KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ARTS AND SOCIAL SCIENCES DEPARTMENT OF ECONOMICS

INFLATION TARGETING, INFLATION AND ECONOMIC GROWTH IN GHANA (1980-2013): AN EMPIRICAL INVESTIGATION

BY

ALHASSAN MOHAMMED

(PG1906214)

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DECLARATION

I hereby declare that this thesis is the result of my own original work and effort towards the Master of Philosophy Degree in Economics. To the best of my knowledge, it neither contains material published by another person or material which has been accepted for the award of any other degree of the University, except where due acknowledgements have been made in the text.

ID NUMBER : PG1906214

ALHASSAN MOHAMMED	…………………	……………………
(STUDENT'S NAME)	SIGNATURE	DATE

CERTIFIED BY:

DR. YUSIF M. HADRAT	…………………..	……………………
(SUPERVISOR)	SIGNATURE	DATE

CERTIFIED BY:

DR. SAKYI DANIEL	…………………..	……………………
(INTERNAL EXAMINER)	SIGNATURE	DATE

CERTIFIED BY:

DR. YUSIF M. HADRAT	…………………..	……………………
(HEAD OF DEPARTMENT)	SIGNATURE	DATE

ABSTRACT

The Bank of Ghana (BoG) adopted inflation targeting as a nominal anchor in 2007 to address macroeconomic stability. Given Ghana's chequered history of high volatile inflation and the recent adoption of inflation targeting as an important monetary policy instrument, it is significant to investigate the effect of inflation targeting and inflation on economic growth in Ghana. However, the only known study that investigated the effect of inflation targeting and inflation on economic growth in Ghana did not take inflation volatility into account. This study examines the impact of inflation targeting, inflation level and inflation volatility on economic growth in Ghana. The study used Autoregressive Distributed Lag (ARDL) model to analyze time series data on inflation and real per capita GDP from 1980 – 2013. The results indicate that inflation targeting has a positive and statistically significant impact on economic growth in the long-run, inflation level has a weak negative and significant impact on economic growth in the short-run and inflation volatility has a negative and significant impact on economic growth in both short-term and long-term. Therefore, it is recommended that BoG should strengthen inflation targeting by ensuring a stable financial environment as well as monetary policy accountability and credibility. Also, Ghana needs a comprehensive mix of macroeconomic reforms. Thus the BoG and Ministry of Finance (MoF) should implement interest rate and tax policies that induce investment efficiency in the economy.

DEDICATION

To my loving and caring wife, Nasiru Bebee, for her heightened motivation, unflinching support and endurance throughout the course of this academic exercise.

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AD	Aggregate Demand
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lagged
AS	Aggregate Supply
BoG	Bank of Ghana
BOP	Balance of Payment
DCPS	Domestic Credit to Private Sector
ERP	Economic Recovery Programme
FINSAP	Financial Sector Adjustment Programme
FMOLS	Fully-Modified Ordinary Least Squares
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
GDFCF	Gross Domestic Fixed Capital Formation
GDP	Gross Domestic Product
IFS	International Financial Statistics
IMF	International Monetary Fund
IT	Inflation Targeting
MASD	Moving Average Standard Deviation
MoF	Ministry of Finance
MPC	Monetary Policy Committee
OMO	Open Market Operations
PR	Policy Rate
PSBR	Public sector Borrowing Requirement
SAP	Structural Adjustment Programme
WAMU	West African Monetary Union
WDI	World Development Indicators

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

In the 1960s, Ghana like several other Sub-Sahara African countries, had bright hopes of catching up with the developed world. However, years of economic decline and political upheavals have taken a toll in Ghana and the bright optimism and rapid growth of the 1960s got dissipated before the 1980s. Modigliani et al. (1970) remarked that the use of intangible money in a private enterprise economy implies such an economy needs stabilization, can undergo stabilization and should undergo stabilization, through the use of appropriate fiscal and monetary policy tools. Against this backdrop, Ghana's search for macroeconomic stability led to monetary policy evolution from exchange rate targeting to inflation targeting. From 1964 – 1981, exchange rate was targeted as a nominal anchor i.e., a variable used by the central bank to pin down private agents' expectations.

However, a nasty mix of fiscal indiscipline, loose monetary policy and declining commodity prices resulted in widespread huge budget deficits and deteriorating terms of trade. These disturbances translated into worsening inflation trends with inflation rate reaching a historical high of 143.97% in the second quarter of 1983. Again, food prices hiked and this was mainly attributed to supply shocks that emanated from the severe drought the country experienced in 1983. Indeed, there was persistent decline in real aggregate economic activity as Ghana's economy recorded negative growth rates of about 0.2%, 3.2%, 5.9% and 4.1% in 1980, 1981, 1982 and 1983 respectively.

In an attempt to redirect the economy towards growth, key neo-liberal reforms such as Economic Recovery Programme (ERP) and Structural Adjustment Programme (SAP) were implemented to address internal and external imbalances. The policy actions were implemented in three phases; ERP I from 1983 – 86 specifically aimed at stabilizing the economy, ERP II from 1987 – 90 essentially aimed at integrating stabilization and economic reform while the accelerated growth phase from 1992 – 2000 was meant to propel the economy to a higher middle income status. Despite the fact that gains from SAP and ERP remain contentious, the Ghanaian economy recorded an average annual GDP growth of approximately 5.5% in the decade following the adoption of these neo-liberal reforms.

As a result of Ghana's quest to maintain macroeconomic stability and consolidate the gains from these economic reforms, monetary policy conduct shifted from exchange rate targeting to monetary targeting in 1982. Two phases of monetary targeting that haven been adopted include; domestic direct credit control from 1982-91 and Open Market Operations (OMO) from 1992-2006. However, according to Kwakye (2012), factors such as lack of safety nets in lending, unstable financial environment, absence of clear separation between public sector borrowing requirement (PSBR) and OMO, among others, affected the effectiveness of monetary policy in containing liquidity in the economy. Consequently, annual average GDP growth consistently fell short of the target rate of 8% from 1992-2006. Economic growth is defined as sustained increase in the Gross Domestic Product (GDP) of a country. GDP is the total monetary value of goods and services produced in an economy over a specific period. The ratio of GDP to population is termed as GDP per capita. An increase in per capita GDP generally implies a rise in living standard of the people and a reduction in income disparities, which signifies enhanced economic growth.

Monetary policy and economic growth relationship is such an important discourse that has dominated the monetary economics literature (Friedman, 1995). There have existed dissenting views among monetary economists such as Mckinnon (1973), Shaw (1973), Mathieson (1980), Levine (1997), inter alia, with respect to the contribution of monetary policy to economic growth in both developed and developing economies. Perhaps, the growing significance of monetary policy as a tool for delivering macro-economic stability occasioned the widely shift to inflation targeting by both developed and developing economies (Maumela, 2010).

Bernanke and Mishkin (1977) defined inflation targeting as mechanism in which central banks formally communicate explicit inflation targets or target ranges and are committed to delivering the announced target within a certain time horizon through the actions of government or central bank or their mutual actions. According to Mishkin (2001), inflation targeting is distinct from other frameworks because it has the following key features; (i) explicit central bank mandate to publish and pursue numerical inflation target as primary monetary policy objective; (ii) a framework that operates on technical inflation forecasts as implicit or explicit intermediate target; (iii) use of short term interest rate transmission as a substitute to monetary aggregates; and (iv) impeccable magnitude of central bank accountability and commitment to transparency requirements.

In essence, the principal goal of inflation targeting policy is to maintain inflation within a desirable target range. To deliver the explicit inflation target, monetary policy makers periodically adjust the policy rate (PR). The optimal policy for the central bank is to set the nominal interest rate such that expected future inflation is equal to the explicitly set inflation target (Agenor, 2008). The Monetary Policy Committee (MPC) of the Central bank does this by undertaking monthly or quarterly review of the targeted interest rate and the observed percentage deviation in interest rate is estimated based on signals received from market fundamentals. This ensures that forecasting of market trends generates accurate outcomes towards reaching the quantitative inflation target or target range.

Indeed, this mechanism is proven to be effective in anchoring expectations and thereby keeping inflation stable and less variable (Johnson, 2002). The ultimate goal is to reduce macroeconomic volatility which in turn stabilizes output.

Increasing number of countries have shifted monetary policy from money supply targeting to explicit inflation targeting since New Zealand operated inflation targeting in 1990 (Kumo, 2015). Explicit inflation targeting was introduced in Ghana in 2007. Hammond (2012) reported that at the beginning of 2012, the number of central banks who were regarded as operating full-fledge inflation targeting was 27 and many other economies were in the process of establishing explicit inflation targeting regime. This has inspired research on the effect of inflation targeting on inflation and economic growth. However, there is lack of consensus; while some empirical studies found that inflation targeting contributes significantly to economic growth others argue that the purported benefits of inflation targeting is sheer luck.

Ghana's economy has demonstrated a history of poorly anchored expectations and high volatile inflation. To solve this, two variants of inflation targeting have been adopted; implicit or soft inflation targeting from 2002 to 2006 and explicit inflation targeting in 2007. Consequently, single digit inflation outcomes were delivered in 2010 and 2011 over a continuous thirty-month period, and inflation appeared to be relatively stable and low under the inflation targeting regime. Theory suggests that a stable low and less variable inflation could have significant impact on GDP growth. However, the detailed effect of inflation targeting and inflation on economic growth is not yet established quantitatively in Ghana. This creates a dilemma for policy makers in deciding whether to explore other monetary policy frameworks or strengthen the inflation targeting policy. This makes it crucial to empirically analyze the implications of inflation targeting policy and inflation on economic growth in Ghana.

1.2 Statement of Problem

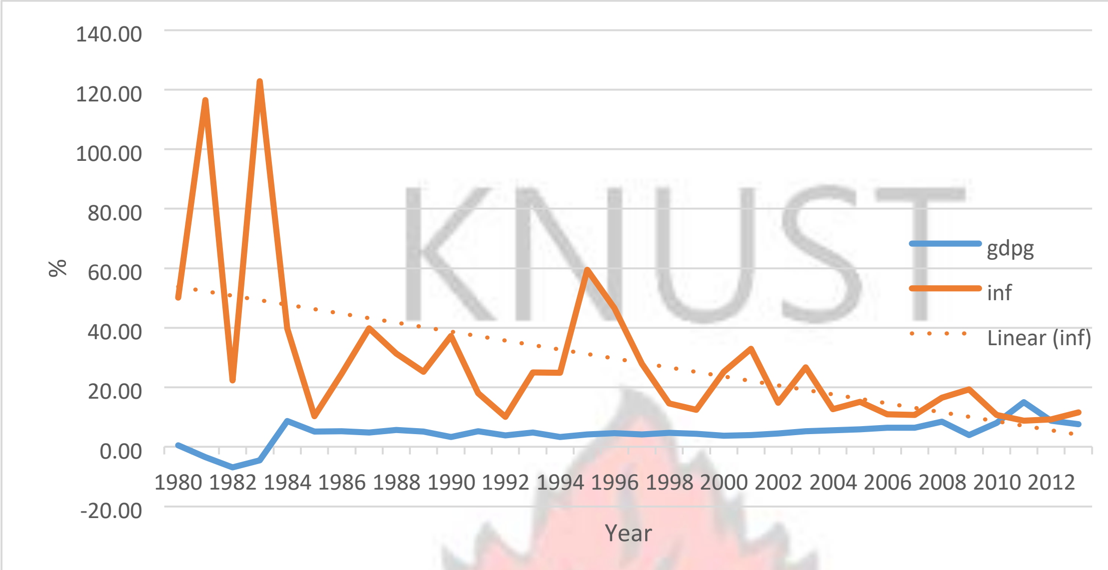
The obsession of reaching higher middle income status by the year 2020 can only be absolute reality if a high, balanced and sustainable annual growth of above 8% is attainable (The Coordinated Programme of Economic and Social Development Policies, 2010 – 2016). Since the early 1980s, the Ghanaian economy has registered positive growth rates. Average annual GDP growth rate accelerated from 1.8% in the 1980s to 4.3% during the 1990s and a further rise to 5.25% from 2000-2009. Average annual growth rate from 1980 to 2013 was approximately 4.5% (Computed from World Development indicators (WDI), 1980-2013). However, these impressive growth statistics between 1980 and 2013 compared with the growth miracle of the economy in the 1960s and 1970s, are considered insufficient to propel the economy to higher middle income status (i.e., from a per capita income level of US$1550 in 2012 to US$12615 by the year 2020). This suggests the need to continue to implement policies that boost GDP growth in Ghana towards the attainment of the international development goals.

Monetary policy is often employed as the starting point for stimulating real aggregate economic activity. Since the 1990s, inflation targeting has been used by many countries as an instrument for delivering the twin macroeconomic goals of price stability and balanced growth. To ensure macroeconomic stability and deliver annual growth targets, BoG followed the example of New Zealand, Chile, Spain, United Kingdom, South Africa; and adopted full-fledged inflation targeting in 2007. The widely adoption of inflation targeting by both developed and developing countries has provoked the interest of researchers in inflation targeting and a lot of studies have investigated the effect of inflation targeting on macroeconomic performance. However, there is no consensus on the effect of inflation targeting on inflation and economic growth.

On the one hand, studies by Batini and Laxton (2007), Goncalves and Salles (2008) and Daboussi (2014) found that inflation targeting has a positive and significant impact on output growth. On the other hand, Duerker and Fischer (2006), Ceccheti and Ehrman (2000) and Romdhane and Mensi (2014) reported that inflation targeting has no significant impact on economic growth.

In the Ghanaian context, it can be shown in Figure 1 that inflation appeared to be more volatile from 1980 to 2001. However, since the adoption of implicit inflation targeting in 2002, inflation has been relatively stable and the economy recorded single digit inflation for a continuous 30-month period in 2010 and 2011. Figure 1 again shows that after registering negative growth rates in the early 1980s, annual GDP growth averaged 4% from 1980-2001 while an average rate of 7.2% was attained during the 2002-2013 period. Before the single digit inflation regime, average annual inflation rate increased steadily from 9.79% in the 1960s to 38.6% in the 1970s and then to a record high of 49.5% during the 1980s before easing to 28.2% during the 1990s. Significant decline in annual inflation rate began during the 2000-2009 decade with an average rate of 19.6%. The statistics suggest that Ghana has had a history of high volatile inflation (Barimah and AmuakwaMensah, 2014). Even during the 1993 –2013 sub-period where inflation was thought to be relatively stable, Figure 1 shows that there were large swings in the inflation rate. Given the chequered history of high and volatile inflation rate in Ghana and the recent adoption of inflation targeting as a significant monetary policy tool, it is important to empirically analyze the effect of inflation targeting and inflation volatility on economic growth.

Figure 1.1: Trends in Inflation and GDP Growth (1980 – 2013)



SOURCE: World Development Indicators (WDI)

A review of relevant literature revealed that the only known empirical study is the one conducted by Puni et al. (2014) on the impact of inflation targeting and inflation rate on GDP growth in Ghana. However, their study did not take inflation volatility into account. There is the need for further studies to be conducted to fill this knowledge gap.

1.3 Objectives of the Study

The main objective of the study is to examine the effect of inflation targeting and inflation on economic growth in Ghana.

The specific objectives of the study are;

- To assess monetary management, inflation outcomes and GDP growth from 1980 – 2013
- To examine the impact of inflation targeting on economic growth
- To examine the impact of inflation level on economic growth
- To examine the impact of inflation volatility on economic growth

1.4 Hypotheses

The hypotheses that were tested are stated as follows;

1. H_0: Inflation targeting has no significant impact on economic growth

   H_1: Inflation targeting has a significant impact on economic growth

2. H_0: Inflation level has no significant impact on economic growth

   H_1: Inflation level has a significant impact on economic growth

3. H_0: Inflation volatility has no significant impact on economic growth

   H_1: Inflation volatility has a significant impact on economic growth

1.5 Significance of the Study

In both developed and developing economies, inflation targeting has been widely adopted as a mechanism for delivering stable low inflation and stimulating real aggregate economic activity. The BOG formally adopted inflation targeting as a policy rule in 2007, making Ghana the second Sub-Sahara African country to operate inflation targeting after South Africa. Theory suggests that stable low and less variable inflation could have significant positive impact on GDP growth.

In order to improve the conduct of monetary policy in Ghana, it is crucial for monetary authorities to have good understanding of how inflation targeting affects inflation and economic wellbeing. Essentially, for policy makers to be informed whether it is beneficial to maintain inflation targeting or explore alternative frameworks for formulating and conducting monetary policy, an empirical study of this kind is useful in seeking to reveal the implications of target inflation on real aggregate economic activity. Also, the findings of the study will be an addition to existing literature.

1.6 Scope

This study is based on the Ghanaian economy over a 34 year period i.e., 1980 – 2013, which was decomposed into pre-inflation targeting period (1980 – 2006) and post-inflation targeting period (2007 – 2013). The choice of the sample size was influenced by data availability. This served as a guide for examining impact of the policy shift on economic growth using a dummy variable.

Economic growth was used as a dependent variable proxied by the natural log of real GDP per capita. The reason is that it gives a better measure of welfare and also serves as an indicator of standard of living (Sorensen and Whitta-Jacobsen, 2010). The main independent variables used in the analysis are inflation level and volatility. The choice of inflation level and volatility as regressors is due to the fact that inflation targeting influences economic growth through its effect on inflation. Also, Gross Domestic Fixed capital Formation/GDP ratio and Domestic Credit to Private Sector/GDP ratio were used as control variables of growth.

1.7 Organization of the study

The study comprises six chapters. Chapter One is the introduction and it consists of background to the study, statement of problem, objectives, hypotheses, scope, significance and organization of the study. Chapter Two constitutes a review of theoretical, empirical and methodological literature on the impact of inflation targeting on economic growth. Chapter Three deals with an overview of monetary management and macro-economic developments in Ghana. Chapter Four describes the types and sources of data, the model specification and the estimation technique. Chapter Five deals with analysis and discussion of empirical results. Finally, Chapter Six presents summary of major findings, conclusions and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In this chapter, the study reviews relevant literature in relation to the effect of inflation targeting and inflation on economic growth in Ghana. It comprises three sections – theoretical, empirical and methodological review. The theoretical review section involves definition of concepts and review of theories on the effect of inflation targeting and inflation on economic growth. Under the empirical review, the study reviews empirical studies on the effect of inflation targeting and inflation on economic growth. The methodological review section deals with assessment of empirical methods used in previous related studies. In the review, it was ascertained that most studies on the effect of inflation targeting and inflation on economic growth largely focused on applying the difference-in-difference estimation panel regression or cross-sectional estimation techniques. Very few of such studies have considered the effect of inflation targeting and inflation on economic growth in a country-specific framework.

2.1 Definition of Concepts and Review of Growth Theories

This section reviews relevant concepts and theories that are applied in subsequent chapters.

2.1.1 Macro-economic Policy

According to Hilbers (2004), macroeconomic policy is an integrated mechanism which constitutes guidelines or actions prescribed or taken by the government, intended to exert stimulating effect on real aggregate economic activity. Macro-economic policy is periodically revised to induce observed changes in macro-economic performance.

Monetary and fiscal policies are two key macro-economic regulatory instruments used to stimulate real aggregate economic activity.

Fiscal Policy

Fiscal policy is generally defined to imply a mechanism in which fiscal authorities alter the direction of expenditure and/or taxation for the purpose of inducing economic performance (Hilbers, 2004). Fiscal policy can take either of two forms; contractionary and expansionary, depending on the direction of change in the key fiscal policy instruments as taxation, government expenditure and government debts and deficits.

Monetary policy

Monetary policy involves the use of nominal anchor or policy rules to control the quantity of money or interest rates in a country for the purpose of achieving a set of goals oriented towards stabilizing inflation and inducing economic growth (Hilbers, 2004; Kwakye, 2012). Monetary policy largely depends on the functional relationship between interest rate and money supply in an economy. Central bankers use different monetary policy instruments to regulate one or both of these, to induce the performance of macro-economic variables. Monetary policy is categorized into two forms; contractionary and expansionary. To this end, whereas monetary policy and fiscal policy are two distinct policy frames, they do not function independently. Changes in one affects the framework of the other and hence, influence the total effect of a policy shift.

2.1.2 The Concept of Economic Growth

Economic growth may be defined in terms of domestic price index (inflation), real GDP growth, unemployment rate and the BOP position. However, economic growth is commonly measured by using percentage changes in GDP overtime. GDP measures the total monetary value of goods and services produced in an economy over a specific period. Thus economic growth can be measured as percentage rate of rise in real GDP overtime. Real per capita GDP of a country is also measured as real GDP/population ratio. A rise in real GDP per capita tends to translate as a rise in productivity and hence signifies growth in an economy. The Bureau of Economic Research (BER) proposes real GDP per capita as a more realistic measure of growth because it is perceived to be a better welfare indicator than bulk GDP itself (Sorensen and Whitta-Jacobsen, 2010). For this reason, this study proxies' economic growth by overtime change in real GDP per capita (Barugahara, 2013).

2.1.3 Key Features of Inflation Targeting

It is uneasy to reach a consensus on what inflation targeting stands for when considering the wide range of academic literature (Freedman & Laxton, 2009). Various authors propose varying definitions (Walsh, 2009). The absence of a standard definition for inflation targeting is because its basic framework has been altered overtime to suit conditions of inflation targeting economies (Amato and Gerlach, 2002). But a comprehensive definition of inflation targeting that was applied for the purpose of this study is the one proposed by Bernake et al. (1999) that inflation targeting is a policy rule characterized by formal communication of numerical inflation targets/or target ranges for a one time or more horizon, and by showing clear commitment to deliver low stable inflation which is the ultimate medium-to long-run policy target. Among significant tenets of inflation targeting is frantic effort to inform the public about central bank's minutes and preferences, as well as their plans, objectives and actions (Maumela, 2010).

Although there appears to be no consensus on the meaning of inflation targeting, Mishkin (2000) proposes the following key features. He notes that a prudent and result-oriented inflation targeting policy should be characterized by;

i) publishing explicit quantitative inflation targets ii) a policy rule that uses tactical inflation forecasting as an intermediate target iii) application of the "Taylor rules" i.e., use of short term nominal interest rate

transmission as the only regulatory policy instrument iv) an impeccable magnitude of accountability and transparency

Based on Mishkin's proposition, the primary objective of inflation targeting policy is to maintain inflation within a desirable target range. Monetary authorities try to deliver the set quantitative inflation target by adjusting its policy rate (PR) at interval. In this regime, rate of interest replaces monetary aggregates as the policy instrument. In the Ghanaian context, the Monetary Policy Committee (MPC) undertakes monthly or quarterly review of the interest rate target and the percentage deviation in interest rate is estimated in response to signals obtained from market fundamentals, to ensure that forecasting of market trends generates accurate outcomes towards reaching the quantitative inflation target. The need for a more transparent monetary policy is to ensure robustness in stabilizing inflationary expectations (Kwakye, 2012).

2.1.3.1 Rationale for the Paradigm Shift to Inflation Targeting

According to Simone (2001) and Strum (2009), the early 1990s represented a revolutionary era for monetary policy in which inflation targeting crept in as an alternative mechanism. Almost three decades down the line, over 20 countries have shifted from traditional approaches to monetary policy conduct i.e., from intermediate monetary aggregates and de facto exchange rate targets, to inflation targeting (Hammond, 2012). It is quite uneasy to point to any single factor as the proximate reason for the adoption of inflation targeting policy because, the fundamental idea behind the policy shift differs from country to country. According to Goncalves and Salles (2008) and Thornton (2009), the shift to inflation targeting was triggered by many factors which include; the need for systematic macro-economic reformation, failure of previous monetary policy regimes to deliver desired macro-economic outcomes, the pursuit of monetary policy accountability and transparency, minimizing high disinflation costs, the absence of more result-oriented monetary policy alternatives, the success story of pioneering inflation targeting countries and the search for a more credible and solid monetary policy anchor (Maumela, 2010).

2.1.3.2 Pre-requisites of Inflation Targeting

Inflation targeting framework was pioneered in New Zealand in the early 1990s and due to the so-called success story of New Zealand's inflation targeting policy, many other countries have embraced the new policy rule. However, inflation targeting itself is not sufficiently robust and so, its success depends to a greater extent on the existence of certain preconditions. (Gottschalk and Moore 2001; Agenor and Montiel; 2008) highlight five main prerequisites that serve as a foundation for a full-fledged inflation targeting to flourish – namely, independence and accountability of the central bank, absence of fiscal dominance, sufficient exchange rate flexibility, sound financial system and tactical ability to forecast inflation.

From the aforementioned, it is crucial for monetary policy makers to understand that inflation targeting policy is a necessary but not a sufficient condition for stable low inflation. Its ability to deliver stable low inflation outcomes depends to a greater extent on stability of the financial environment. Unstable financial environment affects smoothness of the transmission mechanism. Therefore, in Sub-Saharan Africa, inflation targeting may not be an ideal framework because of persistent macro-economic volatility, fiscal indiscipline as well as under-developed financial markets.

3.1.3.3 Inflation Forecast Targeting

The dictum that seems to suggest that long lags in policy imply the need to forecast target inflation other than actual values is traced to Hall (1985). King (1996), asserts that the use of explicit inflation targeting is not an indication that no other intermediate target exists. Rather, the expected level of inflation becomes the preferred intermediate target to correct for the lag in interest rate changes and inflation responses. Inflation forecast by definition, is the current variable that has a significant correlation with the ultimate goal, it is less difficult to control relative to the goal and perhaps, it is more observable relative to the goal. Furthermore, it makes it cheaper to achieve transparency and strengthen central bank's accountability (Svensson, 1997).

Svensson (1999) however, accepts the position of other authors that the process of implementing and monitoring inflation targeting may be affected by some potential setbacks. Firstly, the implementation of inflation targeting may be challenging for the fact that monetary policy authorities do not have perfect control over inflation behaviour. This is because, actual inflation is determined based on past policy decisions and contractual agreements, which implies that central bank's actions can only affect future inflation outcomes. Second, the absence of complete control over inflation creates an inherent impairment in monetary policy monitoring and evaluation. Third, the inherent difficulty in effective implementation, monitoring and evaluation of this policy rule will damage monetary policy accountability and weaken commitment to the monetary policy transmission mechanism. Thus, Heever (2001) argues that the purported benefits of inflation targeting are dubious and proposes a less complicated nominal anchor such as money growth targeting, as a more reliable framework for delivering price stability. Economists such as Hall (1985), King (1996) and Svensson (1997) agree that the potential challenges of the inflation targeting framework are indisputably obvious and can derail the capacity to deliver stable inflation. Notwithstanding, they argue that discarding inflation targeting is a problem solved by creating another. They suggest that a useful alternative is inflation forecast targeting.

Inflation targeting is proven to imply inflation forecast targeting. Basically, deviations of future inflation forecasts from announced explicit targets are used to guide monetary policy-making, with forecast inflation becoming an implicit or explicit intermediate policy target. Periodic adjustments of inflation forecast towards the numerical target are determined by the weight assigned to output stabilization. The process of monetary policy implementation and monitoring is summarized and simplified by inflation forecast targeting (Svensson, 1999). Hence, the solution to the potential setbacks in the implementation process of inflation targeting is to forecast expected future (target) inflation.

In essence, though the effect of inflation targeting on macro-economic performance is contentious, there is no single inflation targeting country that has retrogressed in economic performance. It is a new policy paradigm and the more it is explored the better it becomes. Therefore, if explicit inflation targets are widely missed because of lags in policy, then inflation targeters should consider forecasting target inflation as an intermediate target rather than actual inflation targets.

2.1.3.4 Inflation Targeting and Interest Rate Setting

Recent empirical studies have shown that interest rate rules are influential in monetary policy conduct and monitoring due to their appealing features. The Taylor (1993) rule is a forward-looking formulation in which short-term policy instrument is determined as a linear function of inflation gap and output gap. The simple nature of the rule and its ability to function either as an informative machinery or as a more useful and decisive variable in monetary policy conduct, are the two commonly cited virtues of the Taylor rules (Svensson, 1997).

According to Taylor and Davradakis (2006), these forward-looking Taylor rules are an approximation to the type of forecast-based rules suggested by Haldane and Batini (1998). Such forecast-based rules are derived from the framework of dynamic structural optimizing models that allow for lags in the transmission mechanism of monetary policy, perhaps caused by, for instance, stickiness in prices (Rotenberg and Woodford, 1999) or money market rigidities (Christiano and Gust, 1999). In the presence of inherent lags in monetarypolicy transmission, dynamic structural optimizing models propose that to maximize welfare, forecast inflation should be stabilized around a desirable explicit target at some horizon. Otherwise stated, to control for inflation, short-term interest rate should react to deviations of forecast inflation from predetermined target level in attempting to minimize such departures.

The following expression captures a typical Taylor rule specification;

$$i_t = r^* + \pi_t + \alpha_1(\pi_t - \pi^*) + \alpha_2 y_t \qquad (2)$$

Where, i_t = PR, r* = equilibrium real interest rate, π_t = current mean inflation index, π^* = central bank's target inflation and y_t = output gap. Two main objectives of the Taylor rule include; stabilizing inflation at its target rate and output at its full-employment capacity. While on the average, fluctuations in the interest rate and output are positively correlated, they are not necessarily so over short periods. Using this rule, central bankers raise interest rate if inflation rate exceeds its target and output exceeds full employment capacity (Handa, 2002, 2009).

According to Kozicki (1999), basically, two 'recommendations' can be derived from the Taylor rule;

1) adoption of a tight monetary policy (i.e., relatively high rate of interest);

   i. when an economy operates at a point where output exceeds full employment ii. if the gap between real GDP and its potential is positive iii. when actual inflation exceeds assumed target

2) implementation of a flexible monetary policy (i.e., a relatively low rate of interest) if prevailing economic conditions are in contrast to the aforementioned

However, (Baxa et al., 2013) dispute the linearity of the simple "Taylor rules" and argue that domestic economic activity and inflation are non-linearly related. According to them, Taylor rules are only applicable if inflation is below the band. To a very large extent, the parameter of the output gap rises on consistent basis only in times of significant deviations of output from its potential. In respect of foreign inflation shocks, an analogous conclusion can be drawn especially, in times of significant devaluation of the exchange rate. Generally, there seem to be an impression that inflation expectations may well reflect these foreign shocks (Baxa et al., 2013) and, inflation will likely be above the band. In the presence of inconsistent exogenous shocks, interest rate will respond to a different rule of non-linear nature other than that of the simple Taylor rule, where changes in expected inflation and output gap simply determine the interest rate.

Based on this argument, it is important for inflation targeting central banks to appreciate the fact that exogenous shocks may remain persistent, interest rates are likely to react to a rule of non-linear nature and inflation targets are likely to be missed. Therefore, while inflation targeting operates on the simple Taylor rules, it is crucial to explore different rules that correspond to swings in the economy.

2.1.3.5 Policy Rate Transmission under Inflation Targeting

Simple "Taylor rules" are directly linked to the transmission mechanism of inflation targeting policy rule. Under explicit inflation targeting regime, Svensson (1997) derives the central bank's reaction function using inflation forecasting as a guide. Applying the structural model of a closed economy, he minimizes deviations of inflation from its target and of output from its potential level to obtain the reaction function as follows;

$$i_t = \bar{r} + \pi_t + b_1(\pi_t - \pi^*) + b_2 y_t + b_3 g_t + \varepsilon_t \qquad (2.0)$$

Where, i_t = policy instrument (short term nominal interest rate in period t), π_t = inflation rate in period t, $(\pi_t - \pi^*)$ = difference between current and desired inflation rates, g_t = fiscal impulse or government spending in period t and y_t = output gap in period t.

Based on the specification of the model, the optimal policy for the central bank is to set the nominal interest rate such that the expected inflation for t +2 (relative to t +1), based on information available at t, equal to the explicitly set inflation target. The functional relations for π_t, y_t and g_t are given by;

$$\pi_t = \pi_{t-1} + \alpha_1 y_{t-1} + \alpha_2 g_{t-1} + \varepsilon_t \qquad (2.1)$$

$$y_t = \beta_1 y_{t-1} - \beta_2(i_{t-1} - \pi_{t-1}) + \beta_3 g_{t-1} + \eta_t \qquad (2.2)$$

$$g_t = \gamma g_{t-1} + v_t \qquad (2.3)$$

Where ε_t, η_t and v_t are iid shocks but in practice, shocks are persistent. α_1 and α_2 are positive and $\beta_1 < 1$, $\gamma < 1$ (i.e., β_1 and γ are non-negative).

Equation (1) shows that deviations in inflation are positively related to the cyclical component of output and the fiscal impulse, in both cases with a one period lag. Equation (2) denotes a positive relationship between output gap and both its previous period value and government spending, and negatively to the real interest rate (with a period lag) in the case of the latter two variables. Finally, equation (3) states that fiscal impulse follows a first-order autoregressive process (Agénor and Montiel, 2008).

In an open economy, Svensson's model is augmented to capture effects of foreign economic activity i.e., the role played by exchange rate in monetary policy transmission;

$$i_t = r + \pi_t + b_1(\pi_t - \pi^*) + b_2 y_t + b_3 g_t + b_4 e_t + \mu_t \quad (2.4)$$

Where e_t = exchange rate in period t, b_i = parametric coefficients and μ_t = the stochastic disturbance term which is iid. The model implies that for central bankers to achieve optimal policy, nominal interest rate should be adjusted upward to reflect current inflation rate as well as the difference between actual and desired inflation rates, increases in output, government spending and exchange rate (Agenor and Montiel, 2008).

2.1.3.6 Inflation Targeting and Expectations Formation

Greater portion of economic models imply that when the deviation between actual inflation and central bank's target rate is perceived by private individuals to be wide, unemployment rises because higher inflation expectations result in increased demand for incentives and wages. This may cause firms to set higher prices, which eventually results in output loss (Dotsey and King, 2006). As a consequence, monetary policy authorities have persistently highlighted the relevance of private sector expectations in influencing inflation outcomes. Perhaps, this is what necessitated the reasoning that worsening inflation trajectory of the 1970s and the subsequent high cost of disinflation in the 1980s, were invariably understood as resulting from a history of poorly anchored inflationary expectations. Modern central bankers have consequently designed a new monetary policy paradigm, inflation targeting policy, to reverse such depressing economic experiences. Basically, the argument is that inflation targeting policy will be useful in delivering a less variable inflation and maintaining "properly anchored" inflationary expectations. If this is attainable under inflation targeting, then in principle, the process can effectively minimize the trade-off between stabilizing inflation and output loss. There however seem to be divergent views as to whether the inflation targeting policy really stabilizes or anchors inflation expectations in inflation targeting economies.

According to Bernanke et al. (1999), adjustments in inflation expectations are evident in some inflation targeting economies, but the rate of adjustment has been slow because of significantly imposing inertia. Petursson (2004) suggests that the implementation of inflation targeting as a nominal anchor, stabilizes inflation expectations thereby contributing to reduced deviations of actual inflation from target inflation. Moreover, Ball and Sheridan (2004) assert that inflation targeting policy reduces and stabilizes inflation expectations, which minimizes the impact of real macro-economic shocks on inflation. Johnson (2002) asserts that publishing a specific target inflation in developed countries has significantly contributed to a massive decline in public's expectations of the level of actual inflation.

On the contrary, Levine and Piger (2004) suggest that it appears inflation targeting policy has no appreciable consequence on long run inflationary expectations. Coibion et al. (2015) point out that most firms in New Zealand are not well-informed about the objectives and actions of the central bank and recent inflation dynamics even after the implementation of inflation targeting, so inflation perceptions and expectations appear to be poorly anchored. It must be underscored that the mere adoption of inflation targeting does not sufficiently anchor private agents' expectations. How well expectations are pinned down depends to a very large extent on accountability and credibility of the central bank. The only condition under which well-anchored expectations are guaranteed is when the central bank makes its preferences known and also delivers on announced explicit targets. This way, the public develops confidence in monetary policy making and expectations become stabilized.

2.1.3.7 Inflation Targeting and Inflation Uncertainty (Volatility)

Recent monetary policy regimes including inflation targeting, focus on strengthening monetary policy predictability and lowering inflation uncertainty. Inflation uncertainty, which is defined in terms of inflation variability, is generally perceived to be the immediate consequence of factors (i.e., supply and foreign shocks) exogenous to the monetary policy transmission mechanism as well as shocks transmitted by monetary policy itself. According to Ball and Sheridan (2004), inflation uncertainty arises from the uncertain nature of monetary policy regime, referred to as *regime uncertainty*. Inflation uncertainty may create inflation bias among economic agents which in turn affects the economy adversely. It leads to higher interest rates in the long-term, via the interest rate channel and thereby constraining investment. Also, Friedman (1977) predicts that effects of inflation uncertainty on interest rates and other macro-economic variables are severe, which can possibly cause a decline in private investment and eventually output growth.

Friedman (1977) asserts that inflation hikes cause inflation uncertainty, implying that policy regimes that set out to maintain low stable inflation will be effective in bringing down inflation uncertainty. Mishkin (2000) points out that inflation targeting policy raises monetary policy discipline and lowers inflation uncertainty and therefore strengthens the credibility of monetary policy. One benefit of inflation targeting to developing economies is that it contributes significantly to a fall in both inflation level and volatility (Daboussi, 2014). Furthermore, Batini and Laxton (2007) and Vega and Winkelried (2005) argue that inflation volatility (uncertainty) is relatively lower in inflation targeting economies than in non-targeting economies. Finally, Svensson (1997) points out that the adoption inflation targeting induces reduced inflation volatility (uncertainty).

However, Johnson (2002); Ball and Sheridan (2004) argue that inflation targeting may have a good reputation in anchoring inflationary expectations, but stabilizing inflation expectation does not necessarily imply reduction in inflation uncertainty. Gupta and Uwilingiye (2007) assert that inflation targeting induces high inflation variability because of high public awareness of central bank preferences. In addition, Heever (2001) notes that the heavy reliance of inflation targeting on econometric forecasting in an uncertain economic environment makes it sophisticated and if inaccurate forecasts are churned out, even for unpredictable conditions, credibility of monetary policy could be damaged, damaged credibility in turn causes inflation uncertainty or variability to rise.

It is worthy of note that inflation volatility is directly linked to expectation formation. If private agents' expectations are stabilized then uncertainty about inflation reduces. For central bankers to effectively keep inflation less variable, they should focus on pinning down private agents' expectations by raising public confidence in monetary policy conduct.

2.1.3.8 Inflation Targeting and Inflation level

Inflation targeting countries document low and stable inflation as primary macro-economic objective. Svensson (1997), Mishkin (2000) and Levine et al. (2004) assert that the adoption of formal inflation targeting can facilitate the attainment of favourable macroeconomic inflation outcomes. Particularly, they argue that inflation targeting can effectively induce decreased inflation variability, decreased inflationary effect of shocks and enhanced stabilization of inflationary expectations. The collective impact of these benefits is low and stable inflation. There is a large body of literature that seems to confirm the idea that adoption of inflation targeting reduces inflation level significantly.

Walsh (2009) asserts that inflation targeting policy induces reduction in average inflation in every single inflation targeting country relative to non-targeting countries. Also, according to Mishkin and Posen (1998), inflation targeting seems to be effective in improving monetary policy transparency and in significantly reducing inflation rates in inflation targeting economies such as New Zealand, Canada, UK and Germany, without causing output loss. Again, IMF (2005) points out that the practice of inflation targeting is associated with a reduction in inflation by 4.8 percentage points relative to alternative monetary policy regimes within the period 1990 – 2004.

However, other monetary economists are skeptical about the macroeconomic effects of inflation targeting because, it is unclear as to whether improved inflation outcomes in inflation targeting economies are products of robust inflation targeting or they merely coincide with a stable global economic environment. For instance, Duerker and Fischer (2006) assert that attainment of low and stable inflation in industrialized and emerging inflation targeting economies is not necessarily due to the shift to inflation targeting regime. They argue that stable inflation is observable in both inflation targeting and nontargeting economies, which could as well be attributed to the recent stable outlook of the global economic environment. McDermott and McMenamin (2008) argue that though inflation targeting seems to have successfully reduced inflation, performance of inflation targeting countries with respect to price stability does not significantly differ from what non-targeting economies achieved. In sum, the role of inflation targeting as price stabilizer is in doubt.

2.1.4 Arguments for and against Inflation Targeting

Since the inception of inflation targeting, countries in both developed and developing world have widely adopted the new monetary policy regime. However, there have been some arguments both in favour and against inflation targeting.

Arguments for inflation targeting

Arguments that are raised in favour of inflation targeting are discussed below;

Firstly, publishing a target inflation improves monetary policy transparency and helps to stabilize inflationary expectations, which in turn guides economic agents in their wage demands, investment decisions, pricing decisions, inter alia. When monetary policy transparency is maintained, uncertainty reduces and private sector capacity to infer from goals of the central bank is improved (Maumela, 2010). According to Mishkin and Posen (1998), monetary policy transparency contributes to monetary policy effectiveness in a direct way by making it feasible to easily determine and manage private sector expectations, which induces desired inflation target. Monetary policy transparency is categorized into five kinds – namely, policy, procedural, operational, economic and political transparency (Geraats et al., 2006).

Secondly, inflation targeting policy builds an autonomous and a credible monetary policy that strengthens central bank's capacity to appropriately react to shocks of domestic nature and also protect the economy against exogenous foreign shocks. According to Mishkin (2000), inflation targeting policy aids monetary policy makers to concentrate on internal economic considerations and be proactive in their response to domestically induced shocks and those of foreign origin.

Again, central bank's accountability becomes more solid because the costs of policy imperfections to policy designers is increased under inflation targeting. When accountability of the central bank improves consistency in monetary policy choices is achieved and the public gets insulated against irresponsible actions of monetary authorities (Merwe, 2004).

According to Goodhart (1998), one advantage of inflation targeting is that it permits central banks to constantly provide information to the general public, political heads, financial markets, among others, on variables such as; explicit inflation target and the procedure for deriving them, an explanation for missed inflation targets, how numerical inflation targets will be achieved under prevailing economic conditions, as well as the motive behind target inflation.

Arguments against Inflation Targeting

The following arguments are raised against inflation targeting;

i. Inflation targeting policy can result in persistent output volatility in cases where much attention on target inflation results in inflation bias ii. Inflation targeting is understood to be too rigid and, central banks may be tempted to focus on low inflation objective at the expense of output gains iii. Inflation targeting policy may weaken accountability of the central bank especially, in cases where there exists myriad of variables beyond the control of monetary policy makers iv. The requirement of sufficient exchange rate flexibility under inflation targeting policy may result in financial instability particularly, where the exchange rate pass through effect is penetrating (Maumela, 2010).

2.1.5 Theories on Economic Growth and Inflation

Five main theories that were reviewed include the Monetarist Theory, Keynesian Theory, Classical Theory of Growth, Neo-Classical Growth Model and Endogenous Growth Model.

2.1.5.1 Monetarist Theory

Monetarism is attributable Milton Friedman but Marshall and Pigou also made significant contributions to the functional relationship between nominal money stock and the general price level. According to this school, in a monetary economy, money supply growth is the only determinant of inflation. Monetarism derives its basic framework from the quantity theory of money, which holds that inflation is a phenomenon that results only from money supply fluctuations. The classical quantity theory of money is given by;

$$MV = Py \qquad (2.5)$$

Where M = nominal money supply, P = the general price level, V = Transactions velocity of money circulation and y = real output

Assumptions of the quantity theory of money include;

- V is fixed
- Real income growth is determined by real variables in the long run, though real income could be influenced by monetary aggregates in the short-run. This implies that output is at full employment level in the long run and so y is fixed
- Supply of money is exogenously determined Applying rates of change, we have

$$\dot{m} + \dot{v} = \dot{p} + \dot{y} \qquad (2.6)$$

$$\dot{p} = \dot{m} + \dot{v} - \dot{y} \qquad (2.7)$$

$P^{''}= \pi$ (inflation rate), $M^{''}$= rate of nominal money growth, $V^{''}$= velocity growth rate and $y^{''}$= real output growth rate (Handa, 2002, 2009). This implies that inflation is a function of nominal money growth, velocity growth rate and real output growth. Growth rates of velocity and real output are constant, and so changes in price level are the result of overtime fluctuations in the quantity of nominal money supply. The Monetarists argue that to maintain a stable inflation rate, institutional interventions should stabilize money supply growth rate to be in harmony with the real output growth rate in the long run.

According to Froyen (1998), the basic idea is that expected inflation should be consistent with observable inflation so that in the long run, fluctuations in the volume of money will only affect nominal variables including price levels other than output and employment or some other real variables. This is what the classical school terms as neutrality of money.

By implication, inflation should only be associated with economies that target monetary aggregates. This can be interpreted to mean that if inflation is always driven by monetary phenomenon, then inflation targeting countries are expected to record stable low inflation.

2.1.5.2 Keynesian Theory

Keynes' (1936) publication of *the general theory of unemployment, interest and money* was what provided the basis for Keynesianism. The approach of Pigou and Marshall to quantity theory was rejected by Keynes in the general theory, though he himself had made a contribution to it. Unlike the traditional classical orthodoxy, Keynes argued that output and employment are affected by real factors.

Basically, Keynes' theory focused on the dynamics of aggregate supply (AS) and aggregate demand (AD) in which he contended that deviations at full employment are possible due to persistent exogenous shocks. In times of deviations from full-employment level, he proposed the use of expansionary fiscal policy programmes by the government to resurrect the system wide pathology of the economy.

According to Donbusch and Frenkel (1973), AS curve in Keynes' model has an upward slope so that demand side shocks of the economy will determine the connection between output and price. They base their argument on the fact that some adjustment path is implicit in the AD and AS framework. The adjustment mechanism is such that inflation and economic growth are initially positively related but due to problems with time consistency, this relationship turns negative towards the latter phase of the adjustment. A producer is disillusioned that only the price of his product is rising, when in actual sense, it is the general price level that is rising. The price effect is an incentive to producers, so they expand output to exploit that advantage. Furthermore, firms enter into contracts to supply goods at agreed prices, so the firm cannot abandon production even at higher price levels, implying a positive inflation and economic growth nexus. This confirms Keynes position that a transitory other than long run trade-off exists between output and inflation changes. Unlike the monetarist theory that advocates neutrality of money where output does not respond to price changes in the long-run, Keynes posits that inflation affects output positively in the short-run and negatively in the long-run. This implies that in an economy where inflation is targeted, low stable inflation is likely to cause a fall in output in the shortrun but a rise in output in the long-run.

2.1.5.3 Classical Theory of Growth

The classical growth theory is traced to Adams Smith. He considers production to be a function of labour, capital and technology. He assumes these three variables as determining factors of output growth and so, his production function is defined as follows;

$Y = f(L, K, T)$, where Y = output, L = Labour, K = Capital and T = Technology.

Classical theories do not establish direct explanation of inflation and the effect of inflation tax on profit margins and output. In the model however, saving is the driver of economic growth. According to (Gokal and Hanif, 2004), with output being driven by saving, an implicit negative relationship between inflation and output can be inferred because the producers' profit margins and savings will decline in periods of rising wage costs (caused by inflation tax).

In a nutshell, the argument is that in an economy where stable low inflation is delivered, a fall in wage costs will cause saving to increase and output to rise. This suggests a positive relationship between inflation targeting policy and economic growth. This is because if inflation targeting keeps inflation less volatile, macroeconomic uncertainty reduces and saving increases. Increase in saving means more domestic capital is accumulated and this translates as higher productivity.

2.1.5.4 Neo – Classical Growth Model

Solow and Swan developed the neo-classical growth model. In their model, exogenous technological change replaces capital accumulation (investment) and it operates as the principal production input that explains long run growth dynamics. The neo-classical model is developed based on the assumption of diminishing returns to labour and capital in turns, and constant returns when they are linearly combined.

Though the theory does not posit a clear relationship between inflation and output, some classical economists sought to explain them using conventional wisdom. Inflation could trigger a permanent rise in output growth by inducing investment, because households are likely to hold less in real money balances and more in capital assets in response to inflation (Mundell, 1963). Inflation tax affect demand for real balances. According to Tobin (1965), individuals are likely to convert their money holdings into asset holdings in response to price hikes, which drives capital intensity high and contributes to greater output.

On the other hand, Stockman's (1981) model highlights that real money balances compliment assets so that a rise in inflation lowers real money balances and thus contributes to low level of steady state output, which causes decline in welfare. This accounts for a negative relationship between inflation and output growth.

Unlike the classical model where a rise in inflation necessarily implies a fall in saving or capital accumulation and a decline in output, a review of the neoclassical model reveals mixed results regarding inflation and economic growth nexus.

2.1.5.5 Endogenous Growth Model

Regarding endogenous set of growth theories, output is dependent on endogenous production factors and not exogenous technological change as proposed by the neoclassical growth model. This is perhaps a major distinguishing feature between the two models. Also, the neo-classical growth theory assumes diminishing marginal returns to capital deepening while the endogenous growth theory assumes constant marginal product of capital.

Economic growth rate in the endogenous growth theory is influenced by capital rate of return (i.e., both physical and human capital). Capital rate of return is very responsive to tax changes and thus experiences a sharp decline if taxes are imposed on either form of capital (Mamo, 2012). Therefore, inflation tax exerts depressing consequences on capital rate of return and then economic growth rate (McCullum and Goodfriend, 1987). A review of endogenous growth theory reveals a negative relationship between inflation and economic growth. Therefore, ability to maintain stable low inflation under inflation targeting implies that inflation tax will decline and reduction in inflation tax leads to a rise in capital rate of return which in turn causes investment and output to increase. Based on theory, it appears there are mixed results regarding inflation and economic growth nexus.

2.2 Empirical Literature Review

Numerous empirical studies have been conducted in developing, developed and emerging economies to examine the effect of inflation targeting and inflation on economic growth. In this section, evidence from both existing and previous studies have been classified under three thematic headings – inflation targeting and economic growth, inflation level and economic growth as well as inflation volatility and economic growth.

2.2.1 Inflation Targeting and Economic Growth

The following are some studies that were conducted to examine the impact of inflation targeting on economic growth;

Ball and Sheridan (2004) conducted a comparative study of OECD inflation targeting economies and 13 non-targeting OECD economies to examine differences in economic performance using Ordinary Least Square estimation technique. They revealed that inflation level and volatility declined and economic growth improved in the inflation targeting economies. However their findings show that the non-targeting economies also experienced similar macro-economic improvements. Their argument is that though inflation targeting may not account for these changes, the adoption of inflation targeting does not seem to have negative consequences on the economy either. Also, Daboussi (2014) who employed the empirical approach of Ball and Sheridan (2004) extended the difference-in-difference estimation methodology in panel data regression on inflation targeting and non-targeting countries. He reported that inflation targeting significantly improved economic growth. However, he pointed out that this effect is not necessarily causal and it's likely to be a transitory phenomenon.

Studies such as (Batini and Laxton, 2007; Goncalves and Salles, 2008) used the differencein-difference estimation methodology to examine the impact of inflation targeting on output growth in developing countries. They found that inflation targeting economies experience lower mean inflation, reduced inflation volatility and lower output volatility (implying no output costs) relative to non-targeting economies. In a study by Geraats (2013), he employed the difference-in-difference estimation technique in examining the macro effects of inflation targeting policy and found results from influential empirical researches that suggest that inflation targeting policy does not significantly influence output or other macro variables because of mean-reversion to be misleading. To him, empirical designs employed in those studies to estimate treatment effects are biased and inconsistent and their findings are not robust to distinguish an oasis from a mirage.

On the other hand, in examining effect of inflation targeting on macroeconomic performance for forty six developing economies, Brito and Bystedt (2010) applied the Generalized Methods of Moments (GMM) and difference-in-difference panel data system. They reported that inflation targeting stabilizes inflation but at the expense of economic growth. Their evidence raises doubts about the efficiency of inflation targeting policy in inducing favourable macro-economic outcomes in developing economies. Again, by using propensity score matching estimation approach to assess the effectiveness of inflation targeting in seven inflation targeting industrialized economies and 15 non-targeting industrialized economies, Walsh (2009) finds no significant impact of inflation targeting policy on either output growth or output volatility.

Finally, in examining short-term and long-term treatment effects of inflation targeting on inflation level and output growth and their volatilities in 8 developed and thirty developing economies, Miller et al. (2012) applied the propensity scoring approach. They found that short-run costs resulted in low output growth in developing countries relative to developed countries. Based on the discussion above, there is no consensus on the impact of inflation targeting on economic growth.

2.2.2 Inflation level and Economic Growth

In empirically examining the link between economic growth and inflation level for SouthEast Asia using annually computed IMF's (IFS) time series data, Malik and Chowdhury (2001) applied co-integration analysis and error correction mechanism. They concluded that there exists statistically and economically significant feedback and a direct log-run nexus between the two macro variables. Also, by using co-integration analysis and error correction estimation, Wang Zhiyoug (2008) reported that inflation level and economic growth are positively related over three quarters lag.

In investigating the short-run and long-run nexus between inflation level and economic growth, Ahmed and Mortaza (2005) found that a long run positive link exists between inflation rate and output growth for a group of South East Asian economies; India, Pakistan, Sri lanka and Bangladesh.

On the other hand, Barro (1995) investigated inflation and output correlation by employing panel data regression of about one hundred economies over the 1960 – 1990 period. He found that inflation level and economic growth move in opposite direction because, his regression results revealed that a rise in annual inflation by 10% points causes a decline in output by (0.2 – 0.3) %.

The central finding of Ahmad and Mortaza (2005) based on co-integration analysis and error-correction framework in Bangladesh is that a statistically significant negative long run nexus exists between output growth and inflation level. In confirmation, Abradu-Otoo et al. (2003) examined a wider set of variables including inflation level in the Ghanaian economy from 1983 – 1999, using co-integration and error correction framework. They reported that there is a significant long-run negative correlation between inflation level and real economic growth

Judson and Orphanides (1999) reported in their cross-sectional and panel data alternative frameworks (over a 30 – year period for many countries) that both inflation level and volatility have significant negative correlations with output growth. This revelation was made after they exploited panel data time dimensions. They remarked however that crosssectional analyses are unlikely to generate unbiased and consistent estimates because, their cross-sectional estimates were statistically insignificant for both inflation level and volatility.

Finally, by applying co- integration analysis and error correction technique, Obamuyi (2009) examined the connection between inflation rate and output growth rate in Nigeria from 1970 – 2006 using time series annual data. He found evidence in support of a significant negative long-run association between output growth and inflation rate. Given the literature reviewed, it can be seen that empirical evidence reveal mixed results on the impact of inflation level on economic growth.

2.2.3 Inflation Volatility and Economic Growth

Empirical studies on the effect of inflation volatility on economic growth followed from the well-known Okun (1971) and Friedman (1977) hypothesis that inflation volatility has a negative effect on output growth. However, such empirical enquiries are limited.

First, using the GMM approach to linear dynamic panel models, Barugahara (2013) examined the main and interaction effects of inflation level and volatility on economic growth for ninety two economies over the period 1982 – 2007. The empirical results revealed that both inflation level and volatility have negative impact on economic growth.

Second, a study by Wilson (2006) found empirical evidence to support the position that inflation uncertainty increases mean inflation and reduces mean growth rate.

Also, by the application of a multivariate exponential GARCH-M framework to examine the impact of inflation volatility on economic growth, Bhar and Malik (2010) found that inflation volatility has a significant negative impact on economic growth. Further to this, Grier and Grier (2006) also studied the impact of inflation volatility on output growth in Mexico for the period 1972 to 2001 and they employed the same estimation strategy used by Bhar and Malik (2010). They found that inflation volatility exerts a significant negative effect on economic growth. Coulsion and Robins (1985) found evidence that inflation uncertainty and output growth are negatively correlated in the US. They measured inflation uncertainty by estimating the squared root of conditional variance of inflation level using the GARCH (1, 1) model.

Nevertheless, Becker et al. (1995) studied the impact of inflation volatility on output growth using moving-window methodology and established a significant positive relationship between inflation volatility and output growth during periods of expansion and negative relationship during periods of recession. Their evaluation was based on the disaggregation of inflation volatilities among heterogeneous households with different expenditure weights, as a means of reconciling the apparent inconsistency between theory and empirical findings. By applying the ARCH framework to construct inflation volatility proxies, Jansen (1989) failed to find empirical evidence in support of the hypothesis that volatile inflation causes decline in real economic growth.

It is evident from the literature reviewed that empirical evidence on the impact of inflation volatility on output growth are inconclusive.

2.3 Methodological Review

In examining the impact of inflation targeting regime on economic growth, distinct methodologies have been employed by different studies. Some of these methodologies are reviewed as follows;

Studies by Ball and Sheridan (2004), Batini and Laxton (2007), Goncalves and Salles (2008), Walsh (2009), Brito and Bystedt (2010) and Miller et al. (2012) employed difference-in-difference panel data regression and cross sectional analysis to investigate the effect of inflation targeting policy on economic growth. Also, in investigating the effect of inflation level on economic growth, studies such as Barro (1995), Da'Adda and Scorcu (1997), Judson and Orphanides (1999), Malik and Chowdhury (2001), Abradu-Otoo et al. (2003), Ahmad and Mortaza (2005), Wang Zhiyoug (2008) and Saymeh and Orabi (2013) mostly used cross-sectional or panel data regression or co-integration and error correction estimation approaches.

Clearly, many empirical studies that investigate economic growth determinants are usually cross-sectional or panel in nature and examine the behaviour of heterogeneous economies in many years. First, the treatment effects in these studies are often likely to be biased. Second, Cross-sectional and panel regressions for output growth are fundamentally unstable (Levine and Renelt, 1992); and are thus unlikely to discover significant relationships between inflation level and output growth, though such correlation may be apparent in reality. Third, with cross-sectional and panel data regressions, dynamic changes may be ignored because time series data often reduce to their mean values thereby leading to information loss. Moreover, the widely used error correction strategy in the estimation of inflation-output growth relationship is perceived to correspond to integrated data. So, it is often cited as an inappropriate technique for the analysis of stationary series.

Error correction mechanism is only adequately flexible to model stationary series that have a longer span (Beck and Levine, 2004).

The Autoregressive Distributed Lag Model (ARDL) is a more dynamic model that is adjudged appropriate for evaluating short-run and long-run dynamics using short-memory data or small sample-sized series. This is because ARDL minimizes the endogeneity problem that's associated with several other single equation estimation strategies, as all the series in the model are taken to be endogenous. Also, Pesaran et al. (2001) identify ARDL technique as an alternative to solving the different orders of integration of underlying series. It does not require that variables belong to the same order of integration unlike other single equation estimation strategies.

Studies by Coulsion and Robins (1985), Jansen (1989), Becker et al. (1995), Wilson (2006), Grier and Grier (2006), Bhar and Malik (2010) and Barugahara (2013) are among the few studies that examined the effect of inflation volatility on output growth. A good number of these studies employed moving-window methodology and ARCH model, and a few others used the GARCH model to estimate inflation volatility. Most of these studies proxied inflation volatility by unconditional standard deviation, which is less variable and accurate. However, Taylor (2005) argued that Conditional variance is a better proxy for inflation volatility. Most of the studies that employed conditional variance measure of inflation volatility used the ARCH model. Jansen (1989) points out that a significant limitation of the ARCH technique is that it does not yield perfect results because it is less variable and higher order ARCH is likely to result in possible loss of degree of freedom. For short-memory data, the GARCH method is considered suitable for estimating volatility. The current study thus expands the inflation-growth literature by using appropriate GARCH (1, 1) to construct conditional variance series. Nevertheless, if regime breaks are overlooked in the underlying series, GARCH frameworks are likely to overestimate persistence of conditional variance and underestimate inflation uncertainty. This study accounts for this defect by delimiting the sample period into pre- and postinflation targeting using a dummy variable.

CHAPTER THREE

MONETARY POLICY MANAGEMENT AND MACROECONOMIC DEVELOPMENTS IN GHANA

3.0 Introduction

This chapter presents an overview of monetary policy regimes adopted in Ghana from 1980 – 2013 and a descriptive analysis of inflation outcomes and economic growth trends.

3.1 Overview of Monetary Policy Regimes in Ghana (1982 – 2013)

Shortly after political independence was attained in 1957, Ghana broke away from the West African Monetary Union (WAMU) to set up its own central bank. Policy makers expected that this would significantly improve monetary policy transparency and effectiveness. However, the bright optimism of the 1960s turned into an economic growth disaster episode in the late 1970s and early 1980s. This seemed to suggest that the breakaway was not a sufficient condition for delivering the theoretically promised macroeconomic outcomes (emphasis is mine).

The central issues of monetary policy conduct in Ghana are not different from any other nation that observes standards of international good practice for the conduct of macroeconomic policy. Both developed and developing economies alter their monetary policy practices in response to macroeconomic stability. Since 1964, monetary policy in Ghana has evolved from exchange rate targeting to inflation targeting. Indeed, from 1964 to 1981, exchange rate was targeted as a nominal anchor i.e., a variable used by monetary authorities to stabilize private agents' expectations. Fixed currency convertibility was preferred by monetary authorities from 1964 – 1981. During this phase, exchange rate was fixed in turns to the British pound and the US dollar from 1957 – 1966 and 1966 – 1982 respectively. Consequently, declining economic activity in the early 1980s with the accompanying macroeconomic instability lead to a shift from exchange rate targeting to monetary targeting framework in 1982. Monetary targeting comprised two phases which are; domestic direct credit control from 1982-1991 and OMO from 1992-2006. Monetary authorities later shifted monetary policy conduct from OMO to explicit inflation targeting in 2007 (Kwakye, 2012).

Monetary policy regimes that have been adopted from 1982 – 2013 are discussed as follows;

3.1.1 Monetary Targeting Regime (1982 -2006)

Monetary-targeting focuses on changes in monetary aggregates while alternative monetary policy regimes focus on price signals. Sometimes, an alternative way of describing this approach is “monetarism”, where inflation is assumed to be everywhere a monetary phenomenon. The theoretical foundation for monetary aggregates targeting is the classical quantity theory of money. The monetary targeting framework was developed and popularized by McCallum (1998, 2000), known as the “McCallum rule” on the basis of the quantity theory of money. In this rule, the principal policy objective is to maintain a stable low inflation, which may be pursued in connection with minimization of real macroeconomic volatility (Kwakye, 2012).

In Ghana, monetary-targeting framework was adopted in 1982 to conduct monetary policy on the basis of less sophisticated constant money supply growth. This happened at a time the economy seemed to experience stagflation. Under this regime, growth rate of nominal GDP was the intermediate target and reserve money growth was the policy instrument. A link exists between the policy instrument and the intermediate target via the velocity path. Two variants of monetary targeting that have been applied in Ghana are the direct domestic credit control from 1982 – 1991 and OMO from 1992 – 2006.

3.1.1.1 Direct Domestic Credit Control (1982 – 1991)

Under the direct credit control, monetary authorities set money supply targets on regular basis, taking into consideration price stability as the principal goal and growth as secondary. This was a monetary management phase in which the central bank set out to determine the domestic source of money supply after the external source was computed based on the dynamics of the BOP. The next stage involved measurement of aggregate domestic credit. The BoG then scrutinized commercial banks' lending processes at monthly interval and issued authorized requests to commercial banks to vary their sectorial ceilings, and this was deemed a necessary and sufficient condition for meeting lending requirements.

In all, budget was not operated as planned and so the ceiling set for government was often exceeded. Overall domestic credit ceiling constantly exceeded its target and this in turn destabilized money supply targets and compromised target inflation (Kwakye, 2012). Consequently, monetary policy transparency could not be maintained and so, direct credit control was abandoned in favour of a more liberalized monetary policy in 1992.

3.1.1.2 Quantitative Open Market Operations (1992-2006)

Quantitative OMO replaced domestic credit control as an operating target instrument in 1992. Under this system, the primary objective was to achieve price stability and other supporting macroeconomic objectives (growth), by regulating money supply through trading central bank's financial instruments and/treasury securities. The quest to attain a set target for reserve money on the balance sheet of BoG was the import of these operations. Hence, reserve money served as an operating target, money supply as the intermediate target, with inflation being the ultimate target variable (Quartey and Afful-Mensah, 2014). OMO was adopted to contain liquidity and maintain a stable low inflation. In addition to delivering stable inflation, the sale of treasury securities was also used to accumulate funds for the Public Sector Borrowing Requirement (PSBR).

Although the OMO framework is bi-directional in nature i.e., expand or contract liquidity in the economy, the former was commonly applied in the Ghanaian context. Persistent monetary expansion coupled with explosive fiscal programmes and excessive deficit financing created a phenomenon of excess liquidity in the economy in the early 2000s, thereby contributing to demand-pull inflationary pressures. According to Kwakye (2012), the lack of safety nets in lending, inefficiency in the financial market, absence of clear separation between Public Sector Borrowing Requirement (PSBR) and OMO, eventually stifled the ability of monetary policy to contain liquidity in the economy in the early 2000s. Consequently, GDP growth fell short of the 8% annual target from 1992 – 2006.

3.1.2 Explicit Inflation Targeting (2007 – 2013)

To address decline in economic activity and improve real GDP growth in Ghana, monetary authorities followed the example of many countries like New Zealand, Chile, Spain, United Kingdom, South Africa, and adopted inflation targeting. Initially, an implicit or soft form of inflation targeting was adopted by BoG in 2002 which worked in tandem with OMO until 2006. BoG started operating this regime by setting an implicit inflation target in the second quarter of 2002. By the end of December 2002, there was a remarkable drop in year-on-year inflation. Ghana however experienced high inflationary pressures in the late 2000s due to demand pull factors such as widening fiscal and trade deficits (Barimah and Amuakwa-Mensah, 2014).

This led to the adoption of full-fledged inflation targeting in 2007 where an explicit inflation target or target range is published by the Monetary Policy Committee (MPC), and commitment is demonstrated towards delivering the announced target inflation. The key policy instrument used in the conduct of inflation targeting policy is the interest rate and in Ghana, the central bank applies the PR. The PR denotes the base or rediscount rate for lending to commercial banks and thereby functions as a yardstick for interest rates in the economy. Considering a wider set of macroeconomic dimensions as real economic activity, business and consumer confidence, fiscal position, foreign shocks and even the supply of money, BoG discovers its inflation forecast based on its reaction function.

The core issue is that commercial banks' interest rates reflect the signal from the PR, which in turn affects loan demand, supply of money and consequently, price stability. However, conditions such as tenuous and slow transmission of PR to commercial banks' interest rates, unstable financial environment, absence of safety nets in lending and unchecked excess credit, seem to affect the effective operation of inflation targeting (Kwakye, 2012). Thus, the central bank's inflation target ranges have invariably been missed by wider margins.

Table 3.1 presents the various monetary policy regimes have been adopted from 1982 to 2013.

Table 3.1: Monetary Policy Regimes (1980 - 2013)

Monetary Policy Regime	Period
1. Monetary-targeting	1982-2006
i. Domestic credit control	1982-1991
ii. Quantitative Open Market Operations	1992-2006
2. Explicit inflation targeting	2007-2013+

Author's presentation

3.2 Macroeconomic Developments in Ghana (1982 – 2013)

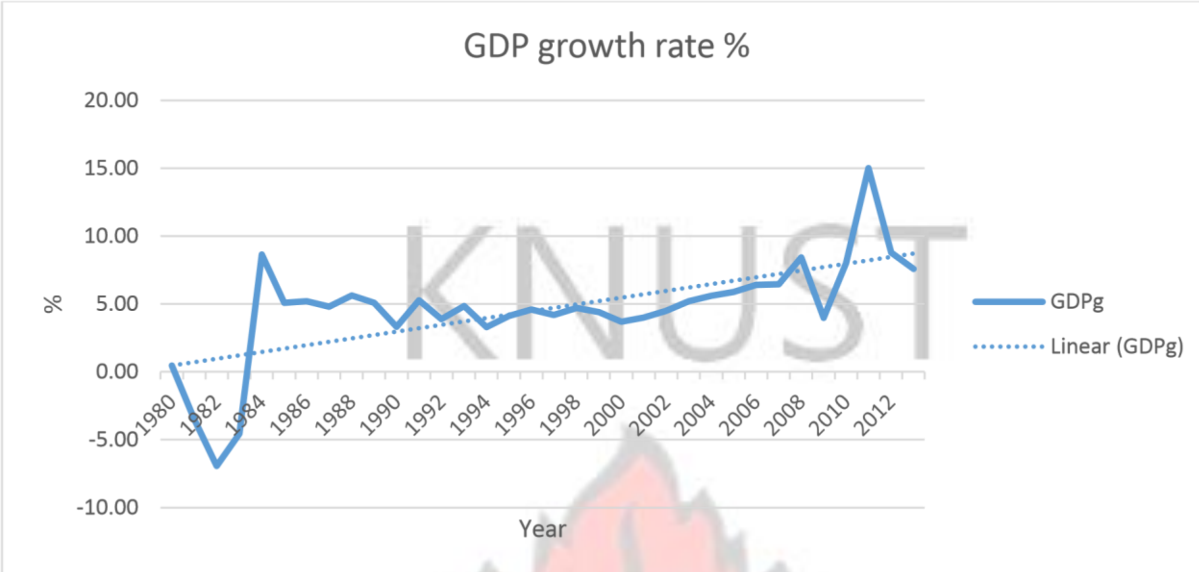
This aspect uses descriptive statistics (tables and graphs) to analyze and discuss GDP growth rates and inflation outcomes in respect of the various monetary policy regimes.

3.2.1 Trends in Economic Growth (1982 – 2013)

The first few years after attaining political independence in 1957 were associated with high hopes of catching up with the developed world. However, years of economic decline and political upheavals took a toll in Ghana and this led to a substantial 30% or so decline in economic growth per annum between the 1970s and the 1980s (Alhassan, 2014). Particularly, insignificant growth rates were recorded in the early 1980s and this was attributed to expansionary fiscal policy programmes, money supply expansion, deteriorating terms of trade and adverse supply shocks. These disturbances imposed the need for monetary policy credibility and neo-liberal reforms. The ERP and SAP were implemented to restructure the economy while monetary targeting framework was used to contain liquidity and consolidate gains from the economic stabilization. As a consequence, significant positive GDP growth rates were registered in the decade following the economic reforms.

Figure 3.1 shows that after a period of negative GDP growth averaging 3.3% per annum from 1980 to 1983, Ghana over the period 1984 – 2006 i.e., the monetary targeting phase, recorded significant rise in GDP growth of about 4.5% per annum. However, GDP growth showed a substantial rise in the years following the adoption of explicit inflation targeting i.e., from 2007-2013.

Figure 3.1: Economic Growth Trends (1980 – 2013)



Source: WDI

Relevant statistics show that before the reform period, Ghana registered negative annual growth rates of 0.2%, 3.2%, 5.9% and 4.1% in 1980, 1981, 1982 and 1983 respectively. It can be shown in Table 3.2 that after the period of stabilization and monetary policy revolution, GDP growth rate averaged 1.77% for the period 1980 – 1989, 4.27% from 1990 – 1999 period, 5.25% from 2000 – 2009 and 9.56% between 2010 and 2012 (computed from WDI). Table 3.2 again shows that average GDP growth rate was higher for the inflation targeting regime (8.13%) than the other sub-periods, while output volatility (measured by unconditional standard deviation) for the inflation targeting period (3.76) exceeded that of the monetary targeting period (3.26) by an insignificant margin of 0.05. It appears that economic growth rate have appreciated to positive values under both monetary targeting and inflation targeting regimes, however, GDP growth seemed to be more

appreciable in the case of the latter.

Table 3.2: Growth Rate for Sub-Periods and Various Decades

	Average Growth Rate	Standard Deviation
Panel A		
Period (Decade)		
1980 – 1989	1.77	5.00
1990 – 1999	4.27	0.67
2000 – 2009	5.25	1.12
2010 – 2013	9.56	3.83
1980 – 2013	4.48	3.73
Panel B		
Direct Credit Control Period	2.27	4.62
OMO Period	4.64	0.85
Monetary Targeting Period	3.67	3.26
Inflation-Targeting Period	8.13	3.73

Author's Estimation

Despite the fact that GDP growth trends have consistently improved since 1984, the target annual growth rate of 8% has not been attained. Ghana Shared Growth and Development Agenda (2010 – 2013) identified some socio-economic factors that constrained the economy in the 2000s as follows;

- High interest rate uncertainty and declining savings levels which resulted in declining investment levels
- Weakness in state institutions due to inability to minimize systematic deficiencies
- Fiscal indiscipline perennially caused large budget deficit in the region of (8-10)% of GDP and seemed to reverse the modest economic benefits derived from the structural reforms
- Intensive borrowing from the central bank by government as a means of financing widening budget deficits, destabilized monetary policy conduct in the early 2000s

- Decline in foreign aid and impaired domestic absorptive capacity which was a typical feature of the economy in the 2000s, led to deteriorating terms of trade and exchange rate instability
- 63% of the rural population still remained below the poverty line despite significant poverty alleviation measures put in place (Alhassan, 2014).

3.2.2 Trends in Inflation rate (1982 – 2013)

This section discusses Ghana's inflation trends during the 1982 – 2013 period.

Relevant statistics show that inflation performance was particularly worse in the early 1980s, interspersed by a nasty mix of fiscal indiscipline, loose monetary policy and declining commodity prices. Widespread huge budget deficits and deteriorating terms of trade transmitted into hiking inflation trends with inflation reaching a record high of 143.97% in the second quarter of 1983. Hikes in food prices were associated with adverse supply shocks that were created by the severe drought the economy experienced in 1983. According to Kwakye (2012), Ghana, compared to its African Peers experienced worse inflation trends in its chequered history.

However, inflation since 1984 has persisted but at a diminishing rate largely due to the stabilization schemes that were implemented by IMF/World Bank, namely ERP and SAP. Implementation of the set of policy actions was carried out in three phases; ERP I from 1983 – 86, ERP II from 1987 – 90 and the accelerated growth phase from 1992 – 2000.

Over the reform period, fiscal discipline and trade liberalization were the most significant and result-oriented policy measures. These measures induced favourable inflation outcomes as average annual inflation rate dropped from 66% in the preceding decade to 50% in the early years of the reforms, which in turn reduced to 27% over the 1987 – 93 sub-period. Average annual inflation of 34% from 1983 to 2000 dropped to 19.57% from

2000 to 2009. Between 1982 and 2006, monetary targeting was operated and despite the much talked-about stable inflation since 1993, the deviation between actual inflation rates and the targets set for each fiscal year was wide over the entire reform period.

Ghana's quest to deliver stable low inflation led to a shift from targeting of monetary aggregates to explicit inflation targeting in 2007. To a greater extent, the performance of inflation targeting policy is satisfactory because inflation has been kept stable and less variable. It can be shown in Table 3.3 that average inflation for the inflation targeting regime was 12.7%, which is significantly lower than average inflation rates of 43.49%, 24.05% and 33.77% for the direct credit control, OMO and entire monetary targeting phases respectively.

Again, Table 3.3 shows that average annual inflation of 9.57% and unconditional standard deviation of 1.54% recorded during the 2010 – 2013 period, were significantly lower than the case of the other decades. Table 3.3 again indicates that periods of lower average inflation are associated with lower standard deviation of inflation level. Inflation variability of 4.32 observed over inflation targeting period is lower relative to the case of alternative policy regimes i.e., compared with variability coefficients of 31.85 and 14.04 for the direct credit control and OMO regimes respectively.

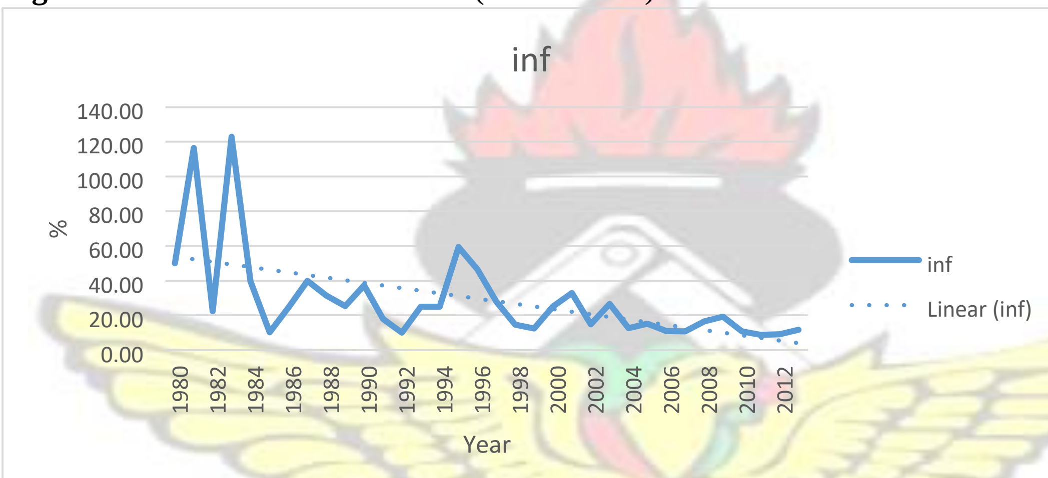
Table 3.3: Inflation Statistics for Sub-Periods and Various Decades

	Average Inflation	Standard Deviation
Panel A		
Period (Decade)		
1980 – 1989	49.5	42.83
1990 – 1999	28.24	16.28
2000 – 2009	19.57	8.49
2010 – 2013	9.57	1.54

1980 – 2013	26.72	24.06
Panel B		
Direct Credit Control Period	43.49	31.85
OMO Period	24.05	14.037
Monetary Targeting Period	33.77	7.93
Inflation-Targeting Period	12.70	4.32

Author's Estimation

Figure 3.2: Trends in Inflation Rate (1980 – 2012)



Source: WDI

It can be shown in Figure 3.2 that there were swings in inflation from the 1980s to the early 2000s suggesting high inflation volatility. However, inflation became relatively stable from 2002 to 2013. This seems to suggest that though inflation targets have been missed under both soft and explicit inflation targeting regimes, inflation has been kept relatively stable and low compared to the monetary targeting phase.

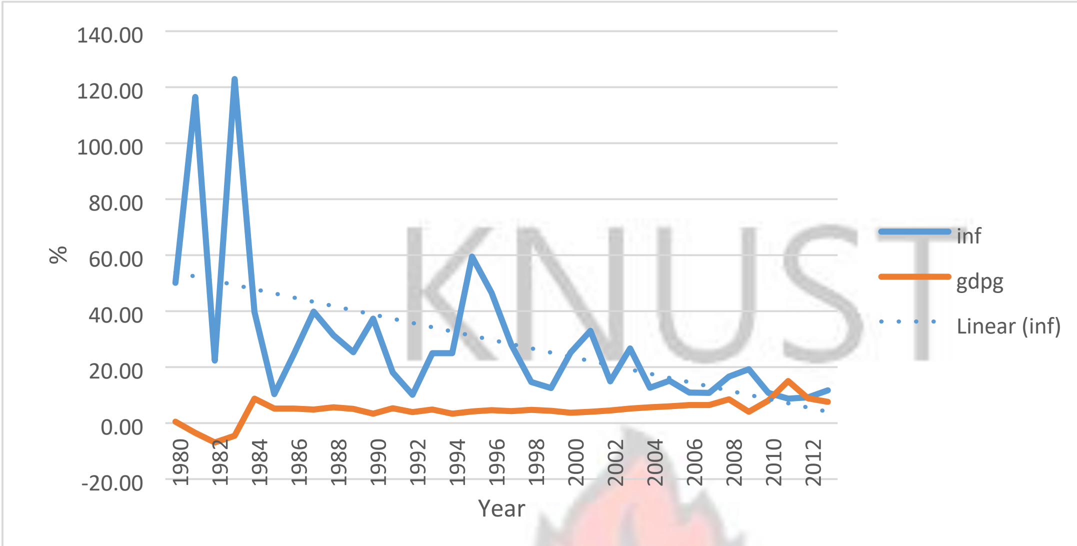
In sum, the statistics suggest that inflation targeting policy in Ghana seems to be more effective than other monetary policy frameworks in delivering the promised inflation and output outcomes.

3.3 Trends in GDP growth and Inflation Rate: Pre and Post Inflation Targeting This section of the study seeks to review macroeconomic effects of inflation targeting by visualizing trends in GDP growth and inflation rate in the pre and post targeting phases.

Figure 3.3 indicates that in the pre-inflation targeting period (1980 – 2006), worsening inflation trends in the early 1980s were associated with negative and insignificant growth rates. But as inflation declined in the late 1980s and early 1990s, GDP growth improved though not very substantial. It can be shown again that adoption of inflation targeting in 2007 coincided with further improved output growth as inflation rate was kept relatively stable and low.

Figure 3.3 again shows that output and inflation outcomes were more favourable under the inflation targeting regime. Mean annual inflation rate was higher in the non-targeting period (33.7%) than it was in the targeting phase (12.70%). A rapid rate of disinflation was attained over the period 2009 – 2013, with average inflation rate hitting single digit in 2010 and 2011 for a continuous 30-month period. The descriptive statistics seem to suggest that under the inflation targeting regime, a stable low inflation was maintained, inflation volatility was lower and inflation persistence seemed to decline. Moreover, real GDP growth perhaps exceeded expectations from 2007 – 2013 i.e., the targeting phase, reaching an average rate of 8.13% relative to 3.67% per annum in the non-targeting period.

Figure 3.3: GDP Growth and Inflation Rate (1980 – 2013)



Source: WDI

As shown in figures 3.3, it can be deduced that while the pre-inflation targeting regime was associated with hiking inflation and stagnant growth, post-inflation targeting was characterized by stable low inflation and improved output outcomes.

CHAPTER FOUR

METHODOLOGY

4.0 Introduction

This chapter presents a description of the types and sources of data used for the empirical analysis, the model specification, statistical tests conducted and the estimation technique.

4.1 Types and Sources of Data

The study employed secondary data from 1980 – 2013 for the analysis which comprised 34 annual observations for each variable. Data on all the variables were sourced from WDI (1980-2014). The two key variables contained in the dataset include; real per capita GDP (in constant prices 2005=100) and year-on-year inflation rate.

4.2 Model Specification

The theoretical framework of this study is the standard neoclassical growth model which predicts that labour and capital fully explain changes in output overtime. The theoretical foundation of this empirical study is based on the aggregate production (AK) model as follows;

$$Y_t = f(A_t, L_t, K_t) \quad (3.0)$$

Where Y, L and K are GDP, labour and capital respectively. A is a variable used to denote technological progress. A is taken to represent total factor productivity (TFP) i.e., it captures the proportion of output growth that is unaccounted for by changes in L and/or K. In this study,

$$A_t = f(\inf_t, garch01_t, ITDum, dcps_t)$$

We augment the model to capture additional determinants of growth such as inflation level and volatility, financial development and *ITDum*. *ITDum*is a dummy variable used to capture the effect of the policy shift (it assumes a value of 1 from 2007 – 2013 and 0 from

1980 – 2006). Population and gross domestic fixed capital formation (GDFCF) represent labour and capital respectively.

Following Barugahara (2013) and Kumo (2015), the empirical models are given by equations 3.1 and 3.2.

MODEL I

$$rpgdp_t = f(\inf_t, ITDum\ dcps\ gdfcf_t, {}_t, {}_t) \tag{3.1}$$

The specific operational model in log form is given by;

$$\ln rpgdp_t = \alpha_0 + \alpha_1 \ln \inf_t + \alpha_2 ITDum_t + \alpha_3 \ln dcps_t + \alpha_4 \ln gdfcf_t + \varepsilon_t \tag{3.1*}$$

Where ε_t is the error term which is independent and identically distributed (iid); α_i (for i = 1, 2, 3, and 4) are parameter estimates; *Ln*inf is log of Inflation level; *ITDum* is inflation targeting dummy; *Lndcps*is log of Domestic Credit to Private Sector/GDP ratio and *Lngdfcf* is log of Gross Domestic Fixed Capital Formation/GDP ratio.

MODEL II

$$rpgdp_t = f\ garch(01_t, ITDum\ dcps\ gdfcf_t, {}_t, {}_t) \tag{3.2}$$

The specific operational model in log form is given by;

$$\ln rpgdp_t = \alpha_0 + \alpha_1 \ln garch01_t + \alpha_2 ITDum_t + \alpha_3 \ln dcps_t + \alpha_4 \ln gdfcf_t + \varepsilon_t \tag{3.2*}$$

Where ε_t is the error term which is independent and identically distributed (iid); a_i (for i = 1, 2, 3, and 4) are parameter estimates and *Lngarch*01is log of conditional variance (inflation volatility).

4.3 Description of Variables

In this section, both the dependent and independent variables are described.

4.3.1 Dependent Variable

Following Barugahara (2013), this study employs real per capita GDP (rpgdp) as the dependent variable. Gross Domestic Product (GDP) is the total output of goods produced by all sectors of the economy including agriculture, manufacturing and services. Real per capita GDP is the ratio of GDP to population adjusted for inflation. Economic expansion is invariably measured in terms changes in GDP overtime. A rise in per capita GDP signifies economic growth and translates as an increase in productivity. This study measures economic growth as percentage change in real per capita GDP overtime. Indeed, the natural log of real per capita GDP was used as proxy for economic growth.

The GDP of an economy is affected by inflation level and volatility, domestic credit to private sector, gross domestic fixed capital formation and policy shifts. Therefore, a functional relationship exists between all these variables and real per capita GDP. This study used real per capita GDP and not nominal GDP because the latter does not adjust for inflation, which means that it experiences substantial fluctuations overtime and cannot give a true reflection of variations in output. According to Sorensen and Whitta-Jacobsen (2010), for the prosperity of a nation, it is GDP per capita other than GDP itself that is important. In this study, real per capita GDP was represented by ‘rpgdp’.

4.3.2 Independent Variables

The independent variables that were used include inflation level and volatility, Gross Domestic Fixed Capital Formation/GDP ratio and Domestic Credit to Private Sector/GDP ratio.

Inflation Level (inf)

Following Kumo (2015), this study used inflation level as an independent variable in analyzing inflation targeting, inflation and economic growth. Inflation level affects GDP growth through its effect on variables such as exchange rate, investment, savings and consumption. Thus inflation is a vital determinant of economic growth. Inflation level is measured either by the use of GDP deflator or the Consumer Price Index (CPI). This study employs inflation rate that is measured as annual percentage change in the CPI. The hypothesis that inflation exerts negative influence on economic growth is confirmed by several studies including; Fischer (1993), Barro (1995), Judson and Orphanides (1999) and Barugahara (2013). However, Malik and Chowdhury (2001), Ahmed and Mortaza (2005) and Wang Zhiyoug (2008) found that inflation level affects economic growth positively. Based on the classical growth model, this study expects inflation level to have a negative effect on economic growth (i.e.,$\beta_1 < 0$). In the empirical model, the symbol used to represent inflation level is ‘inf’.

Inflation Volatility (garch01)

In estimating the effect of inflation targeting and inflation volatility on economic growth in South Africa, Kumo (2015) used inflation volatility as an independent variable. This study also uses inflation volatility as an independent variable. Inflation volatility implies variability in a given measure of the level of inflation. Volatile inflation affects growth because it creates uncertainty about future price movements which makes it difficult for central bankers to stabilize private agents’ expectations. Inflation volatility is measured either by using moving average standard deviation (MASD) or conditional variance of inflation level. By the use of GARCH (1, 1), this study constructed conditional variance series as proxies for inflation volatility. Following the well-known Okun (1971) and Friedman (1977) hypothesis, Wilson (2006), Bhar and Malik (2010) and Barugahara (2013) found that inflation volatility affects economic growth negatively. However, studies by Jansen (1989) and Becker (2015) found that inflation volatility positively affects economic growth.

In this current study, inflation volatility is expected to have a negative effect on economic growth (i.e.,$\square_1 \square 0$). This is because volatile inflation creates uncertainty about investment returns. When investors feel insecure, they invest less which translates as decline in aggregate output. The symbol used in the model to represent inflation volatility is 'garch01'.

Financial Development (dcps)

Financial development is captured as independent and control variable. Financial development implies financial deepening i.e., increased provision of financial services. A major indicator of financial development is the amount of financial resources that is made available by financial institutions to domestic and foreign investors. In this study, financial sector development is measured as Domestic Credit to Private (DCPS)/GDP ratio. Based on the neoclassical growth model, DCPS/GDP ratio is expected to have a positive impact on economic growth (i.e.,$\square\square_3, {}_3 \square 0$). In the model, 'dcps' is the variable used to represent DCPS/GDP ratio.

Gross Domestic Investment (gdfcf)

Following Barugahara (2013), Gross Domestic Investment enters the growth models as independent and control variable. According to Anyanwu (1997), investment is a flow which signifies either addition to existing capital stock or acquisition of new capital assets. Increase in domestic investment stimulates industrial growth and reduces unemployment. Although gross investment is a smaller component of aggregate demand than consumption, it is a major source of short time changes in aggregate demand and so very vital in the

Keynesian analysis. In this study, Domestic investment is measured as Gross Domestic fixed capital Formation (GDFCF)/GDP ratio. Based on the Keynesian theory, GDFCF/GDP ratio is expected to affect economic growth positively (i.e.,□□$_4$, $_4$□ 0). In the model, ‘gdfcf’ is used to represent gross domestic investment.

Table 4.1: Description of Dependent and Independent Variables

Variable	Description	A priori sign
Dependent		
rpgdp	rpgdp is real per capita GDP and is measured as GDP/population ratio adjusted for inflation. The natural log of rpgdp is used as proxy for growth	
independent		
inf	inf represents inflation level. It is measured by annual percentage increase in CPI	Negative(-)
garch01	garch01 represents inflation volatility. It is measured as conditional variance of inflation level.	Negative(-)
dcps	dcps represents financial development and is measured by DCPS/GDP ratio.	Positive(+)
gdfcf	gdfcf represents Gross Domestic Capital and is measured by GDFCF/GDP ratio.	Positive(+)

4.4 Measurement of Inflation Volatility

An important issue in examining the effect of inflation volatility on economic growth is the choice of an appropriate proxy for Inflation volatility. Some empirical studies measured inflation volatility using the MASD and other studies used conditional variance as proxy for inflation volatility. There is no consensus on which volatility measure is appropriate. For the purposes of this study, the GARCH (1, 1) model was employed to construct conditional variance series as proxies for inflation volatility using annual data series. Following (Kumo, 2006; Bollerslev and Mikkelsen, 1996), based on the usual GARCH (p, q) specification, the variance of the disturbance term is incorporated in the autoregressive process as shown below;

$$x_t = x_t'\beta + \varepsilon_t \tag{3.30}$$

Where $\varepsilon_t / \Omega_{t-1} \sim N(0, H_t)$

$$H_t = b_0 + b_1\varepsilon_{t-1}^2 + \dots + b_p\varepsilon_{t-p}^2 + \gamma_1 H_{t-1} + \dots + \gamma_q H_{t-q} \tag{3.31}$$

ε_t is the stochastic disturbance term and Ω_{t-1} represents the set of relevant information and H_t is the conditional variance of the disturbance term. x_t' in equation (3.30) follows the autoregressive process and is considered as the conditional average of the series. The unrestricted specification of the GARCH (p, q) model captures lagged variables with higher order up to (p, q). Models with higher order lags are suitable for long-memory data. Engel (2001) argues that quick and gradual decay of information are peculiar with such models (Kumo, 2015). The most applied GARCH (1, 1) volatility measure has the following features.

$$x_t = \beta_{0,t} + \beta_{1,t} y_{t-1} + \varepsilon_t \tag{3.32}$$

$$\varepsilon_t = H_t^{\frac{1}{2}} \nu_t;\ \nu_t \sim N(0,1) \tag{3.33}$$

$$H_t = b_0 + b_1\varepsilon_{t-1}^2 + \gamma_1 H_{t-1}$$

(3.34) Equation (3.34) specifies the GARCH (1, 1) model which is computed as a union of squared lag residuals and the lag conditional variance itself. Based on this empirical specification, inflation volatility was estimated using annual data for the 1980 to 2013 period.

The GARCH (1, 1) model is best suited for estimating inflation volatility because; (i) GARCH helps to overcome the problem of endogeneity; (ii) GARCH models are reliable in that they allow for conditional variance to depend on previous own lags; and (iii) GARCH models produce robust estimates with few parameters.

4.5 Statistical Tests Conducted

Preliminary tests that were conducted include, unit root tests, model diagnostic and stability tests and coefficient variance decomposition.

4.5.1 Unit Root Tests

In time series estimation, it is crucial to establish stationarity of the variables. This is because spurious regressions are common with non-stationary series. Hendry et al. (1988) have shown that the estimation of time series models with non-stationary variables could generate illogical deductions and conclusions, as the conventional student t and F tests are biased. Unit root tests were conducted to establish the order of integration of the independent and dependent variables. Series that are integrated of order zero are said to be stationary at levels and those that are integrated of higher order are said to be stationary at first differenced.

The DF-GLS test by Elliot et al. (1996) and the ADF test by Dickey and Fuller (1979) were used to test for the existence of unit roots. The DF-GLS and ADF tests work to perfection if the series exhibits an unusual mean or trend (Sakyi et al., 2015). They were applied to test the null hypothesis that unit root exists against the alternative hypothesis that unit root is non-existent.

The Wald test was also applied to test unit root in volatility process. In volatility models, examining the stationarity of conditional variance involves testing the null hypothesis of existence of unit root against its alternative of stationary volatility process. According to Taylor (2005), the null hypothesis for volatility models is stated as H_0: □□1, where□ is the persistence parameter. For GARCH (1, 1) model, it is stated H_0: b_1 + □$_1$ = □=1 and if the restriction b_1 + □$_1$ = □=1 holds, then the GARCH (1, 1) model is said to be strictly covariance stationary.

4.5.2 Model Diagnostic and Stability Tests

The reliability of models I and II was examined using residual diagnostic tests such as multivariate normality, LM White (Heteroskedasticity) and Breusch-Godfrey (Serial Correlation). The model is said to be reliable if all the residual diagnostic tests are statistically insignificant. Also, the stability of the model was examined using recursive estimates such as CUSUM and CUSUM of square tests. The Ramsey reset test was used to test for functional form i.e., whether the model was correctly specified.

4.5.3 Coefficient Variance Decomposition

The study adopted an innovation accounting by stimulating variance decompositions. Variance decompositions were used to examine the effects of shocks to the independent variable on the dependent variable. It was used to capture the proportions of the dependent variable forecast error variance that was explained by its own innovations and innovations to each regressor, over a series of time horizons. Thus, the variance decomposition proportions were used to measure the relative importance of inflation level and volatility, inflation targeting, DCPS/GDP ratio and GDFCF/GDP ratio variations accounting for variations in real per capita GDP.

4.6 Estimation Technique

Different estimation methods have been used by previous studies to investigate economic growth determinants. In examining the effect of inflation targeting and inflation volatility on economic growth in South Africa, Kumo (2015) employed Ordinary Least Square estimation technique. Also, Barugahara (2013) investigated the main and interaction effects of inflation level and volatility on economic growth across countries using the System Generalized Method of Moments (GMM) technique to carry out the panel data regression.

This study employs the use of Autoregressive Distributed lag (ARDL) model to analye the long-run and short-run dynamics of inflation targeting, inflation and economic growth in Ghana. ARDL model was employed because; (i) it is capable of evaluating long-run relationships regardless of whether the underlying series are purely I (0) or purely I (1) and/or both (ii) it also yields robust estimates for analysis of finite-sized samples and can be applied even when the regressors are endogenous (Lawson and Pesaran, 2009).

Generally, ARDL follows three steps; test for unit root, test for co-integration and estimation of short- run and long-run parameters. In testing for co-integration, the ARDL bounds test and the conditional error – correction model (ECM) within the ARDL framework were employed.

4.6.1 Error – Correction Model (ECM)

Engel and Granger (2001) concluded that the presence of co-integration among variables implies that there are forces that tend to ensure convergence to long-run equilibrium each time there is an exogenous shock to the economy. The return to equilibrium follows a process of dynamic short-run adjustment which is usually represented by an error – correction framework. The ECM is specified as follows;

Model I

$$\square\ln rpgdp_t = \square_0 + \sum_{i=0}^{q}\square\ln rpgdp_{t-i} + \sum_{i=1}^{q}\square\square\ln\inf_{t-i} + \sum_{i=1}^{q}\square\square\ln D_{t-i} + \square_1\ln rpgdp_{t-1} + \square_2\ln\inf_{t-1} + \square_3\ln D_{t-1} + v_t \quad (3.4)$$

Where $\square$ represents the first difference operator, rpgdp represents the independent variable, inf and D are the regressors as defined in the base model. D is a vector of control variables of growth. $\square_0$ is the drift component, $\square_i$ are coefficients of the lagged level variables, v_t is the disturbance term which is white noise and q is the optimal lag .

Model II

$$\square\ln rpgdp_t = \square_0 + \sum_{i=0}^{q} A\square\ln rpgdp_{t-i} + \sum_{i=1}^{q} B\square\ln garch01_{t-i} + \sum_{i=1}^{q} C\square\ln D_{t-i} + m_1\ln rpgdp_{t-1} + m_2\ln garch01_{t-1} + m_3\ln D_{t-1} + \square_t \quad (3.5)$$

Where garch01 is an independent variable, $\square_0$ is the drift component and $\square_t$ is the disturbance term which is white noise. All other variables are defined as previous.

4.6.2 Bounds Test - Co-integration

Co-integration is said to exist between or among variables if individually they exhibit nonstationarity, but some linear combination of the set of variables is stationary. By implication, non-stationary series can yield stationary relationships if co-integration exists among the variables.

ARDL approach to establishing existence of co-integration involves estimating the conditional ECM within the ARDL framework for economic growth and its determinants. The bounds test uses the F-statistic as a rule of thumb for establishing co-integrating relationship, by testing the null hypothesis of no co-integration. This involves setting the parameters of the lagged level variables in equations (3.4 and 3.5) to zero i.e., [H_0: $\delta_1 =$

$\delta_2 = \delta_3 = 0$ against H_1: $\delta_1 \neq \delta_2 \neq \delta_3 = 0$ and H_0: $m_1 = m_2 = m_3 = 0$ against H_1: $m_1 \neq m_2 \neq m_3 = 0$] by using OLS to estimate the equations.

The generated F-statistic has two asymptotic critical points referred to as the lower and upper bounds. If the F-statistic exceeds the upper bound, the null hypothesis is rejected implying the presence of co-integration and the existence of long run relationship. Conversely, if the F-statistic is below the lower bound, the null hypothesis is accepted implying the absence of co-integration and the non-existence of long run relationship. The result is inconclusive if the F-statistic lies between the upper bound and lower bound critical points (Sakyi et al., 2012).

4.6.3 Short-run and Long-run Estimations

After establishing the existence of co-integration, the final stage of ARDL involves estimating short-run and long-run parameters of the model. The ARDL specification of the short-run and long-run dynamics are shown blow;

(i) Short-run

The ARDL specification of the short-run dynamics is derived based on the following ECM:

Model I

$$\Delta \ln rpgdp_t = \alpha_0 + \sum_{i=0}^{q} a_1 \Delta \ln rpgdp_{t-i} + \sum_{i=1}^{q} a_2 \Delta \ln \inf_{t-i} + \sum_{i=1}^{q} a_3 \Delta \ln D_{t-i} + a_4 ecm(-1) + v_t \quad (3.6)$$

Model II

$$\Delta \ln rpgdp_t = \beta_0 + \sum_{i=0}^{q} b_1 \Delta \ln rpgdp_{t-i} + \sum_{i=1}^{q} b_2 \Delta \ln garch01_{t-i} + \sum_{i=1}^{q} b_3 \Delta \ln D_{t-i} + b_4 ecm(-1) + \varepsilon_t \quad (3.7)$$

Where $ecm(-1)$ is the error correction term and a_4 or b_4 (for $0 \leq a_4, b_4 \leq 1$) signify the speed of adjustment which must be negative and statistically different from zero. All parameters of the short-run models relate to the short-run dynamics of the system's convergence to long-run equilibrium. In selecting ARDL (q) orders, the Akaike information criterion (AIC) was used (Duasa, 2006).

(ii) Long-run

After obtaining evidence of long-run relationship among the variables, the following longrun models were estimated;

Model I

$$\Delta \ln rpgdp_t = \alpha_0 + \sum_{i=0}^{q} w_1 \Delta \ln rpgdp_{t-i} + \sum_{i=1}^{q} w_2 \Delta \ln \text{inf}_{t-i} + \sum_{i=1}^{q} w_3 \Delta \ln D_{t-i} + v_t \tag{3.8}$$

Model II

$$\Delta \ln rpgdp_t = \alpha_0 + \sum_{i=0}^{q} g_1 \Delta \ln rpgdp_{t-i} + \sum_{i=1}^{q} g_2 \Delta \ln garch01_{t-i} + \sum_{i=1}^{q} g_3 \Delta \ln D_{t-i} + \varepsilon_t \tag{3.9}$$

(Duasa, 2006).

CHAPTER FIVE

EMPIRICAL RESULTS, DISCUSSION AND ANALYSIS

5.0 Introduction

This chapter presents the analysis and discussion of empirical results in the following order; graphical analysis of time series, unit root and co-integration tests, model diagnostic and stability tests, coefficient variance decomposition and the ARDL regression results and analysis.

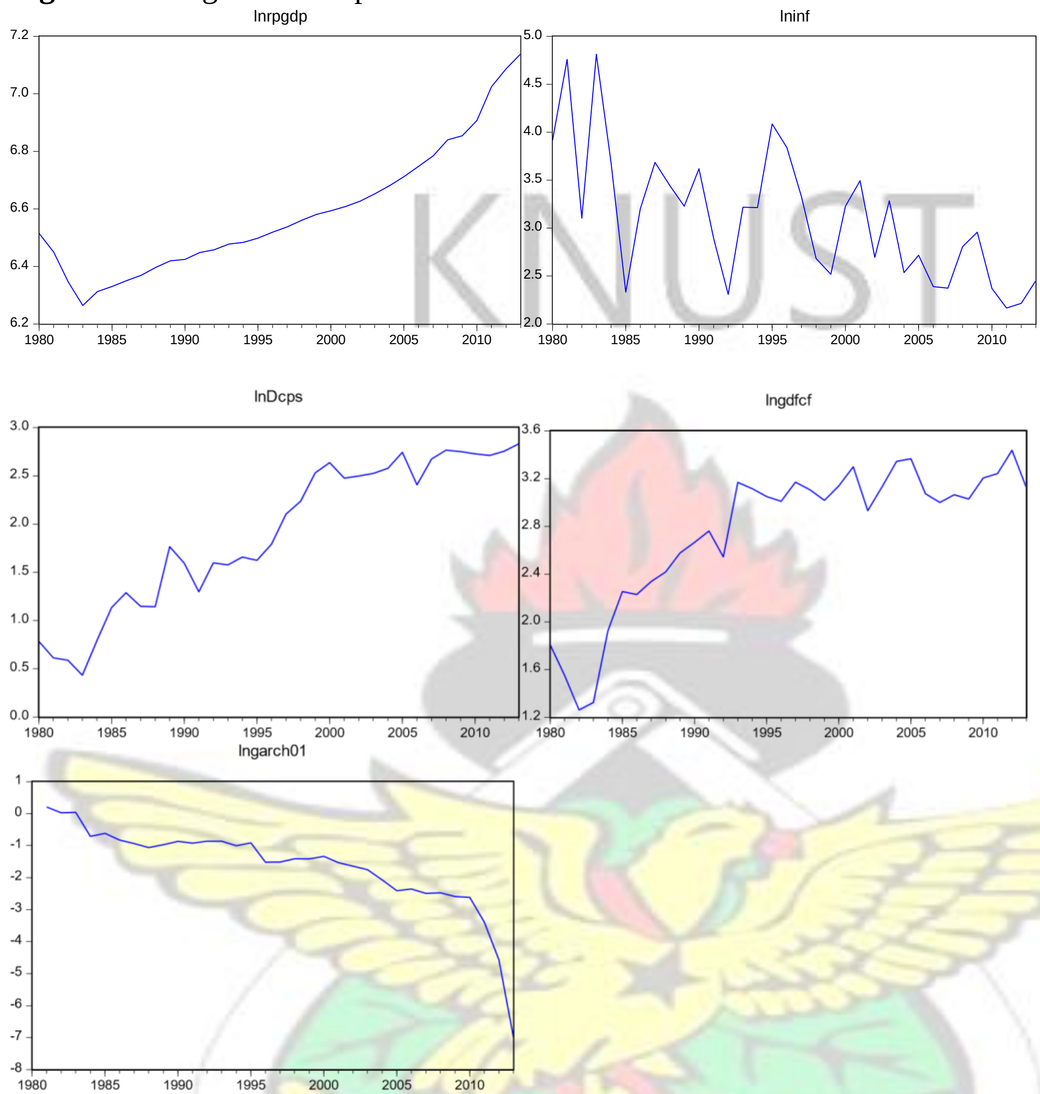
5.1. Graphical Analysis of Time Series

In this section, graphs were used to describe the behaviour of the series both at levels and first difference. This was purposely meant to explore the data in order to develop an indepth understanding of the nature of the series. The essence of taking logs of the variables was to linearize the relationship among the series. This is because the observed fluctuations in the series suggest that the relationship among them is nonlinear.

Figure 5.1 presents graphs of the log level behaviour of real per capita GDP, inflation level, Domestic Credit to Private Sector/GDP ratio, Gross Domestic Fixed Capital Formation/GDP ratio and conditional variance series from 1980 – 2013. It can be observed that with the exception of inflation which fluctuated around its mean, the other series did not. This means only inflation tended to exhibit stationarity at level.

Graphs of the differenced series are presented in Figure 5.2. The trends indicate that the series tended to fluctuate around their mean values on differencing, which implies that they exhibited stationarity after first difference.

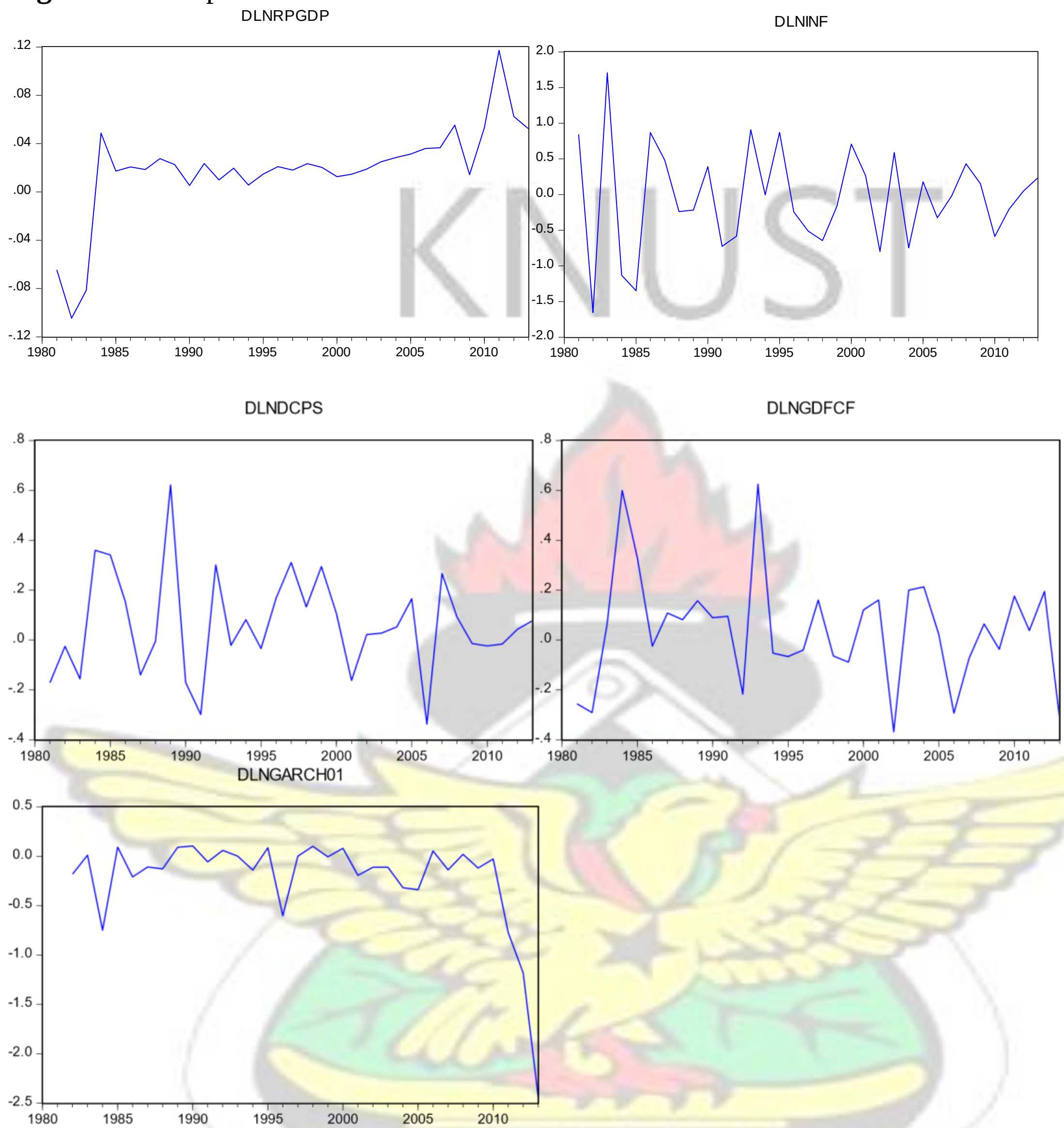
Figure 5.1: Log Level Graphs of Variables



Source: WDI

In empirical estimations, the stationarity or otherwise of series affect the statistical validity of findings and inferences. Stigler and Sherwin (1985) pointed out that unrelated series may tend to have high correlation coefficient at levels but on differencing, the variables might exhibit low or no correlation at all. Nevertheless, two non-stationary variables that are related tend to exhibit high correlation both in levels and first difference. As shown in Fig. 5.2, it can be observed that the variables tended to demonstrate similar behavioural pattern on differencing.

Figure 5.2: Graphs of Differenced Series



Source: WDI

5.2 Statistical Tests Conducted

In this section, preliminary tests that were conducted are presented as follows; unit root tests, model diagnostic and stability tests and variance decomposition.

5.2.1 Unit Root Test Results

Prior to time series estimations, it is crucial to establish stationarity of the series in order to avoid the tendency of spurious regressions. As a result, the time series properties of real per capita GDP, inflation level, Domestic Credit to Private Sector/GDP ratio, Gross Domestic Fixed Capital Formation/GDP ratio and conditional variance series were examined using the DF-GLS, ADF and Wald unit root tests. Wald test was specifically conducted to verify stationarity in volatility process.

Table 5.1: ADF and DF-GLS Tests for the dependent and independent variables

	Variable	ADF		DF-GLS	
		Intercept	Intercept + Trend	Intercept	Intercept + Trend
Level	*L rpgdp*n	3.156824**	0.046264	0.059592	1.119656
	*Ln*inf	3.544721**	5.292265***	3.223255***	5.463407***
	Lndcps	1.481240	2.5910112	0.298030	2.694415
	Lngdfcf	5.059794***	1.737251	0.998120	1.886613
First Difference	*Lrpgdp*	3.004658**	3.662996**	2.076465**	3.54699**
	*Ln*inf	5.190258***	8.582899***	6.7033244***	8.168303***
	Lndcps	5.679929***	5.810988***	5.477615***	6.072146***
	Lngdfcf	5.667575***	5.795395***	1.483972***	5.522551***

Note: *** (**) * denotes rejection of the null hypothesis at 1% (5%) 10% levels of significance.

Table 5.1 indicates that with the exception of inflation level, the computed DF-GLS and ADF test results show that at conventional levels of significance, all the other variables are non-stationary at levels. Thus, the unit root test results can be interpreted to mean that inflation level is integrated of order zero (I 0) while all other variables are integrated of order one (I 1).

Again, since conditional variance proxies were constructed, appropriate unit root test needed to be performed to confirm stationarity in volatility process. According to Lee and Hansen (1994) and Jones et al. (1998), Wald test is a robust unit root test for GARCH (1, 1) volatility models.

Table 5.2: Covariance Wald Stationarity Test

Test statistic	Estimate	Degrees of freedom	Probability
t-statistic	-1.585155	28	0.1154
F-statistic	2.512717	(1, 28)	0.1154
Chi-square ($\chi 2$)	2.512717	1	0.1129
Null-hypothesis: C(4) + C(5) = 1 or ($b_1 + \square_1 = 1$)			
Summary			
Normalized restriction	value	SE	
-1 + C(4) +C(5)	-0.023326	0.014715	
Restrictions are assumed to be linear in parameter estimates			

Source: Author's Estimation

Table 5.2 shows that the volatility process is strictly covariance stationary. The null hypothesis was rejected at 5% significance level. It implies that Ghana's inflation from 1980 – 2013 was characterized by appreciable level of volatility. This means that the constructed conditional variance series can be used to estimate the economic growth model without resulting in illogical inferences.

5.2.2 Model Diagnostic and Stability Test Results

To establish the reliability and stability of models I and II, residual diagnostic tests such as multivariate normality, Breusch-Godfrey (Serial Correlation), LM White (Heteroskedasticity), CUSUM and CUSUM of square tests were conducted. The reliability and stability tests results are presented in Table 5.3.

Table 5.3: Model Diagnostic and Stability Tests

	Dependent variable is *Lnrpgdp*	
Test Statistic	I	II
Serial Correlation χ2 (1)	0.511994	2.278737
	(0.6057)	(0.1225)
Normality χ2 (1)	3.523121	2.132991
	(0.171777)	(0.344213)
Functional Form χ2 (1)	7.809985	0.007032
	(0.0980)	(0.9338)
Heteroscedasticity χ2 (1)	1.350326	1.030699
	(0.2713)	(0.4280)
CUSUM	Stable	Stable
CUSUMQ	Stable	Stable

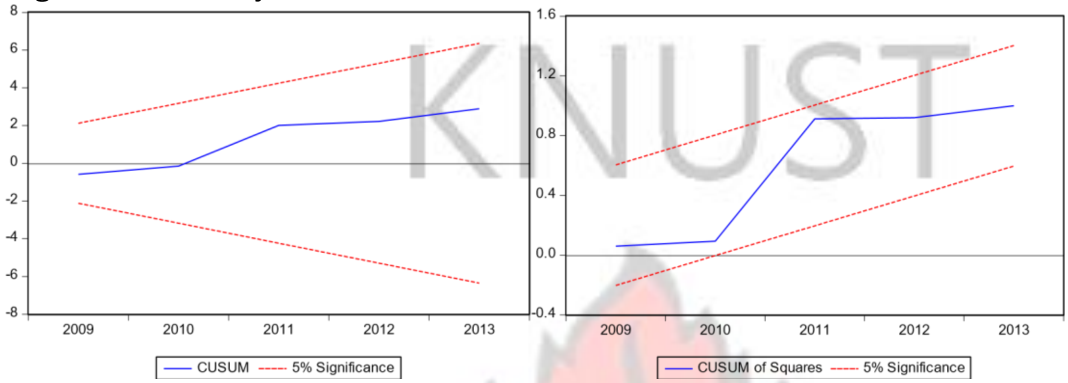
Note: indicated in parenthesis are p – values.

Table 5.3 shows the reliability and stability test results for models I and II. The results indicate that all the diagnostic tests were statistically insignificant implying that models I and II passed the tests against serial correlation, normality and heteroscedasticity. Ramsey Reset test result also suggests that the models were correctly specified.

Figures 5.3 and 5.4 show results of CUSUM and CUSUM of squares stability tests conducted for the growth regressions. The figures indicate variable stability at 5%

significance level. This suggests that the parameter estimates are stable and are within the boundary of critical values.

Figure 5.3: Stability Tests for Model I: CUSUM and CUSUMQ



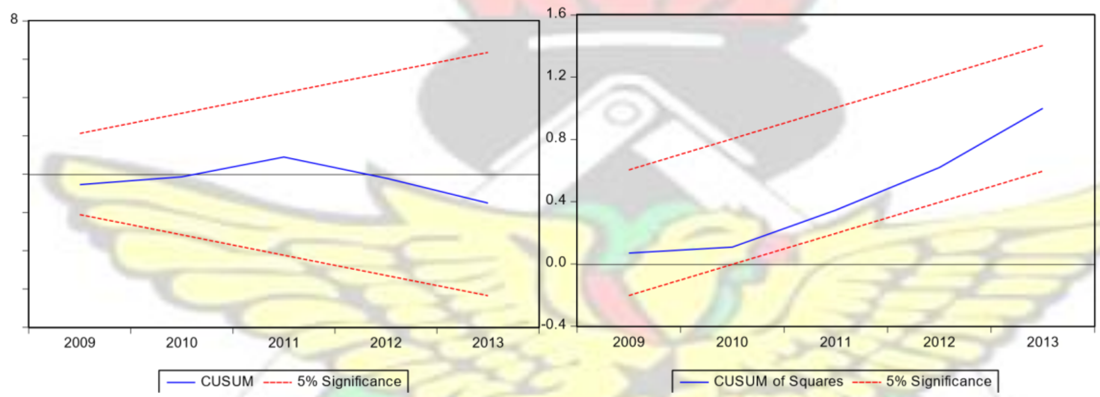


Figure 5.5: The Actual, Fitted and Residual of Growth Regressions (I and II)

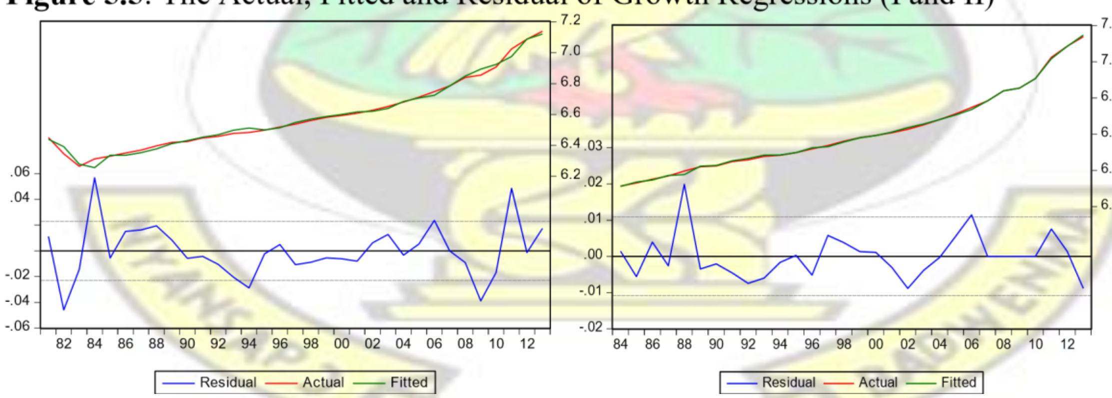


Figure 5.4: Stability Tests for Model II: CUSUM and CUSUMQ

6

4

2

0

-2

-4

-6

-8

.02

.00

Source: Author's Analysis

A graph of the actual, fitted and residual of growth regression shown in Figure 5.5 depicts goodness of fit and approximately normally distributed residuals

5.2.3 Coefficient Variance Decomposition

The proportions of variance decomposition were used to explain the significant role played by inflation level, inflation targeting, DCPS/GDP ratio and GDFCF/GDP ratio in accounting for variations in real per capita GDP.

Table 5.4a: Variance Decomposition Proportions I

	Dependent Variable is *Lnrpgdp*						
Variable	1	2	3	4	5	6	7
LNRPGDP(-1)	0.986274	0.000455	0.001251	0.010826	0.001129	1.15E-05	5.39E-05
LNINF	7.45E-05	0.006755	0.021117	0.882755	0.000422	0.088332	0.000545
IT	0.046715	0.900728	0.003095	0.008748	0.039474	0.001239	2.72E-07
IT(-1)	0.115744	0.784135	0.052761	0.011307	0.035118	0.000935	1.96E-07
LNDCPS	0.335646	0.041304	0.542337	0.056089	0.008012	0.016565	4.70E-05

LNGDFCF	0.052358	0.065148	0.800465	0.018176	0.056310	0.007428	0.000114

Source: Author's estimation

Table 5.4a shows results of variance decomposition proportions for model I. The results show that at 1-year horizon, the proportion of real per capita GDP forecast error variance attributable to the variable's own shock is about 98.6% while shocks to DCPS/GDP ratio, inflation targeting (IT) with a period lag, GDFCF/GDP ratio and IT account for 33.6%, 11.6%, 5.2%, and 4.7% of the fluctuations in the dependent variable respectively. Innovations to inflation level (INF) account for less than 1% of the real per capita GDP forecast error variance. At 2-year horizon, the explanatory power of real per capita GDP and DCPS/GDP ratio declined while that of IT, IT(-1), GDFCF/GDP ratio and INF increased, with innovations to IT accounting for about 90% of variations in real per capita GDP. Innovations to GDFCF/GDP ratio accounts for much of the variations in real per capita GDP at 3-year horizon (80%) while greater percentage of real per capita GDP forecast error variance is attributable to shocks in INF (88.3)% in the fourth year. However, the proportion of real per capita GDP forecast error variance explained by all explanatory variables except INF continuously decline at longer horizon after 4-year horizon, relative to 1-year horizon after the shock.

The results in Table 5.4b presents the variance decomposition proportions for model II. The results show that at 1-year horizon, the proportion of real per capita GDP forecast error variance attributable to variable's own shock is about 99.7% while shocks to DCPS/GDP ratio, inflation volatility (GARCH01), GDFCF/GDP ratio, IT(-1) and IT account for 32.1%, 30.9%, 9.5%, and 2.9% of the variations in the dependent variable respectively.

Table 5.4b: Variance Decomposition Proportions II

Variable	Dependent Variable is *Lnrpgdp*						
	1	2	3	4	5	6	7
LNRPGDP(-1)	0.996503	0.000114	0.001770	8.64E-06	0.001328	0.000229	4.62E-05
IT	0.029331	0.876761	0.005885	0.084684	0.002804	0.000534	4.01E-07
IT(-1)	0.057367	0.811404	0.064358	0.063386	0.003041	0.000445	2.84E-07
LNDCPS	0.321256	0.064108	0.500318	0.043439	0.068549	0.002266	6.33E-05
LNGDFCF	0.094609	0.061557	0.776401	0.005601	0.061562	0.000135	0.000135
LNGARCH01	0.309332	0.003695	0.001822	0.448918	0.105193	0.130714	0.000325

Source: Author's estimation

At 2-year horizon, the explanatory power of real per capita GDP, DCPS/GDP ratio, GDFCF/GDP ratio, and GARCH01 declined while innovations to IT and IT(-1) account for about 87.7% and 81.1% of real per capita GDP forecast error variance respectively. Innovations to GDFCF/GDP ratio account for much of the variations in real per capita GDP at 3-year horizon (77.6%) while greater proportion of real per capita GDP forecast error variance is attributable to shocks in GARCH01 (44.9)% in the fourth year. However, the proportion of real per capita GDP forecast error variance explained by all explanatory variables continuously declined at longer time horizon after the fourth year, relative to 1year horizon after the shock.

5.3 Results of the Estimated GARCH (1, 1) Model

Results of the GARCH (1, 1) model are presented in Table 5.5. The results show that the coefficients of squared lag residual i.e., ARCH (1) and lag conditional variance GARCH (1) are statistically significant at conventional levels. The GARCH (1, 1) estimation results show the presence of strong GARCH effect in the time series. Both the ARCH (1) and

GARCH (1) coefficients are significant at 1% level. The Ghana inflation series was thus found to exhibit a high volatility process.

Table 5.5: Results of Estimated GARCH (1, 1) Model

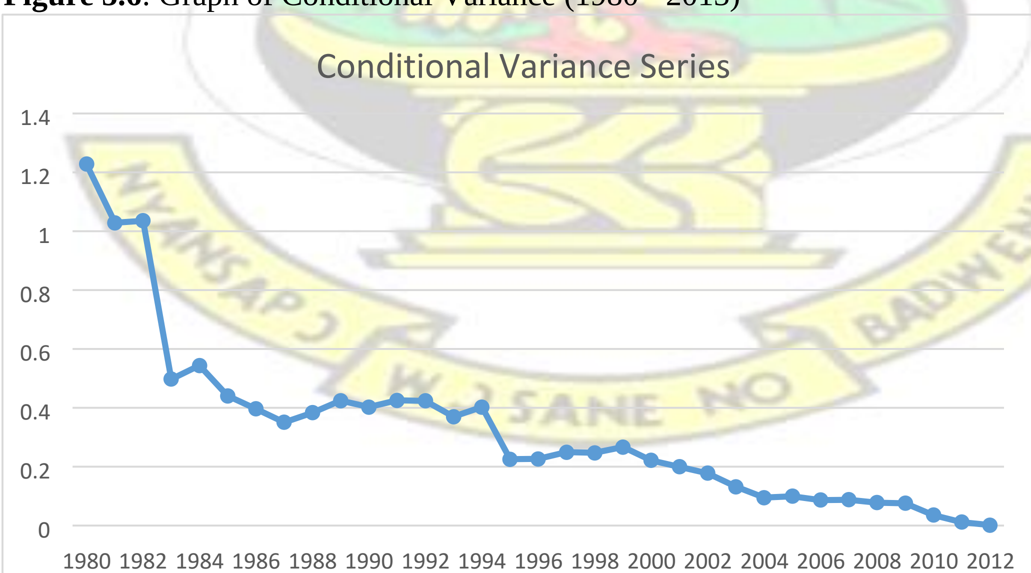
Independent Variable	Dependent variable is GARCH	
	Coefficient	Standard error
Constant	-0.007313***	(0.000145)
ARCH(1)	-0.236793***	(0.002139)
GARCH(1)	1.188620***	(0.001609)

Note: (***) denotes rejection of the null hypothesis at 1% significant level

Following the GARCH (1, 1) estimation, the conditional variance series were then generated and used to estimate the growth regression. A graph of the conditional variance series that were generated from the GARCH (1, 1) model is shown in Figure 5.6.

Figure 5.6 indicates that inflation volatility in Ghana exhibits strong GARCH (1, 1) effect. It appears that periods of high inflation level are associated with high inflation volatility while periods of low inflation rates correspond to low inflation volatility.

Figure 5.6: Graph of Conditional Variance (1980 - 2013)



Indeed, relative to the pre-targeting period (1980 – 2006), inflation volatility tended to decline in the post-inflation targeting period (2007 – 2013) as stable low inflation was delivered. This confirms Friedman's hypothesis that inflation is likely to be more volatile in periods of high inflation.

5.4 Co-integration Test Results

After the time series property of the variables was established, the next stage of the analysis was testing for co-integrating relationship among the variables. This was performed using ARDL bounds testing technique to co-integration. The log of real per capita GDP is the dependent variable for both models I and II. The results in Table 5.6 show that for both models, all the variables were co-integrated.

As shown in Table 5.6, the computed F-statistic exceeds the upper bound critical value at 1% level of significance. The null hypothesis of existence of no co-integration is thus rejected. Hence, it can be conveniently concluded that long-run relationship exists among the variables. Therefore, it is feasible to corroborate the existence of a non-spurious, unique and long run relationship between real GDP per capita and the explanatory variables.

Table 5.6: Co- integration Test Results

F-Statistic I	F-Statistic II	Significance Level	Critical Value Bound I		Critical Value Bound II	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound
		10%	2.45	3.52	2.45	3.52
6.703317***	7.497764***	5%	2.86	4.01	2.86	4.01
		1%	3.74	5.06	3.74	5.06

Source: Author’s Analysis

Note: *** denotes rejection of the null hypothesis at 1% significance level.

5.5 Analysis of Regression Results

In this section, the regression results for short-run and long-run are discussed.

5.5.1 Analysis of Short-run Regression Results

The short-run regression results for both models I and II are reported in table 5.7. The Akaike Information Criterion (AIC) was used in selecting ARDL (1, 0, 1, 0, 0) order for both models.

It is crucial to note that the statistical adequacy and fit of the ARDL model critically depends on the computed *ecm*(1)□ coefficient**.** For this reason, the *ecm*(1)□ coefficients for models I and II were reported in Table 5.7 together with the short-run results.

Table 5.7: Regression Results for Short-run Relationship

	Dependent variable is *Lnrpgdp*	
Independent Variables	I	II

$ecm(-1)$	-0.124983**	-0.232446***
	(0.054726)	(0.059931)
D(*Ln*inf)	-0.015052*	
	(0.008045)	
D(*ITDum*)	0.033673	0.039111
	(0.026073)	(0.023706)
D(*Lndcps*)	-0.003972	0.010701
	(0.017552)	(0.015630)
D(*Lngdfcf*)	0.055215***	0.045261***
	(0.016029)	(0.015086)
D(*Lngarch*01)		-0.018300***
		(0.006105)

Note: Standard errors of short-run parameter estimates are indicated in parenthesis. *** (**) and * denotes rejection of the null hypothesis at 1% (5%) and 10% significance level.

Table 5.7 shows that for both models I and II, the $ecm(-1)$ coefficient is negative and statistically significant. This confirms the ARDL bounds test results that a unique and long run relationship exists between the dependent and independent variables. The error correction coefficients give an indication of a less than average speed of adjustment from short-run equilibrium. The $ecm(-1)$ coefficient for model I (0.124983) is interpreted to mean that in the event of shocks to the explanatory variables, the speed with which real per capita GDP adjusts to equilibrium is approximately 12%. For model II, The coefficient of $ecm(-1)$ is 0.232446 is interpreted to mean that if there are shocks to the explanatory variables, real per capita GDP adjusts to equilibrium at an approximate speed of 23%.

Also, Table 5.7 presents the short-run regression results for models I and II. In the case of model I, as expected, the results indicate that the coefficient of inflation level is statistically significant at 10%. This suggests that all other things being equal, an increase in inflation by 1% is likely to trigger decline in real GDP per capita growth in the short-term by 0.015052%. This finding implies that inflation has a weak negative and significant impact on economic growth in the short-run. It suggests that innovations to inflation affect pricing, investment, consumption and savings decisions of private agents in the short-run. Perhaps, this is so because according to monetarism, fluctuations in prices affect real variables only in the short-run. This confirms the findings of Fischer (1979), Barro (1995) and Judson and Orphanides (1999). However, it is inconsistent with the findings of Malik and Chowdhury (2001), Ahmed and Mortaza (2005) and Wang Zhiyoug (2008), who concluded that a positive relationship exists between inflation and economic growth

Table 5.7 again shows that the coefficient of Gross Domestic Fixed Capital Formation/GDP ratio is positive and statistically significant at 1% level. This indicates that holding all other variables constant, a 1% increase in GDFCF/GDP ratio is likely to cause real GDP per capita to increase by 0.055215%. It means that investment significantly contributes to economic growth in the short-term and so conditions that raise investor confidence in the short-term should be made to prevail. This confirms the Keynesian perspective that investment affects growth positively.

The coefficient of inflation targeting dummy is positive. This means that if inflation targeting is strengthened, real per capita GDP grows by 0.033673%. However, the coefficient is statistically insignificant at 1%, 5% and 10% levels. This means that inflation targeting has no significant impact on real GDP per capita growth in the short-run. Perhaps, this is so because of long lags in policy. It takes significant amount of time for policy changes to yield the desired impact.

In addition, the coefficient of Domestic Credit to Private Sector/GDP ratio is negative and statistically insignificant at conventional levels. This means that DCPS/GDP ratio has does not significantly determine economic growth. Perhaps, this is due to the dearth of welldeveloped financial systems that have the institutional capacity to convert some uncertainty into quantifiable risk and allow access to financial resources at all levels, while favouring incentives that are oriented at producing some growth and not only income.

For model II, the coefficient of inflation volatility is negative and statistically significant at 1% level. This suggests that if all other variables are held fixed, an increase in inflation volatility by 1% is likely to trigger 0.018300% decline in real per capita GDP growth in the short-run. This confirms a priori expectation. The implication is that a less variable inflation reduces uncertainty about investment returns in the short-term. Investors feel secured to commit their resources into investment portfolios when inflation is less volatile and since investment is a key driver of economic growth, this phenomenon translates into higher growth in the short-term.

As expected, the parameter estimate for GDFCF/GDP ratio is positive and statistically significant at 1% level. This means that an increase in GDFCF/GDP ratio by 1% causes real per capita GDP growth to accelerate by 0.045261%. However, the coefficient of inflation targeting dummy is positive and that of DCPS/GDP ratio is negative and both are statistically insignificant at 1%, 5% and 10% levels. This could be attributed to long lags between policy and macro outcomes.

5.4.2 Analysis of Long-run Regression Results

Table 5.8 reports the long-run regression results for models I and II. In selecting ARDL (1, 0, 1, 0, 0) order for models I and II, the AIC was used. Models I^* and II^* were estimated using Fully-Modified Ordinary Least Squares (FMOLS) technique as robust check for the ARDL (I and II) long-run estimates.

Table 5.8: Regression Results for Long-run Relationship

Independent Variables	Dependent variable is *Lnrpgdp*			
	I	I^*	II	II^*
*Ln*inf	-0.120434	0.008654		
	(0.086623)	(0.028332)		
ITDum	0.554175^{***}	0.321419^{***}	0.292949^{***}	0.174494^{***}
	(0.162697)	(0.046042)	(0.073656)	(0.028697)
Lndcps	-0.031780	0.168086^{***}	0.046038	0.121591^{***}
	(0.017552)	(0.050878)	(0.061609)	(0.025860)
Lngdfcf	0.441785*	-0.001475	0.194718^{***}	0.010266
	(0.016029)	(0.055770)	(0.091728)	(0.029418)
*Lngarch*01			-0.078729^{***}	-0.059065^{***}
			(0.292949)	(0.009805)
Constant	5.816292^{***}	6.192362^{***}	5.833353^{***}	6.194128^{***}
	(0.384011)	(0.145963)	(0.166126)	(0.048117)

Note: Standard errors of the long run parameter estimates are indicated in parenthesis. *** (**) and * indicates rejection of the null hypothesis at 1% (5%) and 10% significance level.

For models I and I^*, Table 5.8 reports that the coefficient of Inflation level is negative for model I and positive for model I^*. The coefficient in both cases is statistically insignificant at conventional levels. This suggests that inflation level is not a robust determinant of growth in the long run, at least for the sample period. This finding implies that lower inflation rates associated with inflation targeting has a statistically insignificant impact on economic growth in the long run. While in the short-run inflation level has a statistically significant impact on growth, it has no statistically significant impact in the long-run. This confirms the basic idea of monetarism that inflation does not influence real variables in the long-run.

Also, for both models I and II, the coefficient of DCPS/GDP ratio is negative and statistically insignificant at conventional levels. It confirms the short-run results. This is interpreted to mean that it has no significant impact on economic growth in the long-run. The coefficient of GDFCF/GDP ratio is positive for model I. Table 5.8 shows that the coefficient for GDFCF/GDP ratio is statistically significant only at 10%. The coefficient is interpreted to mean that in the long-run, a 1% rise in domestic investment triggers about 0.441785% increase in economic growth. For model II, the coefficient of GDFCF/GDP ratio is positive and statistically significant. This is interpreted to mean that a 1% rise in domestic investment is likely to cause real GDP per capita growth to increase by 0.194718%. It is evident from Table 5.8 that the contribution of domestic capital to economic growth is greater than that of inflation volatility. This is consistent with the shortrun finding and it also confirms the finding of Barugahara (2013). This finding is in tune with the classicalist view that economic growth is driven by investment. Investment behaviour is influenced by the degree of inflation variability because, inflation is a tax on capital rate of return. A less volatile inflation leads to increased investor confidence and since a positive relationship exists between investment and real per capita GDP growth, economic growth also increases.

For both models I and II, the coefficient for inflation targeting dummy is positive and statistically significant at conventional levels. For model I, it is revealed that Inflation targeting accounts for about 55% of variations in real GDP per capita growth while for model II, it contributes to about 29% of fluctuations in economic growth. It implies that inflation targeting has a positive impact on economic growth in the long-run. This confirms the findings of Batini and Laxton (2007) and Goncalves and Salles (2008). Also, it can be shown that the coefficient for inflation targeting is positive for models I, I^*, II, and II^*, implying that inflation targeting is a robust determinant of economic growth in the longrun. This indicates that inflation targeting significantly affects real aggregate economic activity through expectation formation. Ability to stabilize private agent's expectations induces investment and consumption and hence economic growth in the long-run.

Finally, as expected, the results revealed that the coefficient of inflation volatility is negative for both models II and II^* and statistically significant at 1% level. Since inflation volatility is not model dependent, it is considered a robust determinant of economic growth in the long-run, at least for the sample period. The results indicate that if all other factors are held fixed, an increase in inflation volatility by 1% is likely to cause 0.078729% decline in economic growth in the long-term. This is consistent with the short-run results and also confirms the findings of Barugahara (2013) and Kumo (2015). The implication of this finding is that less volatile inflation associated with inflation targeting has contributed significantly to real per capita GDP growth.

Hypothesis One: Test Result for Impact of Inflation targeting on Economic Growth

The first hypothesis that was tested is that inflation targeting has no significant impact on economic growth. For the short-run analysis, with a probability value of (0.1110) and significance levels of 1%, 5% and 10%, we fail to reject the null-hypothesis. This means that inflation targeting has no significant impact on economic growth in the short-run. In the long run however, with a probability value of (0.0005) and significance level of 1%, 5% and 10%, the null hypothesis was rejected implying that inflation targeting has a significant impact on economic growth in the long run (see appendix 5).

Hypothesis Two: Test Result for Impact of Inflation Level on Economic Growth

The second hypothesis that was tested is that inflation level has no significant impact on economic growth. In the short-run, with a probability value of (0.0726) and a significance level of 10%, the null hypothesis was rejected in favour of its alternative. This means that inflation level has a significant weak impact on economic growth in the short-run. However, with a probability value of (0.1762) and significance level of 1%, 5% and 10%, we fail to reject the null hypothesis implying that inflation level has no significant impact on economic growth in the long run (see appendix 5).

Hypothesis Three: Test Result for Impact of Inflation volatility on Economic Growth

The third hypothesis that was tested is that inflation volatility has no significant impact on economic growth. With probability values of (0.0059) and (0.0018) in the short-run and long run respectively and at conventional significance levels, the null hypothesis was rejected in favour of its alternative. This means that inflation volatility has a significant impact on economic growth in both short-term and long-term (see appendix 5).

CHAPTER SIX

SUMMARY OF MAJOR FINDINGS, CONCLUSIONS AND POLICY RECOMMENDATIONS

6.0 Introduction

This chapter presents summary of major findings of the research, conclusions and policy recommendations.

6.1 Summary of Major Findings

The main objective of the study was to examine the effect of inflation targeting and inflation on economic growth in Ghana using annual time series from 1980 – 2013. The specific objectives were to review monetary management, inflation outcomes and GDP growth and examine the impact of inflation targeting, inflation level and volatility on economic growth. Based on the analysis that was done using GARCH (1, 1) and ARDL estimation techniques, the major findings of the study are reported as follows;

First and foremost, a review of monetary management, inflation outcomes and GDP growth in Ghana from 1980 – 2013 revealed that inflation was less variable under the inflation targeting regime (4.32) than that of monetary targeting regime (7.93). Also, average annual growth was higher for the inflation targeting regime (8.13%) than the monetary targeting period (3.67%). This implies the efficiency of monetary policy depends to a very large extent on the framework adopted.

Secondly, the regression results indicate that inflation targeting is a robust determinant of economic growth in the long run. It was established that for model I, inflation targeting accounts for approximately 55.4% of variations in real per capita GDP and for model II, it contributes to about 29.3% of fluctuations in in real GDP per capita. It was found that inflation targeting has a statistically significant impact on economic growth in the longrun.

Thirdly, the study found that inflation level has a statistically significant impact on economic growth in the short-run. The results indicated that an increase in inflation level by 1% is likely to trigger decline in real GDP per capita by 0.015052% in the short-run.

However, in the long-run, the study revealed that inflation level has a negative impact on economic growth but this was found to be insignificant. While inflation level significantly affects investment, savings, exchange rate and consumption in the short-term, it does not do so in the long-term.

Again, the results of the study revealed that inflation volatility has a statistically significant impact on real per capita GDP. A rise in inflation volatility by 1% causes growth in real per capita GDP to reduce by 0.018300% and 0.078729% in the short-run and long run respectively. This means that inflation volatility affects economic growth more strongly in the long-term than short-term. The implication is that savings and investment decisions are significantly influenced by inflation volatility in both long-term and short-term. Further to this, the study revealed that Domestic Credit to Private Sector has a negative impact on economic growth. It was however found to have statistically insignificant effect on economic growth.

Finally, the study found that domestic capital is a robust determinant of economic growth in the short-term and long-term. In the short-term, it accounts for approximately 5.5% and 4.5% of variations in real per capita GDP in models I and II respectively. It means that if domestic capital increases by 1% real per capita GDP growth is likely to increase by 0.055215% and 0.045261% respectively. In the long run, it accounts for approximately 44.2% and 19.4% of fluctuations in real per capita GDP for models I and II respectively. This is interpreted to mean that if domestic capital increases by 1% real per capita GDP growth increases by 0.441785% and 0.194718% in the short-run and long-run respectively. It was revealed that the impact of domestic capital on economic growth is greater than that of both inflation level and volatility.

6.2 Conclusions

The principal objective of this study was to examine the effect of inflation targeting and inflation on economic growth in Ghana using the Auto Regressive Distributed lag (ARDL) model. Theoretical and empirical foundations were established to ensure that results obtained could be interpreted within conventional research requirements. The revelations that emerged from the study are;

The adoption of inflation targeting in Ghana has achieved its principal objective of stabilizing inflation and its secondary objective of enhancing economic growth. This means that the effectiveness of monetary policy depends to a very large extent on the framework adopted.

Also, the study concludes that inflation targeting has a positive and significant impact on economic growth in the long-run.

Again, inflation level has a weak negative and significant impact on growth in the shortrun. Inflation volatility has a negative and significant impact on economic growth in both shortrun and long-run.

Finally, Gross Domestic Fixed Capital Formation/GDP ratio has a significant positive impact on economic growth in both short-term and long-term. However, in absolute terms, Gross Domestic Fixed Capital Formation/GDP ratio was found to contribute more to economic growth than both inflation level and volatility.

6.3 Policy Recommendations

Based on the findings and conclusions of the study, the following recommendations are made;

It is recommended that the BoG should strengthen inflation targeting by ensuring a stable financial environment, to effectively deliver stable low inflation conducive for sustainable and balanced long-term growth.

Again, firms, businesses and households should consider inflation behaviour when making investment and saving decisions in short horizons.

The BoG should enhance monetary policy accountability and credibility to be able to maintain a medium-run focus on keeping inflation less variable in both short-term and long term. How well expectations are anchored depends on public confidence in monetary management.

Finally, Ghana needs a comprehensive mix of macroeconomic reforms. It is thus recommended that the BoG and MoF should implement policies that induce investment efficiency. Since inflation is a necessary but not a sufficient condition for sustained growth, overconcentration on inflation will result in inflation bias. To this end, tax and interest rate policies that are disincentive to investors should be avoided.

6.4 Limitation of the Study

The limitation of this study was availability of data from domestic sources such as the BoG, the Ghana Statistical Service and MoF. Missing data on macroeconomic variables used in the study was a major setback and as such, all the data used were sourced from WDI.

Annual data were used for the analysis because high frequency quarterly data on some of the variables were not available.

6.5 Suggestions for Future Research

Further studies could be conducted on a relatively longer horizon time scale provided supportive data is available. Also, high frequency data could be employed, if available, to capture large variations in the series which suits co-integration and error correction techniques. Again, future studies could do pre and post targeting analysis so as to contrast the performance of inflation targeting against alternative monetary policy regimes. Finally, it is reckoned that future studies on the response of other macroeconomic variables such as real interest rates and the business cycle to inflation targeting will be crucial in assessing the overall impact of the inflation targeting regime.

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APPENDIX 1 (Data)

Appendix 1: Data Used for Estimations:

Model I: $rpgdp = f(\text{inf}, ITDum, dcps, gdfcf)$ Model II: $rpgdp = f(garch01, ITDum, dcps, gdfcf)$

Year	rpgdp	gdfcf	inf	Dcps	ITDum	garch01
1980	675.06	6.10	50.07	2.19	0.00	
1981	632.92	4.72	116.50	1.85	0.00	1.228012
1982	570.09	3.53	22.30	1.80	0.00	1.02851
1983	525.46	3.76	122.87	1.54	0.00	1.035801
1984	551.61	6.85	39.67	2.21	0.00	0.497427
1985	561.23	9.53	10.31	3.11	0.00	0.543626
1986	572.94	9.30	24.57	3.63	0.00	0.440341
1987	583.65	10.36	39.82	3.15	0.00	0.396376
1988	599.93	11.24	31.36	3.14	0.00	0.350752
1989	613.62	13.16	25.22	5.84	0.00	0.383523
1990	616.90	14.39	37.26	4.93	0.00	0.424461

1991	631.59	15.82	18.03	3.66	0.00	0.402307
1992	637.91	12.74	10.06	4.94	0.00	0.425202
1993	650.54	23.79	24.96	4.84	0.00	0.423867
1994	654.24	22.57	24.87	5.25	0.00	0.369716
1995	664.01	21.13	59.46	5.07	0.00	0.402268
1996	678.05	20.30	46.56	6.01	0.00	0.225382
1997	690.45	23.84	27.89	8.20	0.00	0.226481
1998	706.80	22.36	14.62	9.36	0.00	0.249317
1999	721.22	20.47	12.41	12.56	0.00	0.247214
2000	730.39	23.10	25.19	13.97	0.00	0.266742
2001	741.17	27.12	32.91	11.88	0.00	0.221517
2002	755.23	18.77	14.82	12.15	0.00	0.199623
2003	774.33	22.94	26.67	12.49	0.00	0.178188
2004	796.74	28.38	12.62	13.17	0.00	0.132022
2005	822.11	29.00	15.12	15.54	0.00	0.094845
2006	852.25	21.64	10.92	11.09	0.00	0.099542
2007	884.03	20.11	10.73	14.49	1.00	0.086612
2008	934.32	21.45	16.52	15.88	1.00	0.08759
2009	947.77	20.67	19.25	15.66	1.00	0.078126
2010	999.56	24.66	10.71	15.29	1.00	0.075913
2011	1123.75	25.61	8.73	15.05	1.00	0.035889
2012	1196.17	31.13	9.16	15.72	1.00	0.011669
2013	1260.17	22.67	11.61	16.99	1.00	0.001356

Source: WDI

Definition of Variables:

rpgdp = real per capita GDP, inf = inflation level, garch01 = inflation volatility, ITDum = Dummy for inflation targeting, dcps = Domestic Credit to Private Sector/GDP ratio and gdfcf = Gross Domestic Fixed capital Formation/GDP ratio.

APPENDIX 2: (Unit Root Test Results)

Table 1: ADF and DF-GLS Test Results for the Dependent and Independent Variables Independent Variable is *Lnrpgdp*

		ADF		DF-GLS	
	Variable	Intercept	Intercept + Trend	Intercept	Intercept + Trend
Level	*L rpgdp*n	3.156824**	0.046264	0.059592	1.119656
	*Ln*inf	3.544721**	5.292265***	3.223255***	5.463407***
	Lndcps	1.481240	2.5910112	0.298030	2.694415
	Lngdfcf	5.059794***	1.737251	0.998120	1.886613
First Difference	*Lrpgdp*	3.004658**	3.662996**	2.076465**	3.54699**
	*Ln*inf	5.190258***	8.582899***	6.7033244***	8.168303***
	Lndcps	5.679929***	5.810988***	5.477615***	6.072146***
	Lngdfcf	5.667575***	5.795395***	1.483972***	5.522551***

Table 2: Wald Test Stationarity Results

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-1.585155	28	0.1154
F-statistic	2.512717	(1, 28)	0.1154
Chi-square	2.512717	1	0.1129

Null Hypothesis: C(4)+C(5)=1 Null
Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
-1 + C(4) + C(5)	-0.023326	0.014715

Restrictions are linear in coefficients.

APPENDIX 3 (Stability and Diagnostic Tests Results)

APPENDIX 3A: Stability and Diagnostic Tests for Model I

Breusch-Godfrey Serial Correlation LM Test:

Method: ARDL
Included observations: 33
Sample: 1981 – 2013

F-statistic	0.511994	Prob. F(2,24)	0.6057
Obs*R-squared	1.350368	Prob. Chi-Square(2)	0.5091

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRPGDP(-1)	-0.002306	0.056011	-0.041179	0.9675
LNINF	0.001763	0.009055	0.194658	0.8473
IT	-0.001657	0.026798	-0.061829	0.9512
IT(-1)	0.002454	0.027674	0.088686	0.9301
LNDCPS	0.003869	0.018339	0.210967	0.8347
LNGDFCF	-0.003640	0.016775	-0.216962	0.8301
C	0.012224	0.352189	0.034707	0.9726
RESID(-1)	0.101740	0.229486	0.443337	0.6615
RESID(-2)	-0.196230	0.208786	-0.939862	0.3567

R-squared	0.040920	Mean dependent var	8.00 E-16
Adjusted R-squared	-0.278773	S.D. dependent var	0.020718
S.E. of regression	0.023429	Akaike info criterion	-4.442696
Sum squared resid	0.013174	Schwarz criterion	-4.034557
Log likelihood	82.30448	Hannan-Quinn criter.	-4.305369
F-statistic	0.127998	Durbin-Watson stat	1.908024

Prob(F-statistic)	0.997339

Heteroskedasticity Test: Breusch-Pagan-Godfrey

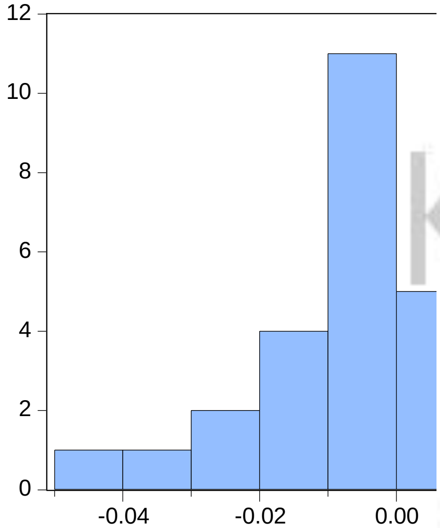
F-statistic	1.350326	Prob. F(6,26)	0.2713
Obs*R-squared	7.840153	Prob. Chi-Square(6)	0.2500
Scaled explained SS	7.968370	Prob. Chi-Square(6)	0.2404

Method: ARDL
Sample: 1981-2013
Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006461	0.011124	0.580828	0.5664
LNRPGDP(-1)	-0.000609	0.001764	-0.345438	0.7325
LNINF	-0.000226	0.000259	-0.871775	0.3913
IT	-0.000101	0.000840	-0.119933	0.9055
IT(-1)	0.000977	0.000852	1.146181	0.2622
LNDCPS	-0.000163	0.000566	-0.287522	0.7760
LNGDFCF	-0.000425	0.000517	-0.823321	0.4178

R-squared	0.237580	Mean dependent var	0.000416
Adjusted R-squared	0.061637	S.D. dependent var	0.000765
S.E. of regression	0.000741	Akaike info criterion	-11.39144
Sum squared resid	1.43E-05	Schwarz criterion	-11.07400
Log likelihood	194.9588	Hannan-Quinn criter.	-11.28463
F-statistic	1.350326	Durbin-Watson stat	2.815664
Prob(F-statistic)	0.271324		

Multivariate Normality Test



Series: Residuals
Sample 1981 2013
Observations 33

Mean	8.00e-16
Median	-0.003340
Maximum	0.056828
Minimum	-0.045889
Std. Dev.	0.020718
Skewness	0.484176
Kurtosis	4.274584
Jarque-Bera	3.523121
Probability	0.171777

Ramsey RESET Test (Functional Form)

	Value	df	Probability
t-statistic	2.794635	25	0.0980
F-statistic	7.809985	(1, 25)	0.0980

F-test summary:

	Sum of Sq.	df	Mean Squares

Test SSR	0.003270	1	0.003270
Restricted SSR	0.013736	26	0.000528
Unrestricted SSR	0.010466	25	0.000419

Dependent Variable: LNRP GDP
Method: ARDL
Sample: 1981 – 2013
Included Observations: 33
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic):
Fixed regressors: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRPGDP(-1)	-2.425763	1.182118	-2.052049	0.0508
LNINF	0.045135	0.022696	1.988652	0.0578
IT	-0.093996	0.051241	-1.834369	0.0785
IT(-1)	-0.123005	0.061436	-2.002171	0.0562
LNDCPS	0.029501	0.019687	1.498484	0.1465
LNGDFCF	-0.149496	0.074628	-2.003209	0.0561
C	10.55883	3.531518	2.989885	0.0062
FITTED^2	0.281366	0.100681	2.794635	0.0098

R-squared	0.993729	Mean dependent var	6.590478
Adjusted R-squared	0.991973	S.D. dependent var	0.228381
S.E. of regression	0.020461	Akaike info criterion	-4.733378
Sum squared resid	0.010466	Schwarz criterion	-4.370588
Log likelihood	86.10073	Hannan-Quinn criter.	-4.611310
F-statistic	565.9606	Durbin-Watson stat	2.275815
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Coefficient Variance Decomposition

Sample: 1981 - 2013

Eigenvalues	0.122264	0.001192	0.000417	0.000127	7.17 E-05	1.43 E-05	2.45 E-07
Condition	2.00E-06	0.000205	0.000587	0.001933	0.003411	0.017145	1.000000

Variance Decomposition Proportions

Variable	1	2	3	4	5	6	7

LNRPGDP(-1)	0.986274	0.000455	0.001251	0.010826	0.001129	1.15 E-05	5.39 E-05
LNINF	7.45E-05	0.006755	0.021117	0.882755	0.000422	0.088332	0.000545
IT	0.046715	0.900728	0.003095	0.008748	0.039474	0.001239	2.72E-07
IT(-1)	0.115744	0.784135	0.052761	0.011307	0.035118	0.000935	1.96E-07
LNDCPS	0.335646	0.041304	0.542337	0.056089	0.008012	0.016565	4.70E-05
LNGDFCF	0.052358	0.065148	0.800465	0.018176	0.056310	0.007428	0.000114
C	0.999989	2.45E-07	1.80E-08	1.03E-05	5.61E-08	1.16E-07	3.13E-08

Eigenvectors

	Associated Eigenv alue						
Variable	1	2	3	4	5	6	7
LNRPGDP(-1)	0.155434	0.033819	-0.094814	-0.506095	0.217121	-0.049143	-0.812415
LNINF	0.000199	-0.019155	-0.057262	0.671837	-0.019511	-0.632904	-0.379528
IT	-0.016116	-0.716818	0.071045	0.216748	0.611637	0.242962	-0.027472
IT(-1)	-0.025723	0.678169	0.297440	0.249863	0.584970	0.213945	-0.023663
LNDCPS	-0.029082	0.103335	-0.633117	0.369467	-0.185501	0.597944	-0.243279
LNGDFCF	0.010489	-0.118514	0.702404	0.192065	-0.449092	0.365661	-0.346689
C	-0.986896	-0.004952	0.002265	-0.098472	0.009650	-0.031145	-0.123480

APPENDIX 3B: Stability and Diagnostic Tests for Model II **Breusch-Godfrey Serial Correlation LM Test:**

F-statistic	2.278737	Prob. F(2,26)	0.1225
Obs*R-squared	4.921762	Prob. Chi-Square(2)	0.0854

Method: ARDL
Sample: 1981 – 2013
Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
		0.038178		
C(1)	0.008175		0.214130	0.8321
C(2)	-0.006888	0.034265	-0.201034	0.8422
C(3)	0.021807	0.040168	0.542880	0.5918
C(4)	0.008562	0.014029	0.610289	0.5470
C(5)	-0.035690	0.063581	-0.561335	0.5794

RESID(-1)	0.448653	0.212102	2.115272	0.0441
RESID(-2)	-0.064570	0.213771	-0.302051	0.7650

R-squared	0.149144	Mean dependent var	4.07 E-15
Adjusted R-squared	-0.047207	S.D. dependent var	0.053944
S.E. of regression	0.055203	Akaike info criterion	-2.769768
Sum squared resid	0.079232	Schwarz criterion	-2.452327
Log likelihood	52.70117	Hannan-Quinn criter.	-2.662959
F-statistic	0.759579	Durbin-Watson stat	1.650670
Prob(F-statistic)	0.607965		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.030699	Prob. F(6,26)	0.4280
Obs*R-squared	6.340953	Prob. Chi-Square(6)	0.3861
Scaled explained SS	7.935656	Prob. Chi-Square(6)	0.2429

Method: ARDL
Sample: 1981 – 2013
Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004826	0.012897	-0.374170	0.7113
LNRPGDP(-1)	0.000900	0.002026	0.443952	0.6608
IT	-0.000186	0.000802	-0.231834	0.8185
IT(-1)	0.000851	0.000823	1.034525	0.3104
LNDCPS	-0.000200	0.000528	-0.377641	0.7088
LNGDFCF	-0.000145	0.000510	-0.284778	0.7781
LNGARCH01	3.60E-05	0.000206	0.174477	0.8628

R-squared	0.192150	Mean dependent var	0.000351
Adjusted R-squared	0.005723	S.D. dependent var	0.000716
S.E. of regression	0.000714	Akaike info criterion	-11.46651
Sum squared resid	1.32E-05	Schwarz criterion	-11.14907
Log likelihood	196.1974	Hannan-Quinn criter.	-11.35970
F-statistic	1.030699	Durbin-Watson stat	2.777479
Prob(F-statistic)	0.428041		

Ramsey RESET Test (Functional Form)

	Value	df	Probability
t-statistic	0.083855	25	0.9338
F-statistic	0.007032	(1, 25)	0.9338

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	3.26E-06	1	3.26E-06
Restricted SSR	0.011582	26	0.000445
Unrestricted SSR	0.011579	25	0.000463

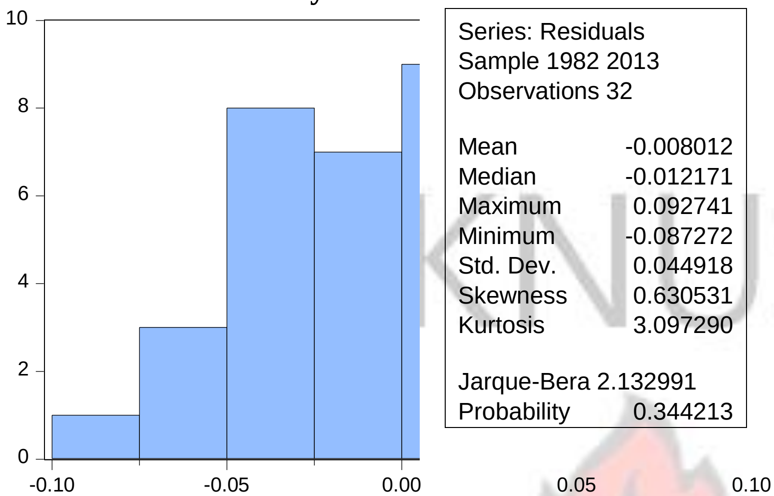
Dependent Variable: LNRP GDP
Method: ARDL
Sample: 1981 – 2013
Included observations: 33
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion
(AIC) Dynamic regressors (1 lag, automatic):
Fixed regressors: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRPGDP(-1)	0.573794	2.311465	0.248238	0.8060
IT	0.029092	0.121899	0.238660	0.8133
IT(-1)	0.020280	0.106713	0.190046	0.8508
LNDCPS	0.008851	0.027217	0.325209	0.7477
LNGDFCF	0.034402	0.130415	0.263786	0.7941
LNGARCH01	-0.012495	0.069512	-0.179747	0.8588
C	1.837395	5.754718	0.319285	0.7522
FITTED^2	0.019293	0.230076	0.083855	0.9338

R-squared	0.993062	Mean dependent var	6.590478
Adjusted R-squared	0.991120	S.D. dependent var	0.228381
S.E. of regression	0.021521	Akaike info criterion	-4.632333
Sum squared resid	0.011579	Schwarz criterion	-4.269543
Log likelihood	84.43349	Hannan-Quinn criter.	-4.510265
F-statistic	511.2242	Durbin-Watson stat	1.881332
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Multivariate Normality Test



Coefficient Variance Decomposition

Sample: 1980 – 2013
Included observations: 33

Eigenvalues	0.149218	0.001004	0.000347	0.000114	4.29 E-05	6.88 E-06	2.28 E-07
Condition	1.53E-06	0.000227	0.000658	0.002005	0.005315	0.033181	1.000000

Variance Decomposition Proportions

	Associated Eigenvalue						
Variable	1	2	3	4	5	6	7
LNRPGDP(-1)	0.996503	0.000114	0.001770	8.64 E-06	0.001328	0.000229	4.62 E-05 IT 0.029331
0.876761	0.005885	0.084684	0.002804	0.000534	4.01E-07		
IT(-1)	0.057367	0.811404	0.064358	0.063386	0.003041	0.000445	2.84E-07
LNDCPS	0.321256	0.064108	0.500318	0.043439	0.068549	0.002266	6.33E-05
LNGDFCF	0.094609	0.061557	0.776401	0.005601	0.061562	0.000135	0.000135
LNGARCH01	0.309332	0.003695	0.001822	0.448918	0.105193	0.130714	0.000325
C	0.999998	1.21E-07	5.37E-08	2.55E-07	7.98E-07	2.50E-07	2.62E-08

Eigenvectors

	Associated Eigenv alue						
Variable	1	2	3	4	5	6	7

			-0.135399	-0.016509			
LNRPGDP(-1)	0.154876	0.020233			0.333319	-0.345839	0.852228
IT	-0.010510	-0.700658	0.097653	-0.646599	0.191554	0.208954	0.031409
IT(-1)	-0.015092	0.692063	0.331576	-0.574371	0.204816	0.195676	0.027165
LNDCPS	-0.022934	0.124917	-0.593664	-0.305333	-0.624478	0.283663	0.260323
LNGDFCF	0.012013	-0.118148	0.713816	0.105827	-0.571214	0.066852	0.366619
LNGARCH01	0.008790	0.011713	0.013994	-0.383383	-0.302153	-0.841559	-0.230412
C	-0.987384	-0.004181	-0.004747	0.018039	0.051978	-0.072729	0.129289

APPENDIX 4 (GARCH (1, 1) Results)

RESULTS OF ESTIMATED GARCH (1, 1) MODEL

Dependent Variable: LNINF
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Sample: 1981 – 2013
Included observations: 33 after adjustments
Failure to improve likelihood (non-zero gradients) after 48 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

Variable	Coefficient Error	Std.	z-Statistic	Prob.
C	1.157863	0.179348	6.455965	0.0000
LNINF(-1)	0.572288	0.043616	13.12116	0.0000
	Variance Equation			
C	-0.007313	0.000145	-50.50277	0.0000
RESID(-1)^2	-0.236793	0.002139	-110.6895	0.0000
GARCH(-1)	1.188620	0.001609	738.6732	0.0000

R-squared	0.128903	Mean dependent var	3.079722
Adjusted R-squared	0.100803	S.D. dependent var	0.677907
S.E. of regression	0.642832	Akaike info criterion	1.658471
Sum squared resid	12.81021	Schwarz criterion -	1.885215
Log likelihood	22.36477	Hannan-Quinn criter.	1.734764
Durbin-Watson stat	2.281070		

APPENDIX 5 (Regression Results)

APPENDIX 5A: Regression Results for Model I

ARDL (OLS Estimation)

Dependent Variable: LNRPGDP
Method: ARDL
Sample (adjusted): 1980 – 2013
Included observations: 33 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): LNINF IT LNDCPS LNGDFCF
Fixed regressors: C
Number of models evalulated: 16
Selected Model: ARDL(1, 0, 1, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRPGDP(-1)	0.875017	0.054726	15.98901	0.0000
LNINF	-0.015052	0.008045	-1.870957	0.0726
IT	0.033673	0.026073	1.291508	0.2079
IT(-1)	0.035589	0.026437	1.346159	0.1899
LNDCPS	-0.003972	0.017552	-0.226297	0.8227
LNGDFCF	0.055215	0.016029	3.444832	0.0020
C	0.726936	0.345082	2.106561	0.0450

R-squared	0.991770	Mean dependent var	6.590478
Adjusted R-squared	0.989871	S.D. dependent var	0.228381
S.E. of regression	0.022985	Akaike info criterion	-4.522127
Sum squared resid	0.013736	Schwarz criterion	-4.204686
Log likelihood	81.61509	Hannan-Quinn criter.	-4.415317
F-statistic	522.2077	Durbin-Watson stat	1.837681
Prob(F-statistic)	0.000000		

ARDL Bounds Test

Sample: 1981 – 2013
Included observations: 33
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	6.703317	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Dependent Variable: D(LNRPGDP)
Method: Least square
Sample: 1981 – 2013
Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IT)	0.043362	0.033124	1.309087	0.2020
C	1.087403	0.470862	2.309386	0.0291
LNINF(-1)	-0.003020	0.010244	-0.294794	0.7705
IT(-1)	0.088705	0.027763	3.195113	0.0036
LNDCPS(-1)	0.015005	0.020737	0.723605	0.4758
LNGDFCF(-1)	0.044002	0.019988	2.201357	0.0368
LNRPGDP(-1)	-0.186477	0.076096	-2.450560	0.0213

R-squared	0.565974	Mean dependent var	0.018915
Adjusted R-squared	0.465815	S.D. dependent var	0.039476
S.E. of regression	0.028852	Akaike info criterion	-4.067424
Sum squared resid	0.021644	Schwarz criterion	-3.749983
Log likelihood	74.11249	Hannan-Quinn criter.	-3.960615
F-statistic	5.650715	Durbin-Watson stat	1.505412
Prob(F-statistic)	0.000727		

ARDL Co-integrating and Long Run Form

Dependent Variable: LNRPGDP
Selected Model: ARDL(1, 0, 1, 0, 0)
Sample: 1980 – 2013
Included observations: 33

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINF)	-0.015052	0.008045	-1.870957	0.0726
D(IT)	0.033673	0.026073	1.291508	0.2079
D(LNDCPS)	-0.003972	0.017552	-0.226297	0.8227
D(LNGDFCF)	0.055215	0.016029	3.444832	0.0020
Coint Eq (-1)	-0.124983	0.054726	-2.283783	0.0308

Cointeq = LNRPGDP - (-0.1204*LNINF + 0.5542 *IT - 0.038*LNDCPS + 0.4418*LNGDFCF + 5.8163)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINF	-0.120434	0.086623	-1.390315	0.1762
IT	0.554175	0.162697	3.406170	0.0022
LNDCPS	-0.031780	0.148847	-0.213509	0.8326
LNGDFCF	0.441785	0.249400	1.771393	0.0882
C	5.816292	0.384011	15.146158	0.0000

FM OLS RESULTS – ROBUST CHECK

Dependent Variable: LNRPGDP
Method: Fully Modified Least Squares (FMOLS)
Sample (adjusted): 1981 – 2013
Included observations: 33 after adjustments
Co-integrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINF	0.008654	0.028332	0.305449	0.7623
IT	0.321419	0.046042	6.980948	0.0000
LNDCPS	0.168086	0.050878	3.303721	0.0026
LNGDFCF	-0.001475	0.055770	-0.026453	0.9791
C	6.192362	0.145963	42.42426	0.0000

R-squared	0.883398	Mean dependent var	6.590478
Adjusted R-squared	0.866740	S.D. dependent var	0.228381
S.E. of regression	0.083370	Sum squared resid	0.194615

Long-run variance 0.006619

APPENDIX 5B: Regression Results for Model II ARDL OLS (Estimation)

Dependent Variable: LNRPGDP
Method: ARDL
Sample: 1981 - 2013
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): LNGARCH01 IT LNDCPS LNGDFCF
Fixed regressors: C
Number of models evalulated: 16
Selected model: ARDL (1, 0, 1, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRPGDP(-1)	0.767554	0.059931	12.80722	0.0000
LNGARCH01	-0.018300	0.006105	-2.997603	0.0059
IT	0.039111	0.023706	1.649824	0.1110
IT(-1)	0.028983	0.024340	1.190763	0.2445
LNDCPS	0.010701	0.015630	0.684665	0.4996
LNGDFCF	0.045261	0.015086	3.000134	0.0059
C	1.355937	0.381414	3.555028	0.0015

R-squared	0.993060	Mean dependent var	6.590478
Adjusted R-squared	0.991459	S.D. dependent var	0.228381
S.E. of regression	0.021106	Akaike info criterion	-4.692657
Sum squared resid	0.011582	Schwarz criterion	-4.375216
Log likelihood	84.42885	Hannan-Quinn criter.	-4.585848
F-statistic	620.1097	Durbin-Watson stat	1.867491
Prob(F-statistic)	0.000000		

ARDL Bounds Test

Sample: 1981 – 2013

Included observations: 32
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	7.497764	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

ARDL Co-integrating and Long Run Form

Test Equation:
Dependent Variable: D(LNRPGDP)
Method: Least Squares
Sample(adjusted): 1981 – 2013
Included observations: 32 after adjust ıents

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IT)	0.031459	0.030037	1.047343	0.3050
C	1.799741	0.585612	3.073267	0.0051
LNGARCH01(-1)	-0.038572	0.015272	-2.525662	0.0183
IT(-1)	0.070491	0.026829	2.627386	0.0145
LNDCPS(-1)	0.016769	0.018803	0.891811	0.3810
LNGDFCF(-1)	0.025239	0.019453	1.297409	0.2063
LNRPGDP(-1)	-0.296893	0.093474	-3.176213	0.0039

R-squared	0.602129	Mean dependent var	0.021521
Adjusted R-squared	0.506641	S.D. dependent var	0.037113
S.E. of regression	0.026068	Akaike info criterion	-4.265565
Sum squa0.6red resid	0.016989	Schwarz criterion	-3.944935
Log likelihood	75.24904	Hannan-Quinn criter.	-4.159285
F-statistic	6.305752	Durbin-Watson stat	1.873636
Prob(F-statistic)	0.000388		

Dependent Variable: LNRPGDP
Selected Model: ARDL(1, 0, 1, 0, 0)
Sample: 1981 – 2013
Included observations: 33

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGARCH01)	-0.018300	0.006105	-2.997603	0.0059
D(IT)	0.039111	0.023706	1.649824	0.1110
D(LNDCPS)	0.010701	0.015630	0.684665	0.4996
D(LNGDFCF)	0.045261	0.015086	3.000134	0.0059
CointEq(-1)	-0.232446	0.059931	-3.878528	0.0006

Cointeq = LNRPGDP - (-0.0787*LNGARCH 01 ++ 0.0460
0.2929*IT
*LNDCPS + 0.1947*LNGDFCF + 5.8334)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGARCH01	-0.078729	0.022713	-3.466285	0.0018
IT	0.292949	0.073656	3.977259	0.0005
LNDCPS	0.046038	0.061609	0.747263	0.4616
LNGDFCF	0.194718	0.091728	2.122786	0.0435
C	5.833353	0.166126	35.113961	0.0000

FMOLS RESULTS (ROBUST CHECK)

Dependent Variable: LNRPGDP
Method: Fully Modified Least Squares (FMOLS)
Sample(adjusted): 1982 – 2013
Included observations: 32 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IT	0.174494	0.028697	6.080556	0.0000
LNDCPS	0.121591	0.025860	4.701886	0.0001

LNGDFCF	0.010266	0.029418	0.348966	0.7298
LNGARCH01	-0.059065	0.009805	-6.024181	0.0000
C	6.194128	0.048117	128.7301	0.0000

R-squared	0.960819	Mean dependent var	6.594857
Adjusted R-squared	0.955015	S.D. dependent var	0.230623
S.E. of regression	0.048915	Sum squared resid	0.064601
Long-run variance	0.001750		