sought to empirically examine the dynamics of inflation, with much focus on the money supply and fiscal deficits in Ghana for the period 1960 to 2012. By employing the conventional Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, we found that our variables are mixed integrated of orders zero ($I(0)$) and one ($I(1)$). Using the ARDL bounds test, we established the existence of long run cointegration relationship among inflation and its determinants.

Summarized below are the key findings from our analysis of the long-run and short-run models and causality tests:

Firstly, we found that fiscal deficits has a significant negative impact on the price level in long-run, and is positively related to the price level in the short run and highly significant as well. Thus whereas, running fiscal deficits may fuel inflationary pressures in the short run (due to unaccompanied rise in total output), it will significantly lead to lower prices in the long run as both employment and output have fully responded. From the Granger causality test, we found a unidirectional causality running from fiscal deficit to inflation and from fiscal deficit to the monetary aggregates. The implication is that while the past values of fiscal deficits provide important information to predict the current values of inflation and the monetary aggregates, the past values of inflation and the monetary aggregates cannot predict the current values of the fiscal deficit.

Secondly, all the monetary aggregate have positive impact on inflation both in the long run and short run, confirming monetarists theory of inflation. We also found the existence of reversed causality between money supply and inflation. However, money supply is found not to Granger cause fiscal deficits. This implies that while the past values of the monetary aggregates can predict the current values of inflation, the same cannot be said for fiscal deficits.

Thirdly, we found that in the long-run, the joint impact on inflation of both money supply and fiscal deficits was positive and statistically significant when $M2^{+}$ (the Bank of Ghana's targeted monetary aggregate) is interacted with fiscal deficits. However, their combined impact is reversed in the short-run. This evidence intimates that the Sargent and Wallace hypothesis holds for Ghana only in the long-run.

Fourthly, real income was found to be the factor that exerts the greatest impact on the price level in Ghana, both in the short run and long run. Expansion in real income (total output) was found to be negatively and statistically significantly related to the price level in our dynamic analyses.

Fifthly, the interest rate was also found to be positively and highly significantly associated with inflation both in the long and short run.

Sixthly, depreciation in the external value of the cedi (increase in the nominal exchange rate) was found to be significantly inflationary in the short-run. However, in the long run when supply conditions fully adjust to meet the initial rise in demand for domestic goods, it was found to exert negative but significant effect on the price level.

Finally, whereas our Granger Causality test showed feedback causality from inflation to the monetary aggregates and vice versa, we found no statistical evidence in support of the hypothesis that inflation Granger causes fiscal deficits in Ghana.

5.3 Conclusion

The study sought to estimate the inflationary consequences of higher budget deficits and money growth in Ghana, while controlling for some key determinants of inflation over the period 1960-2012. The ARDL econometric approach was used to model the short and long run models of inflation for Ghana. The study found the existence of cointegration relationship among inflation and its determinants. It was also found that real income, interest rate, exchange rate, fiscal deficits and money growth all have significant impact on the inflationary process in the Ghanaian economy. These findings draw the implication that to maintain a low and sustained inflation rate, government must target reducing fiscal deficits and the growth in money supply in Ghana.

5.4 Policy Implications and Recommendation

The observed results provide invaluable information for policy formulation and implementation. The results imply that controlling fiscal deficits and the money supply is one way of achieving the objective of maintaining low inflation in Ghana.

Since the overall impact of monetary growth on inflation is positive and with a unidirectional causality such that changes in monetary growth precede changes in inflation, any policy aimed at curbing inflation should be targeted at a reduction in the monetary growth. It is, therefore, recommended that constraining the growth in money supply, while maintaining a sustainable amount of money in the economy, should continue to be of paramount interest to the Bank of Ghana and policy makers as whole.

Furthermore, since monetization of deficits is found to directly increase the money in circulation in an economy and therefore fuel inflation in the long run, with a unidirectional causality running from fiscal deficit to inflation, it is recommended that the government should borrow from the public to finance its deficits rather than monetizing it (as this is not inflationary because it temporary redistributes the amount of disposable resources already in circulation rather than adding to it). Again the government should aim at improving the current tax administration regime so that it could bolster revenue generation to meet its expanding expenditure.

Lastly, the fact that SW-H holds for Ghana implying that the long run incidence of fiscal deficits lead to the increases in money supply which is then translated into increases in the general price level implies that the interdependency between fiscal policy and monetary policy and therefore, the effectual coordination of these policy tools is important for the achievement of price stability in Ghana.

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APPENDICES

Appendix A: ARDL ESTIMATES

Without interaction

M1

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 24/03/2014                                                           12:14:05

                  Autoregressive Distributed Lag Estimates
       ARDL(1,0,0,1,2,1) selected based on Schwarz Bayesian Criterion
 ******************************************************************************
 Dependent variable is LNP
 51 observations used for estimation from 1962 to 2012
 ******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 LNP(-1)                    .58857            .060589             9.7141[.000]
 LNY                       -1.0175             .16579            -6.1376[.000]
 LNIR                       .16397            .051949             3.1564[.003]
 LNEX                       .10398            .050383             2.0637[.046]
 LNEX(-1)                  -.20211            .045154            -4.4760[.000]
 LNM1                       .45835            .090649             5.0563[.000]
 LNM1(-1)                  -.25114             .13312            -1.8865[.066]
 LNM1(-2)                   .33679            .095188             3.5382[.001]
 FD                        .013800           .0049333             2.7973[.008]
 FD(-1)                   -.027782           .0047160            -5.9909[.000]
 C                          7.4163             1.4770             5.0214[.000]
 ******************************************************************************
 R-Squared                     .99976   R-Bar-Squared                   .99970
 S.E. of Regression           .071608   F-Stat.    F(10,40)    16505.3[.000]
 Mean of Dependent Variable   -.17681   S.D. of Dependent Variable      4.1147
 Residual Sum of Squares       .20511   Equation Log-likelihood        68.2932
 Akaike Info. Criterion       57.2932   Schwarz Bayesian Criterion     46.6682
 DW-statistic                  2.1854   Durbin's h-statistic     -.73450[.463]
 ******************************************************************************

Testing for existence of a level relationship among the variables in the ARDL model
 ******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   15.5480         2.9195           4.2353           2.4601           3.6291

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   93.2883        17.5167          25.4115          14.7609          21.7749
 ******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.


                             Diagnostic Tests
 ******************************************************************************
 *    Test Statistics  *        LM Version       *           F Version        *
 ******************************************************************************
 *                     *                         *                            *
 * A:Serial Correlation*CHSQ(1)  =   .73940[.390]*F(1,39)      =   .57375[.453]*
 *                     *                         *                            *
 * B:Functional Form   *CHSQ(1)  =   .39166[.531]*F(1,39)      =   .30182[.586]*
 *                     *                         *                            *
 * C:Normality         *CHSQ(2)  =   1.7584[.415]*       Not applicable       *
 *                     *                         *                            *
 * D:Heteroscedasticity*CHSQ(1)  =   1.0250[.311]*F(1,49)      =   1.0050[.321]*
 ******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

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24/03/2014                                                           12:14:22
```

Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,0,0,1,2,1) selected based on Schwarz Bayesian Criterion

Dependent variable is LNP
51 observations used for estimation from 1962 to 2012

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNY	-2.4732	.28511	-8.6744[.000]
LNIR	.39854	.11766	3.3873[.002]
LNEX	-.23852	.064369	-3.7055[.001]
LNM1	1.3222	.062303	21.2222[.000]
FD	-.033983	.015143	-2.2441[.030]
C	18.0257	2.8007	6.4361[.000]

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
15.5480	2.9195	4.2353	2.4601	3.6291

W-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
93.2883	17.5167	25.4115	14.7609	21.7749

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations using 20000 replications.

24/03/2014 12:14:45

Error Correction Representation for the Selected ARDL Model
ARDL(1,0,0,1,2,1) selected based on Schwarz Bayesian Criterion

Dependent variable is dLNP
51 observations used for estimation from 1962 to 2012

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
dLNY	-1.0175	.16579	-6.1376[.000]
dLNIR	.16397	.051949	3.1564[.003]
dLNEX	.10398	.050383	2.0637[.045]
dLNM1	.45835	.090649	5.0563[.000]
dLNM11	-.33679	.095188	-3.5382[.001]
dFD	.013800	.0049333	2.7973[.008]
ecm(-1)	-.41143	.060589	-6.7905[.000]

List of additional temporary variables created:
dLNP = LNP-LNP(-1)
dLNY = LNY-LNY(-1)
dLNIR = LNIR-LNIR(-1)
dLNEX = LNEX-LNEX(-1)
dLNM1 = LNM1-LNM1(-1)
dLNM11 = LNM1(-1)-LNM1(-2)
dFD = FD-FD(-1)
ecm = LNP + 2.4732*LNY -.39854*LNIR + .23852*LNEX -1.3222*LNM1 + .033983*FD -18.0257*C

R-Squared	.88248	R-Bar-Squared	.85310
S.E. of Regression	.071608	F-Stat. F(7,43)	42.9092[.000]
Mean of Dependent Variable	.22946	S.D. of Dependent Variable	.18683
Residual Sum of Squares	.20511	Equation Log-likelihood	68.2932
Akaike Info. Criterion	57.2932	Schwarz Bayesian Criterion	46.6682
DW-statistic	2.1854		

R-Squared and R-Bar-Squared measures refer to the dependent variable dLNCPI and in cases where the error correction model is highly restricted, these measures could become negative.

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
15.5480	2.9195	4.2353	2.4601	3.6291

W-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
93.2883	17.5167	25.4115	14.7609	21.7749

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations

using 20000 replications.

M2

```
24/03/2014                                                            12:16:38

Autoregressive Distributed Lag Estimates
ARDL(1,0,1,1,2,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
Dependent variable is LNP
51 observations used for estimation from 1962 to 2012
*******************************************************************************
Regressor              Coefficient       Standard Error         T-Ratio[Prob]
LNP(-1)                    .67418             .074783             9.0151[.000]
LNY                       -1.1828              .18829            -6.2822[.000]
LNIR                       .20934             .058724             3.5648[.001]
LNIR(-1)                  -.15130             .079318            -1.9076[.064]
LNEX                      .068516             .054185             1.2645[.214]
LNEX(-1)                  -.15405             .051368            -2.9991[.005]
LNM2                       .34313              .12532             2.7381[.009]
LNM2(-1)                  -.19931              .15579            -1.2793[.208]
LNM2(-2)                   .33159              .10672             3.1072[.004]
FD                        .010424            .0055634             1.8737[.068]
FD(-1)                   -.028806            .0052674            -5.4688[.000]
C                          9.2829              1.6762             5.5380[.000]
*******************************************************************************
R-Squared                     .99975   R-Bar-Squared                    .99968
S.E. of Regression           .073810   F-Stat.    F(11,39)    14122.9[.000]
Mean of Dependent Variable   -.17681   S.D. of Dependent Variable       4.1147
Residual Sum of Squares       .21247   Equation Log-likelihood         67.3944
Akaike Info. Criterion       55.3944   Schwarz Bayesian Criterion      43.8034
DW-statistic                  2.0785   Durbin's h-statistic      -.33162[.740]
*******************************************************************************

Testing for existence of a level relationship among the variables in the ARDL model
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   18.7059         2.9195           4.2353           2.4601           3.6291

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
  112.2354        17.5167          25.4115          14.7609          21.7749
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.


                            Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *          F Version         *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(1)  =    .27268[.602]*F(1,38)      =   .20426[.654]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(1)  =    .24301[.622]*F(1,38)      =   .18194[.672]*
*                     *                          *                            *
* C:Normality         *CHSQ(2)  =    .64938[.723]*      Not applicable        *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(1)  =    .86305[.353]*F(1,49)      =   .84348[.363]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values



24/03/2014                                                            12:16:48

           Estimated Long Run Coefficients using the ARDL Approach
        ARDL(1,0,1,1,2,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
 Dependent variable is LNP
 51 observations used for estimation from 1962 to 2012
*******************************************************************************
```

```
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 LNY                        -3.6303             .64988            -5.5861[.000]
 LNIR                        .17811             .21365             .83366[.410]
 LNEX                       -.26253            .088196            -2.9767[.005]
 LNM2                        1.4591             .11956            12.2038[.000]
 FD                        -.056419            .031883            -1.7696[.085]
 C                          28.4907             6.1860             4.6057[.000]
*******************************************************************************

Testing for existence of a level relationship among the variables in the ARDL model
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   18.7059         2.9195           4.2353           2.4601           3.6291

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
  112.2354        17.5167          25.4115          14.7609          21.7749
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.
```



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 24/03/2014                                                             12:17:03

        Error Correction Representation for the Selected ARDL Model
       ARDL(1,0,1,1,2,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
 Dependent variable is dLNP
 51 observations used for estimation from 1962 to 2012
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLNY                       -1.1828             .18829            -6.2822[.000]
 dLNIR                       .20934            .058724             3.5648[.001]
 dLNEX                      .068516            .054185             1.2645[.213]
 dLNM2                       .34313             .12532             2.7381[.009]
 dLNM21                     -.33159             .10672            -3.1072[.003]
 dFD                        .010424           .0055634             1.8737[.068]
 ecm(-1)                    -.32582            .074783            -4.3569[.000]
*******************************************************************************
 List of additional temporary variables created:
 dLNP = LNP-LNP(-1)
 dLNY = LNY-LNY(-1)
 dLNIR = LNIR-LNIR(-1)
 dLNEX = LNEX-LNEX(-1)
 dLNM2 = LNM2-LNM2(-1)
 dLNM21 = LNM2(-1)-LNM2(-2)
 dFD = FD-FD(-1)
 ecm = LNP +   3.6303*LNY   -.17811*LNIR +   .26253*LNEX   -1.4591*LNM2 +
 .056419*FD  -28.4907*C
*******************************************************************************
 R-Squared                    .87826   R-Bar-Squared                     .84393
 S.E. of Regression          .073810   F-Stat.    F(7,43)     40.1945[.000]
 Mean of Dependent Variable   .22946   S.D. of Dependent Variable        .18683
 Residual Sum of Squares      .21247   Equation Log-likelihood          67.3944
 Akaike Info. Criterion      55.3944   Schwarz Bayesian Criterion       43.8034
 DW-statistic                 2.0785
*******************************************************************************
 R-Squared and R-Bar-Squared measures refer to the dependent variable
 dLNCPI and in cases where the error correction model is highly
 restricted, these measures could become negative.

Testing for existence of a level relationship among the variables in the ARDL model
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   18.7059         2.9195           4.2353           2.4601           3.6291

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
  112.2354        17.5167          25.4115          14.7609          21.7749
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications
```

$M2^+$

24/03/2014 12:19:38

Autoregressive Distributed Lag Estimates
ARDL(1,0,2,1,0,1) selected based on Schwarz Bayesian Criterion

Dependent variable is LNP
51 observations used for estimation from 1962 to 2012

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNP(-1)	.66712	.072830	9.1599[.000]
LNY	-1.0575	.17052	-6.2015[.000]
LNIR	.19877	.058143	3.4187[.001]
LNIR(-1)	-.19322	.075577	-2.5566[.014]
LNIR(-2)	.12849	.054042	2.3777[.022]
LNEX	.048013	.052991	.90605[.370]
LNEX(-1)	-.15138	.050860	-2.9765[.005]
$LNM2^+$	.46264	.076463	6.0506[.000]
FD	.012943	.0052163	2.4813[.017]
FD(-1)	-.019366	.0052581	-3.6831[.001]
C	7.7591	1.4996	5.1742[.000]

R-Squared	.99975	R-Bar-Squared	.99969
S.E. of Regression	.073023	F-Stat. F(10,40)	15871.7[.000]
Mean of Dependent Variable	-.17681	S.D. of Dependent Variable	4.1147
Residual Sum of Squares	.21329	Equation Log-likelihood	67.2954
Akaike Info. Criterion	56.2954	Schwarz Bayesian Criterion	45.6703
DW-statistic	2.3157	Durbin's h-statistic	-1.3197[.187]

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
23.3757	2.9195	4.2353	2.4601	3.6291

W-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
140.2541	17.5167	25.4115	14.7609	21.7749

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations using 20000 replications.

Diagnostic Tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1) = 2.2208[.136]	F(1,39) = 1.7756[.190]
B:Functional Form	CHSQ(1) = .26148[.609]	F(1,39) = .20098[.656]
C:Normality	CHSQ(2) = .45139[.798]	Not applicable
D:Heteroscedasticity	CHSQ(1) = 1.4474[.229]	F(1,49) = 1.4312[.237]

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

24/03/2014 12:19:48

Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,0,2,1,0,1) selected based on Schwarz Bayesian Criterion

Dependent variable is LNP
51 observations used for estimation from 1962 to 2012

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNY	-3.1767	.54509	-5.8278[.000]
LNIR	.40269	.19303	2.0862[.043]
LNEX	-.31053	.087479	-3.5498[.001]
$LNM2^+$	1.3898	.10100	13.7607[.000]
FD	-.019295	.025624	-.75300[.456]
C	23.3087	5.1780	4.5015[.000]

Testing for existence of a level relationship among the variables in the ARDL model

```
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   23.3757         2.9195          4.2353          2.4601          3.6291

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
  140.2541        17.5167         25.4115         14.7609         21.7749
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.


 24/03/2014                                                           12:20:02

         Error Correction Representation for the Selected ARDL Model
        ARDL(1,0,2,1,0,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
 Dependent variable is dLNP
 51 observations used for estimation from 1962 to 2012
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLNY                      -1.0575            .17052            -6.2015[.000]
 dLNIR                      .19877           .058143             3.4187[.001]
 dLNIR1                    -.12849           .054042            -2.3777[.022]
 dLNEX                     .048013           .052991             .90605[.370]
 dLNM2+                     .46264           .076463             6.0506[.000]
 dFD                       .012943          .0052163             2.4813[.017]
 ecm(-1)                   -.33288           .072830            -4.5707[.000]
*******************************************************************************
 List of additional temporary variables created:
 DlnP = LNP-LNP(-1)
 dLNY = LNY-LNY(-1)
 dLNIR = LNIR-LNIR(-1)
 dLNIR1 = LNIR(-1)-LNIR(-2)
 dLNEX = LNEX-LNEX(-1)
 dLNM2+ = LNM2+-LNM2+(-1)
 dFD = FD-FD(-1)
 ecm = LNP +   3.1767*LNY   -.40269*LNIR +   .31053*LNEX   -1.3898*LNM2+ +
 .019295*FD  -23.3087*C
*******************************************************************************
 R-Squared                     .87779   R-Bar-Squared                   .84724
 S.E. of Regression           .073023   F-Stat.    F(7,43)     41.0432[.000]
 Mean of Dependent Variable    .22946   S.D. of Dependent Variable      .18683
 Residual Sum of Squares       .21329   Equation Log-likelihood        67.2954
 Akaike Info. Criterion       56.2954   Schwarz Bayesian Criterion     45.6703
 DW-statistic                  2.3157
*******************************************************************************
 R-Squared and R-Bar-Squared measures refer to the dependent variable
 dLNCPI and in cases where the error correction model is highly
 restricted, these measures could become negative.

Testing for existence of a level relationship among the variables in the ARDL model
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   23.3757         2.9195          4.2353          2.4601          3.6291

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
  140.2541        17.5167         25.4115         14.7609         21.7749
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.
```

WITH INTERACTION

M1

```
 24/03/2014                                                           12:25:28

                  Autoregressive Distributed Lag Estimates
       ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
```

```
 Dependent variable is LNP
 51 observations used for estimation from 1962 to 2012
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 LNP(-1)                    .58079            .057385            10.1209[.000]
 LNY                       -1.0287             .15634            -6.5803[.000]
 LNIR                       .15988            .049404             3.2361[.003]
 LNEX                       .13249            .049730             2.6641[.011]
 LNEX(-1)                  -.21030            .042813            -4.9122[.000]
 LNM1                       .41967            .088827             4.7246[.000]
 LNM1(-1)                  -.25360             .12554            -2.0201[.050]
 LNM1(-2)                   .37357            .092501             4.0385[.000]
 FD                        .018278           .0050032             3.6533[.001]
 FD(-1)                   -.034640           .0051446            -6.7333[.000]
 LNM1FD                    -.0013453           .8896E-3            -1.5122[.139]
 LNM1FD(-1)                .0026314           .0010056             2.6166[.013]
 C                          7.6573             1.3956             5.4869[.000]
*******************************************************************************
 R-Squared                     .99980   R-Bar-Squared                    .99973
 S.E. of Regression           .067501   F-Stat.    F(12,38)    15479.7[.000]
 Mean of Dependent Variable   -.17681   S.D. of Dependent Variable       4.1147
 Residual Sum of Squares       .17314   Equation Log-likelihood         72.6136
 Akaike Info. Criterion       59.6136   Schwarz Bayesian Criterion      47.0567
 DW-statistic                  2.1960   Durbin's h-statistic     -.76716[.443]
*******************************************************************************

Testing for existence of a level relationship among the variables in the ARDL model
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   13.3074         2.7139          4.0524           2.3193           3.4991

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   93.1515        18.9976         28.3665          16.2350          24.4940
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.


                              Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *           F Version        *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(1)  =    .78411[.376]*F(1,37)       =   .57775[.452]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(1)  =    1.4240[.233]*F(1,37)       =   1.0628[.309]*
*                     *                          *                            *
* C:Normality         *CHSQ(2)  =    3.8664[.145]*      Not applicable        *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(1)  =    .20891[.648]*F(1,49)       =   .20154[.655]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values


 24/03/2014                                                         12:25:36

           Estimated Long Run Coefficients using the ARDL Approach
       ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
 Dependent variable is LNP
 51 observations used for estimation from 1962 to 2012
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 LNY                       -2.4540             .26462            -9.2738[.000]
 LNIR                       .38137             .10937             3.4869[.001]
 LNEX                      -.18563            .061322            -3.0271[.004]
 LNM1                       1.2873            .057390            22.4301[.000]
 FD                       -.039030            .014545            -2.6834[.011]
 LNM1FD                   .0030678           .0024069             1.2746[.210]
 C                         18.2661             2.6005             7.0240[.000]
*******************************************************************************

Testing for existence of a level relationship among the variables in the ARDL model
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
```

```
  13.3074          2.7139          4.0524          2.3193          3.4991

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   93.1515        18.9976          28.3665         16.2350         24.4940
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.


 24/03/2014                                                          12:25:49

         Error Correction Representation for the Selected ARDL Model
       ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
 Dependent variable is dLNP
 51 observations used for estimation from 1962 to 2012
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLNY                      -1.0287            .15634              -6.5803[.000]
 dLNIR                      .15988           .049404               3.2361[.002]
 dLNEX                      .13249           .049730               2.6641[.011]
 dLNM1                      .41967           .088827               4.7246[.000]
 dLNM11                    -.37357           .092501              -4.0385[.000]
 dFD                       .018278          .0050032               3.6533[.001]
 dLNM1FD                 -.0013453          .8896E-3              -1.5122[.138]
 ecm(-1)                   -.41921           .057385              -7.3052[.000]
*******************************************************************************
 List of additional temporary variables created:
 dLNP = LNP-LNP(-1)
 dLNY = LNY-LNY(-1)
 dLNIR = LNIR-LNIR(-1)
 dLNEX = LNEX-LNEX(-1)
 dLNM1 = LNM1-LNM1(-1)
 dLNM11 = LNM1(-1)-LNM1(-2)
 dFD = FD-FD(-1)
 dLNM1FD = LNM1FD-LNM1FD(-1)
 ecm = LNCPI +   2.4540*LNRGDP   -.38137*LNIR +   .18563*LNEX   -1.2873*LNM1 +
 .039030*FD -.0030678*LNM1FD  -18.2661*C
*******************************************************************************
 R-Squared                     .90079   R-Bar-Squared                   .86947
 S.E. of Regression           .067501   F-Stat.    F(8,42)     43.1305[.000]
 Mean of Dependent Variable    .22946   S.D. of Dependent Variable     .18683
 Residual Sum of Squares       .17314   Equation Log-likelihood       72.6136
 Akaike Info. Criterion       59.6136   Schwarz Bayesian Criterion    47.0567
 DW-statistic                  2.1960
*******************************************************************************
 R-Squared and R-Bar-Squared measures refer to the dependent variable
 dLNCPI and in cases where the error correction model is highly
 restricted, these measures could become negative.

Testing for existence of a level relationship among the variables in the ARDL model
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   13.3074          2.7139          4.0524          2.3193          3.4991

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   93.1515        18.9976          28.3665         16.2350         24.4940
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.
```

M2

```
 24/03/2014                                                          12:27:53

                    Autoregressive Distributed Lag Estimates
       ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
 Dependent variable is LNP
 51 observations used for estimation from 1962 to 2012
```

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNP(-1)	.58147	.059384	9.7917[.000]
LNY	-1.2095	.17902	-6.7563[.000]
LNIR	.15771	.051040	3.0899[.004]
LNEX	.12495	.051042	2.4481[.019]
LNEX(-1)	-.20474	.043613	-4.6944[.000]
LNM2	.44749	.10410	4.2987[.000]
LNM2(-1)	-.28420	.14379	-1.9766[.055]
LNM2(-2)	.38714	.10360	3.7370[.001]
FD	.021590	.0053205	4.0578[.000]
FD(-1)	-.033410	.0053870	-6.2020[.000]
LNM2FD	-.0021004	.9166E-3	-2.2916[.028]
LNM2FD(-1)	.0029561	.0010292	2.8724[.007]
C	9.1199	1.5672	5.8193[.000]

R-Squared	.99978	R-Bar-Squared	.99971
S.E. of Regression	.069895	F-Stat. F(12,38)	14437.1[.000]
Mean of Dependent Variable	-.17681	S.D. of Dependent Variable	4.1147
Residual Sum of Squares	.18564	Equation Log-likelihood	70.8358
Akaike Info. Criterion	57.8358	Schwarz Bayesian Criterion	45.2790
DW-statistic	2.0872	Durbin's h-statistic	-.34363[.731]

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
13.3713	2.7139	4.0524	2.3193	3.4991

W-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
93.5994	18.9976	28.3665	16.2350	24.4940

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations using 20000 replications.

Diagnostic Tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1) = .16073[.688]	F(1,37) = .11698[.734]
B:Functional Form	CHSQ(1) = 3.0995[.078]	F(1,37) = 2.3942[.130]
C:Normality	CHSQ(2) = 2.5585[.278]	Not applicable
D:Heteroscedasticity	CHSQ(1) = .019617[.889]	F(1,49) = .018855[.891]

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

24/03/2014 12:28:01

Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion

Dependent variable is LNP
51 observations used for estimation from 1962 to 2012

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNY	-2.8899	.28794	-10.0363[.000]
LNIR	.37682	.11312	3.3311[.002]
LNEX	-.19064	.064114	-2.9734[.005]
LNM2	1.3152	.061064	21.5375[.000]
FD	-.028242	.015369	-1.8376[.074]
LNM2FD	.0020445	.0024749	.82612[.414]
C	21.7905	2.7821	7.8324[.000]

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
13.3713	2.7139	4.0524	2.3193	3.4991

```
 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   93.5994        18.9976         28.3665         16.2350         24.4940
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.


 24/03/2014                                                           12:28:15

         Error Correction Representation for the Selected ARDL Model
       ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
 Dependent variable is dLNP
 51 observations used for estimation from 1962 to 2012
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 dLNY                      -1.2095            .17902             -6.7563[.000]
 dLNIR                      .15771           .051040              3.0899[.004]
 dLNEX                      .12495           .051042              2.4481[.019]
 dLNM2                      .44749            .10410              4.2987[.000]
 dLNM21                    -.38714            .10360             -3.7370[.001]
 dFD                       .021590          .0053205              4.0578[.000]
 dLNM2FD                  -.0021004          .9166E-3             -2.2916[.027]
 ecm(-1)                   -.41853           .059384             -7.0477[.000]
*******************************************************************************
 List of additional temporary variables created:
 dLNP = LNP-LNP(-1)
 dLNY = LNY-LNY(-1)
 dLNIR = LNIR-LNIR(-1)
 dLNEX = LNEX-LNEX(-1)
 dLNM2 = LNM2-LNM2(-1)
 dLNM21 = LNM2(-1)-LNM2(-2)
 dFD = FD-FD(-1)
 dLNM2FD = LNM2FD-LNM2FD(-1)
 ecm = LNP +   2.8899*LNY   -.37682*LNIR +   .19064*LNEX   -1.3152*LNM2 +
 .028242*FD -.0020445*LNM2FD  -21.7905*C
*******************************************************************************
 R-Squared                     .89363   R-Bar-Squared                   .86004
 S.E. of Regression           .069895   F-Stat.    F(8,42)     39.9062[.000]
 Mean of Dependent Variable    .22946   S.D. of Dependent Variable      .18683
 Residual Sum of Squares       .18564   Equation Log-likelihood        70.8358
 Akaike Info. Criterion       57.8358   Schwarz Bayesian Criterion     45.2790
 DW-statistic                  2.0872
*******************************************************************************
 R-Squared and R-Bar-Squared measures refer to the dependent variable
 dLNCPI and in cases where the error correction model is highly
 restricted, these measures could become negative.

Testing for existence of a level relationship among the variables in the ARDL model
*******************************************************************************
 F-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   13.3713         2.7139          4.0524           2.3193          3.4991

 W-statistic  95% Lower Bound  95% Upper Bound  90% Lower Bound  90% Upper Bound
   93.5994        18.9976         28.3665         16.2350         24.4940
*******************************************************************************
 If the statistic lies between the bounds, the test is inconclusive. If it is
 above the upper bound, the null hypothesis of no level effect is rejected. If
 it is below the lower bound, the null hypothesis of no level effect can't be
 rejected. The critical value bounds are computed by stochastic simulations
 using 20000 replications.
```

$M2^+$

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 24/03/2014                                                           12:30:01

                    Autoregressive Distributed Lag Estimates
       ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion
*******************************************************************************
 Dependent variable is LNP
 51 observations used for estimation from 1962 to 2012
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 LNP(-1)                    .54941           .058362              9.4137[.000]
 LNY                       -1.3151            .17804             -7.3864[.000]
 LNIR                       .19664           .050492              3.8945[.000]
```

LNEX	.11514	.049587	2.3220[.026]
LNEX(-1)	-.20318	.042478	-4.7833[.000]
$LNM2^{+}$	.50005	.11653	4.2910[.000]
$LNM2^{+}$(-1)	-.30995	.16678	-1.8584[.071]
$LNM2^{+}$(-2)	.39529	.11772	3.3577[.002]
FD	.024582	.0052987	4.6394[.000]
FD(-1)	-.031892	.0053795	-5.9284[.000]
$LNM2^{+}$FD	-.0018585	.8636E-3	-2.1521[.038]
$LNM2^{+}$FD(-1)	.0038059	.9852E-3	3.8633[.000]
C	9.8312	1.5401	6.3834[.000]

R-Squared	.99980	R-Bar-Squared	.99973
S.E. of Regression	.067223	F-Stat. F(12,38)	15608.2[.000]
Mean of Dependent Variable	-.17681	S.D. of Dependent Variable	4.1147
Residual Sum of Squares	.17172	Equation Log-likelihood	72.8243
Akaike Info. Criterion	59.8243	Schwarz Bayesian Criterion	47.2674
DW-statistic	2.2665	Durbin's h-statistic	-1.0468[.295]

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
12.3400	2.7139	4.0524	2.3193	3.4991

W-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
86.3803	18.9976	28.3665	16.2350	24.4940

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations using 20000 replications.

Diagnostic Tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1) = 1.6435[.200]	F(1,37) = 1.2320[.274]
B:Functional Form	CHSQ(1) = .59520[.440]	F(1,37) = .43691[.513]
C:Normality	CHSQ(2) = 1.0697[.586]	Not applicable
D:Heteroscedasticity	CHSQ(1) = .0087578[.925]	F(1,49) = .0084158[.927]

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

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Estimated Long Run Coefficients using the ARDL Approach
ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion

Dependent variable is LNP
51 observations used for estimation from 1962 to 2012

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNY	-2.9185	.25774	-11.3236[.000]
LNIR	.43640	.10074	4.3319[.000]
LNEX	-.19539	.057229	-3.4142[.002]
$LNM2^{+}$	1.2991	.053587	24.2435[.000]
FD	-.016223	.013660	-1.1876[.242]
$LNM2^{+}$FD	.0043220	.0021158	2.0427[.048]
C	21.8184	2.4848	8.7807[.000]

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
12.3400	2.7139	4.0524	2.3193	3.4991

W-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
86.3803	18.9976	28.3665	16.2350	24.4940

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations using 20000 replications.

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Error Correction Representation for the Selected ARDL Model
ARDL(1,0,0,1,2,1,1) selected based on Schwarz Bayesian Criterion

****

Dependent variable is dLNP
51 observations used for estimation from 1962 to 2012

****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
dLNY	-1.3151	.17804	-7.3864[.000]
dLNIR	.19664	.050492	3.8945[.000]
dLNEX	.11514	.049587	2.3220[.025]
dLNM2$^+$	.50005	.11653	4.2910[.000]
dLNM2$^+$1	-.39529	.11772	-3.3577[.002]
dFD	.024582	.0052987	4.6394[.000]
dLNM2$^+$FD	-.0018585	.8636E-3	-2.1521[.037]
ecm(-1)	-.45059	.058362	-7.7206[.000]

****

List of additional temporary variables created:
dLNP = LNP-LNP(-1)
dLNY = LNY-LNY(-1)
dLNIR = LNIR-LNIR(-1)
dLNEX = LNEX-LNEX(-1)
dLNM2$^+$ = LNM2$^+$ -LNM2$^+$(-1)
dLNM2$^+$1 = LNM2$^+$(-1)-LNM2$^+$(-2)
dFD = FD-FD(-1)
dM2$^+$FD = M2$^+$FD-M2$^+$FD(-1)
ecm = LNP + 2.9185*LNY -.43640*LNIR + .19539*LNEX -1.2991*LNM2$^+$ + .016223*FD -.0043220*LNM2$^+$FD -21.8184*C

****

R-Squared	.90161	R-Bar-Squared	.87054
S.E. of Regression	.067223	F-Stat. F(8,42)	43.5278[.000]
Mean of Dependent Variable	.22946	S.D. of Dependent Variable	.18683
Residual Sum of Squares	.17172	Equation Log-likelihood	72.8243
Akaike Info. Criterion	59.8243	Schwarz Bayesian Criterion	47.2674
DW-statistic	2.2665		

****

R-Squared and R-Bar-Squared measures refer to the dependent variable dLNCPI and in cases where the error correction model is highly restricted, these measures could become negative.

Testing for existence of a level relationship among the variables in the ARDL model

****

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
12.3400	2.7139	4.0524	2.3193	3.4991

W-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
86.3803	18.9976	28.3665	16.2350	24.4940

****

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations using 20000 replications.