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Dollarization and Macroeconomic Instability in Ghana

By

George Tweneboah

A Doctoral Thesis Submitted in fulfilment of the requirements for the award of Doctor of Philosophy

The Graduate School of Business Administration

University of the Witwatersrand

Supervisor: Professor Paul Alagidede

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ABSTRACT

The liberalization of foreign exchange markets occasioned by the widespread acceptance of floating exchange rate systems brought about prevalent acceptance of foreign currency (usually U.S. dollars) in many developing and transition economies. Facing both domestic and foreign imbalances, a number of developing economies have embraced foreign currencies as a store of value (asset substitution), and in some instances as a medium of exchange for domestic transactions (currency substitution). This thesis examines dollarization/currency substitution, its impact on macroeconomic fundamentals, and the challenges it poses for effective formulation and transmission of monetary policy in Ghana. The entire thesis is organised into five empirical essays, each touching on a specific subject within the broad theme of dollarization and economic instability. The first essay explores the macroeconomic determinants of financial dollarization. The evidence establishes that exchange rate depreciation and financial development drive dollarization. Additionally depreciation of the domestic currency increases demand for foreign currencies, while a more developed financial sector tends to curtail dollarization. The second essay models a long-run money demand function for Ghana within the portfolio balance framework. The results indicate that, although foreign interest rates and expected exchange rates (either separately or jointly) are relevant elements in the money demand function, there evidence is more in support of capital mobility and not currency substitution. The third essay provides evidence on how financial dollarization affects the volatility of nominal and real Ghana cedi/U.S. dollar exchange rates. The study showed that the effect of financial dollarization on nominal exchange rate volatility in Ghana is positive, thus, as demand for U.S. dollars becomes more extensive, the cedi/dollar exchange rate becomes more volatile and unstable. The fourth essay investigates the role of dollarization in the dynamics of inflation and inflation uncertainty. Contrary to common logic, the results indicate that dollarization has not played a significant role in the dynamics of inflation volatility. The study posits that, although there is no significant impact of dollarization on inflation volatility, inflation targeting affects the inflation-inflation

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uncertainty relationship in Ghana. The last essay considers the effectiveness of monetary policy transmission in Ghana and examines whether the degree of dollarization hinders or facilitates that process by accounting for the role of the inflation targeting. The results show that credit and exchange rate channels dominate the transmission mechanism, with the former assuming a more significant role in the inflation targeting period. Moreover, the contribution of dollarization has diminished in the post-inflation targeting era, suggesting that monetary authorities have paid more attention to the effects of dollarization in the current monetary regime. A number of policy prescriptions arising from the thesis are presented to guide domestic authorities in smoothing the path of the instability in the economy.

Keywords: Dollarization, exchange rate, inflation, monetary policy, cointegration, multivariate GARCH, Ghana

JEL Classification: E41, F3, F21, F40, F41, O24, O53

DECLARATION

I, **George Tweneboah**, hereby declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in fulfilment of the requirements for the award of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.



George Tweneboah

Signed at ……

On the …….. day of …… 2016

DEDICATION

To the memory of my beloved late mother ~ Mary Afia Pokuaa

MESSAGE OF THANKS AND APPRECIATION

I extend my utmost appreciation to the Almighty God for providing me with healthy life and divine protection throughout my life and in the course of my PhD studentship. Like all other doctoral studies, the tasks undertaken in the process involved in the successful completion of this doctoral research benefited from the invaluable contribution of many characters than just the student. I feel profoundly indebted and eternally thankful to Professor Paul Alagidede for the supervision and direction he gave me during this journey. Your resolve to have faith in my capabilities has brought a lot of opportunities to me. May the Almighty richly shower His manifold blessings upon you and replenish all that you spent on my sojourn. I hope you will be very proud of this work. My profound thanks also encompass the words of encouragement and useful comments from Professors Kalu Ojah (Professor of Finance, Wits Business School), Eric Schaling (Professor and Jelle Zijlstra Chair of International Finance, Wits Business School), Christopher Malikane (Associate Professor of Economics, Wits School of Economics), and Nicholas Biekpe (Professor of Development Finance and Econometrics, Graduate School of Business, Cape Town). I am most grateful for the time you allocated out of your tiring schedules to make me who I am today. I sincerely appreciate the contribution of Dr Christopher Odongo Kodongo (Wits Business School), Professor Gregory John Lee, Dr George Adu (Kwame Nkrumah University of Science and Technology), Dr Anokye Mohammed Adam (University of Cape Coast), Dr Daniel Agyapong (University of Cape Coast), Dr Kolawole Ijasan (University of the Witwatersrand), Nana Kwame Akosah (Bank of Ghana), Kwabena Atakora (University of Education, Winneba), and Gilbert Kwabena Amoako (Kumasi Polytechnic). I also acknowledge the financial assistance offered by the University of the Witwatersrand, through the award of the Postgraduate Bursary and Bradlow Foundation PhD Scholarship. I say a big thanks to Mrs Mmabatho Leeuw and all administrative staff as well as colleague students at the Wits Business School. I am infinitely grateful to my wife (Rose) and children (Nana Osei, Owura Addae and Maame Pokuaa). I would not have been this far without your love, understanding, sacrifice, and

resilience. Finally, to all those who contributed in sundry ways towards my education up to this point whom I have not specifically mentioned here, I say a big THANKS to all of you. I respectfully request that the Almighty GOD continues to unleash His manifold blessings upon your lives.

The usual disclaimer applies.

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LIST OF ABBREVIATIONS

ABBREVIATION	MEANING
ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive Distributed Lag
ARMA	Autoregressive Moving Average
BOG	Bank of Ghana
CCR	Canonical Cointegrating Regression
CEPA	Centre for Economic Policy Analysis
CIEA	Composite Index of Economic Activity
CS	Currency Substitution
DF-GLS	Dickey-Fuller Generalized Least Squares
DOLS	Dynamic Ordinary Least Square
EGARCH	Exponential General Autoregressive Conditional Heteroskedasticity
ERP	Economic Recovery Programme
FCD	Foreign Currency Deposit
FEVD	Forecast Error Variance Decomposition
FINSAP	Financial Sector Adjustment Programme
FMOLS	Fully Modified Ordinary Least Squares
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
GOG	Government of Ghana
GPH	Geweke and Porter-Hudak
GSS	Ghana Statistical Service

HIPC	Heavily Indebted Poor Countries
HQIC	Hannan-Quinn Information Criterion
IMF	International Monetary Fund
IRF	Impulse Response Function
IT	Inflation Targeting
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
LBQ	Ljung-Box Q-statistics
MDRI	Multilateral Debt Relief Initiative
MGARCH	Multivariate Generalized Autoregressive Conditional Heteroskedasticity
MPFSD	Monetary Policy and Financial Stability Department
NEER	Nominal Effective Exchange Rate
REER	Real Effective Exchange Rate
SAP	Structural Adjustment Programme
SIC	Schwarz Information Criterion
SVAR	Structural Vector Autoregression
VAR	Vector Autoregression
VECM	Vector Error Correction Model
WDI	World Development Indicators

CHAPTER ONE

INTRODUCTION

1.1. Background to the study

Over the years, policies and initiatives of governments in Ghana have centred on creating a stable macroeconomic environment in order to boost economic growth and development. Despite some significant improvement in the macroeconomic fundamentals in the last few years, the Ghanaian economy continues to be characterised by relatively high and persistent inflation rates, continuous depreciation of its currency, unbridled recurrent budget deficits, and soaring public debt levels (Bawumia, 2014). Recent figures from the Bank of Ghana (BoG) and Ghana Statistical Service (GSS) have indicated that the inflation rate which dropped from 18.1 percent in 2008 to 12.5 percent in 2011 has increased steadily to 17.0 percent in October 2014 (GSS, 2014). Fiscal deficit and stock of public debt have seen dramatic increases reaching 10.8 and 55.5 share of Gross Domestic Product (GDP) respectively at the end of 2013 (Terkper, 2014). According to the Finance Minister, the stock of public debt stood at 60.8 percent of GDP at the end of September 2014.

Also, despite all the policies embarked upon by the Bank of Ghana and other policymaking fronts, the cumulative depreciation of the local currency, the Ghana cedi, against the major trading currencies reached almost 30 percent in the first half of 2014 (BoG, 2014). The monetary authorities have been searching for what has brought about this level of instability in the economy. A lot of questions have been raised about the effectiveness of policies and the way forward for attenuating this situation. Both the World Bank and the International Monetary

Fund have expressed a worrying response about the deteriorating macroeconomic fundamentals and the challenges engulfing the lower middle income country.[1]

One issue that has trapped the attention of the monetary authorities and policymakers in Ghana is the growing dollarization in the economy. The phenomenon has become a notable feature of financial development under fragile macroeconomic conditions, and emerged as vital in explaining the vulnerabilities and currency crises, experienced in parts of Latin America, Asia, and Eastern Europe (Mecagni et al., 2015). The extent of the phenomenon has become one of the most challenging issues bothering monetary authorities and policymakers. This is because of the risks and costs it presents to macroeconomic management. The extent of dollarization points out that currency and/or asset substitution exist in the country such that economic agents swap domestic and foreign currencies, which makes the control of liquidity much difficult. Whilst there have been findings to support that a fully dollarized economy does not suffer considerably from currency fluctuations (see Mengesha & Holmes, 2013), others have argued strongly that it poses crucial challenges for policymaking since exchange rate possibly responds to money demand fluctuations (for example, Mizzen & Pentecost, 1996; Chang, 2000; Galindo, Izquierdo, & Montero, 2005; Erasmus, Leichter, & Menkulasi, 2009). The extant body of knowledge is replete with fresh evidence; however, much focus has been given to Latin American countries such as Ecuador and Argentina that experienced currency crises in the 1980s and 1990s.

Although there are some benefits, the rising trend of dollarization may present dreadful consequences for macroeconomic management and as such exploring its evolution and resulting impacts on the economy is not only academically important but also of policy significance. A comprehensive analysis of the extent of dollarization is important in evaluating exchange rate

[1]Ghana has undertaken a bailout programme (through the extended credit facility) with the IMF. This aimed at ensuring stability of the cedi and to further give much credibility to its "*home-grown*" policies.

choices and monetary policy regime. This is because high levels of dollarization can undermine the effectiveness of policy formulation and implementation. The study is particularly relevant for emerging economies that abandoned the fixed exchange rate system and switched to flexible regimes. Although many countries in sub-Saharan Africa that moved to flexible exchange rate regimes as part of liberalization policies embarked upon in the 1980s have experienced high degrees of foreign currencies in their economies, it seems baffling that the empirical dimension on the determinants and policy implications of dollarization remains very scanty.

An improvement in our knowledge on the behaviour of demand for money in a dollarized economy where other currencies circulate is very significant for macroeconomic thinking and policymaking. The argument that there is high risk of exposure to currency and financial crises in dollarized countries will be explored. Accordingly, financial dollarization which is argued to be closely linked to exchange rate policy and financial stability will be investigated to unravel the threats it poses to macroeconomic balance. This becomes particularly relevant for the Ghanaian economy that has been characterized by untamed fiscal deficits, high rates of inflation, and leaning towards fuller liberalization of its capital accounts.

Based on our findings and drawing from experiences of other countries around the world, the study shall prescribe specific policy options. The intention is to present some explanation on the extent of dollarization in Ghana and possible policy options that may be adopted by the authorities to attenuate the prevalence of dollarization in Ghana and its potential benefits or harmful implications for macroeconomic management.

1.2. Magnitude of dollarization in Ghana

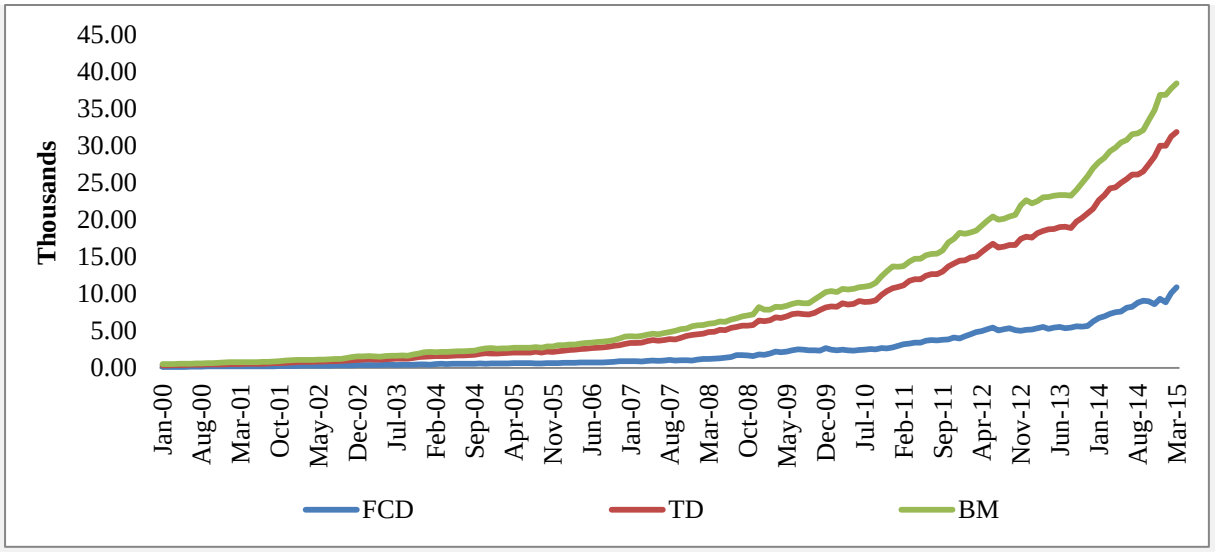
We explore the extent or magnitude of demand for foreign currency with two measures of unofficial financial dollarization. As asset substitution, we define it as the ratio of foreign

currency denominated deposits to total deposits in the domestic banking system. Total deposit is the sum of foreign currency deposits and local currency deposits (DR1). Another standard measure that has been widely applied in the literature is defined as the proportion of foreign currency to broad money supply (in the case of Ghana, M2+). The International Monetary Fund (IMF) defines the monetary aggregate, M2+ as the sum of M1 and foreign currency deposits.[2] This second proxy for dollarization (that is, the ratio of foreign currency to broad money) is denoted DR2. Although normalizing the foreign currency deposits with broad money tends to underestimate the relative weight of foreign currency in the banking system as it includes the local currency in circulation, we include it to enable us make comparisons[3]. In Figure 1.1, graphs of foreign currency deposit (FCD), total deposits (TD), and broad money (BM) in millions of Ghana cedi (GH₵) are presented. It can be observed that the use of foreign currency deposit in the banking sector has been on a rising trend reaching its highest of GH₵10,868 million in March 2015 from as low as GH₵96.90 million in January 2000. Although the month-to-month growth rates have witnessed some ups and downs, it can be argued that there have been few declines. Aside this, variations in the domestic currency value of foreign currency attributable to exchange rate variations has been exposed.

[2] Broad money (M2+) = M2 + FX Deposits, where M1= Currency in Circulation + Demand Deposits and M2= M1 + Time Deposits

[3] Our measure of dollarization does not involve the estimated foreign currency in circulation because there is no data on that in Ghana. This is not surprising because that has been established for other developing countries. Also, due to the same challenge we are not considering the extent of *liability* or *real* dollarization.

Figure 1.1: Trend of FCD, total deposit, and broad money (millions of GH¢)



In Figure 1.2 are plots of the growth rate (percentage change) of broad money, total deposit, and foreign currency deposits in Ghana for the period 2000:1 to 2015:3. As may be observed from the graph, there are many episodes of changes in the growth rate associated with the domestic currency value of FCD. Since the foreign currency deposit figures were converted to their domestic currency equivalent by multiplying by the respective exchange rates, it could as well be argued that dollarization ratios during the period have been influenced by both the actual dollar deposits in the banking system and the valuation effects resulting from the exchange rate movements. It can be said that, the movement has not followed a month-to-month increasing trend but the cumulative effect has been a higher current figures in recent years compared to earlier figures. For instance, we witness a number of declines some exceeding negative 10 percent such as for the months January 2004 (-11.56 percent) and 7.97 percent decline in January 2010. Notwithstanding such declines, the persistent increases in foreign currency deposits in the subsequent months have always cancelled such major reductions. For example, after the figure has reduced by 11.56 percent from GH¢457.60 million in December 2003 to GH¢404.70 million in January 2004, it again increased to GH¢496.70 million in February 2004 representing a growth

of 22.73 percent. Other high growth rates have been a 17.19 percent, 15.33 percent, and 13.76 percent growth rates in August 2008, December 2009, and February 2015 respectively. Consistent with the observation made by Kessy (2011) for Tanzania, the graph depicts that there are many episodes of changes in the growth rate of dollar value of FCD which are associated with much larger changes in the growth rate of domestic currency value of FCD. In a study for Tanzania, Kessy (2011) argues that, "*this suggests that dollarization ratios have been influenced by both the actual dollar deposits in the banking system and the valuation effects resulting from the exchange rate movements*". This supports the argument that, depreciation of the domestic currency may have an effect on the domestic currency value of dollar denominated assets even if there is no change in the dollar value of those assets.

Figure 1.2: Trend in the growth of foreign currency deposit, total deposit, and broad money

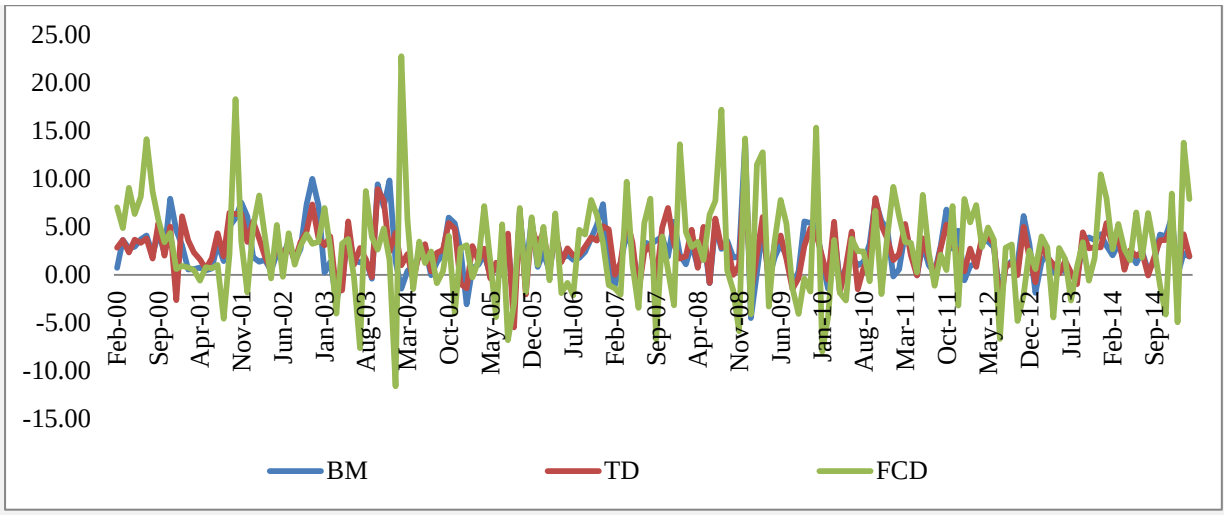
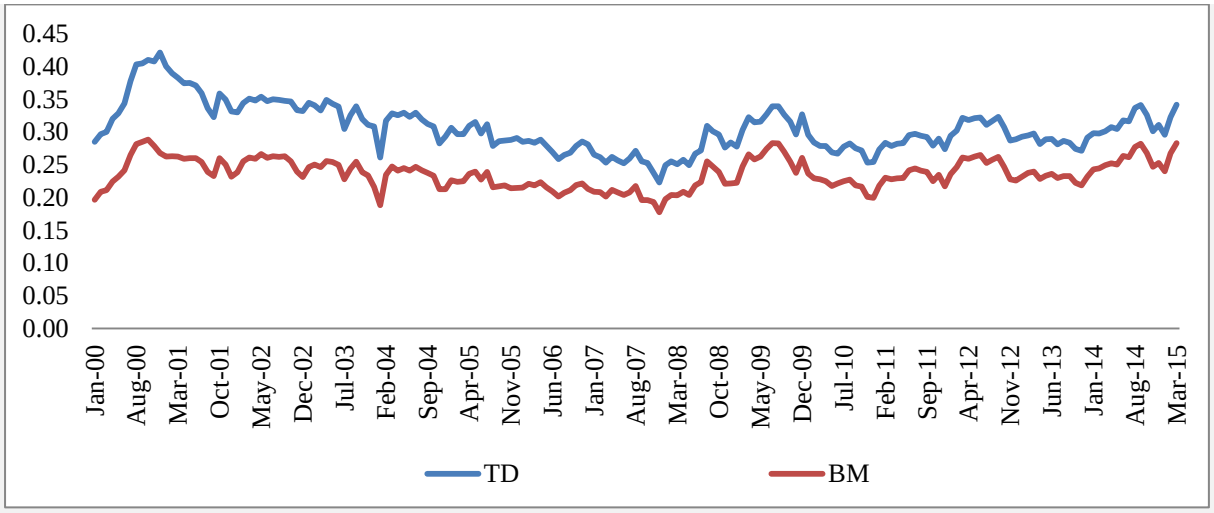


Figure 1.3 indicates that the share of foreign currency deposit (expressed in domestic currency) to total deposit and broad money have followed similar patterns except that the ratio has been high for total deposit. A cursory glance at the figures for total deposits indicates a continuous growth baring few instances of minor monthly declines. From as low as GH¢339.74 million total

deposits in January 2000 the figure has seen a dramatic rise to GH¢31,812.00 million in March 2015. This represents 28.53 percent and 34.16 percent of BM and TD, respectively. Comparing FCD to TD, we find that FCD has composed on the average 30.65 percent of TD. The lowest share of FCD was 22.32 percent in December 2007 and the highest share was 42.13 percent in December 2000. It is again detected that, the share of FCD in TD has stayed above 30 percent in most instances in recent years (see Figure 1.3 below). Also, the average proportion of FCD in BM has been 23.68 percent over the period. The least percentage of FCD in BM was recorded as 17.75 percent in December 2007, whereas the highest proportion has been 28.83 percent for October 2000. In March 2015, FCD was 28.31 percent of BM.

Undoubtedly, these figures represent dramatic increases over the period under review. The figures indicate that there have been sizable and persistent growth rates in FCD. This indicates the important role of FCD in domestic banking transactions, which could be attributed to the high degree of openness of the Ghanaian economy, higher integration with the rest of the world, or persistent loss of confidence in the domestic currency as a store of value, also partly due to high rates of inflation or persistent depreciation of the local currency.

Figure 1.3: Trends in share of foreign currency deposit in total deposits and broad money



1.3. Statement of the research problem

Macroeconomic stability has continued to be at the centre of policymaking due to the importance attached to it and the conundrums it presents to monetary authorities and policymakers. Stabilization policies have been initiated and targets have always been fixed in budget statements of governments in Ghana but out turns usually tend to deviate markedly from the targets. Policy directions have continuously shifted mostly in response to the dynamics in macroeconomic fundamentals. Although some achievements have been chalked under one programme/policy or the other, macroeconomic indicators still appear very difficult to control. The challenges associated with this are largely, if not wholly, attributable to the limited knowledge of policy makers or their poor understanding of the behaviour of some parameters driving the pillars of macroeconomic instability in Ghana.

Like most other sub-Saharan African countries, Ghana – which was characterized by protracted instances of macroeconomic instability, conflicts, and social turmoil – has seen significant improvements in recent years. Some of the ills associated with the macroeconomic and financial landscape in the country, although not fully exterminated, have somehow diminished. Governance systems and state institutions have seen some improvement, as well as major enhancements in budgetary and monetary policies which are making them seemingly more sustainable. Although Ghana's financial system has remained underdeveloped, there has been some improvement in financial deepening following the financial sector adjustment programme (FINSAP) embarked upon in the late 1980s. These developments have exposed the financial landscape to some important risks such as dollarization/currency substitution. The increasing trend at which Ghanaians hold deposits and credits denominated in foreign currency – notably the U.S. dollar – has generated a lot of controversy in macroeconomic discourse recently. This experience is similar to what compelled some emerging economies to officially adopt foreign currencies. Although the issue has become widespread in sub-Saharan Africa, to the extent that

Zimbabwe has officially substituted its currency, a large body of the extant literature has focused on Latin American countries[4]. These previous studies that sought to provide answers to some of the questions on the subject have at best reported contradictory findings. The question of whether dollarization should be encouraged or restricted is still not conclusive. Whether the increasing trend of dollarization in transition economies is due to institutional reforms, financial development, and/or weakened macroeconomic fundamentals, has remained an elusive empirical quest. This makes the subject open for further research advances.

A focus on Ghana is very interesting because the subject has generated an on-going debate on both economic and political platforms. Nonetheless, not much empirical research has been advanced to find solutions to the possible challenges associated with it. It is not an exaggeration to state that research on the actual consequences of the phenomenon on macroeconomic stability remains one of the less explored areas in Africa. To the best of our knowledge, no study focuses on the issue of dollarization in the Ghanaian context. The scantiness of published academic work and the limited range of empirical techniques employed can be confirmed by a quick check of the existing literature. The consequence of this situation is that, macroeconomic policy making in Ghana and the African continent as a whole has not benefited significantly from scientific knowledge on the evolution and the costs associated with dollarization.

The non-existence of empirical research on the Ghanaian economy has left important gaps in the empirical and theoretical literature that merits the attention of academia and policymakers. This situation engenders the application of modern advances in econometric techniques to unravel some of the questions hanging on the neck of monetary authorities in Ghana. The lack of

[4] Some of the studies are Ortiz (1983), Canto (1985), Ramirez-Rojas (1985), Marquez (1987), Melvin (1988), Agenor and Khan (1992), Clements and Schwartz (1992), Rojas-Suarez (1992), and Savastano (1992). See reviews by Calvo and Vegh (1992), and Giovannini and Turtelboom (1994) for complete references.

empirical evidence to guide policy direction strengthens the statement of the problem and sets the pitch for this study. A focus on Ghana is extremely justified because Ghana is one of only two countries in Africa (aside South Africa) that have adopted full-fledged inflation targeting as a monetary policy framework. An understanding of how this inflation targeting monetary policy would function in a dollarized economy is very significant. This study seeks to cover important gaps in the literature by providing answers to some questions and enable us to draw implications and policy options for macroeconomic policymaking against the backdrop of rising dollarizing effect.

1.4. Motivation and purpose of the thesis

Given the wide range of issues on the roots, the risks, and the costs associated with dollarization, this proposed thesis is narrowed to focus on the extent of dollarization in Ghana and its consequences on macroeconomic stability. This research investigates the evolution of dollarization and its implications for macroeconomic stability in Ghana. The study seeks to unzip knowledge on imperative aspects of dollarization that have dodged macroeconomic policy and debate in Ghana for so many years. Specifically, the thesis seeks to achieve the following objectives:

1. To evaluate the major drivers of dollarization in Ghana. This objective seeks to explore the major macroeconomic drivers of the evolution of dollarization in Ghana. The study shall explore the interactions of the degree of dollarization with its major drivers within a cointegration framework.
2. To establish whether there is evidence of currency substitution in Ghana. This explores the effects of dollarization on stability of money demand function in Ghana within a framework that distinguishes capital mobility and currency substitution.
3. To investigate the impacts of dollarization on macroeconomic performance. Since macroeconomic instability can take the form of *volatility* or *unsustainability* in the behaviour of

some key macroeconomic variables, the study shall establish the contribution of rising dollarization to the behaviour of exchange rates, interest rates and inflation (see, Montiel & Serven, 2004).

4. To examine how monetary policy can function as an effective tool for macroeconomic stability in a dollarized economy. The study shall consider the effects of dollarization on monetary policy formulation and implementation. It shall also investigate whether monetary policy can be used to curb the macroeconomic effects of dollarization. In effect, this chapter shall ascertain the extent to which the effectiveness of inflation targeting monetary policy can be enhanced in a dollarized economy.

1.5. Research questions

The thesis seeks to provide answers to the following questions that relate to the macroeconomic determinants of dollarization and the costs associated with that of Ghana:

1. What are the major drivers/determinants of dollarization in Ghana?
2. Is there evidence of currency substitution in Ghana?
3. To what extent has dollarization impacted on macroeconomic performance?
4. How can monetary policy function as an effective tool for macroeconomic stability in a dollarized economy?

1.6. Significance and contribution to knowledge

The issue of dollarization has become very widespread in emerging economies in the past few decades due to the extensive switch to floating exchange rates and the subsequent removal of capital controls which came with the economic liberalization adopted in most developing countries. A number of questions that require the attention of further research and empirical advances on dollarization and its implications for macroeconomic stability in Africa and other emerging markets remain less explored, and has left important gaps in the literature. The ability

to provide such answers would equip economic policymakers with the requisite knowledge and understanding to be able to implement appropriate policy choices.

Attaining this greater understanding of the dynamic interrelationships between dollarization/currency substitution and macroeconomic variables in Ghana is very crucial to the sustainable growth and development of developing economies, albeit not much empirical research has been conducted to provide options for economic authorities. Considering the historical developments and peculiarity of the Ghanaian economy, it is important for the authorities to harness the necessary efforts to consolidate the achievements chalked thus far. Consequently, the thesis is a significant contribution to the knowledge on the subject in the beleaguered West African country.

Most prominently, the econometric models employed in this work constitute a significant methodological contribution to the literature on dollarization and macroeconomic instability in Africa. In addition to that, the following noteworthy contributions have been made to the empirical literature. First, by ascertaining the macroeconomic factors that drive the widespread dollarization in the Ghanaian economy, we provide a powerful tool to curtail the phenomenon and ensure macroeconomic stability. Second, we provide evidence on the relevance of developments in foreign interest rates and expected exchange rates in the money demand model in Ghana. Third, by determining whether dollarization is the precursor of the incessant depreciation of the domestic currency or otherwise, we seek to bring to rest the on-going hullabaloo surrounding the subject. Fourth, a greater understanding of the effect of dollarization on price developments in Ghana would benefit households, firms, and policymakers alike. Fifth, monetary authorities would benefit immensely from the findings of the effects of dollarization on the effectiveness of monetary policy transmission in Ghana. Taking a clue from the most recent case of full dollarization in Zimbabwe, the study will make a great contribution

particularly because Ghana occupies a special space in that it is dollarized and at the same time practising inflation targeting policy framework which only one African country (South Africa) is using. Finally, it is hoped that other researchers with focus on Africa would take inspiration from this great stride to explore further on the subject matter.

1.6. Structure of the thesis

The entire thesis report is divided into eight (8) chapters. The remainder of the thesis is organised as follows. Chapter Two is a review of the literature on dollarization and macroeconomic instability. It provides a survey of the conceptual definitions, the types, and measures of dollarization or currency substitution as applied in the extant literature. It also presents a review of the existing theory and empirics on the determinants and effects of financial dollarization. The next five chapters cover standalone essays on five different empirical quests. The last chapter covers the conclusions, policy implications, and recommendations proffered based on the findings of the study. It recapitulates salient findings of the research and highlights the evident policy options, in addition to pointing out areas of future research opportunities on the subject.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter covers a brief review of the extant literature on dollarization/currency substitution, its determinants, and effects on the macroeconomic performance. It is organized as follows. Section 2.2 provides a survey of the conceptual definitions, the types, and measures of dollarization/currency substitution as applied in the extant literature. Section 2.3 presents a review of the theory and empirics on the drivers or determinants of financial dollarization. Section 2.4 discusses the effects of dollarization on inflation and exchange rates, as well as the costs and benefits associated with the concept. Section 2.5 covers monetary policy as a tool for macroeconomic stability. Section 2.6 summarizes some empirical evidence from Ghana and section 2.7 concludes.

2.2. Conceptual definitions, types, and measurement of dollarization

2.2.1. Definition and types

The traditional uses of money have been to function as a unit of account, as a store of value or as a medium of exchange or transaction. The purpose for which a particular currency is used depends on the confidence economic agents build in that currency. The persistent rise in the cost of holding a particular currency usually due to high inflation rate and high rate of depreciation leads to loss of confidence in that currency. When this happens, it becomes indispensable for economic agents to protect the worth of their assets by replacing their local currency with another currency for some or all the functions of money (Calvo & Vegh, 1992). Different terminologies have been assigned in the literature to different scenarios depending on the degree of substitution by the foreign currency. The two terminologies, *currency substitution* and

dollarization, have been used for different meanings or sometimes interchangeably depending on what function of money the foreign currency performs in the domestic economy.

Another definition of dollarization is given by Savastano (1996) as the substitution of domestic currency. In general, one can argue that, dollarization and currency substitution have somewhat alternative meanings in the literature. Calvo and Vegh (1992) slightly distinguish between the terminologies by describing currency substitution as transfer of transaction function of local currency, whereas dollarization is described as transfer of the other functions of money. On the other hand, Mueller (1994) suggests a contrasting definition in which currency substitution and dollarization describe the case where demand for foreign money is *reversible* and *non-reversible*, respectively.

Regardless of what term is used to describe it, the phenomenon can hold crucial implications for economic modelling and policy analysis. Whenever a foreign currency performs any of the three traditional functions of money, the words are used as transposable in the extant literature. On the other hand, when the actual function being performed by the foreign currency is considered, they become quite differentiated or distinguished. Quite clearly, dollarization is a process and as to whether an economy is described as *partially* dollarized or *fully* dollarized also depends on the function of money a foreign currency provides in the economy.

When the preference for foreign currency has been to function as a store of value, economic agents do so with the intent to preserve their wealth as the domestic currency persistently loses its economic value or worth as a result of high rates of depreciation and/or inflation which leads to erosion of purchasing power of the local currency against other trading currency (Calvo & Vegh, 1992). For economic agents to achieve this, they hold banknotes of foreign currency; hold foreign currency accounts in the domestic banks or hold foreign accounts with foreign

currencies or invest in foreign bonds. This stage where the preference for holding foreign currency is to serve a store-of-value function begins a process is known as *partial dollarization* (Ferrer, 2003).

When the foreign currency is freely in circulation, private sector financial accounts begin to be maintained in foreign denomination and goods and services begin to be indexed in the foreign denomination. When this happens, the domestic currency gradually sheds its function of serving as a unit of account. As this continues, it necessitates a gradual undemanding acceptability of the foreign currency as medium for payments of goods and services. Usually when goods and services are indexed to the foreign currency, the domestic currency gradually loses its property of general acceptability or medium of exchange function. When this situation occurs, the process is termed *full dollarization* or *currency substitution*. This simply indicates that, currency substitution is used when domestic currency is fully replaced or substituted with a foreign currency to serve all its functions including as a medium of transaction. Currency substitution then becomes the final stage of the process of dollarization.

McKinnon (1985) argues that, as the store of value is closely linked to international capital mobility, discussions about the theory of currency substitution brings out discussions about the money demand framework in an economy where multiple currencies circulate. Another distinction has been drawn between *asset substitution* and *currency substitution* also based on the extent of the switch between currencies. According to the argument of Sahay and Vegh (1995), currency substitution relates to using foreign currency as a medium of payment, whereas asset substitution or financial dollarization has the foreign denomination performing the function of storing wealth.

The process can be described as being *official* (*de jure*) or *unofficial* (*de facto*). It is termed "*official"* when the foreign currency has been adopted as a legal tender and as *"unofficial"* when both currencies are used together with the domestic currency maintaining its status as the exclusive legal tender. This makes *currency substitution* or *full dollarization* the highest stage of dollarization. *Official dollarization* (or currency substitution) entails the authorized complete replacement of the domestic currency with foreign notes and coins. Another important understanding in the literature rests on the words *substitution* and *substitutability*. According to Komarek and Melecky (2001), the words are not the same. Substitution refers to the potential for partial replacement of a currency and its dimension, whereas substitutability is the ability to use foreign money as a medium of transaction or at least as unit of account. It follows to argue that, when it becomes more customary for economic agents to use foreign denominations in exchange, the potential to substitute foreign notes is larger. Similarly, it can depend on how long people have used different currencies in account transactions. In the description of Calvo and Vegh (1992), currency substitution occurs when different currencies serve as a medium of transaction. McKinnon (1985) also distinguishes between *direct* and *indirect* substitution. Whereas the direct involves when two or more currencies compete as a means of payment within the same economy, the indirect is used when investors switch between securities in domestic and foreign denominations.

On the basis of money and its functions, another classification was put up by De Nicolo, Honohan, and Ize (2005) as *financial* dollarization, *real* dollarization and *transaction* dollarization. Financial dollarization (or asset substitution) is when domestic investors hold financial assets or liabilities in foreign denomination. The authors refer to the indexation of local wages and prices in foreign denomination as real dollarization whereas transaction dollarization occurs when foreign notes and coins serve as medium of exchange or payment.

A similar distinctive classification has been provided by Ize and Parrado (2002). They give three types of dollarization in the economy as *financial* dollarization, *real* dollarization and *payments* dollarization. Financial dollarization, also called asset substitution by De Nicolo et al. (2005) involves foreign currency being used by financial intermediaries as deposits and loans. According to them, the use of foreign currency to index prices, wages, and real contracts in the economy is real dollarization. As already defined by De Nicolo et al. (2005), payments dollarization and currency substitution refer to foreign currency performing as a medium of transaction or exchange.

2.2.2. Measures of dollarization/currency substitution

The literature is replete with different measures of dollarization although it is difficult to quantify some hampered by unavailability of time series data. Financial dollarization has been broadly defined to capture both deposit and liability dollarization. Deposit dollarization is generally defined in nominal terms as FCD relative to broad money. Although this measure of deposit dollarization has been questioned for neglecting other forms of dollarization that can exist in the economy, it continues to be widely used as the standard measure of dollarization by the IMF and other studies that focus on deposit dollarization. Some studies that employ this measure include Clements and Schwartz (1993), Agenor and Khan (1996), Akçay, Alper, and Karasulu (1997), Balino, Bennett, and Borensztein (1999), Komarek and Melecky (2001), Viseth (2001), and Yinusa (2008). Another measure of deposit dollarization considers the proportion of FCDs in total deposits in the banking sector. Studies by Levy-Yeyati (2006), Rennhack and Nozaki (2006) and De Nicolo et al. (2005) relied on this measure rather than broad money. A major drawback of these measures is that they consider only onshore dollar deposits and fail to incorporate offshore dollar deposits.

Since deposit dollarization captures only one side of the balance sheet, liability dollarization has also been used in the literature as foreign currency loans (FCLs) issued by the domestic banking sector either to domestic firms and households or to foreign institutions. Reinhart, Rogoff, and Savastano (2003) define a partially dollarized economy as one where households and firms hold a fraction of their portfolio in foreign currency assets and/or where the private and public sector have debts denominated in foreign currency. Different measures have been constructed under this type. In a study by Fuentes (2009), the share of firms' dollar denominated debt in firms' total assets was employed in analysing the causes and effects of dollarization on Chilean firms at micro level. Another study by Honig (2009) to identify the determinants of dollarization uses the sum of firm liabilities and bank liabilities as a measure of dollarization.

Another form of liability dollarization occurs when the right to borrow abroad in your own currency and the right to borrow in local currency at long maturities and fixed rates are denied. This has been referred to as "Original Sin" by Eichengreen and Hausmann (1999). The phrase has been used in the literature to refer to the inability to borrow long-term in domestic currency (even within the domestic market) or to borrow internationally (even short-term) in domestic currency. The Original Sin index was developed by Hausmann, Panizza, and Stein (2001) and Hausmann and Panizza (2003) based on the extent of liabilities contracted in foreign currencies.

Reinhart et al. (2003) also constructed the composite index which combines both deposit and liability dollarization. The index covers the ratios of foreign currency deposits to broad money, total external debt to Gross Domestic Product, and domestic government debt denominated in foreign currencies to total domestic government debt. While the original sin index is useful only in capturing the liability dollarization, the composite index puts emphasis on dollar loans issued to the government without including the dollar loans issued to the private sector.

A recent study by Mengesha and Holmes (2011) develop a new index of dollarization that intends to measure the overall dollarization [see Mengesha and Holmes (2013) for application to the Eritrean economy]. The study adopts a holistic approach to measuring the dollarization based on the incorporation of all major forms of dollarization that exist in the Eritrean economy. The index includes financial dollarization and liability dollarization. Most importantly, it also captures the extent of dollarization in the black market economy.

An attempt to construct a measure of dollarization requires an answer to the vital question of what role the foreign currency assumes in the economy. Whether the foreign currency only takes the store of value function, the unit of account function, or the means of payment function hold different implications for policymaking. However, it remains a tedious task to determine the amount of foreign currencies circulating in the economy and foreign currency loans and deposits in offshore accounts. It is also challenging to capture the extent to which prices and wages are denominated in foreign currency.

2.3. Drivers of dollarization/currency substitution

The empirical literature on dollarization or currency substitution has focused on different strands such as drivers/determinants, benefits/effects, and strategies to de-dollarize. Several explanations have been offered for the persistent rate of financial dollarization phenomenon in transition and emerging economies. De Nicolo et al. (2003) and Levy-Yeyati (2006) have provided a summary of the major drivers/determinants under the currency substitution theory, the portfolio theory, the market failure theory, and the institutional theory.

2.3.1. The Currency Substitution Theory

This theory explains financial dollarization or asset substitution based on the consequences of high and variable inflation rate and currency depreciation. It posits that, countries characterized

by those features exhibit a high opportunity cost of holding the domestic currency, thereby inducing economic agents to find confidence in foreign currencies as a store of value and sometimes as a medium of transaction[5]. This view propounds a negative relationship between the demand for domestic currency and inflation. The theory requires economic agents to hedge against the risks associated with the erosion of purchasing power occasioned by the weakening macroeconomic fundamentals (that is, high rates of inflation and exchange rate fluctuations).

The ratio between local and foreign currency nominal balances, *c*, as a function of the nominal interest rates in each currency, yields $c = f(i, i^*)$, with $f' < 0, f' > 0$, where i and i^* are the domestic and foreign interest rates, respectively.

Assuming interest rate parity,

$$i = i^* + E(\Delta e) \tag{2.1}$$

where $E(\Delta e)$ denotes the expected rate of depreciation), then

$$c = f(i^*, E(\Delta e)) \tag{2.2}$$

Thus, as much as inflation is eventually reflects in the nominal exchange rate, expected inflation is predicted to induce currency substitution.

According to Savastano (1996), this postulates that economic agents maintain long-lasting memories of past inflation that induces high inflation expectations even after years of price stability. Again, it argues that monetary policy lacks credibility to achieve and sustain stable prices and currencies. As contended by Guidotti and Rodriguez (1992), since long period of inflation and depreciation have been cited as the justification for the switch to foreign currency, then a similarly long period of currency stability is necessary to reverse the process once it occurs.

[5] See Sahay and Vegh (1996); Savastano (1996); Balino et al. (1999); De Nicolo et al., (2005) for details.

The main thrust of the currency substitution view is that, movements in prices and/or exchange rate depreciation lead to loss in the real value of financial assets, which increases the motivation to hold assets in foreign currency if economic agents expect any of those to occur. The importance of the relative volatility of inflation and exchange rate has been highlighted by a number of recent studies [for example, Ize & Levy-Yeyati (2003, 2005]. Kokenyne, Ley, and Veyrune (2010) find a positive link between real exchange rate and deposit dollarization. Also, the study reports a negative effect of exchange rate volatility on foreign currency deposits as well as foreign currency credits.

Some empirical studies that find exchange rate volatility as a significant determinant of dollarization includes Arteta (2002), Kesriyeli, Ozmen, and Yigit (2011), Yinusa (2008), among others. Arteta (2002) assembled unbalanced monthly panel dataset for 92 developing and transition economies covering 1975 to 2000. The author used different definitions for credit and deposit dollarization. Whereas the first scaled foreign-currency deposits and credit by total deposits and total credit, respectively; the second scaled foreign-currency credit and deposits by total assets and total liabilities, respectively. Based on the credit and deposit dollarization ratios, the deposit-credit mismatch ratio was also measured as the difference between foreign currency deposits and foreign currency credit divided by total bank liabilities. The results indicate that deposit dollarization significantly increases and currency mismatches are more severe in financial intermediation following the adoption of a flexible exchange rate regime.

Kesriyeli et al. (2011) investigate the causes and consequences of non-financial corporate sector liability dollarization in Turkey using sector-level disaggregated annual data compiled by the Central Bank of the Republic of Turkey for the period of 1992 – 2003. The evidence suggests that, an increase in the real exchange rate (real appreciation) encourages liability dollarization potentially because it decreases the real cost of foreign-currency debt in terms of domestic

currency, which can lead to borrowing from abroad. This finding strongly supports that the structure and currency composition of balance sheets of the main sectors in an economy may substantially matter as suggested by wide and a growing body of the recent theoretical and empirical literature.

Yinusa (2008) examines currency substitution in Nigeria using quarterly data for 1986 to the second quarter of 2005. According to the author, this period covers the entire period of liberalization which witnessed the emergence of dollarization in the economy. The variables used in the model included the expected change in exchange rate, domestic policy interest rate, demand for domestic money, GDP, the consumer price index, Federal Funds rate (proxy for foreign interest rate), and a measure of exchange rate volatility. A measure of currency substitution index was defined as FCD as a ratio of M2 (less domestic currency in circulation). The results highlight the relevance of exchange rates to the currency substitution process, implying that the more volatile naira/dollar exchange rate becomes the more Nigerians switch to holding foreign currency for store of value purposes.

Honohan (2007), using 121 countries for the period 1993 to 2004, contends that a depreciation of the domestic currency reinforces dollarization due to agents' expectations about the path of the exchange rate. However, the study documents a too trivial response of dollarization to exchange rate changes. This provides some support for earlier findings by Rojas-Suarez (1992) and El-Erian (1988). Rojas-Suarez (1992) highlights that exchange rates affect the desire to hold foreign currency for Peru. The period covered January 1978 – December 1990 when fully convertible U.S. dollar denominated bank deposits was allowed in the Peruvian economy. El-Erian (1988) reports similar findings for Egypt and the Yemen Arab Republic over the period 1980 – 1986. Elkhafif (2003) uses monthly data in an error-correction model to examine the dynamic of the currency substitution phenomenon in Egypt and South Africa for the period

1991 – 2001. The results of the error correction model, which was confirmed by Granger causality tests, indicate a unidirectional Granger-causal relationship from the exchange rate to dollarization in both Egypt and South Africa.

2.3.2. The Portfolio Theory

Ize and Levy-Yeyati (2003) proposed the minimum variance portfolio and attributed dollarization to expectations of high uncertainties associated with inflation relative to that of the real exchange rate[6]. The theory assumes the validity of the uncovered interest rate parity, such that an increase in the variance of domestic inflation relative to the variance of real currency depreciation induces financial dollarization as the domestic currency becomes unattractive. This theory predicts that risk-averse resident investors seek to optimise the gains in the determination of asset portfolio. Consequently, while the real return on assets denominated in local currency is influenced by variations in inflation, the real return on foreign currency denominated assets is affected by real exchange rate fluctuations.

Consider a risk-averse resident investor with an investment menu comprising foreign and domestic interest-bearing bank deposits. The real returns $r = E(r) - \varepsilon_\pi - \varepsilon_s$, and $r^* = E(r) - \varepsilon_s$, respectively, where ε_π and ε_s are zero-mean disturbances to the local inflation and real devaluation rates, and $E(r^j)$ denotes the expected real return on the assets. Assuming further that the investor maximizes the utility function

$$\max_{xj} U = E(r) - \text{var}(r)/2, \text{ with } x_j \geq 0, j = d, f, \quad (2.3)$$

denote the domestic and foreign proportions, respectively, and $r = \sum_j x_j r_j$ is the real return on the portfolio. If the uncovered interest rate parity condition holds, the foreign currency share of the optimal investment portfolio is equal to

[6] See also De Nicolo et al. (2005)

$$mvp \equiv \frac{\text{var}(\pi) + \text{cov}(\pi, s)}{\text{var}(\pi) + \text{var}(s) + 2\,\text{cov}(\pi, s)} \tag{2.4}$$

Replacing $\varepsilon_s \approx \varepsilon_e - \varepsilon_\pi$, where e denotes the nominal rate of depreciation, the deposit dollarization ration reduces to

$$mvp = \frac{\text{var}(\pi)}{\text{cov}(\pi, e)} \tag{2.5}$$

The proponents of this theory argue that, barring real interest rate differentials across currencies, investors design currency portfolios that minimize the variance of portfolio returns which depends on the volatility of inflation and the rate of real currency depreciation. The portfolio model has the following implications: First, exchange rate regimes are effective only when they combine with monetary policy. In the context of a floating exchange rate regime, a high and volatile inflation may induce residents to dollarize. This infers that a combination of flexible exchange rates and price stability curtails incentives to dollarize. Second, more open countries are likely to display higher rates of dollarization, suggesting that when the import component is large it feeds into higher pass-through effect of exchange rates to price dynamics.

The role of interest rate spreads on residents' decision to switch demand between local and foreign currency holdings has been captured in some aspect of the literature. These differentials relate expectations of exchange rate movements through the uncovered interest parity. Studies that confirm the role of interest rate differentials include Basso, Calvo-Gonzales, and Jurgilas (2011), Rosenberg and Tirpak (2008), Luca and Petrova (2008), *inter alia*. According to Basso et al. (2011), the interest rate differential has a negative effect on deposit dollarization while access to foreign funds increases credit dollarization but at the same time decreases deposit dollarization. They report a negative relationship between deposit dollarization and the difference between domestic and foreign currency interest rates for 24 transition economies over the period 2000 – 2006.

A panel of 10 countries was studied by Rosenberg and Tirpak (2008) using quarterly data for the period 1999 – 2007[7]. The share of loans denominated in (and indexed to) foreign currency in total domestic bank loans to the non-financial private sector was used as the dependent variable, together with an alternative specification that includes the private sector's direct borrowing from abroad. Interest rate differential, loan-to-deposit ratio, openness, and severity of regulatory measures aimed at discouraging foreign currency borrowing were used as regressors. It was reported that interest rate differential is an important factor in decisions to borrow in foreign currency. Consistent with the theory, a higher interest rate differential causes liability dollarization in a country.

For emerging Europe, Luca and Petrova (2008) provides an in-depth analysis of the impact of bank and firm variables on credit dollarization. They study specified an optimal portfolio allocation model and used new aggregate data for 21 economies from Central and Eastern Europe and Central Asia for the period 1990 – 2003[8]. Variables used in the baseline model included interest rate differential, the minimum variance portfolio dollarization share, the change in the rate of inflation, an index of asymmetry of exchange rate movements, and exchange rate intervention. They find a positive relationship between aggregate shares of foreign currency loans to interest rate differentials. Neanidis and Savva (2009) used an unbalanced panel monthly data for 11 transition economies from 1993 – 2006[9]. The evidence is that the short-run dynamics of both deposit and loan dollarization are influenced by the relative rate of return.

[7] The sample of countries includes Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Slovakia, Bulgaria, Romania, and Croatia

[8] The sample includes Albania, Armenia, Azerbaijan, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, and Ukraine.

[9] Armenia, Bulgaria, Czech Rep., Estonia, Georgia, Kyrgyz Rep., Latvia, Poland, Romania, Russia, and Ukraine

2.3.3. The Market Failure Theory

This theory spotlights the relationship between dollarization and the extent to which economic agents have access to foreign currency for financial intermediation. It claims that financial dollarization increases when agents can easily access foreign currency denominated credit facilities without regard for the risks emanating from currency depreciation. This behaviour is influenced by two motivating factors. First, when a central bank seeks to achieve exchange rate stability, they make credit facilities in foreign currency less risky, which increases information asymmetry and moral hazard in the financial system. Second, when the existing regulatory framework fails to adequately address market imperfections and externalities it creates a dollarization bias. According to Broda and Levy-Yeyati (2006), this dollarization bias crops up when the probability of default correlates positively with real exchange rate and when there is imperfect information on the borrower's currency composition.

One key issue in the dollarization literature regards how the level of deposit dollarization determines the level of credit dollarization. In a study to empirically examine the determinants of credit dollarization of 21 transition economies, Luca and Petrova (2008) report that deposit dollarization and the decision of banks to equate the assets and liabilities sides of their balance sheet, compels the rate of credit dollarization. Neandis and Savva (2009) also indicate that deposit dollarization and loan deposit dollarization are positively associated. A study by Bednarik (2007) to determine the drivers of loan dollarization in Czech Republic, Slovakia, Poland, and Hungary shows that deposit dollarization has a positive impact on loan dollarization.

Contrary to these findings, Basso, Calvo-Gonzales, and Jurgilas (2007) establish a negative correlation between foreign currency deposits and foreign currency loans. There was no evidence that banks match deposit dollarization with loans dollarization. They concluded that, whereas relative rate of return increases credit dollarization, it lowers deposit dollarization. Also, whilst

access to foreign fund causes credit dollarization to increase, it causes deposit dollarization to decline. Another study by Honohan and Shi (2002) support that credit dollarization declines when deposit dollarization increases. On the other hand, the authors report of a positive association between deposit dollarization and offshore deposits of banks in emerging economies.

2.3.4. The Institutional Theory

The institutional theory highlights how the commitment of policymakers to build stable exchange rates creates financial dollarization. This occurs since policymakers seek to build credible exchange rates economic policy makers build their credibility on a stable exchange rate instead of regulations or strong institutional frameworks to boost the confidence in the domestic currency. Such imperfections in the institutional set up increase financial dollarization and the costs associated with exchange rate depreciation (Reinhart et al., 2003; De Nicolo, et al., 2005; Rajan and Tokatlidis, 2005). The quality of institutions may dampen or enhance the drivers of dollarization. Whereas a good institutional record would be associated with low repudiation expectations, low interest rates, and no inflation bias, a bad record would be associated with high interest rates and high inflation bias. Rajan (2004) argues that institutions may also influence financial dollarization through their effects on inflation, because countries with poor institutions tend to rely more on inflation tax during economic downturns.

2.4. Dollarization and macroeconomic fundamentals

2.4.1. Effects of dollarization on exchange rate

The effect of dollarization on exchange rate of an economy depends on the form or degree of dollarization *vis a vis* the exchange rate regime employed in that country. It has been argued that partial dollarization aggravates exchange rate volatility, whereas full dollarization results in stability of exchange rates. The theory of how dollarization affects exchange rate volatility hinges on demand and supply of currencies. The theoretical underpinning of this is that, partial

dollarization points out the presence of asset and/or currency substitution in the economy, which suggests that economic agents can swap foreign and domestic currencies to suit their portfolio needs. When this happens, it is likely that the fluctuations in the money demand function would be transferred to the dynamics of the exchange rate. This theory posits the probability of swings in the value of the exchange rate depending on the market dynamics – demand and supply. In this case, if the demand for a currency is high, the currency becomes strengthened as its value is pushed up, while a lower demand causes the currency to depreciate or become less valuable. Within this circumstance, it becomes somehow improbable for such countries to predict the exchange rate or at best experience stable exchange rates for extended periods.

On the other hand, in a fully dollarized economy where the foreign currency has been adopted as legal tender, the volatility of the domestic currency is directly linked to the fluctuations associated with the foreign currency. In such an economy the interaction of demand and supply would not play a greater role in the determination of exchange rates. This is the reason why the volatility of exchange rates in countries that fix their currencies against a hard (or a more stable or stronger) currency such as the U.S. dollar is minimal. Most countries have pegged their currencies against the U.S. dollar and the use of the U.S. dollar by those countries that are fully dollarized provides the benefits related to its stability.

2.4.1.1. Partial dollarization and exchange rate volatility

A number of studies have reported that partial dollarization causes an increase in exchange rate volatility. In a currency substitution model developed by Girton and Roper (1981), money demand functions were used to prove the effect of currency substitution on exchange rate instability. According to the authors, there is a positive correlation between the degree of currency substitution and variations in the exchange rate. The higher the degree of partial

dollarization, the more volatile the exchange rate becomes. The theory built by Corrado (2007) also suggests that financial dollarization causes higher exchange rate movements. The methodology based on a general equilibrium framework which includes imperfect competition and nominal rigidities in the non-tradable goods sector.

Akcay et al. (1997) also developed a theoretical model on how currency substitution or dollarization increases the instability of exchange rates. They concluded that, currency substitution increases the change in the exchange rate required to restore equilibrium when there are deviations from the steady state. Besides this theory, Akcay et al. (1997) provide evidence that exchange rate instability in Turkey increases with an increasing degree of currency substitution using an Exponential GARCH modelling approach. Similarly, Honohan (2007) focus on the response of dollarization to exchange rate variations. The findings indicate very little response, although high dollarization is shown to increase the risk of depreciation. However, the author provides empirical support for the hypothesis that high dollarization increases the risk associated with depreciation.

The GARCH modelling technique has also been employed by Lay, Kakinaka, and Kotani (2012) to test whether dollarization caused currency depreciation in Cambodia using monthly data for the period June 1998 to January 2008. The authors applied Granger causality tests with the GARCH approach and incorporated foreign exchange reserves and interest rate differentials. Data employed included nominal exchange rate of the riel against the US dollar, broad money (M2), foreign exchange reserve, consumer price index, interest rate (deposit deposit), and foreign currency deposits. Their findings indicate that dollarization causes exchange rate depreciation in instability of the Cambodian currency.

The connection between dollarization and exchange rate volatility has remained unresolved both theoretically and empirically. Earlier studies focused on Latin American and Asian economies. A couple of studies provide empirical evidence for some African countries. Applying the Granger causality test within a Vector Autoregressive model, Yinusa (2008) explores the link between dollarization and nominal exchange rate volatility in Nigeria for the period 1986 – 2003. According to the results, there is a bi-directional causal relationship between dollarization and exchange rate volatility, although the causality running from dollarization to exchange rate volatility seems stronger. The author argues that strategies aimed at averting exchange rate volatility in the Nigerian economy must incorporate measures to address the issue of rising dollarization.

Another study by Mengesha and Holmes (2013) uses Eritrean quarterly data for the period 1996 – 2008 to scrutinize the importance of dollarization in exchange rate fluctuations or instability in the economy. With official and black market exchange rate data, the exponential GARCH model supports that a positive relationship exists between dollarization and real exchange rate volatility. The findings suggest that an increased dependence on foreign currency increases the volatility of both the official and black market exchange rates.

2.4.1.2. Full dollarization and exchange rate stability

Although the generally purported view is that partial dollarization causes exchange rate volatility, full dollarization is expected to lead to lower risk premia, as it alleviates the depreciation of the domestic currency against the anchor currency. A country that adopts a hard currency as legal tender eliminates the risks associated with the discrepancy between foreign currency deposits and foreign currency inflows. The supposed elimination of this problem is expected to lead to reduction in the sovereign risk. Also, the lower currency risk (risk premia) enhances the competitiveness of the dollarized countries, leads to improved access to the international capital

markets and enhanced financial sector stability, lower risk of capital controls, and lower information costs (Berg & Borensztein, 2000a; Calvo, 2002). Moreover, since currency stability is a necessity for financial development, dollarization is expected to boost the development of a country's financial sector and lead to strong economic growth (Hausmann, Gavin, Pages-Serra, & Stein, 1999; Berg & Borensztein, 2000b).

Some studies provide evidence that official dollarization causes a decline in volatility of exchange rates of the dollarized country. Akofio-Sowah (2009), Lange and Sauer (2005), Bogetic (2000), among others, consider the impact of full dollarization and report that the volatility of exchange rates in Latin American countries has lowered. For the Euro zone area, studies like Barrell, Davis, and Pomerantz (2009), Schnabl (2007), Bartram and Karolyi (2006), and Clark, Tamirisa, Wei, Sadikov, and Zeng (2004) also evinced that full dollarization causes a drop in exchange rate volatility. Similar findings have been reported by Savvides (1996) for the Franc zone compared to non-Franc zone. According to Fielding and Shields (2003), full monetary union bring lower real exchange rate volatility than under a fixed exchange rate system.

2.4.2. On dollarization and the dynamics of inflation

The view proposed by Milton Friedman (1956), which has provided the central theoretical building block in the doctrine in "monetarism" suggests the important role of demand for money in the dynamics of inflation. The monetarists maintain that, "*Inflation is always and everywhere a monetary phenomenon*" which makes it imperative to empirically explore the role of money demand in a multi-currency economy[10]. This is because, if inflation is indeed a monetary phenomenon, then overlooking the importance of foreign currency in the domestic economy would deceive the monetary policymaking process. The literature on the dollarization – inflation

[10] In a multi-currency situation, more than one currency circulates. A multi-currency economy is dollarized (*de facto* or *de jure*). Zimbabwe is one of the countries that have officially allowed the use of multiple currencies. There are also countries that have not adopted foreign currencies as legal tender but they are used by agents.

nexus identifies two main channels through which dollarization causes inflation. A high degree of liability dollarization in an economy is associated with a higher exchange rate pass-through due to the balance sheet effect of currency depreciation. When firms issue bonds in foreign currency, exchange rate depreciation affects the firm's balance sheet due to the mismatch of cash flow. If the firm's revenue is denominated in local currency and its debt is foreign-currency denominated, it becomes a challenge when the currency depreciates. When there is depreciation of the currency, the firms' debt rises when converted into the local currency, because a large amount of local currency would be required to pay for small amounts of debt in foreign currency. This increase in debt position causes firms to adjust prices upwards to cover the increase. The bottom line is that, if a larger amount of debt is denominated in foreign currency; the effect of the exchange rate depreciation on the firms' balance sheet becomes bigger. This eventually increases the pass-through effect on prices.

Some empirical studies provide evidence that inflation is driven by rising dollarization levels. Bahmani-Oskoee and Domac (2003) used a generalized impulse response functions in a vector autoregression model to test the importance of dollarization in the evolution of inflation for the Turkish economy. The results of the study indicate that, dollarization increases inflation despite the initial drop in monetary base in response to dollarization shock. In a recent study by Mengesha and Holmes (2015) for Eritrea, inflation is modelled under partial dollarization within a vector error correction model framework and dynamic ordinary least squares for the period 1996 to 2008. The findings of the study point out that, inflation increases owing to an upsurge in dollarization in both the short-run and long-run dynamics notwithstanding whether official or black market exchange rate is employed in the analysis.

The debate on the relationship between dollarization and inflation still remains inconclusive. Whereas Levy-Yeyati (2006), Reinhart et al. (2003), Karacal (2005), Ghalayini (2011), and others

support that high dollarization is associated with high rates of inflation, studies by Berg, Borensztein, and Mauro (2003), Gruben and Mcleod (2004), among others; report otherwise. Reinhart et al. (2003) based on panel estimation techniques and reported that the average inflation rate is consistently higher and more variable in economies with a high degree of dollarization than in economies with low to moderate degrees of dollarization.

In a related literature, the effect of dollarization on exchange rate pass-through has also been considered. This strand of the literature claims that exchange rate pass-through increases with rising degree of dollarization. Reinhart et al. (2003) used panel regressions for 90 countries covering the period 1996 – 2001, to provide evidence that the inflationary impact of exchange rate variations differs across highly dollarized and less dollarized economies. Precisely, the pass-through effect of exchange rate to prices was higher in economies with high degree of dollarization than in countries with less dollarization. Similar findings have been reported by Alvarez-Plata and Garcia-Herrero (2008), Leiderman, Manio, and Parrado (2006) for Peru, Goujon (2006) for Vietnam, Oomes, and Ohnsorge (2005) for Russia, among others.

Contrary to the above evidence, other studies report that exchange rate pass-through is less in dollarized countries. For example, Billmeier and Bonato (2002) employs vector autoregression and cointegration models and find that the exchange rate pass-through effect is low in a highly dollarized economy, Croatia. The contentious evidence suggests that exchange rate pass through could be positive or negative as argued by Carranza, Galdon-Sanchez, and Gomez-Biscarri (2009).

The effect of full dollarization on inflation is reaching a consensus, which is anchored on the widely held view among economists and policymakers that full dollarization eliminates (or at best reduces) the mismatch effect in the balance sheet of firms. It has been argued by Alesina and

Barro (2001, p. 382) that, approving another country's currency "*eliminates the inflation-bias challenge associated with discretionary monetary policy*." Under full dollarization, banks lend foreign currencies and expect to receive payments in the foreign currency. Contrasting firms in partially dollarized economies, those in fully dollarized economies receive foreign currencies, to enable them to trade and repay their debts in foreign currency. Under such circumstances, exchange rate pass-through effect is avoided in fully dollarized economies unlike in partially dollarized economies (Mengesha & Holmes, 2015).

Edwards and Magendzo (2001) use a matching estimator approach and find that inflation is significantly lower in highly dollarized countries than less-dollarized economies. In the words of Kurasawa and Marty (2007), the advantage of dollarization in terms of lowering inflation is higher than the loss of seigniorage in Argentina, Ecuador, and El-Salvador. Another study on Ecuador by Soto (2008) uses quarterly data for 1991:1 – 2006:4 and documents that the rate of inflation declines under full dollarization. Meller and Nautz (2009) use monthly data to compare the country-specific order of integration estimated for the period 1966 – 1998 to the integration of Euro-area inflation during the period after those countries joined the European Monetary Union, 1999.01 – 2008.07. [11] A similar outcome has also been highlighted by Payne (2009) in a study on El-Salvador. The author find evidence of reduced the persistence of inflation volatility.

In investigating the relationship between exchange rate pass-through and the monetary regime for a sample of 15 Sub-Saharan Africa countries and 12 Latin American countries[12], Akofio-Sowah (2009) covers the period 1980 – 2005 and indicates that countries that have officially

[11] The countries considered were Austria (AT), Belgium (BE), Germany (DE), Spain (ES), Finland (FI), France (FR), Italy (IT), Luxembourg (LU), Netherlands (NL), and Portugal (PT).

[12] The Latin American countries are Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Nicaragua, Panama, Paraguay, Uruguay, and Venezuela. Sub-Saharan Africa: Burundi, Cameroon, Central African Republic, Congo DR, Cote D'Ivoire, Gabon, Gambia, Ghana, Lesotho, Malawi, Nigeria, Sierra Leone, South Africa, Togo, and Uganda

adopted other currencies exhibit lower average inflation rate than unofficially dollarized countries. In a related estimation, the author includes a dummy variable to represent currency union countries and reveals that the average rate of inflation is lower in currency unions of Sub-Saharan African countries than countries that are not connected by currency unions. Elbadawi and Majd (1996) employ a modified control group approach and probit model to examine the economic performance of the CFA franc zone versus non-CFA countries in recent years. The evidence provides support for lower inflation rate in the Franc Zone area as against sub-Saharan countries that are not members of the Franc zone.

The literature on the effects of dollarization on inflation has become very debatable. One strand of the literature that considers the impacts of dollarization in currency unions (*fully*-dollarized countries) usually conclude that dollarization has generally brought about lower rates of inflation in dollarized economies. Akofio-Sowah (2009) considers countries that have adopted foreign currencies *de jure* (officially dollarized) and countries that use foreign assets and liabilities *de facto* (unofficially dollarized) countries. Through a regression analysis and a dummy variable in some countries within a currency union, the study reports lower average inflation rate in the former category as compared to countries in the latter. This reveals that dollarization reduces inflation through accession to currency unions in sub-Saharan African countries. Elbadawi and Majd (1996) also compare inflation rates in the Franc countries to sub-Saharan African countries outside the Franc zone. They conclude that inflation rates were lower in the Franc currency zone compared to inflation rates in the other countries. Another research by Meller and Nautz (2009) employs fractional integration to investigate the impact of the European Monetary Union (EMU) on inflation persistence in member countries. The study finds that inflation persistence in the Euro area reduced after countries joined the EMU.

Beyond these studies that focus on dollarization in currency unions are others that are based on *full* dollarization in individual countries. In the case of Ecuador and El Salvador, Soto (2008) and Quispe-Agnoli and Whisler (2006) report that full dollarization brought about decline in the rate of inflation. Another finding by Payne (2009) argues that besides helping economies reduce inflation, full dollarization also reduced the magnitude of inflation volatility persistence in El-Salvador. Focusing on Argentina, Ecuador and El-Salvador, Kurasawa and Marty (2007) explores the cost of loss of *seigniorage* due to dollarization and the gains in terms of inflation. The authors report that the costs of dollarization in terms of seigniorage are lower than the benefit of lower rates of inflation. Similar outcomes have been reported by Edwards and Magendzo (2001), Kim, Nelson, and Piger (2004) among others that inflation is lower in *fully*-dollarized economies than non-dollarized economies.

Whereas the above studies focus on full dollarization, another aspect of the literature investigates the impact of *partial* dollarization on inflation. Unlike the near consensus in the case of full dollarization, the findings of studies in this category are conflicting. Although some of these studies argue that partial dollarization decreases inflation, others diverge. For instance, for Southern and Central American countries, a study by Berg et al. (2003) report reduced rates of dollarization whether dollarization is in full or partial form. Another empirical inquiry by Gruben and Mcleod (2004) find lower inflation in Latin America and some other twenty countries. This study was based on the transaction cost driven from money demand function.

Contrasting these findings are Bahmani-Oskooee and Domac (2003), Karacal (2005), Levy-Yeyati (2006), Ghalayini (2011), and others that find that dollarization plays a role in the high inflation rates experienced in some countries. Bahmani-Oskooee and Domac (2003) empirically examines this relationship for the Turkish economy by specifying vector autoregression models and generalized impulse response functions. Although the authors report an initial reduction in

the monetary base due to a shock on dollarization, the phenomenon eventually increases inflation. A similar conclusion is reached by Karacal (2005) for the Turkish economy within an autoregressive distributed lag (ARDL) framework. According to the author, dollarization leads to inflation. Considering the situation of Lebanon, Ghalayini (2011) employs Granger causality test and reports that causality runs from dollarization to inflation. A recent study by Mengesha (2013) applies cointegration and error correction models to study the role of dollarization in Eritrea for the period 1996 to 2008. The findings show that there is a positive effect of dollarization on inflation both in the short run and the long run. Bailey (2007) undertakes a study on the effects of dollarization in Jamaica using VAR models and generalized impulse response functions. The findings of the study suggest that increases in dollarization are associated with inflationary pressures in the Jamaican economy. Levy-Yeyati (2006) tests a simple specification based on the log linearization of a standard money demand equation for 122 developed and developing countries in Latin America, sub-Saharan Africa and transition economies. The analysis which covers the period 1975-2002 turns out that financially dollarized economies experience higher inflation rates than less dollarized economies.

The effects of dollarization on inflation through the exchange rate pass-through channel have also been investigated in the literature. This category of the literature holds that rising dollarization leads to high pass through of exchange rates. Alvarez-Plata and Garcia-Herrero (2008) estimated country-to-country VAR models[13] to assess the effects of dollarization on inflation through the exchange rate pass-through effect using impulse response functions. The study uses quarterly data from 1986:4 to 2006:3 for most of the countries, whereas Cambodia, Lao P.D.R., and Vietnam have data covering 1993:1 to 2006:3. The findings show an increase in the exchange rate pass-through with the increase of the degree of dollarization. Reinhart et al.

[13] The countries in the study are Argentina, Bolivia, Cambodia, Chile, China, Ecuador, Indonesia, Israel, Korea, Lao PDR, Malaysia, Peru, Philippines, Russia, Thailand, Uruguay, and Vietnam.

(2003) also employs a panel analysis to test the pass-through effect for over 90 countries grouped into four different categories. The authors confirm that highly dollarized countries have high rates of exchange rate pass-through. A similar finding based on a baseline VAR is reported by Leiderman et al. (2006). They show that the exchange rate pass-through is higher for a highly dollarized economy (Peru) than for a low dollarized economy (Chile). For the Vietnam and Russian economies respectively, Goujon (2006) and Oomes and Ohnsorge (2005) provide comparable evidence using an error correction model.

Emphasizing on the policy implications of high rate of exchange rate pass-through associated with dollarization, some authors assert that dollarization may create problems for the implementation of inflation targeting especially in emerging markets. Mishkin (2000) argues that since inflation targeting allows for flexible exchange rate, the value of balance sheets of banks as well as firms and households may decrease as a result of currency depreciation. According to the author this may increase the weight of foreign currency denominated debt, and push the financial markets into a crisis. Alvarez-Plata and Garcia-Herrero (2008) assert that dollarization is linked to important costs such as comparatively higher effect of exchange rates on prices and increases the susceptibility of the economy to balance sheet effects. In their opinion, as the former limits the control of monetary authorities over inflation, the latter may make the exchange rate flexibility more disruptive and costly.

On the contrary, other studies claim that inflation targeting regime is suitable in a dollarized economy. According to De Nicolo, Honohan, and Ize (2003), the best monetary policy regime in dollarized economies would be inflation targeting and free floating exchange rates. The authors assert that targeting inflation is associated with a decrease in the level of dollarization. However, they argue that proper de-dollarization and a strong domestic currency would require continuous reforms. They recommend further a gradual process to limit the fluctuations in the exchange rate

in order to boost credibility. Similar arguments have been advanced by Ize and Levy-Yeyati (2003). Ize and Levy-Yeyati, however, emphasize that a greater impact of inflation targeting on inflation and exchange rates in a dollarized economy would be achievable unless both prices and wages are denominated in foreign currency, and the pass through effect of exchange rate is restrained. Also, Batini, Levine, and Pearlman (2008) assess whether inflation target can be achieved in a dollarized economy. They conclude that, although the conduct of monetary policy in a dollarized economy could be more challenging, an inflation targeting central bank could make it more successful at low cost.

2.4.3. Other costs associated with dollarization

The literature on dollarization identifies at least four potential costs associated with full or official dollarization: currency mismatch, loss of seigniorage, loss of the lender of last resort facility of monetary authorities and reduction in the effectiveness of monetary policy.

2.4.3.1. Currency mismatch

One problem associated with high rate of liability dollarization is financial fragility. This occurs when the economy becomes highly prone to exchange rate volatility risks, which negatively affects the financial position of local firms that have outstanding loans denominated in foreign currencies. It has been defined Goldstein and Turner (2004) as the sensitivity of the present value of net income or net worth to exchange rate movements. Currency mismatch is a situation where firms have their streams of cash flows in one currency, usually the domestic currency; and hold liabilities in other currencies. When this happens, a depreciation of the domestic currency would lead to increase in the debt position, which increases the probability of default, weakens the financial position of banks, and makes them more fragile. This fragility can lead to financial crisis.

Without appropriate hedging mechanisms, this problem with currency mismatch could possibly be eradicated by boosting banks access to foreign currency to be able to extend credit facilities to firms with stream of income denominated in foreign currency. Attempts to curb this problem in some countries have resulted in foreign exchange regulations that require that foreign currency credit should be used to pre-finance exports. It is in this light that, Bleakley and Cowan (2005) provide evidence that firms that produce tradable goods in Latin American countries seem inclined to liability dollarization than non-tradable firms.

There is some empirical evidence on the effects of financial dollarization on financial fragility. Using the Z-index as a proxy for probability of default, De Nicolo et al. (2003) conclude that dollarized banking sectors are characterized by higher insolvency risk. Their results also suggest that, highly dollarized economies exhibit higher rates of deposit volatility as confirmed by the greater volatility associated with broad money. In a related work on emerging economies, Calvo, Izquierdo, and Mejia (2004) document that the degree of financial dollarization increases the tendency to suffer "sudden stops" in capital inflows (that is, sharp capital account reversals). The authors employed, as a proxy for financial dollarization, the share of the sum of dollar deposits and foreign liabilities in the domestic banking sector in the Gross Domestic Product. Domac and Peria (2003) find the ratio of foreign liabilities to assets of local banks as positively correlated with the probability of facing a systemic banking crisis.

2.4.3.2. Loss of seigniorage

Another problem connected to the substitution of domestic currency with a foreign currency is the loss of seigniorage – the revenue associated with the printing of domestic currency. Both partial and full dollarization leads to this kind of loss. In a partially dollarized economy – where the foreign currency has not completely replaced the domestic currency – economic agents choose between two or more currencies including the domestic currency. In this case, the

government faces loss of seigniorage although in smaller magnitude than in the case of full dollarization. Under full dollarization – official or unofficial – the currency of another country is adopted as the legal tender for the performance of all the functions of money (Berg & Borensztein, 2000b).

Since the country eliminates its currency and adopts foreign currency as legal tender, the central bank can no longer print units of domestic currency at a minimum cost and use it to finance public spending. This phenomenon eliminates the option for the government to finance fiscal deficit with seigniorage. Although it has been widely speculated that high levels of dollarization limits government's profit garnered from seigniorage, there is little empirical evidence on the subject. In a study to examine the seigniorage costs of official dollarization in 15 Latin American countries, Lange and Sauer (2005) decomposed the total costs into seigniorage transferred to the foreign country that issues the currency and the lost due to greater financial stability in the dollarized country. The findings indicate that seigniorage costs and their components are significant, although considerably different across countries.

Apart from this, some studies have estimated the seigniorage costs for some Latin American countries. According to Bogetic (2000), the estimated seigniorage loss for Latin American countries for the period 1991 – 1997 range from 0.5 percent of GDP for Argentina to about 7.5 percent of GDP in Ecuador. Likewise, Humpage (2002) estimated seigniorage loss for the period 1990 – 2000 to range from 0.1 percent of GDP in Ecuador to about 5.5 percent of GDP in Chile. Contrary to the evidence that high degree of dollarization is associated with high seigniorage loss, Reinhart et al. (2003) report that the profits accruing to the monetary authority from issuing currency and degree of dollarization among East African Community countries during the period 2000 – 2008 was generally independent.

Despite the attempts to quantify or provide estimates of seigniorage loss, Chang (2000) argues that such estimates should be construed with care. He argues that in instances where the credibility of macroeconomic policy is questionable, the interpretation of seigniorage loss becomes challenging. In most economies where dollarization is widespread, credibility of policies stands to be questioned. Chang (2000) further argues that purely considering computed seigniorage loss can only be unambiguously interpreted as "real losses" to the economy if policy credibility is guaranteed.

2.4.3.3. Loss of Lender of Last resort functions of the Central Bank

Another challenge connected to the incidence partial dollarization is the constraint it inflicts on the lender of last resort function of the central bank. Aside the role of central banks in providing short-term liquidity to solvent banks facing liquidity problems, they also serve as the ultimate guarantee to maintain the stability of the financial and payments systems in the event of a systemic bank run. This function performed by the central banks is linked to their responsibility to print currency. The ability to print and issue money enables a central bank to provide the necessary guarantee beyond any doubt to settle all claims in domestic currency.

However, the capacity of a central bank in an economy characterized by high deposit dollarization may be impugned or impaired to bailout domestic banks in case of distress or bank runs (Berg & Borensztein, 2000b). Because foreign reserves serve as the only cushion to stem such a crisis, this situation can be avoided if the monetary authorities save enough foreign reserves or perhaps secure emergency lines of credit with international banks to avert such situations when the international reserve is depleted.

2.5 Monetary policy as tool for macroeconomic stability in Ghana

2.5.1 Monetary policy and inflation expectations

One of the recognised tools used for macroeconomic policy implementation is monetary policy (Arestis & Sawyer, 2008). It is therefore very important to ensure its effectiveness in affecting macroeconomic indicators such as inflation, exchange rate, and general economic activity to achieve a stable environment. The effectiveness of transmitting monetary policy decisions to economic variables depends on the general features of the economy such as the size of the banking system, the extent of financial development and capital inflow, and the level of monetization. Monetary policy can be said to transmit through different channels. Although the process differs across countries, six different paths have been identified: interest rate channel, balance sheet channel, asset price channel, exchange rate channel and credit channel (see Dabla-Norris & Floerkemeier, 2006; Horvath & Maino, 2006; Samkharadze, 2008).

There have been arguments surrounding the strength of monetary policy as a tool for macroeconomic stability in developing countries. These are assessed based on how effective policy decisions run through one or more of the above channels to affect the desired variables. The evidence points out that the interest rate channel, which has become widely recognized as a dominant transmission channel in industrial countries with developed financial markets, is not as effective as the exchange rate channel in transition economies (Egert & MacDonald, 2009). Similarly, small open (developing) economies find the exchange rate channel predominantly important while the other channels remain largely ineffective (Christensen, 2011; Dabla-Norris & Floerkemeier, 2006).

It is now widely accepted that the primary role of monetary policy is to maintain price stability (see Batini & Yates, 2003; and Pianalto, 2005). According to Greespan (1996), price stability is when economic agents no longer take account of the prospective change in the general price

level in their economic decision making. Some authors have argued that price stability corresponds to an annual rate of inflation in the low single digits (see Bernanke et al, 1999; Mishkin & Schmidt-Hebbel, 2002; Brook, Karagedikli, & Scrimgeour, 2002; Batini, 2004; and Burdekin & Siklos, 2004). In order to attain this stable inflation and long-run growth which is generally associated with a vigorous economy, economists quested for a monetary policy to anchor inflation expectations decorously. Establishing inflation expectations as the key determinant of inflation persistence requires that anchoring expectations must be related to monetary policy. Thus, a monetary policy framework that can successfully anchor inflation expectations can succeed in reducing or eliminating inflation persistence (Mishkin, 2007). The role of expectations implicitly featured in traditional Phillips curve analysis for many years and has now become a more obvious central feature of new Keynesian Phillips curves, in which current period inflation is a function of expectations next period and output gap.

In recent years, inflation targeting has gained an increasing recognition as a popular monetary policy framework among several industrialized and emerging market economies, especially since New Zealand first adopted it in early 1990. The number of countries considered as practising inflation targeting including both industrialized and emerging countries increased to 29 by the start of 2013. There are several other emerging countries that have adopted some aspects of the regime and are in the process of switching to a fully-fledged inflation targeting. Mishkin (2000) argues that, although inflation targeting is not a panacea and may not be appropriate for many emerging countries, it can be a highly expedient strategy in a number of them. Although Walsh (2008) reports that research relating to developed economies generally suggests that inflation targeting has resulted in better anchored expectations, Martinez (2008) claims that the benefits of inflation targeting for developing economies have been different in nature than those experienced in industrialized economies.

The literature has offered several different definitions of inflation targeting. According to Bernanke and Mishkin (1997), inflation targeting involves five main elements: the public announcement of medium-term numerical targets for inflation; an institutional commitment to price stability as the primary goal of monetary policy, to which other goals are subordinated; an information inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments; increased transparency of the monetary policy strategy through communication with the public and the markets about the plans, objectives, and decisions of the monetary authorities; and increased accountability of the central bank for attaining its inflation objectives (see Leiderman and Svensson, 1995; Mishkin, 1999; and Bernanke et al, 1999; among others for other definitions).

Hammond (2012) lists the essential elements of an inflation targeting regime as having price stability explicitly recognised as the main goal of monetary policy; a public announcement of a quantitative target for inflation; having a monetary policy based on a wide set of information, including an inflation forecast; transparency; and accountability mechanisms. A hallmark of the framework is the public announcement of medium-term inflation target by the government or the central bank, or some combination of the two, with an institutional commitment by the monetary authority to achieve these targets. This increases communication with the public and the markets about the plans and objectives of monetary policymakers, in order to ensure increased transparency and accountability of the central bank for its inflation objectives. Based on this, monetary policy decisions will be guided by the deviation of forecasts of future inflation from the announced inflation target, and the inflation forecast then serves as the intermediate target.

The framework gives the central bank an explicit and permanent commitment to price stability. If this commitment is credible, it allows the anchoring of expected inflation at the target level,

enhances the effectiveness of monetary policy, and serves as a possible strategy to restore the role of the domestic currency. Inflation targeting seeks to enjoy flexibility in responding to shocks and still reserve the credibility of the regime. It benefits from increased transparency and a coherent policy framework. Orphanides and Williams (2003) argue that, announcing the inflation target informs and anchors the expectations process. Levin et al (2004) find evidence that persistence is lower, and expectations more anchored in inflation targeting countries. Although it has been stated by Ball and Sheridan (2004; p. 250) that "*there is no evidence that inflation targeting improves performance as measured by the behaviour of inflation, output, or interest rates",* the regime appears to have been associated with lower inflation, lower inflation expectations, and lower inflation volatility (IMF, 2005). These benefits are allied with the systematic approach involved in the framework, which makes it predictable and gives more influence over expectations (Hammond, 2012). According to King (2005), inflation targeting provides a rule-like framework for private firms and individuals to anchor their expectations about future inflation. This has led to the general conclusion that, inflation targeting augments a central bank's ability to anchor inflation expectations successfully (see Kohn, 2007; Swanson, 2006; and Levin et al, 2004).

The importance of inflation expectations in monetary policy has been increasingly stressed in the literature. Inflation persistence generates from limited information and uncertainties on the part of private agents about the central bank's objectives and actions. Erceg and Levin (2003) and Orphanides and Williams (2007) show that inflation tends to be less persistent if agents are more confident about the central bank's inflation objectives. Inflation targeting has become recognised as very instrumental in anchoring inflation expectations and reducing persistence, because it provides a monetary framework characterized by high degree of transparency, accountability, and communication. By regulating information sets across agents, the regime is perceived to be able to anchor inflation expectations more quickly and robustly than other strategies (Bernanke et al., 1999).

Another reason for the recognition that inflation targeting serves as a nominal anchor for the monetary policy and anchors expectations faster than other frameworks is that it targets inflation directly not through intermediate targets (Svensson, 1998). According to Svensson (1998), the regular inflation forecasts prepared by central banks over the medium term target horizon serve as the *de facto* intermediate target. The forecasts show the relationship between current actions of monetary policy and the target. The forecasts and explanations[14] on how the central bank plans to control inflation when properly communicated increase the credibility of the central bank. As a result, people's expectations on future inflation are low because they become more confident that the central bank will achieve the goal of price stability. Also, it has been pointed out that committing to inflation target reduces the chances for discretionary monetary policy (Debelle, 1997).

2.5.2 Elements of Inflation Targeting in Ghana[15]

Over the years, the Bank of Ghana has pursued its policies and activities in line with the changing conditions of the economy. The Bank of Ghana Ordinance (No. 34) of 1957 explicitly defined the role of the Bank to suit the circumstances at that period by pursuing proactive policies to foster the credit system, creating financial institutions as growth-promoting vehicles, while exercising its fundamental responsibilities of currency management and acting as the Government's banker. The laws relating to the objective of the Bank of Ghana has been amended and consolidated by the laws of Ghana, including the Bank of Ghana Act 1963 (Act 182), Bank of Ghana (Amendment) Act 1965 (Act 282), and the Bank of Ghana Act 2002 (Act 612).

[14] Inflation targeting central banks publish regular monetary policy reports that include the forecasts of inflation and other variables, a summary of its analysis behind the forecasts, and the motivation for its policy decisions. The emphasis on transparency is based on the insight that monetary policy actions and announcements affect agent expectations.

[15] Refer to Hammond (2012) for further details

The Bank of Ghana Act 2002 (Act 612) establishes that the primary objective of the Bank should be to maintain stability in the general level of prices. In addition to this objective, the Act stipulates that the Bank of Ghana shall, without prejudice to the primary objective, support the general economic policy of the Government. By further establishing that the Bank shall be independent of instructions from the Government or any other authority, the Bank can be said to have reached a considerable degree of *de jure* independence necessary for the conduct of monetary policy. While the inflation target is jointly set by the government and the Bank, responsibility for interest rate decisions has been referred to the Monetary Policy Committee (MPC) of the Bank.

After the Bank was granted operational independence in 2002, it started practising some aspects of inflation targeting until it officially ushered into a fully-fledged inflation targeting in May 2007, as the second country in Africa (after South Africa). This inflation targeting framework involves targeting inflation directly without using a monetary aggregate as an intermediate variable. There are some practical issues regarding the implementation of inflation targets. The main issues are the assignment of the target, the interaction of the target with other policy goals, the appropriate definition of the target, the role of inflation forecasts and the degree of the accountability of the central bank to achieve the target.

2.5.2.1 Target Horizon

The implementation of inflation targeting in Ghana is considered to be similar to what is being practised elsewhere. The announcement and specification of the inflation target which depends on the degree of the central bank's independence differs across countries. While in some countries the target is set by the government (e.g. Brazil, Israel, Norway and United Kingdom), in others it is jointly set by the government and the central bank (e.g. Canada, Czech Republic,

South Africa and New Zealand). Some suggestions are that, in order to improve the credibility of the monetary policy, the central bank and the government should work together in such a manner that the government decides on the goal of the monetary policy and delegates its operation to the central bank.

Since monetary policy affects the economy and particularly inflation with long, variable, and uncertain lags, it is important to specify the time it takes for policy decisions to achieve the preannounced target and the time period that the target predominates. Most inflation targeting countries set the target horizon by considering the level of inflation at the time of specifying the target which also depends on whether the inflation targeting is flexible or strict; and the ability of monetary policy to offset deviations from short-term shocks. The target horizon for Ghana, which is assessed and revised annually, is 1 year.

2.5.2.2 Inflation Forecasts

One major difference between the inflation targeting regime and other policy regimes stems from the intermediate role played by inflation forecasts. Essentially, the regime is based on the conception that policy is designed to target inflation through inflation forecasting. Jonsson (1999) argues that in an inflation targeting regime, monetary authorities should be able to model inflation dynamics and to forecast the inflation to a reasonable degree. It further assumes that monetary authorities have access to policy instruments that are effective in influencing the inflation outcomes, enhanced by sufficiently developed financial markets. This requires the Bank to build powerful models that can explain the dynamics of the economy properly. Such models enable the policymakers to fully understand the linkages between monetary policy instruments and the various macroeconomic variables. This modelling effort includes a macroeconomic model of the economy, a satisfactory model to forecast inflation, and an empirical description of the monetary transmission mechanism. Under the inflation targeting framework, the Central

Bank forecasts the future path of inflation and reacts to deviations between the inflation forecast and actual inflation at any time. The deviation determines how much monetary policy has to be adjusted. The forecasting models used at the Bank of Ghana include a micro-founded forward looking rational expectations macro-econometric model, as well as auto-regressive and error correction forecasting models for the short term dynamics.

2.5.2.3 Monetary Policy Formulation

With regards to monetary policy formulation, the Act delegates that to a seven-member MPC which includes the Governor, the two Deputy Governors, Head of Banking Supervision, and the Head of Monetary Policy and Financial Stability Department (MPAFSD). In the discharge of its duties, the MPC holds bi-monthly meetings to set the interest rate it judges would enable the Bank achieve its inflation target. During this meeting, the Head of MPAFSD presents technical reports and extensive briefing on the economy including developments in the global economic environment and an inflation forecast to the Committee. Relevant issues will be identified and discussed, and the individual members will have the opportunity to explain their cases for what level of interest rates they prefer. The final decision is taken by voting. The side with majority votes carries the day. In the case of a tie, the direction of vote of the Governor would be used to determine the direction of the prime rate. After the meeting, the MPC-led by its Chairman – holds a press conference at which the decision of the Committee is communicated and explained to the general public. Although interest rate assumptions are not communicated at this press briefing, the details feature in the regular reports published by the Bank on its website.

2.5.3 Monetary policy in a dollarized economy

A common view shared by many studies is that dollarization makes monetary policy more complicated and less effective. The existence of dollarization generally makes the credit, balance sheet, and interest rate channels less effective, while the exchange rate channel is more effective.

One reason for the exchange rate channel to be more effective is that dollarization makes exchange rate more volatile, which forces central banks to frequently intervene in the foreign exchange market in an attempt to stabilize the exchange rate. Also, openness, remittance, and availability of external funds for loans give individuals a wider opportunity to finance their consumption as well as investment. As a result, even if there is a change in domestic monetary policy, the response might be slow which makes the interest rate and bank lending channels less effective.

One key finding in the dollarization literature hypothesizes that, since dollarization reduces the costs associated with switching to use of foreign currency, it causes an increase the volatility of money demand, which impinges on the central bank's capacity to conduct monetary policy. One challenge that policymakers contend with relates to the choice of intermediate target for monetary policy. This occurs especially with reserve money targeting framework, where the central bank has to choose whether to take account of or omit foreign currency in the definition of monetary aggregates. A commonly held view is that, a suitable intermediate target depends on the control it has on the final target – usually price level (see Balino et al., 1999).

This has generated an unending debate. Alvarez-Plata and Garcia-Herrero (2008) argue that, if the choice of intermediate target is dependent on its effect on the price level through transaction demand for money, then including foreign currency in circulation in the targeted monetary aggregate is appropriate. Accordingly, if foreign currency deposits are held as store of value but not as means of payment or unit of account, it should be omitted. Opposing this line of argument, Berg and Bonensztein (2000a) provide evidence for Latin American countries and suggest that monetary aggregates that comprise foreign currency deposits are better. According to them, including foreign currency in circulation does not enhance the power of narrow monetary aggregates in predicting prices. This issue becomes more crucial in the case of

developing countries where the determination of foreign currency in circulation remains a tedious job.

Billmeier and Banoto (2004) argue that, the effectiveness of monetary policy is not hampered if dollarization takes the form of asset substitution. This is because domestic currency is still used as a medium of transactions, even if there is asset substitution which involves using foreign currency holdings for store of value functions. This suggests that monetary policy is only hampered when there is currency substitution – where the function of foreign currency is to serve as a medium of exchange in the domestic economy. According to Balino et al. (1999), whether it takes the form of currency substitution or asset substitution, dollarization makes the demand for domestic money more volatile. A side issue of this argument is that the control of broad monetary aggregate becomes challenging due to the existence of the foreign currency component. This usually confounds the role of the central bank in the fight against inflation. Zamaroczy and Sa (2003) provide evidence for Cambodia where the difficulty associated with the control of narrow money has rendered the monetary aggregate channel of monetary policy ineffective.

The widespread acceptance that dollarization weakens the monetary policy transmission mechanism is anchored on the purported limited effect of monetary to control monetary aggregates. The inability of the central bank to control liquidity could fuel consumer price inflation, particularly as monetary policy instruments affect only a portion of domestic currency holdings. Also, the fact that high dollarization reduces the capacity of central banks to stem a liquidity crisis by playing the role of lender of last resort, exposes the financial system to liquidity and solvency risks (Mengesha & Holmes, 2015). Since international reserves are the only cushion to curb bank runs on foreign currency deposits, the incidence of high rates of deposit dollarization also impinges a colossal limitation on monetary policy management.

It has been argued that a higher degree of partial dollarization would create a potentially serious problem for inflation targeting. According to Calvo (1999), this is expected to be more crucial in emerging markets where the balance sheets of households, firms, and financial institutions are substantially dollarized, and the bulk of long-term liabilities are denominated in foreign currencies. Because inflation targeting necessarily requires flexible exchange rates, exchange rate fluctuations are inescapable. However, large and abrupt depreciations may increase the burden of debt denominated in foreign currency, bring about deterioration of balance sheets, and build-up the risks of a financial crisis along the lines discussed in Mishkin (1996). This recommends that the exchange rate cannot be ignored under an inflation targeting regime in emerging economies, although the importance ascribed to this should be subordinated to the inflation objective. This also denotes that strict supervision of, and severe prudential regulations on financial institutions aimed at ensuring that the system is capable of withstanding exchange rate shocks, is imperative for a viable inflation targeting regime (Mishkin, 2000).

A few studies on African economies provide some empirical findings to show that one policy instrument or the other has been ineffective or weak (Christensen, 2011). Although Cheng (2006) and Ngalawa and Viegi (2011) provide some evidence of effective monetary transmission in Malawi, a number of studies report otherwise. In particular, Buigut (2009) finds the interest rate channel ineffective in three East African Countries, namely Kenya, Uganda and Tanzania. The study by Mugume (2011) also demonstrates that the exchange rate, interest rate, and credit channels are less successful in Uganda. Also, Saxegaard (2006) describes the transmission mechanism in three Sub-Saharan African countries, namely Kenya, Nigeria, and Uganda as weak.

Among other factors, the study by Christensen (2011) points out that an underdeveloped financial market has undermined the monetary policy transmission mechanisms in most African

countries, including the financially developing low income African countries of Angola, Ethiopia and Malawi. Conclusively, the ability of monetary policy adjustments to direct the development of prices and economic activity is still limited, since important transmission channels are virtually ineffective. The difficulty with stabilization in developing countries is severe indeed, which possibly presents a key challenge to policymaking.

In the case of Ghana, research on this subject is virtually absent. The only study that addresses monetary policy transmission is Abradu-Otoo, Amoah, and Bawumia (2003) for 1969-2002. Analysis of impulse response functions reveals that monetary policy in Ghana is less effective, whether M2 (broad money) or Treasury bill rate is used as the policy variable. The study reports some findings that are not consistent with theory. For example, inflation increases and exchange rates depreciate in response to a positive movement in the rate of return on Treasury bill.

On methodology, analysis based on vector autoregression (VAR) technique proposed by Sims (1972) in the form of impulse response function and variance decomposition has been applied extensively in the literature. A vast body of economic literature applies VAR estimation to explore monetary policy instruments and their relationship with macroeconomic variables for developed economies (for example, Bernanke & Woodford, 1997; Blanchard, 1989; Christiano, Eichenbaum & Evans, 1996; Friedman & Kuttner, 1992; Sims, 1992). The technique has been applied to studies in emerging and developing countries including the ones reviewed above.

Overall, the review has revealed that both the interest rate and the monetary base have served as a weak tool for monetary policy transmission in sub-Saharan Africa. Again, whether the said variable is modelled within the structural or recursive means does not yield different results (Mishra & Montiel, 2012). The emerging economies face crucial challenges in the

implementation of monetary policy. Actually, monetary policy in these countries has experienced occasions of very high inflation and instability (Mishkin, 2000).

2.6. Some empirical studies on Ghana

2.6.1 Drivers of inflation and its control in Ghana

The two major causes of inflation entrenched in the economics theory are propounded by the monetarists who consider inflation as basically a monetary phenomenon (see Hendry, 2001; Friedman, 1963) and structuralists who conversely emphasize that supply-side constraints determine inflation (Bernanke, Boivin, & Eliasz, 2005). This dissenting theory has spurred a controversy on the true determinants on inflation. Ghana has experienced persistent problems with out-of-control inflation dynamics. Earlier studies based on the Ghanaian economy prior to 1983 did not show divergence on the causes of inflation. According to Sowa and Kwakye (1993), the predominance of demand factors in the inflationary process was confirmed in pre-1983 studies by Lawson (1966), Ahmad (1970), Ewusi (1977) and Steel (1979). A post-1983 study by Chhibber and Shafik (1990) confirms that monetary growth was instrumental in determining the pace of inflation. A rebuttal by Sowa and Kwakye (1993) that real-side dynamics like food prices are vital in price formation spurred a platform for interminable arguments. They suggest that output volatility, especially in food production, rather than monetary factors drive inflation.

Through a vector error correction model, Attah-Mensah & Bawumia (2003) affirm that inflation in Ghana can be described as a monetary process. However, the possible effect of real factors in the formation of prices was not considered in the study. Another attempt to model inflation Ghana was Ocran (2007). The error correction model finds as short-run drivers; inflation inertia, Treasury bill rates, exchange rates, and money supply. The inflation inertia is found to be the dominant factor of inflation in Ghana. The author argues that inflationary expectations need to

be reduced considerably in order for the Treasury bill rates to serve as an effective nominal anchor.

Arguing on methodological grounds that most of the earlier studies have applied short run estimators like VEC models, Adu and Marbuah (2011) employ the autoregressive distributed lag (ARDL) methodology in examining the short-run and long-run drivers of inflation in Ghana. They also document that the estimator is appropriate for the sample because of its good small sample properties. In line with the findings of Sowa and Kwakye (1993), they report that the drivers of inflation are both structural and monetary forces. On this basis, it was argued that supply-side constraints should be the target in order to bring inflation to moderate levels.

Another side of the argument, contrary to the findings of Chhibber and Shafik that depreciation of the official exchange rate could not have impacted inflation significantly[16]; has been built on the conclusion by Sowa and Kwakye (1993) that exchange rate depreciation was considerable in the inflationary process. To that effect, it could not be discounted in characterising price generation and inflationary trends. Other studies argue that the depreciation of the domestic currency is an important source of inflation. They include Sanusi (2010) and Donyina-Ameyaw (2004). In the case of Donyina-Ameyaw (2004), the official interest rate was dropped and the exchange rate in the black market had significant pass-through effects. The significant contribution of exchange rate depreciation in the inflationary trend has been buttressed in other empirical studies (see, for example, Attah-Mensah & Bawumia, 2003; Bawumia & Abradu-Otoo, 2003).

[16] The authors argued on the basis that most prices except petroleum prices were transacted at the parallel exchange rate and were assumed to have already adjusted to the rate

The exchange rate has been recognized as a useful variable in the dynamics of inflation in Ghana to the extent that Ghana's inability to achieve low inflation rates has been somehow linked to the persistent fall of the cedi in the flexible exchange rates era. Some studies have also sought to establish the extent of pass-through effects of exchange rate on inflation. Some empirical findings suggest a low consumer price response to exchange rate changes in sub-Saharan African and to some extent even zero (example, Devereux & Yetman, 2010; Frimpong & Adam, 2010).

Basing on the findings of some Ghanaian studies that depreciation of the cedi is a major component of inflationary trends in Ghana (for example, Sowa & Kwakye, 1993; Bawumia & Abradu-Otoo, 2003); Sanusi (2010) concludes that the pass-through effect of exchange rate in Ghana is considerably high. Such studies have linked Ghana's inability to attain lower rates of inflation with the continuous erosion of the value of the cedi. Adu, Karimu, and Mensah (2015) provide fresh evidence on exchange rate dynamics in Ghana and their implications for domestic price stability. In particular the authors identify the sources of exchange rate movements and estimate the degree of exchange rate pass-through effect on consumer price inflation. The results highlight supply, demand, and nominal shocks as significant drivers of exchange rate movements in Ghana although with varying magnitude and direction. The authors also report of a high but incomplete pass-through effect of exchange rate movements on domestic prices.

Some previous studies also considered the consequences of exchange rate on the general economy. For example, Jebuni, Sowa, and Tutu (1991) ascertain how the real exchange rate affects output, imports, and exports. They report how significantly the real exchange rate explains output whereby appreciation causes a decline in output. Depreciation of the real exchange rate was also found to exert negative and positive effects on imports and exports respectively.

On the determinants of exchange rates, a handful of studies have been conducted using Ghanaian data. Using two-stage least squares regression, Chhibber and Shafik (1990) ascertain the causes of black market premium and inflation for 1965 – 1988. According to them, the real effective official exchange rate, expected depreciation of exchange rate and interest rate differentials affect the premium. They find that, real effective exchange rate devaluation reduces the premium, whereas widening interest rate differentials also causes increases in the premium.

The determinants of the parallel market exchange rates have also been explored by Gyimah-Brempong (1992) using quarterly data for the period 1972 – 1987. The study reports that the parallel market rate is affected by official exchange rate policy both directly and indirectly. The study concludes that official exchange rate devaluation brings about appreciation of the black market premium. A related study by Mumuni and Owusu-Afriyie (2004) using cointegration and VEC analysis find the Treasury bill and inflation rates as useful in explaining the cedi/dollar dynamics. They find that, inflation and interest rates have opposite effects for the cedi/dollar exchange rates.

The dynamics of inflation in Ghana has generated a continual debate, with divergent opinions on the factors behind persistent rising prices. Spurred by the high and unpredictable trend of consumer price inflation experience in the pre and post Economic Recovery Programme (ERP) era policymakers and academics alike have analyse the potential sources, both theoretical and empirical, but the findings are largely inconclusive. According to Sowa and Kwakye (1993), most studies conducted prior to the ERP affirmed that inflation in Ghana is a monetary phenomenon (see Lawson, 1966; Ahmad, 1970; Ewusi, 1977; Steel, 1979; Kwakye, 1981 cited therein). However, the recent literature contend that excessive demand pressure among other factors are important in explanation the patterns of inflation.

A study conducted by Chhibber and Shafik (1990) also established that monetary growth has been instrumental in determining the pace of inflation in Ghana. However, economists questioned why inflation had continued to be above targets set within the ERP/Structural Adjustment Programme that had implemented price stabilization policies mostly directed at restricting excessive monetary growth including elimination of fiscal deficits. Despite the near-consensus of the preceding literature, a rebuttal by Sowa and Kwakye (1993) that supply-side dynamics like food prices are vital in price variations spurred a platform for interminable arguments between *monetarists* and *structuralists* blocs that has ensued to date. Consistent with the *structuralists* view, they believe that supply-side rather than monetary effects drive inflation in Ghana.

Application of the error correction technique by Sowa (1994, 1996) using Ghanaian data covering 1963 to 1990 rectified the short-run dynamics deficient in prior studies including Sowa and Kwakye (1993). After establishing the integration process of the variables as order 1, inflation was found to share a common long run process with money, output, and exchange rate. The short-run as well as long-run dynamics highlighted that output volatility fuels inflation more than monetary factors. For that reason, the author argued that more attention should be paid to supply-side factors in Ghana's quest to achieve low inflation.

Following this, most empirical studies that modelled inflation dynamics in Ghana over the past decade have employed the cointegration and error correction technique thanks to its strength in modelling both the short-run and long-run dynamics. Using monthly data from 1983-1999, Bawumia and Abradu-Otoo (2003) model inflation within an error correction mechanism using expected inflation, money supply, real output and exchange rate as determinants. The authors point out a long-run equilibrium relationship and corroborate that, whereas inflation in Ghana is positively related to money supply and exchange rates, the contrary is true for real output.

Similarly, Atta-Mensah and Bawumia (2003) employs the error correction framework to model inflation for 1969:1 to 2002:4. The dynamics of the model attributes Ghana's high inflation rates to the rapid growth of money and exchange rate depreciation. The authors concluded that Ghana's inflationary tendencies has been purely a monetary phenomenon and admonished the Bank of Ghana to remain extra vigilant in its monitoring of the growth rate of broad money.

Another study by Abradu-Otoo et al. (2003) covering 1969:4 to 2002:4 supports the view that money supply and exchange rate depreciation cause a rise in inflation. The authors cite the findings of Sowah and Kwakye (1991) that monetary factors account for about 15% of the total variation in prices, and uphold that inflation in Ghana is a monetary phenomenon. Ocran (2007) uses quarterly data spanning 1960:1 – 2003:4 within the Johansen (1988) cointegration and error correction technique and reports that past inflation is a significant determinant of inflation, as well as growth in money and changes in Treasury bill rate. Whereas exchange rates appeared significant in the short-run, terms of trade and foreign price levels were not direct determinants of short-run inflation.

On the part of Adu and Marbuah (2011), the determinants of inflation in Ghana were explored for the period 1960 – 2009. The Autoregressive Distributed Lag (ARDL) model confirmed the role of money in the dynamics of inflation in Ghana. In the long-run, fiscal deficit and nominal interest rate followed money supply in defining price development. The authors based on the high elasticity of inflation to monetary growth to argue that the ability to control monetary expansion is likely to be more effective in cementing price stability efforts in Ghana.

The studies reviewed above have indicated that, although monetary variables are an important determinant of price movements in Ghana, other factors such as exchange rate depreciation, wages, and exogenous shocks in the domestic food supply, petroleum prices, and government

fiscal policy, are also important. Contrary to the findings of Chhibber and Shafik (1990) that depreciation of the official exchange rate could not have impacted inflation significantly, a number of studies have built on the argument raised by Sowa and Kwakye (1993) that exchange rate depreciation was considerable in the inflationary process. Supporting this finding, Dordunoo (1994a) underscores the role of rapid depreciation of the cedi and resultant hikes in import prices to the inflationary patterns. The author argues that it is difficult to downplay the significant contribution of currency depreciation in characterising price generation in Ghana. This has been buttressed in other empirical studies for example, Sanusi, 2010; Donyina-Ameyaw, 2004; Attah-Mensah & Bawumia, 2003; Bawumia & Abradu-Otoo, 2003; Ocran, 2007).

2.6.2. Asset substitution and stability of money demand function

Demand for money models have been tested extensively in empirical studies as one of the pillars of macroeconomic theory and policy modelling especially for monetary policy formulation and implementation. It has gained renewed interest due in part to advances in econometric applications. Bahmani-Oskooee and Chomsisengphet (2002) refer to the introduction of the cointegration technique and its application as a major boost for studies in both developed as well as less developed countries. The cointegration technique has become widely recognised in the assessment of the nature and stability of the long-run money demand function. In its original framework, evidence of cointegration has been taken to suggest a stable relationship between some measure of monetary aggregates and other determining variables such as real income, inflation, and interest rates. A few studies have also considered the money demand function in Africa. There have been some individual country studies including Domowitz and Elbadawi (1987) for Sudan, Adam (1992) for Kenya, Fielding (1999) for Cote d'Ívoire, Henstridge (1999) for Uganda, Randa (1999) for Tanzania, Adam (1999) for Kenya, Nell (2003) for South Africa, Anoruo (2002), Akinlo (2006) and Nwafor, Nwakanma, Nkansah, and Thompson (2007), Kumar, Webber, and Fargher (2013), among others for Nigeria. Other studies have also

considered a group of African country (Arize, Darrat, & Meyer, 1990; Bahmani-Oskooee & Gelan, 2009; Fielding, 1994; Simmons, 1992).

A few studies have concentrated on Ghana such as Kovanen (2011), Dagher and Kovanen (2011), Bawumia and Abradu-Otoo (2003), Andoh and Chappell (2002), Ghartey (1998a) and Kallon (1992). These studies differ in terms of time period, choice of variables, data frequency, and methodological approach. Dagher and Kovanen (2011) employ the bounds testing procedure to test the stability of the long-run money demand using quarterly data from 1990Q1 to 2009Q4. The study reports a strong evidence of a stable and well-defined long-run money demand function based on cointegration between broad money (M2/M2+), prices, income, nominal effective exchange rate, and other interest rate variables in Ghana and US. Since the interest rate variables were found statistically insignificant, the model was estimated with money, income, and nominal exchange rates. A related study by Andoh and Chappell (2002) which covers 1960 - 1996, uses real per capita money stock (M2), real per capita income as "transactions demand" variable and inflation or nominal interest rate as "speculative demand" variable. The study established evidence of cointegration and reported that the demand for money in Ghana became less sensitive to inflation after 1983.

Ghartey (1998b) tests the stability of narrow money for 1970Q4 to 1992Q4 using the two-stage error correction mechanism. Variables included are narrow money, income and prices since inflation and interest rates were insignificant or wrongly signed. The study confirmed the price homogeneity property and long-run unit income elasticity. The exchange rate variable was also negatively correlated to money demand. Kallon (1992) also modelled a demand function for narrow money using real Gross National Product, discount rate and inflation as determinants, for 1966Q1 - 1986Q4. These studies have found the demand for money as income elastic and interest rate inelastic.

As financial markets become more open and integrated, the need to incorporate the contributions of international variables such as interest rates and exchange rates in money demand models has become imperative. The argument has been that the financial liberalization in most countries has made it easy and attractive to demand and use other currencies as a means of transactions. Consequently, money demand functions may become unstable which can render monetary policy ineffective. Studies that have sought to achieve this have followed the portfolio balance approach popularized by Cuddington (1983) and Branson and Henderson (1984) to explore the effects of stability of money demand models in the presence of currency substitution or capital mobility. Other studies had focused on money demand in Canada (for example, Bordo & Choudhri, 1982; Imrohoroglu, 1994; Miles, 1978).

A well-documented strand of the literature has sought to apply the model in investigating how expected changes in relative risks and returns among currencies lead economic agents to diversify their portfolios of domestic and foreign money balances, and the impacts that can have on the financial and economic structure of an economy. For example, the works of Ramirez-Rojas (1985), Melvin (1988), Melvin and Afcha (1989), Savastano (1996) provide evidence on currency substitution for Latin American countries. The model has also been adopted for studies by El-Erian (1988) for Egypt and Yemen Arab Republic, Mueller (1994) for Lebanon, Akçay et al. (1997) for Turkey, among others. Alami (2001) also sought to extend the model to differentiate currency substitution (holding foreign money as a medium of exchange) from dollarization (holding foreign money as a store of value) in a developing economy where foreign currency deposits earn a competitive rate of return.

Variants of models that account for developments in the external sector have been in existence for quite some time. For instance, Arango and Nadiri (1981) estimated the demand for money in

open economies by verifying the hypothesis that foreign financial aid and monetary influences on the demand for real cash balances are transmitted by changes in foreign interest rates and exchange rate expectations. The authors estimated the demand for real cash balances on real permanent income, short-term domestic interest rates, short-term foreign interest rates and the exchange rate, exchange rate expectations, inflationary price expectations. In their conclusion, it was argued that discarding the effects of foreign interest rates and exchange rate expectations might lead to demand for money misspecification.

Other studies have also attempted to define a proxy for currency substitution and modelled its demand in the domestic economy. In Elkhafif (2003), the share of nominal foreign currency in money supply was used as a variable for currency substitution and was modelled as a function of the nominal exchange rate, and the interest rate differential between the interest rate on local currency and that on the dollar within an error-correction framework for Egypt and South Africa. The study used the elasticity of the exchange rate as a measure of currency substitution and concluded that currency substitution does exist, although the elasticity was larger in South Africa than for Egypt. Yinusa and Akinlo (2008) also estimated different models of money demand for Nigeria. The study confirmed the presence of currency substitution in the domestic banking system in Nigeria. A major factor driving this process was exchange rate volatility especially real parallel market exchange rate volatility.

A recent argument based on the theory of asset demand by Baharumshah, Mohd, and Masih (2009) is that the demand for money should be a function of the resources available to individuals, including their wealth and the expected return on other assets relative to the expected returns on money such as stock returns. Their model of money demand with stock market prices suggested that real money balances are in long-run relationship with real income,

inflation, real foreign interest rates, and stock prices, pointing to the wealth effect of stock returns on the money demand function.

2.7. Conclusion

This chapter has covered a brief review of the definitions, types, and measures of dollarization or currency substitution and also presented some theories on the determinants along with the costs and benefits associated with the phenomenon. Under the definition, it was concluded that dollarization and currency substitution have been used interchangeably. There is no single definition that exists for dollarization or currency substitution. The widely held definition has been the adoption of a foreign currency to perform the functions of money. On the issue of how the foreign currency is used, there are two types of dollarization – partial dollarization (where the foreign currency performs some functions of money) and full dollarization (where the foreign currency performs all the functions of money – currency substitution).

The process of dollarization has been described as a continuum with the last stage described as the use of foreign currency as a medium of exchange and known as currency substitution. Several measures or indicators have been used to describe the concept. The most commonly used has been defined as deposit dollarization, which is the ratio of foreign currency deposit to total deposit in the banking sector. On the consequences of dollarization, some key issues emerge – the function of money being performed by the foreign currency, whether the foreign currency has been officially adopted (*de jure*) or not (*de facto*), and the extent at which the foreign currency is been used in the domestic economy (full dollarization or partial dollarization).

It is also clear from the review that many of the studies that have been conducted in the emerging market economies, often citing data constraints, have tilted towards Latin American and East Asian countries. However, as a segment of the emerging markets, Africa's financial

markets appear not to have received adequate attention by researchers on these issues. The paucity of literature on sub-Saharan African countries like Ghana and the continent in general makes it difficult to establish the exact nature of the relationship between dollarization and macroeconomic fundamentals. This study has made the attempt at filling this significant gap in the literature. The study reported in this thesis focuses on dollarization and macroeconomic instability, with particular focus on Ghana in a collection of essays. The remainder of the chapters are empirical essays which explore different questions connected to the determinants of financial dollarization and the consequences on macroeconomic stability in Ghana.

CHAPTER THREE

DETERMINANTS OF DOLLARIZATION IN GHANA

3.1. Introduction

The rising trend of demand for foreign currency[17] in recent years presents a major challenge for policymaking in developing countries. Most of these countries have witnessed the use of other country's currency as a store of value, as a unit of account, or as a medium of exchange. In most extreme instances, the foreign currencies replace the local currency or at best used alongside as though it has been given the necessary backing as the legal tender for transactions in the country. The phenomenon has generally been triggered by macroeconomic instability manifesting in high and volatile rates of inflation, strong and intractable depreciation of the domestic currency, undeveloped capital market, market imperfections, and inadequate regulations which lead to loss of confidence in the local currency to serve as a legal tender.

The mounting evidence of dollarization in Ghana has been gathered from, among other things, the increasing demand for and use of foreign currency for transactions, quotation of prices of some domestic goods and services in foreign currency (notably the United States dollar), and statements made by leading government officials and economists alluding to the growing phenomenon in the economy. The theme has attracted the interest of policymakers in recent discourse on the stability of the Ghanaian economy and has been in the spotlight given that the incessant depreciation of the cedi has somewhat been attributed to the mounting dollarizing effect in the Ghanaian economy. The debate was further fuelled when the Bank of Ghana instituted what has been described in some circles as "*draconian*" measures in February 2014 in its bid to avert the rapid depreciation of the cedi.[18]

[18] According to the Bank of Ghana, the attempts to enforce restrictions on foreign exchange transactions were meant to halt the free fall of the cedi. In a statement issued on Friday, 08/08/2014, the Bank reversed almost all the directives. It stated that the

Another branch of the literature has focused on the determinants and characteristics of currency substitution and dollarization in developing countries (for example, Ortiz, 1983; Canto, 1985; Ramirez-Rojas, 1985; El-Erian, 1988; Melvin, 1988; Calvo & Vegh, 1992). Several theories have sought to explain the relationship between macroeconomic fundamentals and dollarization. Empirical modelling of dollarization in developing countries has produced nothing but controversial results, with the direction and statistical significance of the effects of macroeconomic variables on dollarization varying from one study to the other (see, *inter alia*, Savastano 1996; Sahay & Vegh 1996; De Nicolo et al., 2003; Ize & Levy-Yeyati 2003; Rennhack & Nozaki, 2006; Levy-Yeyati, 2006). This makes the subject an interesting empirical adventure that seeks further endeavours to model the evolution of dollarization and the crucial dilemmas it presents to macroeconomic management and policymaking.

In the case of Ghana, there is an on-going debate on the drivers of dollarization. The Central Bank implemented foreign exchange rules based on its belief that the rising dollarization is the cause of exchange rate depreciation. On the other hand, some economists, including a former deputy Governor of the Bank, have questioned the prudence in that attempt. They argue that, it is rather the depreciation of the cedi that brings about dollarization and not the other way. There is little empirical work on the determinants of dollarization. Interestingly, to the best of the author's knowledge, there is no empirical study that captures the determinants of dollarization in Ghana despite the heightened controversy. Ghana is one of two countries in Africa that formally adopted inflation targeting framework/regime in the early 2000. It also embarked on a redenomination of its currency in July 2007 by knocking four zeros off the old currency.

reversal had been based on consultations with stakeholders and the general public as well as analysis of the available data and the fact that it has observed some implementation challenges, which indicated that the rules have had limited effect and confirmed the position of those who had argued earlier that the directives were inappropriate.

However, no study has considered whether the turn of events has contributed to the trend of dollarization in the economy. The subject has become more imperative, especially with the difficulty in proving whether weak macroeconomic fundamentals is the precursor to dollarization as argued by Bawumia (2014) or otherwise.

The rise in demand for foreign currency in Ghana has been described as a remarkable attribute of the financial sector reforms and liberalization that started in the 1980s (Adenutsi & Yartey, 2007). With the aim of integrating domestic financial markets with the rest of the world, capital account controls/restrictions have been relaxed and to some extent have paved way for the conduct of transactions in both domestic and foreign currencies, albeit within some restrictions. This has seen astronomical growth in the share of foreign currency denominated assets and liabilities in the financial system. Despite some significant improvement in the macroeconomic fundamentals in the last few years, the Ghanaian economy continues to be characterised by relatively high and persistent inflation rates, continuous depreciation of its currency, unbridled recurrent budget deficits, and rising stock of public debt (Bawumia, 2014). The inflation rate which declined from 18.1 percent in 2008 to 12.5 percent in 2011 has increased steadily to 17.4 percent in October 2015 (Ghana Statistical Service, 2015). Fiscal deficit and stock of public debt have seen dramatic increases reaching 10.8 and 55.5 percent of GDP respectively at the end of 2013 (Terkper, 2014). According to the Finance Minister, the stock of public debt stood at 60.8 percent of GDP at the end of September 2014. Also, despite all the policies embarked upon by the Bank of Ghana and other policymaking agencies, the cumulative depreciation of the cedi against the major trading currencies reached almost 30 percent in the first half of 2014 (Bank of Ghana, 2014). Both the World Bank and the International Monetary Fund (IMF) expressed a worrying response about the deteriorating macroeconomic fundamentals and the challenges

engulfing the lower middle income country.[19] It has been argued that macroeconomic stability and fiscal discipline are necessary for curbing dollarization as against direct measures such as compulsory conversion of foreign currency earnings to the domestic currency as it substantially diminishes the government's credibility and hypes the risk perceived by domestic residents (Berg & Borensztein, 2000b). However, the success or failure of such attempts would be based on understanding the true drivers of the process in both the short and long-run. To the best of our knowledge, despite the debate and controversy surrounding the evolution of dollarization of the Ghanaian economy no study has attempted to establish its driving forces empirically.

This study strengthens the frontiers of the existing literature on the determinants of dollarization in emerging markets. The purpose is to present further evidence on dollarization in Ghana by exploring the long-run determinants of the process. The study makes use of most updated data. The fact that we make use of monthly data up to March 2015 is a novelty because most previous studies have at best used quarterly data. Besides, our study does not include the fixed exchange rate regime. Some of the landmark activities during the period are the implementation of HIPC, adoption of inflation targeting monetary policy, major reforms in the financial sector, redenomination of the domestic currency, among others have been captured in this present study. Due to these developments, the study makes another contribution to the literature by including proxies for financial development and economic activity. We include a proxy for economic activity to encompass potential market failures and fluctuations in aggregate demand not captured by the other measures, such as economic and institutional factors that influence the development of local currency markets (Levy-Yeyati, 2006). It is expected that a well-developed financial system would be associated with better management and investment opportunities in domestic currency. We capture the credibility of macroeconomic policies by including a proxy

[19] Ghana reached a US$1bn bailout agreement with the IMF in February 2015 to shore up the economy and bring about fiscal consolidation in order to ensure stability of the cedi and further give credibility to government policies.

for inflation targeting. This is because the adoption of explicit (fully-fledged) inflation targeting monetary policy in May 2007 was expected to boost the credibility of macroeconomic policies, and therefore the regime is expected to reduce the extent of dollarization in the economy. This would shed light on the pattern of the phenomenon, extract the possible implications for policymaking, and prescribe options to contend with the situation. The empirical evidence suggests that financial dollarization shares a common stochastic trend with exchange rates, inflation, interest rate differential, real output, and financial development. The long and short run analysis points to the important role of exchange rates depreciation and financial development in the dollarization process in Ghana. Whereas the depreciation of the cedi induces a switch to the use of foreign currency, financial development diminishes the trend.

The remaining sections of the chapter are structured as follows: Section 3.2 relates the behaviour of dollarization to the movements of exchange rates, interest rates, inflation, and the other variables under consideration. The properties of the data, data sources, descriptive statistics, and correlation are presented. We do this to present a preliminary evidence of possible association of the variables. Section 3.3 is an empirical model for the evolution of dollarization and an overview of the econometric methodology. Section 3.4 presents the results and analysis, indicating a long-run relationship between the variables within the ARDL bounds testing framework. Section 3.5 is the conclusion and policy recommendations.

3.2. Macroeconomic factors and the dollarization process

The process of dollarization has usually been described to reflect economic agents' efforts to protect the value of their wealth and income, in the context of deteriorating macroeconomic fundamentals, that have an adverse effect on the expected return of domestic currency holdings relative to those on foreign balances, as well as in response to changes in institutional, political and external factors that influence expectations regarding the liquidity of domestic versus foreign

currency denominated assets (Bahmani-Oskooee & Domac, 2003). In this section, we highlight the key determinants of the rise in dollarization in Ghana since January 2000. The data used and their sources are described in Table 3.1 below.

Table 3.1: Variable description and sources

Symbol	*Variable name*	*Description and source*
FCD	Foreign currency deposits	Natural logarithm of foreign currency deposit in Deposit Money Banks *Source:* Bank of Ghana Research Department database
TD	Total deposits	Natural logarithm of stock of total deposits with Deposit Money Banks – end of period *Source:* Bank of Ghana Research Department database
p	Price level	Natural logarithm of consumer price index (2010=100) *Source*: International Financial Statistics (IFS) 2015 database
x	Exchange rate	Natural logarithm of end of period nominal GH¢:US$ exchange rate *Sources*: Bank of Ghana Research Department database and International Financial Statistics (IFS) database
M	Money supply	Broad money (M2 and M2+) *Sources*: Bank of Ghana Research Department database and International Financial Statistics (IFS)
y	Real output	Natural logarithm of the Composite Index of Economic Activity compiled by the Bank of Ghana *Source:* Bank of Ghana Research Department
r	Domestic interest rates	Discount rate on 91 Treasury bill rate *Source*: International Financial Statistics (IFS) 2015 database
r*	Foreign interest rates	Discount rate on U.S. Government Securities (3 months) *Source*: International Financial Statistics (IFS) 2015

3.2.1. Inflation rate

To the extent that inflation is ultimately reflected in the nominal exchange rate, expected inflation usually underpins the process of currency substitution. The inflation rate (p) measures the overall macroeconomic stability with the assumption that a fall in the rate of inflation would improve agent's confidence in domestic currency and reduce the demand for foreign currency deposits. Prices have generally increased in Ghana, although it has been minimal in recent years. The month-on-month rate of inflation shown in Figure 4 depicts a highly volatile behaviour. The year-on-year rate of inflation displayed in Figure 3.5 also reduced from as high as 41.94 percent in March 2001 to its lowest rate of 8.40 percent in September 2011. The average inflation rate for the entire period is 16 percent, which is comparatively lower as against the pre-reforms figures in the 1970s and early 1980s. As observed from the year-on-year inflation figures, Ghana recorded an unprecedented single-digit inflation rate for three consecutive years (that is 36 months) between June 2010 and June 2013. However, the rate has picked up again in recent years reaching 17.4 percent in September 2015.

Figure 3.1: Trend of inflation (*month-on-month*)

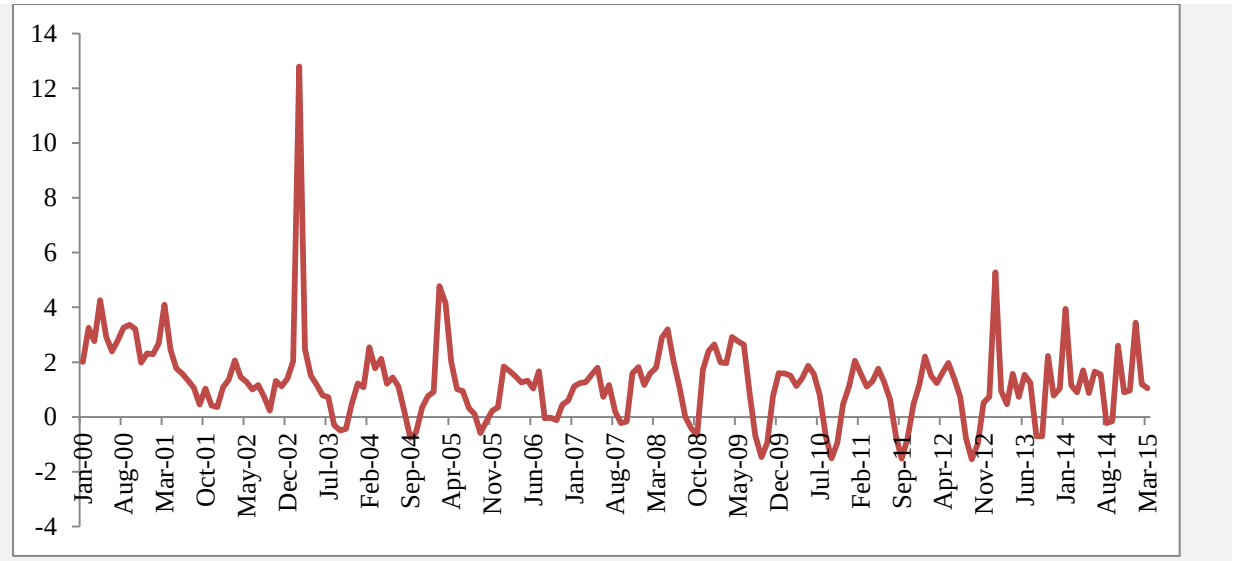
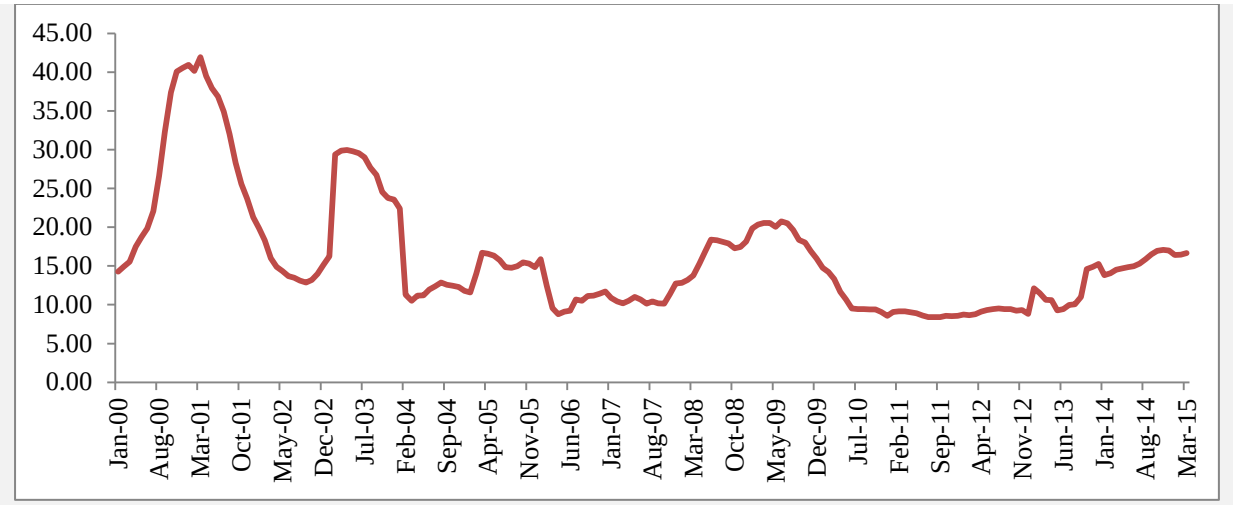


Figure 3.2: Trend of inflation (*year-on-year*)



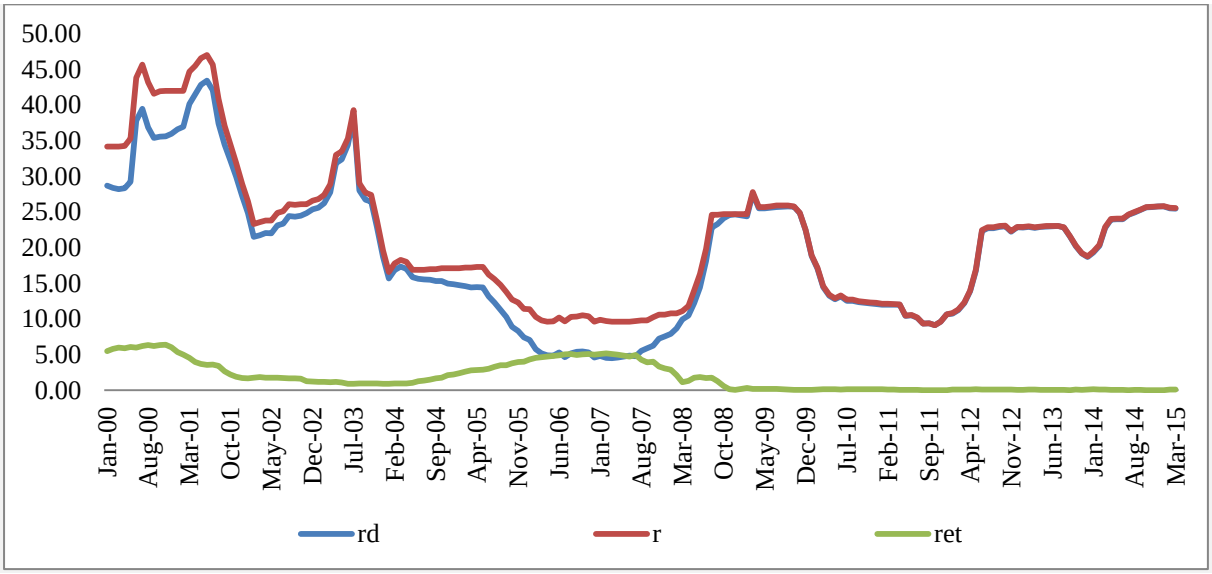
3.2.2. Domestic and foreign rates of return

Figure 3.3 is a graph representing the domestic interest rate, returns on foreign currency deposits, and the interest rate differential. The interest rate (r^d) is the rate of return on deposits denominated in Ghana cedi, whereas returns (r^*) is the expected return on U.S. dollar deposits[20]. The theory of asset demand predicts that the desire to hold foreign currency deposits is essentially a choice between domestic and foreign assets influenced by the differences (differential) in rates of return on the assets. When economic agents expect the interest rate on foreign currency deposits to be higher relative to that of local currency deposits, they balance their portfolio holdings by shifting some of their domestic currency deposits to foreign currency deposits. Thus, the sign of the domestic interest rate is expected to be negative in the estimated model since an increase is expected to stimulate domestic savings and discourage the demand for

[20] This variable is defined simply as the sum of the interest rate on dollar deposits r^* and the expected appreciation (depreciation) of the dollar (cedi). The expected depreciation is given as $(e_{t+1} - e_t)/e_t$, where the spot monthly exchange rate (amount of cedi required to purchase one unit of dollar) is denoted by e_t and the expected exchange rate for the next 12 months period by e_{t+1}. Therefore, the expected return on foreign currency deposits can be denoted as $r^* + (e_{t+1} - e_t)/e_t$

foreign currency holdings. On the other hand, the sign of the returns variable is expected to be positive. Put together, we expect the interest rate differential variable to have a negative sign such that an increase in that would diminish financial dollarization rather than fuelling a surge in the trend. Somewhat, whereas the domestic interest rate reflects monetary policy actions and/or stance, the interest rate differential serves as an indication of high rates of inflation, high inflows of foreign capital, and the presence of arbitrage opportunities. The interest rate differential is defined as the difference between domestic currency interest rates and the returns variable which represents the U.S. dollar interest rates (with the Federal funds rate as proxy) adjusted for exchange rates [see Kessy (2011) for a similar definition]. The figure indicates that domestic interest rate has been relatively higher than the returns on U.S. dollar denominated deposits. This thesis also follows the assumption that if decisions by economic agents to hold dollar deposits depend on the difference between the rate of returns on FCD and cedi deposits, then a widening of the differentials would be predicted to bring about a negative effect on deposit dollarization as argued by Basso et al. (2011).

Figure 3.3: Interest rate variables



3.2.3. Exchange rates

A measure of expected exchange rate (x) is included in the model to capture exchange rate risk. The hypothesis is that major fluctuations in the exchange rate will create uncertainty among economic agents about likely future path of exchange rate, in which case they will feel safer in foreign currency holdings. A graph of the nominal exchange rate is presented in Figure 3.4. By way of construction, an increase in the exchange rate reflects a depreciation of the domestic currency or an appreciation of the foreign currency (U.S. dollar). An appreciation of the foreign currency (that is, an increase in expected exchange rates) usually leads to an increase in value of foreign assets measured in terms of domestic currency. However, it has been argued that when the domestic currency depreciates, there could be expectation of further depreciation which may result in an increase in demand for foreign currency or a decrease in the demand for domestic currency. Thus, expected exchange rate is predicted to carry a positive sign in the specified model. The percentage change (returns) of the nominal exchange rate is presented in Figure 3.5 below.

Figure 3.4: The nominal Ghana cedi/U.S. dollar exchange rate

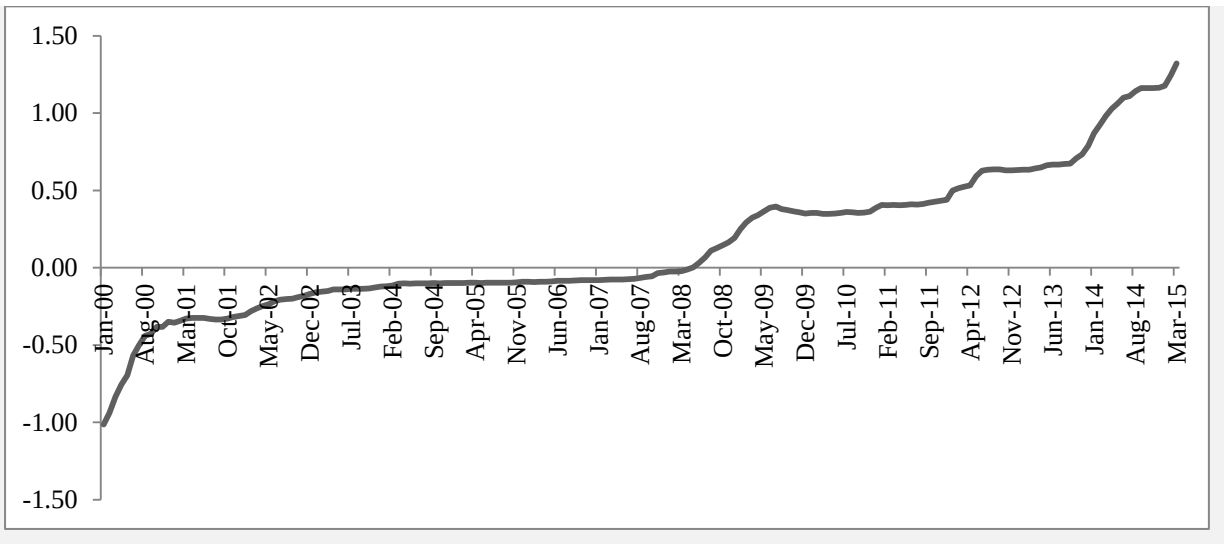
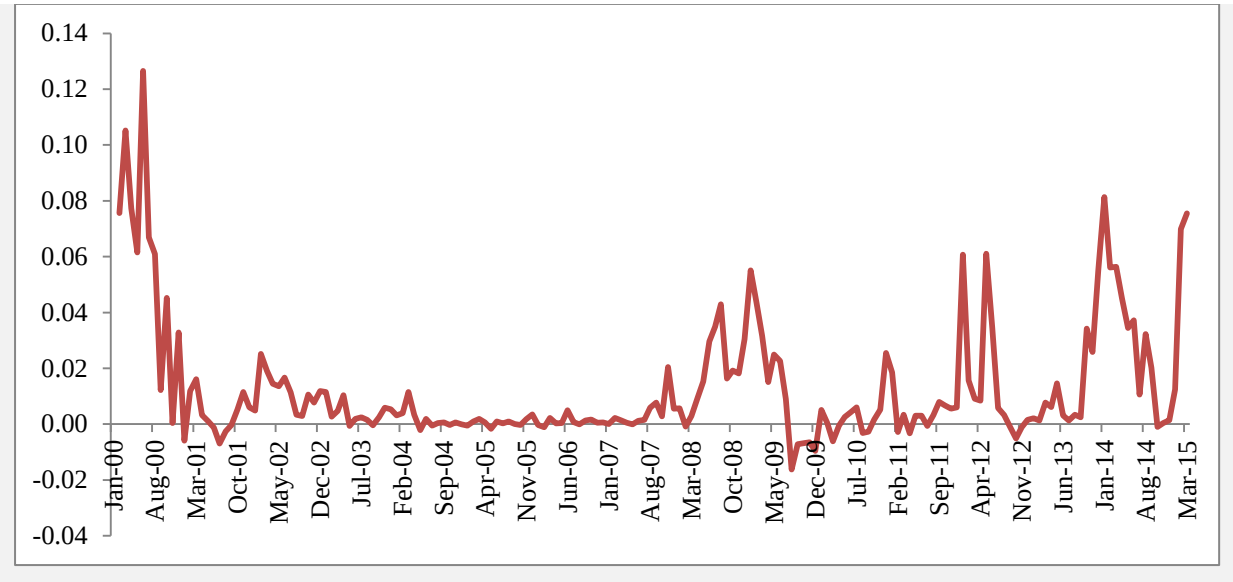


Figure 3.5: Trend of returns in nominal exchange rate

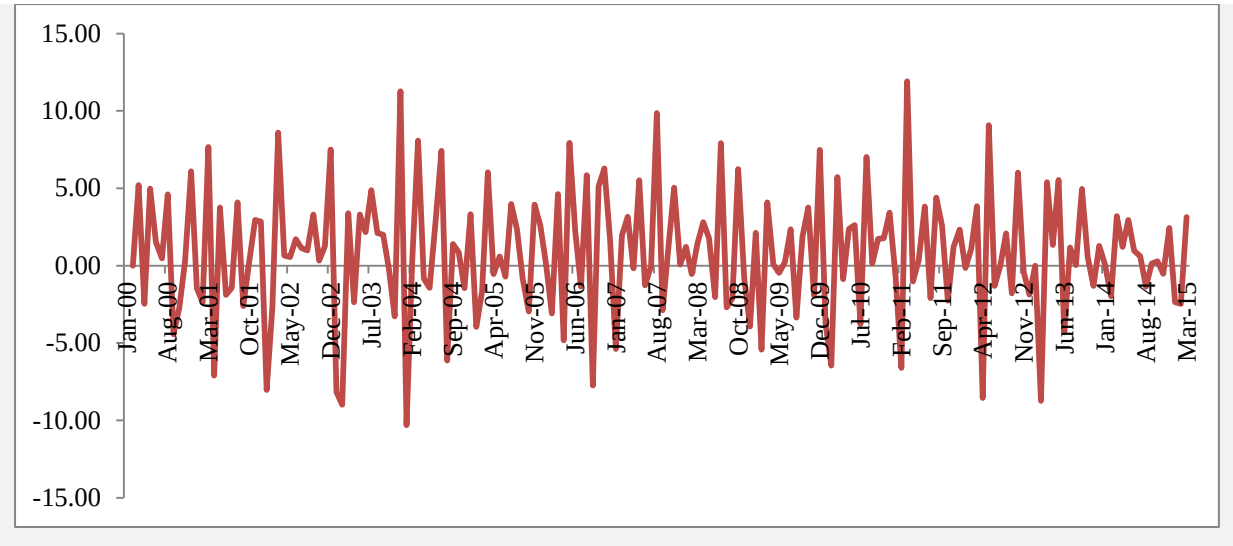


3.2.4. Real output (Composite Index of Economic Activity)

The portfolio theory of demand for money predicts that, a higher real output or income leads to higher demand for money. Under such conditions it is not wrong to predict that, as economic agents demand for more money their demand for foreign currencies increase as a store of value or for international transactions. In the case of Ghana where capital controls are more relaxed, economic agents exercise the right to hold foreign currencies. In other studies, the real output has been used as a measure of market development or market failure, whereby an increase is deemed to reduce the reliance on foreign currency. Income per capita has also been applied as a proxy for economic and institutional factors that influence the development of local currency markets. On the other hand, some authors have documented that dollarization/currency substitution lead to higher rates of growth. According to Dornbusch (2001), dollarized countries tend to grow faster than non-dollarized countries. This has been explained by Edwards and Magendzo (2003) to occur through two channels. First, in a dollarized economy the lower interest rates lead to higher investment, which also induces growth. Second, since dollarized countries alleviate the risk associated with exchange rate volatility, it encourages international

trade which results in higher growth rates (Rose, 2000; and Rose & van Wincoop, 2001). Yinusa (2008) also used GDP as a measure of transactions in the economy and possibly accumulation of wealth. This study follows the assumption of Yinusa (2008) and uses a proxy for real output. The Composite Index of Economic Activity (CIEA) compiled by the Bank of Ghana is used to substitute the real output variable. The advantage of this data is that it comes in monthly frequency. The growth rate of the CIEA variable is presented in Figure 3.6 below.

Figure 3.6: Trend in growth rate of real output

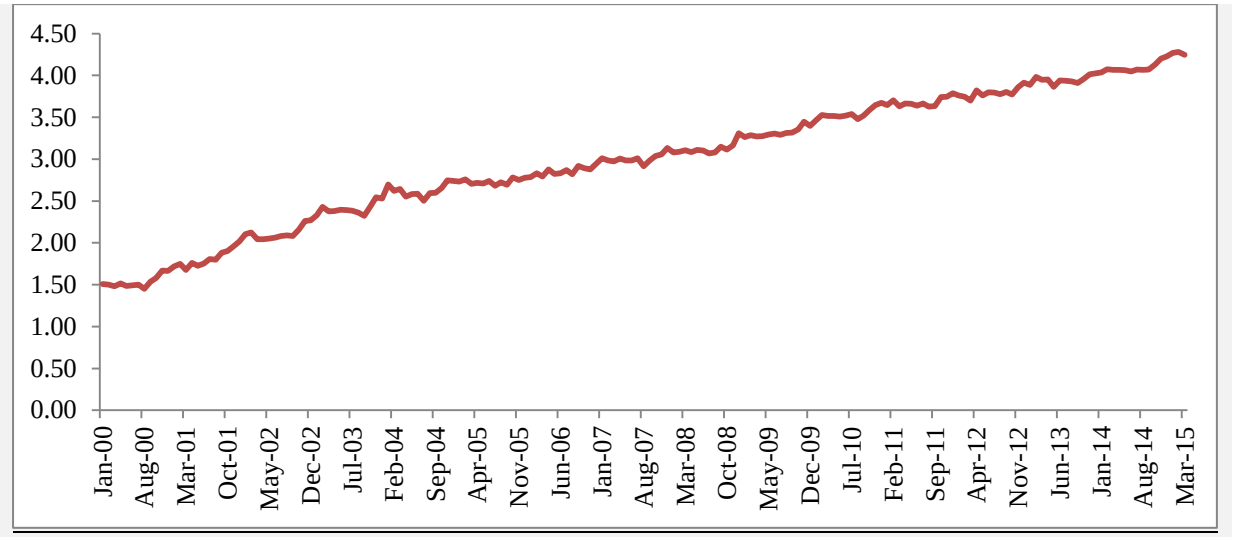


3.2.5. Financial sector development

In an attempt to capture the role of financial sector development on the trend of dollarization, we include a proxy generally defined as broad money (M2) as a ratio of GDP. The inclusion of this variable highlights the role of financial deepening in the dollarization process. We hypothesize that a highly developed financial market makes available more financial products which can be invested in the domestic currency, to eventually cause a decline in dollarization. The extent of financial sector development presumably does not capture only the diverse investment opportunities available, but also a reflection of a more stable macroeconomic environment. According to Feige (2003) and Ize and Levy-Yeyati (2003), underdeveloped

domestic financial markets are partly responsible for high levels of financial dollarization in some countries. Shallow financial systems or limited financial deepening provide limited investment opportunities in local currency. In Ghana the financial system is mainly constituted by banks, which tends to lend to the sovereign or to large companies in order to reduce the risk associated with default. Accordingly, a highly developed financial system would be expected to reduce dollarization. Figure 3.7 is a graphical representation of the ratio of broad money supply to GDP.

Figure 3.7: Trend of financial sector development (M2/GDP)



3.3. Estimation methodology

Empirical modelling of dollarization has generally been built on simple money demand functions and portfolio balance models. Within that theoretical framework, the demand for foreign currency by economic agents has been assumed to be driven by differences between returns on domestic currency and returns on deposit denominated in foreign currencies. Based on this assumption, the most widely used determinants have been interest rate differentials, expected exchange rate depreciation, expected inflation rate, institutional factors as well as measures of

credibility of macroeconomic policies (see, Yinusa, 2008; Irfan, 2003; Rojas-Suarez, 1992; El-Erian, 1988). In the form of a simple money demand function in a flexible exchange rate regime, the model can be specified as follows:

$$m_t - p_t = \alpha_0 + \beta_1 E(\pi) + \beta_2 y_t + u_t \tag{3.1}$$

where $m_t - p_t$ represents the real money balances, where m_t is the log of money supply and p_t is the log of price level. $E(\pi)$ is the expected inflation rate and y_t is the log of aggregate income. In this equation, the expected inflation rate is the relevant opportunity cost of holding domestic money balances. The assumption is applicable in the case of a country with thin financial markets in which interest rates do not respond quickly to market dynamics.

The analysis is based on a modified version of the model, using dollarization as dependent variable and other macroeconomic variables as determinants. The dollarization process can be modelled as a function of the following variables:

$$dr_t = F(x_t, p_t, \mathrm{y}_t, r_t^d, \mathrm{f}_t^d, dr_{t-1}) \tag{3.2}$$

The variables x_t, p_t, y_t, r_t^d, and f_t^d are defined as the proxy for expected exchange rate depreciation, prices, proxy for real output, interest rate differential, and proxy for financial development respectively. All the variables are in logarithms except the returns variable. The specific model of the above equation takes the following multiplicative form:

$$dr_t = A x_t^{\beta_1} p_t^{\beta_2} \mathrm{y}_t^{\beta_3} r_t^{d\beta_4} \mathrm{f}_t^{d\beta_5} dr_{t-1}^{\beta_6} e^{\mu_t} \tag{3.3}$$

Expressing the above equation in a log-linear form gives the following operational model for the long run determinants of dollarization in Ghana:

$$lndr_t = \alpha_0 + \beta_1 lnx_t + \beta_2 lnp_t + \beta_3 lny_t + \beta_4 r_t^d + \beta_5 lnf_t^d + \beta_6 lndr_{t-1} + u_t \quad (3.4)$$

where $\alpha_0 = \ln A$ and u_t is the disturbance term, which is assumed to have zero mean, constant variance and not correlated with the regressors.

In order to establish long-run relationships between the variables, we employ the autoregressive distributed lag model proposed by Pesaran and Shin (1995, 1999), Pesaran, Shin, and Smith (2001), and Pesaran and Pesaran (1997). A major advantage of the ARDL bounds test is that it is applicable regardless of the stationarity properties or irrespective of whether the regressors are purely *I*(0) or *I*(1), or a mixture of both. The approach avoids the potential bias associated with unit root tests and is robust for cointegration analyses with small samples (Pesaran et al., 2001). Basically, the ARDL approach to cointegration involves estimating the conditional error correction model of the dollarization and its determinants as follows:

$$\Delta ln(dr)_t = \alpha_0 + \sum_{i=1}^{k} \varphi_i \Delta ln(dr)_{t-i} + \sum_{i=0}^{k} \beta_i ln\Delta x_{t-i} + \sum_{i=0}^{k} \theta_i ln\Delta p_{t-i} + \sum_{i=0}^{k} \phi_i \Delta ln\, y_{t-i} + \sum_{i=0}^{k} \Omega_i \Delta r_{t-i}^d + \psi \Delta lnf_{t-i}^d$$
$$+\delta_1 ln(dr)_{t-1} + \delta_2 lnx_{t-1} + \delta_3 lnp_{t-1} + \delta_4 ln\, y_{t-1} + \delta_5 r_{t-1}^d + \delta_5 lnf_{t-1}^d + \mu_t \quad (3.5)$$

where dr, r, r^*, x and p are dollarization (defined as foreign currency deposits as a share of total deposit or broad money), rate of return on assets denominated in domestic currency, rate of return on foreign currency denominated assets, exchange rate, and prices respectively. Δ is the first difference operator, *k* is the optimal lag length, *ln* is the natural logarithm, and μ_t is a white noise disturbance error term.

The long-run relationship between the variables under consideration can be deduced based on the Wald (*F*-statistic) test by imposing restrictions on the estimated long-run coefficients of one period lagged level of the variables to be zero. The null hypothesis is H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$, against the alternative hypothesis H_1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$. The *F*-test has a non-standard distribution which depends on (i) whether variables included in the model are *I*(0) or *I*(1), (ii) the number of regressors, and (iii) whether the model contains an intercept and/or a trend. Given that our sample size is large enough (171 observations falls outside the small sample size of 30 – 80 to suggest the application of the critical values reported by Narayan (2004). Two sets of critical values are generated for *I*(1) series (upper bound critical values) and *I*(0) series (lower bound critical values). If the *F*-statistic exceeds the respective UB critical values, there is evidence of cointegration between the variables regardless of the order of integration of the variables, whereas if the test statistic is below the LB critical value, the null hypothesis of no cointegration cannot be rejected. If it lies between the two bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying regressors. In that case further evidence would be required to guide the interpretation. Alternatively, Kremers, Ericsson, and Dolado (1992) and Banerjee, Dolado, and Mestre (1998) have demonstrated that in an error correction model, significant lagged error-correction term is a relatively more efficient way of establishing cointegration. So, the error correction term can be used when the F-test is inconclusive.

After testing for this cointegration and evidence of a long-run relationship has been established, the following long-run model will be specified:

$$ln(dr)_t = \alpha_1 + \sum_{i=0}^{k} \varphi_{1i} ln(dr)_{t-i} + \sum_{i=0}^{k} \beta_{1i} lnx_{t-i} + \sum_{i=0}^{k} \theta_{1i} lnp_{t-i} + \sum_{i=0}^{k} \lambda_{1i} lny_{t-i} + \sum_{i=0}^{k} \phi_{1i} r^d_{t-i} + \sum_{i=0}^{p} \psi_{1i} lnf^d_{t-i} + \mu_t \quad (3.6)$$

The orders of the lags in the ARDL model are selected by either the Akaike Information criterion (AIC) or the Schwarz Bayesian criterion (SIC) as discussed in Lutkepohl (1991, Section 4.3), before the selected model is estimated by ordinary least squares. In this study, the Schwarz Bayesian Criterion is employed. The ARDL specification of the short-run dynamics can therefore be derived by constructing an error correction model of the following form:

$$\Delta ln(dr)_t = \alpha_2 + \sum_{i=0}^{k} \varphi_{2i} \Delta ln(dr)_{t-i} + \sum_{i=0}^{k} \beta_{2i} \Delta lnx_{t-i} + \sum_{i=0}^{k} \theta_{2i} \Delta lnp_{t-i} + \sum_{i=0}^{k} \lambda_{2i} \Delta lny_{t-i} + \sum_{i=0}^{k} \phi_{2i} \Delta r^d_{t-i} + \sum_{i=0}^{k} \psi_{2i} \Delta lnf^d_{t-i} + \eta ECT_{t-1} + \upsilon_t \quad (3.7)$$

where ECT_{t-1} is the error correction term, defined as

$$ECT_t = ln(dr)_t - \alpha_1 - \sum_{i=0}^{k} \varphi_{1i} ln(dr)_{t-i} - \sum_{i=0}^{k} \beta_{1i} lnx_{t-i} - \sum_{i=0}^{k} \theta_{1i} lnp_{t-i} - \sum_{i=0}^{k} \lambda_{1i} lny_{t-i} - \sum_{i=0}^{k} \phi_{1i} r^d_{t-i} - \sum_{i=0}^{k} \psi_{1i} lnf^d_{t-i} \quad (3.8)$$

All coefficients of the short-run equation relate to the short run dynamics of the model's convergence to equilibrium. The coefficient of the error correction term represents the speed of adjustment. The statistical significance of the *ECT* indicates that deviations due to shocks to the system are temporal and the system gravitates to a long-run equilibrium state.

In addition, we adopt an innovation accounting by simulating forecast error variance decomposition and impulse response functions (IRFs) for further inferences. The tools are used for evaluating the dynamic interactions and strength of causal relations among variables in the system. The decompositions indicate the percentages of a variable's forecast error variance

attributable to its own innovations and innovations in other variables. Thus, from the decompositions, we can measure the relative importance of real exchange rate, interest rates, and price fluctuations in accounting for fluctuations in the dollarization variable. Moreover, the IRFs trace the directional responses of a variable to a one standard deviation shock of another variable. This means that we can observe the direction, magnitude, and persistence of dollarization to variations in the independent variables. The Granger causality tests will be used to augment the short run analysis.

The first step in cointegration estimation involves exploring the data generating process of the variables under consideration to confirm that none of the variables is I(2). We employ three different tests for unit root and integration – Augmented Dickey Fuller (ADF) test (originally implemented by Dickey & Fuller, 1979) with critical value estimates based on MacKinnon (1993, 1996); Dickey-Fuller Test with GLS detrending (DF-GLS) test (Elliot, Rothenberg, & Stock, 1996) and Kwiatkowski, Phillips, Schmidt & Shin (KPSS) test (KPSS, 1992). Whereas the other tests have a null hypothesis of unit root in the variable, the KPSS has a null hypothesis that the variable is stationary.

3.4. Results and discussion

3.4.1. Long-run determinants of dollarization

Before proceeding to the cointegration test, we undertake unit root tests to establish the order of integration of the variables. The results presented in Table 3.2 clearly suggest that none of the variables is integrated of order 2 indicating applicability of the ARDL and bounds testing methodology.

Table 3.2: Unit root and stationarity tests results

	levels		*first difference*	
variable	*constant*	*with trend*	*constant*	*with trend*
Augmented Dickey Fuller (ADF) test				
dollarization	-2.65	-2.93	-14.81**	-14.77**
exchange rate	0.67	-0.97	-5.18**	-5.16**
prices	-2.13	-3.88**	8.07**	-8.27**
interest rate differential	-2.27	-2.18	-9.12**	-9.14**
real output	-0.32	-2.35	-15.63**	-15.59**
financial development	-1.21	-2.69	-17.65**	-17.66**
Dickey-Fuller Test with GLS Detrending (DFGLS)				
dollarization	-2.36**	-2.49**	-2.11	-13.06**
exchange rate	-2.57**	-1.27	-1.94*	-2.86*
prices	2.92	1.00	-0.31	-7.50**
interest rate differential	-1.41	-2.17**	-9.03**	-9.18**
real output	3.65	-2.09**	-14.63**	15.07**
financial development	3.42	-1.91**	-0.77	-16.52**
Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test				
dollarization	0.67**	0.29**	0.08	0.08
exchange rate	1.66**	0.25**	0.20	20
prices	1.75**	0.33**	0.51**	0.13
interest rate differential	0.44	0.29**	0.12	0.05
real output	1.76**	0.16**	0.22	0.22**
financial development	1.74**	0.27**	0.18	0.06

Notes: ** indicates rejection at the 5 percent level. The critical values at the 5 percent significance level are -2.88, -1.94, & 0.46 (include constant) and -3.43, -2.95, & 0.15 (include constant and trend) for ADF, DF-GLS, and KPSS respectively.

Following the unit root and stationarity tests, the ARDL model was estimated so that we can proceed to test the cointegration hypothesis. Table 3.3 presents the estimates of the ARDL (1, 0, 0, 2, 0, 1) model selected based on Schwarz Bayesian Criterion. The model includes one lag for the dependent variable (dollarization index) and financial sector development, and two lags of real output. No lag was selected for exchange rate, interest rate differential, and inflation.

Table 3.3: Estimates of Autoregressive Distributed Lag Model (Dependent variable: DR1)

Regressor	*Coefficient*	*Standard error*	*Prob*
DR1(-1)	0.699	0.049	0.000
NER	0.144	0.033	0.000
CPI	-0.068	0.059	0.260
Y	-0.507	0.096	0.000
Y(-1)	0.393	0.111	0.001
Y(-2)	0.178	0.076	0.020
RD	0.000	0.000	0.549
FSD	-0.683	0.080	0.000
FSD(-1)	0.588	0.086	0.000
C	-0.150	0.124	0.229
R-*Squared*	0.9168	R-Bar-Squared	0.9123
Log likelihood	352.4279	AIC	342.4279
SBC	326.4910	DW-statistic	2.0597

Note: ARDL (1,0,0,2,0,1) was selected based on Schwarz Bayesian Criterion

The results of the bounds test for cointegration between dollarization and its determinants reported in Table 3.4 show the rejection of the null hypothesis of no long-run relationship (cointegration) when dollarization index is used as the dependent variable in the model estimated. Given that the calculated *F*-statistics exceeds the upper bound critical values at the 5 percent significance level, we reject the null hypothesis of no level relationship, and conclude that there is a strong evidence of a long-run steady state relationship between dollarization and its covariates. This suggests that exchange rates, inflation, interest rate differential, real output, and financial development are the long-run forcing determinants of dollarization in Ghana.

Table 3.4: ARDL Bounds test for cointegration relationship

	Critical value bounds of the F –statistic: intercept and no trend					
k	*99%*		*95%*		*90%*	
	I(0)	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*
5	**3.41**	**4.68**	**2.62**	**3.79**	**2.26**	**3.35**

Model	Calculated *F*-statistic	Inference
$F_{dr}(dr\|x,p,y,r^d,f^d)$	6.702**	Cointegration

Note: ** denote statistical significance at 5% significance level

The results of the long-run dollarization models are presented in Table 3.5. Baring few instances, all the models provide consistent results demonstrating the robustness of the long-run estimates. In some instances, whereas the ARDL and DOLS give similar findings, the FMOLS and CCR are also consistent in terms of direction and magnitude. In terms of significance, exchange rates and financial development are the only important variables in the long run evolution of dollarization. Changes in exchange rate is by far the most significant driving factor of dollarization in the long-run followed by changes in financial development. Going by the estimates of the ARDL model, all other factors held constant, percentage point depreciation in exchange rate increases dollarization by close to 0.5 percent. On the other hand, a percentage increase in financial development reduces dollarization averagely by 0.3 percent.

Table 3.5: Estimated long-run dollarization models (Dependent variable: DR1)

	ARDL	*DOLS*	*FMOLS*	*CCR*
Exchange rate	0.479**	0.431**	0.355**	0.350**
	(0.095)	(0.000)	(0.073)	(0.078)
Prices	-0.224	-0.053	0.042	0.068
	(0.205)	(0.728)	(0.124)	(0.129)
Real output	0.214*	0.019	-0.055	-0.050
	(0.116)	(0.821)	(0.080)	(0.091)
Interest rate differential	0.001	0.002	0.003**	0.004**
	(0.002)	(0.043)	(0.001)	(0.001)
Financial development	-0.305**	-0.275**	-0.297**	-0.309**
	(0.154)	(0.015)	(0.091)	(0.100)

Notes: ** and * indicate significance at the 5% and 10% confidence levels respecively. Standard errors are in ( ). DOLS, FMOLS, and CCR stand for Dynamic Least Squares, Fully Modified Least Squares, and Canonical Cointegrating Regression respectively.

For the direction, all the models give consistent estimates except for prices. Whereas ARDL and DOLS give a negative estimate of prices, FMOLS and CCR give positive estimates. With magnitude and significance, exchange rate and financial development have been consistently significant, whereas prices and output have consistently been insignificant. DOLS, FMOLS, and CCR give significant estimates of interest rate differential, but find real output insignificant in all instances although the dynamic and static models give different directions. Again, the variables have the expected signs except for inflation which has a wrong (negative) sign and insignificant at the 5 percent level of significance. The coefficient on inflation is not statistically different from zero, which means that inflation has no effect on dollarization in Ghana. This finding seems peculiar albeit squares with the available data. During the study period, inflation has been quite moderate in Ghana and the year-on-year rate has seen record single digit rate for 31 consecutive months, from June 2010 to December 2012. Despite the evidence that inflation dropped to 9 percent on the average, the level of foreign currency holdings was constantly increasing over the period. As a measure of the overall macroeconomic stability, we expected that declining rates of inflation will induce improved confidence in domestic currency and therefore reduce foreign currency holdings, all else held constant. However, this was not the case probably due to

unstable and persistent depreciation of the domestic currency. This finding is similar to what some existing studies have reported [for example, see Kessy (2011) for Tanzania, and Adam (2013) for Maldives].

The coefficient of the exchange rate variable, which measures expected exchange rate risk, is also significant at the 5 percent confidence level and positive as expected. This indicates that, in the long run a depreciation of the domestic currency will lead to an increase in dollarization. This is consistent with the hypothesis that uncertainties regarding the future path of exchange rate lead economic agents to feel safer in holding foreign currencies. The highly significant positive relationship between the exchange rate variable and the dollarization index suggests that the exchange rate has played a key role in influencing the level of dollarization in Ghana, mainly through the significant effect on import and export earnings.

In addition, the signs possessed by prices and interest rate differential are contrary to theoretical predictions. Theory holds that the higher the domestic interest rates relative to foreign interest rate, the higher the demand for domestic currency and consequently, the less demand for foreign currency. However, the positive sign carried by the interest rate differential, which was defined as the difference between domestic interest rate and foreign interest rate suggests a contrary relationship between the variables. It means that, the long-run semi-elasticity of domestic interest rate and expected return on foreign currency deposits are not of the expected signs. The evidence points out that, in the long run a percentage point increase in the rate of return on foreign currency deposits (due to depreciation and/or increase in the interest rate) would decrease dollarization, all else held constant; whereas a percentage increase in the rate of return on domestic currency deposits would increase dollarization. This is inconsistent with the hypothesis that demand for dollar deposits by economic agents is driven by the differentials of

real rate of return on local currency denominated deposits and foreign currency denominated deposits.

Another finding is that, although the coefficient of real output is positive it is insignificant. We expect an increase in real output to result in high demand for foreign currency, however insignificant based on the estimates of the dynamic models. Furthermore, there is a statistically significant negative relationship between financial development and the measure of dollarization. This evidence suggests that attempts to develop the financial markets would bring about a fall in demand for foreign currency, since a higher level of financial development is likely to bring about better management, more investment opportunities, and high level of confidence in the domestic currency.

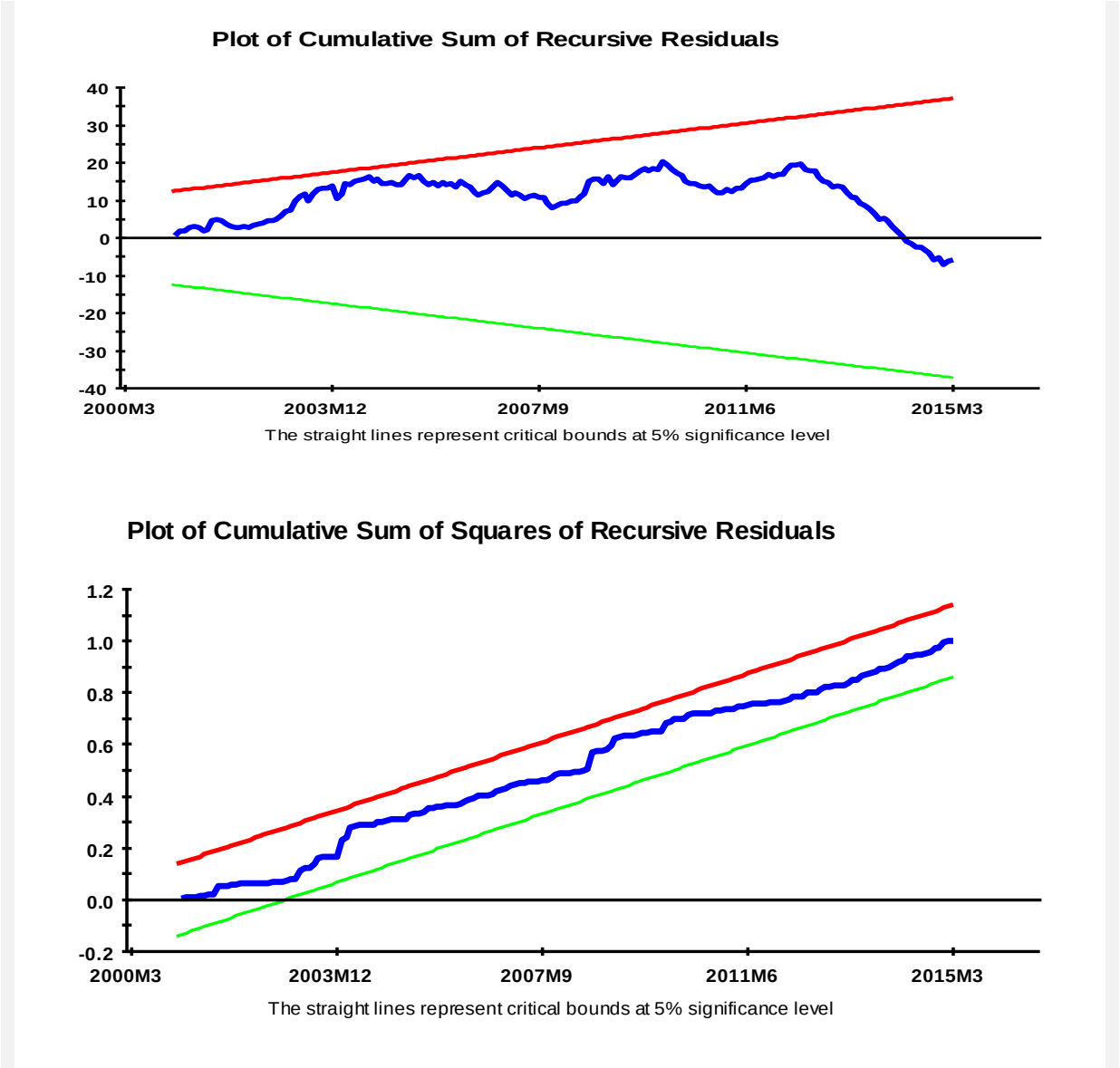
3.4.2. Model stability and diagnostic tests

To establish the stability of the specified model, tests for serial correlation, normal distribution, functional form, and heteroskedasticity are performed. The results of the tests in Table 3.6 confirm the stability of the model. Additional diagnostic tests based on the CUSUM and CUSUM square tests are also used to test the stability of residual variance. The CUSUM and CUSUM square tests presented in Figure 3.8. As with the CUSUM test, movement outside the critical lines is suggestive of parameter or variance instability. This suggests that the residual variance is somewhat stable as the curve is generally within the 5% significance lines.

Table 3.6: Diagnostic Tests of ARDL Model

Test statistics	*LM Version*	*Test Basis*
Serial Correlation	15.2093 [0.230]	Lagrange multiplier test of residual serial correlation
Functional Form	3.3131 [0.069]	Ramsey's RESET test using the square of the fitted values
Normality	1.7716 [0.412]	Based on a test of skewness and kurtosis of residuals
Heteroskedasticity	13.7135 [0.319]	Based on the regression of squared residuals on squared fitted values

Figure 3.8: CUSUM and CUSUM square of residuals



3.4.3. Short run drivers of dollarization

The error correction representation for the selected ARDL model is presented in Table 3.7. According to the results, prices and interest rate differential are not significant, suggesting that the two variables are not relevant in the dynamics of dollarization in the short-run. In terms of significance, exchange rate, real output, and financial development are relevant in driving dollarization in the short-run. In terms of direction, the results point out that depreciation in exchange rate leads to an increase in dollarization, whereas output and financial development

cause a decline in dollarization. In the case of the effect of real output, there is a change in direction in the short run as against the long-run. This brings to fore the case that, promoting real output growth would serve as an effective strategy in the fight against dollarization in the short run. However, since a high percentage of our consumption basket is composed of imported goods, in the long run output growth brings about high demand for foreign currency suggesting that Ghana cannot be successful in fighting dollarization whilst promoting growth through a strategy that is import driven.

Table 3.7: Error Correction Representation for the Selected ARDL Model (1,1,0,0,0,2)

Differenced Regressor	*Coefficient*	*Standard error*	*Probability*
Exchange rate	0.146**	0.332	0.000
Prices	-0.061	0.057	0.288
Real output	-0.515**	0.096	0.000
Interest rate differential	0.001	0.000	0.590
Financial development	-0.683**	0.080	0.000
Error correction term	-0.300**	0.049	0.000

Notes: ** indicates significance at the 5% confidence level. Standard errors are in ( ). ARDL (1,0,0,2,0,1) selected based on Schwarz Bayesian Criterion. Newey-West adjusted S.Es Bartlett weights applied with a truncation lag of 12.

3.4.3.1. Speed of adjustment and short run dynamics

The error correction model has cointegration relations built into the specification that restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term, known as the *error correction* term (ECT) defined in equation 8 above, corrects deviation from long-run equilibrium gradually through a series of partial short-run adjustments. The results of the error correction representation of the selected ARDL show that the error correction term is correctly

signed (negative) and statistically significant at the 1 percent level. The negative sign and significance of the correction term is a confirmation of the long-run relationship between the variables. It implies that, although there may be deviations in the short run, the long-run equilibrium relationship is always restored. This ensures the attainment of long-run convergence to the steady state following disequilibrium in the system due to a shock. The coefficient of ECT_{t-1} measures the speed of adjustment of the dollarization process with respect to changes in the other variables.

The magnitude suggests that, 30 percent of deviations from the steady state are corrected at every stage of the readjustment process until all the errors have been corrected (that is, to re-establish equilibrium). This has implications for restoration of equilibrium state. The estimate of the *ECT* for the model indicates an average correction of 30 percent of the deviations in the subsequent period. This faster pace suggests that the system takes a very short time to revert to the equilibrium state. It means errors have the tendency to disappear quickly and return the system to its original state. The findings underscores that exchange rate, output growth, and financial development play significant roles in the adjustment process.

3.3.2.2. Impulse response functions

To be able to ascertain the response of the dynamic interactions of the variables to shocks in the other variables and also measure the contributions of the variables to the movements of other variables, we employ impulse response functions and variance decomposition within vector autoregression models to augment the short-run dynamics. We decompose the dynamics of dollarization and analyse the contribution of the driving forces to the process. While impulse response functions trace the effects of a shock to one endogenous variable on the other variables in the system, the forecast error variance decomposition separates the movements in the dollarization process into component shocks to the other variables. Thus, the variance

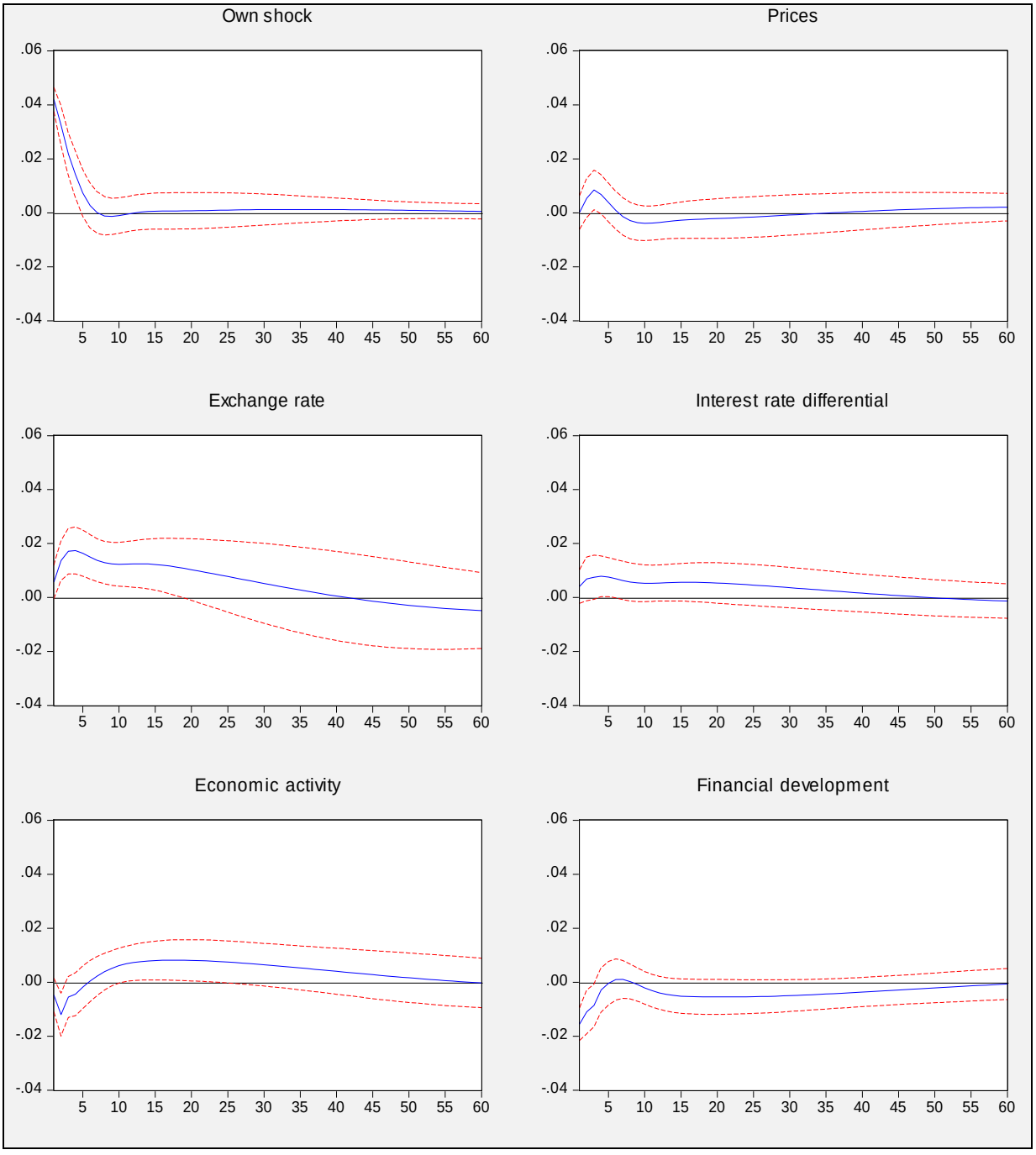
decomposition provides information about the relative importance of a random innovation to the driving factors of dollarization. It indicates the proportion of the movements due to its "own" shocks and shocks due to the other variables.

The essence of the impulse response functions is to trace the effects of a shock to one endogenous variable on the other variables in the VAR. We compute the first 60 impulse responses, which correspond to a time span of 5 years for monthly data. The generalized impulse response approach recommended by Pesaran and Shin (1998) is applied. Unlike traditional impulse response analysis (such as Lutkepohl & Reimers, 1992), which considers orthogonalised shocks based on the Cholesky decomposition, the new approach desirably yields unique impulse response functions that are invariant to the ordering of variables. The responses of dollarization to its own shocks and innovations in exchange rates, prices, and interest rates are indicated. For the sake of brevity, only the graphs are reported. With that we report only the direction of movement to innovations rather than the extent or its significance.

Figure 3.9 plots the response of the dollarization index with respect to innovations in the endogenous variables of interest over a horizon of 60 months. We observe that consistent with our expectations, a one-percent innovation in the exchange rate causes a positive movement in the measure of dollarization. In a similar manner, an innovation in interest rates on foreign currency deposits has a positive effect on the movement of the dollarization index albeit lower than that caused by a shock to exchange rates. On the other hand, shocks to both prices and returns on deposits denominated in local currency have a negative effect on dollarization. Again, we can see that the effect of inflation on dollarization in the short run is not consistent with the theoretical postulations. Although this finding is in agreement with some aspect of the literature, it beats our understanding particularly when it confirms that the relationship between inflation and exchange rates has not been strong in the case of Ghana. This argument has been

propounded by Adu and Marbuah (2011). Ghana experienced single-digit inflation consecutively for 31 months from June 2010 to December 2012, yet the cedi was seen depreciating against the major trading currencies which led to some debate on the link between inflation and exchange rates in Ghana.

Figure 3.9: Response of dollarization to shocks



3.3.2.3. Variance decomposition

The results from variance decompositions (reported in Table 3.8) suggest that, over a 60-month horizon, 45 percent of the forecast error variance of dollarization can be accounted by shocks to exchange rates. The contribution of own (dollarization) shocks to the dynamics of dollarization is overtaken by the proportion contributed by shocks to exchange rates within 8 months highlighting the important role of exchange rates. The role of interest rates on foreign currency deposits in the dollarization process is reflected in its contribution of less than 3 percent in 12 months. Also, over the whole 60 months, shocks on inflation contributed a little over 11 percent to the movement in dollarization. Thus, we argue that the impact of inflation has not been very important in the evolution of dollarization in Ghana. Going by economic theory, greater dollarization or currency substitution makes the domestic currency less attractive. The resultant switch to foreign currency holdings make the control of money challenging, which leads to higher rates of inflation. However, our results seem to support that it is the reverse that is being experienced in Ghana. Rising depreciation of the cedi puts pressure on prices to rise. The importance of the exchange rate variable in the dollarization process is again underscored by the dominance of its contribution to dollarization.

Table 3.8: Variance decomposition of endogenous variables

Period	*s.e.*	*dr1*	*p*	*x*	r^d	*y*	f^d
1	0.040452	70.78665	0.752709	1.916355	0.335988	0.001033	26.20727
2	0.050813	59.81763	0.568247	7.243162	0.554934	2.391238	29.42479
3	0.056782	54.21440	0.647573	14.00875	0.713221	2.074995	28.34106
4	0.060990	50.21843	0.582103	20.42508	0.903392	2.046623	25.82437
5	0.064204	46.54097	0.622600	26.34831	1.116917	1.862286	23.50891
6	0.067106	43.07132	1.060478	31.29390	1.340102	1.714830	21.51936
7	0.069980	39.74945	1.954249	35.19432	1.557437	1.690220	19.85433
8	0.072894	36.66750	3.143133	38.16523	1.760682	1.827243	18.43622
9	0.075823	33.89134	4.418470	40.41821	1.947853	2.127802	17.19633
10	0.078718	31.44536	5.619112	42.15640	2.121141	2.561544	16.09645
11	0.081537	29.31570	6.661196	43.53206	2.284030	3.090987	15.11603
12	0.084254	27.46993	7.521435	44.64549	2.439904	3.680189	14.24305
24	0.107293	17.12015	10.85941	48.56217	4.151159	10.31738	8.989733
36	0.116470	14.54483	11.33216	47.02743	5.374441	14.08369	7.637451
48	0.118951	14.01360	11.32482	45.70112	5.933915	15.65642	7.370120
60	0.119562	13.99772	11.23159	45.43554	6.034714	15.92528	7.375159

3.3.2.4. Granger causality tests

We augment the short run analysis with pairwise Granger causality tests[21] (results not reported but available upon request). This is aimed at determining the direction of causality and the

[21] The Granger Causality approach designed by Granger (1969) to the question of whether *x* causes *y* tests how much of the current *y* can be explained by past values of *x*. *y* is said to be Granger-caused by *x* if *x* helps in the prediction of *y*, or equivalently if the coefficients on the lagged *x*'s are statistically significant. Note that two-way causation is applied when *x* Granger causes *y*

predictive power of the shocks due to other variables. According to the evidence reported in Table 3.9, we reject the null hypothesis that, exchange rates and prices do not Granger-cause dollarization at the 5 percent significance levels. This implies that, shocks to exchange rates and inflation can cause a change in dollarization in the short run. However, the causal strength of the interest rate variables is not significant at the 5 percent level. This means that, the returns variables are not significant in the prediction of dollarization in Ghana.

Table 3.9: VAR Granger Causality/Block Exogeneity Wald Tests

Excluded	*DR1*	*DR2*
Inflation → dollarization	2.21 [0.33]	2.57 [0.27]
Exchange rate → dollarization	18.45*** [0.00]	17.52*** [0.00]
Interest rate differential → dollarization	1.06 [0.59]	0.81 [0.67]
Real output → dollarization	10.16** [0.01]	15.87*** [0.00]
Financial development → dollarization	3.14 [0.21]	6.55** [0.04]
All the variables → dollarization	57.10*** [0.00]	60.91*** [0.00]

Notes: → represents "does not Granger cause". ** represent rejection of the null hypothesis at the 5% significance levels. The probabilities for the Chi squares are reported in [ ].

3.4. Effects of inflation targeting and redenomination on dollarization

In this section, we explore the effects of two important developments in the monetary policy framework in Ghana within the past decade. These are the adoption of inflation targeting monetary policy in 2002 (but officially in May 2007) and the redenomination of the currency in July 2007. The redenomination entailed knocking four zeros off the existing denominations.

and *y* Granger causes *x*. Hence, the statement "*x* Granger causes *y*" does not imply that *y* is the effect or the result of *x*. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term.

Arguments that were raised to suggest that this operation would have any consequences for the value of the domestic currency were refuted blatantly by the Bank of Ghana. Indeed, the value of the currency was expected to remain the same as old currency denominations were exchanged for their equivalents in the new currency without any losses. However, the debate continues on the effects of the redenomination exercise on the depreciation of the Ghanaian cedi. This study makes another contribution to the literature on dollarization by exploring the effects that the redenomination has had on the demand for foreign currency. We capture the adoption of the inflation targeting regime by creating a dummy variable that takes 0 before 2002 and the value 1 after 2002. The redenomination is also captured by a dummy variable that takes the value 0 before May 2007 and 1 after May 2007. The results of this estimation produce no significant effect of the two variables on the level of dollarization in Ghana, both in the long-run and in the short-run. Similar to the earlier findings, exchange rates, and financial development are significant in the long-run whilst the same variables in addition to real output are significant in the short-run.

3.5. Conclusion

This paper aimed at addressing two important objectives. First, it intended to measure the extent of dollarization in Ghana and provide a brief description of the key factors that affect the dollarization process. Second, it aimed at empirically investigating the short and long-run determinants of dollarization in Ghana using cointegration and error correction techniques. The magnitude of dollarization in Ghana has been measured by the proportion of foreign currency deposits in total deposits and broad money. Going by the yardstick of Balino et al. (1999), the Ghanaian economy can be considered highly dollarized since the ratio of foreign currency deposits to broad money exceeds 30 percent. This suggests that, the domestic banking market is dollarized and presents some conundrums for liquidity risk management because monetary authorities may not be able to play their role of lender of last resort. This requires that

commercial banks maintain adequate levels of foreign currency liquid assets in order to serve as a buffer in case of a bank run. The Bank of Ghana can use differential reserve requirements whereby foreign currency deposits attract higher reserve requirements.

Our empirical analysis has been based on the macroeconomic determinants of dollarization using the ARDL bounds testing and cointegration technique. The study confirmed the important role played by exchange rates in explaining demand for foreign currency in both the long-run and short-run. The evidence suggests that dollarization is generally driven by the loss of confidence in the cedi due to the deteriorating macroeconomic fundamentals and a desire by economic agents to hedge against exchange rate risks. By ensuring stable exchange rates the Central Bank can reduce the demand for foreign currency deposits. This provides some support for Bawumia (2014) that stabilising the cedi would bring down the levels of dollarization. However, there is no guarantee that stabilising the cedi will stop the trend of dollarization due to the irreversible behaviour of the phenomenon. The policy prescription here is that the monetary authorities should take steps to confront the causes of the weakening domestic currency, which is most often driven by the excessive supply of the domestic currency. The Bank of Ghana should focus on how to stabilize the domestic currency, given Ghana's high import dependence and fiscal indiscipline, which most often than not lead to fiscal deficit and current account overruns.

Also, the findings provide some impetus to support the position of the Bank of Ghana. The decision to reverse the exchange rate rules is commendable, as they appeared counter-productive. Lessons from other countries suggest that fighting dollarization through direct measures has not seen much success. Galindo and Leiderman (2005) assert that, countries such as Chile, Israel, and Poland have reaped some benefits from market-oriented measures and better macroeconomic policies that keep the exchange rates and prices stable. Resorting to practical market-driven de-dollarization approach is thus preferred to forced policies (see,

Herrera and Valdes (2003) for Chile and Mercedes (2010) for Peru as cited in Kessy (2011)). Thus, instead of the Bank of Ghana imposing directives on foreign currency dealings, which almost always distort the exchange rate market and heighten the dollarization process, adopting a market-oriented approach is shown to be far superior to forced de-dollarization.

In conclusion, the Bank of Ghana needs to restore confidence and credibility in the domestic currency and institutions by ensuring long-term macroeconomic stability, coupled with the development of domestic risk hedging instruments and financial markets in order to reverse the trend of dollarization in Ghana. There is, therefore, an urgent need to deal with the different forms of dollarization appropriately by pursuing feasible and applicable policies that ensure the effectiveness of the cedi as a store of value, as a unit of account and as a legal tender for transactions in Ghana.

CHAPTER FOUR

ASSET SUBSTITUTION AND STABILITY OF MONEY DEMAND

4.1. Introduction

Monetary policymakers in Ghana have become very disconcerted about the policy implications of the widespread demand and use of foreign currencies in the economy in recent years.[22] The growing trend of what is known in the literature as "*dollarization*" influenced the decision of the Bank of Ghana to implement some strict exchange controls in February 2014 as an attempt to curb further depreciation of the domestic currency. The Bank of Ghana has consistently warned against indexation of prices of goods and services to foreign currencies and at some point had dispatched task forces to ensure that the Ghanaian cedi retains its status as a legal tender in all transactions in Ghana. Notwithstanding the rising trend of dollarization and gradual shift to the foreign currency one question has remained an empirical quest. Is there an empirical evidence of *asset substitution* in Ghana?[23] Has the high demand for foreign currencies amount to empirical evidence of asset substitution in Ghana? The ability to provide answers to such questions is very relevant and warrants the attention of academics and policymakers.

Although the literature on the stability of money demand is replete with fresh evidence, a few studies have been undertaken to shed light on the behaviour of monetary aggregates in Ghana. The evidence provided has at best been mixed. Whereas some studies report stability in the money demand function (for example, Andoh & Chappell, 2002; Dagher & Kovanen, 2011; Ghartey, 1998a), others argue that the structural reforms and deregulation of the financial sector

[22] The liberalization of the Ghanaian economy led to the removal of most exchange controls which made it easy and attractive for economic agents to legally hold foreign currencies in the form of deposits. However, the Ghanaian cedi remains the legal tender for transactions within the economy, as there has not been any *de jure* adoption of a foreign currency.

[23] In this study currency substitution is used to mean the use of foreign currency for domestic transactions in the light of Calvo and Vegh (1992).

have resulted in parameter instability in the demand for broad money in late 1990s (see, Amoah & Mumuni, 2008; as cited in Dagher & Kovanen (2011). The study by Dagher and Kovanen (2011) which tests whether the demand for money in Ghana has remained stable during the financial reforms and liberalization policies implemented in the 1980s and 90s, provides contradictory evidence in support of earlier evidence by Bawumia and Abradu-Otoo (2003).

Besides the inconclusive evidence, a key weakness of those earlier studies is that none specifically addresses the effects of capital mobility and/or currency substitution on the stability of money demand in Ghana. Moreover, although most of the studies have impliedly assumed the existence of structural breaks, none actually tested whether the relationship between real money balances and its determinants has been subject to breaks, or at best employed methods that account for breaks in the data generation process. This study augments the literature and furthers the frontiers of our understanding of the money demand equation in small open economies by employing a model that incorporates currency substitution and capital mobility effects. The empirical approach follows the portfolio balance model pioneered by (Branson & Henderson, 1984; Cuddington, 1983). Within the theoretical framework, this models the demand for asset as a function of real return on the asset and real income in which a domestic investor allocates his wealth among domestic money, domestic bonds, foreign money, and foreign bonds. The portfolio balance approach has been applied in a number of studies (for example, Akçay et al., 1997; Alami, 2001; Ramirez-Rojas, 1985). Arize et al. (1990) estimates money demand for some African countries within the portfolio balance approach using monetized real income, expected rate of inflation, foreign interest rates, expected exchange rate, and a measure of capital mobility.[24] Arize et al. (1990) argued that money demand equations that fail to account for the openness of African economies could lead to biased results. According to them, for monetary

[24] They based on the Plosser, Schwert, and White (1982) test, and combined foreign interest rates and expected exchange rates as the measure of capital mobility for Egypt, Gambia, Nigeria, and Somalia in their model for narrow money demand.

policies in African countries to be effective, they need to integrate the response of domestic money demand to developments in the external markets. Earlier arguments by Ramirez-Rojas (1985) support that it is imperative to include a measure of currency substitution in money demand functions for developing countries. Also, according to Domowitz and Elbadawi (1987), if foreign currency serves as a substitute for domestic money omitting a variable that measures the return on the foreign currency in the demand function for real money may bias the model towards overstating the influence of inflation.

The inclusion of foreign factors (foreign interest rate and exchange rate) to capture currency substitution and capital mobility, holds important practical implications for the historic macroeconomic "*policy trilemma"* or the "*impossible trinity*" faced by policymakers in open economies. The challenge is on the trade-offs among monetary autonomy, unrestricted capital mobility, and exchange rate stability as advanced in some studies (see, Hsing, 2012; Obstfeld, Shambaugh, & Taylor, 2005; Schoenmaker, 2011). It has been generally documented that, unrestricted mobility of capital, which can eventually lead to the substitution of domestic currency, is crucial for macroeconomic management as it affects the stability of monetary aggregates, effectiveness of monetary and fiscal policy options, and exchange rate stability, among others (see, Agenor & Khan, 1996; Giovannini & Turtelboom, 1994; Imrohoroglu, 1994). As argued in the literature, these international influences affect the sustainability of government's fiscal position because it reduces government's revenue through seigniorage (for example, Easterly, Mauro, & Schmidt-Hebbel, 1995; Levich, 1986; Mundell, 1963).

This study follows the cointegration and error correction framework to model a money demand function for Ghana for the period 1960 – 2013. The ARDL approach and other techniques that account for structural breaks are employed. The study reports that there is a stable long-run relationship between real money balances [defined in narrow (M1) and broad (M2+) terms] and

real income, domestic interest rates, foreign interest rates and exchange rates. All the variables are statistically significant and show signs that are consistent with theoretical predictions. The results indicate the relevance of foreign interest rates and expected exchange rates (either separately or jointly) in the modelling of money demand function in Ghana.

The remainder of this paper is structured as follows: section 4.2 presents a brief review of literature on money demand and currency substitution. Section 4.3 is the model empirical strategy. Section 4.4 is a discussion of the findings and section 4.5 is the conclusion and policy recommendations.

4.2. Model and empirical methodology

The study is based on the portfolio balance approach advanced by Cuddington (1983) and Branson and Henderson (1984) which takes its roots from models developed by Tobin (1969). It assumes that there exist bonds in both domestic and foreign currency denominations. A further assumption is that the demand for an asset is a function of real return on the asset and real income and as such a domestic investor allocates his wealth among the four different assets: domestic money balance (M), domestic bonds (B), foreign money (M^*), and foreign bonds (B^*). All assets are available to portfolio holders and economic agents maximize their return of the portfolio depending on the income, wealth and the respective returns on the assets. The model highlights the store-of-wealth function, and consequently applies money as substitute for both monetary and non-monetary assets.

When expressed in logarithms, the real demand for each currency and own real return is assumed to be positively related; and also negatively related to the real return of each alternative asset in the portfolio according to the relation:

$$\ln\left(\frac{M}{P}\right)_t = \partial_0 + \partial_1 \ln r_t + \partial_2 \ln(r^* + e^e)_t + \partial_3 \ln y_t + \partial_4 e^e + \partial_5 \ln\left(\frac{M}{P}\right)_{t-1} + \omega_t \qquad (4.1)$$

where y is the real income, r is the domestic interest rate and r^* foreign interest rates, e^e is the expected change in the exchange rate, $r^* + e^e$ is the rate of return on foreign bonds. Branson and

Henderson (1984) postulate that, the demand for assets by domestic residents would depend on the relative returns according to some wealth constraints. Accordingly, given that r is the return on bonds indexed in domestic currency relative to the return on domestic money (less inflation), we assume that the four assets serve as substitutes in the portfolio. This implies that, an increase in r raises domestic bonds demand and as such, the demand for its substitutes in the portfolio drops. In addition, given that e^e is the expected change in the exchange rate and r^* is the nominal return on foreign currency bonds; $r^* + e^e$ is the return on domestic currency equivalent of assets denominated in foreign currency. An increase in this would raise the demand for foreign securities, which negatively affects the demand for other assets.

Consistent with this line of argument, a statistically significant negative coefficient of e^e would be interpreted to suggest evidence of currency substitution, whereas a significant negative coefficient of $r^* + e^e$ would be taken to reflect evidence of capital mobility. This interpretation assumes that the Fisher open condition whereby domestic and foreign bonds are perfect substitutes does not hold exactly (see, Cuddington, 1983; for further explanation). Again, if evidence is established that there is capital mobility, it would suggest that e^e does not affect money demand directly but rather through $r^* + e^e$.

The data for the analysis is annual series from 1960 – 2013. All the data were extracted from the World Development Indicators published by the World Bank. It includes M1 and M2+ as definitions for narrow and broad money balances respectively, deflated by the consumer price index. The other variables are real income, domestic interest rate, foreign interest rate and exchange rate all retrieved from the same source.

The empirical strategy is built on the Autoregressisve Distributed Lag (ARDL) model proposed by Pesaran et al. (2001), Pesaran, Shin, and Smith (1999), and Pesaran and Pesaran (1997). The bounds testing approach pioneered by Pesaran et al. (2001) within the ARDL framework is followed in the test for cointegration between money balances and their components. This approach to cointegration has the ability to provide robust results "*irrespective of whether the regressors are purely I(0), purely I(1) or mutually cointegrated*" (Pesaran et al., 2001, pp. 289-290). According to the proponents, the approach is also robust for cointegration analyses with small sample study (Pesaran et al., 2001). Following the ARDL framework, the money demand is modelled as follows:

$$\Delta ln\left(\frac{M}{P}\right)_t = \alpha_0 + \sum_{i=1}^{k} \varphi_i \Delta ln\left(\frac{M}{P}\right)_{t-i} + \sum_{i=0}^{k} \theta_i \Delta lnr_{t-i} + \sum_{i=0}^{k} \lambda_i \Delta ln(\mathrm{r}^* + \mathrm{e}^e)_{t-1} + \sum_{i=0}^{k} \phi_i \Delta ln\, \mathrm{e}^e{}_{t-i} + \sum_{i=0}^{k} \Omega_i \Delta lny_{t-i}$$
$$+\delta_1 ln\left(\frac{M}{P}\right)_{t-1} + \delta_2 lnr_{t-1} + \delta_3 ln(\mathrm{r}^* + \mathrm{e}^e)_{t-1} + \delta_4 ln\, \mathrm{e}^e{}_{t-1} + \delta_5 lny_{t-1} + \varepsilon_t \qquad (4.2)$$

In this model, $\left(\frac{M}{P}\right)$, r, $r^* + e^e$, e^e and y are real money balances (M1, M2 and M2+), rate of return on assets denominated domestic currency, rate of return on foreign currency denominated assets, expected exchange rate, and real income, respectively. Δ is the first difference operator, k is the optimal lag length, *ln* is the natural logarithm, and ε_t is a white noise disturbance error term.

The long-run relationship between the variables under consideration can be deduced based on the Wald (*F*-statistic) test by imposing restrictions on the estimated long-run coefficients of one period lagged level of the variables to be zero. The null hypothesis is H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$, against the alternative hypothesis H_1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$. The *F*-test has a non-standard distribution which depends on (i) whether variables included in the model are *I*(0) or *I*(1), (ii) the number of regressors, and (iii) whether the model contains an intercept and/or a trend. Given that the sample size of 54 observations falls within the small sample size of 30 – 80, the critical values reported by Narayan (2004) will be applied. Two sets of critical values are generated for *I*(1) series (upper bound critical values) and *I*(0) series (lower bound critical values). If the *F*-statistic exceeds the respective Upper bound critical values, there is evidence of cointegration between the variables regardless of the order of integration of the variables, whereas if the test statistic is below the Lower bound critical value, the null hypothesis of no cointegration cannot be rejected. If it lies between the two bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying regressors. In that case, further evidence would be required to guide the interpretation.

After testing for this cointegration and evidence of long-run relationships established, the following long-run model is specified:

$$ln\left(\frac{M}{P}\right)_t = \alpha_1 + \sum_{i=1}^{k} \varphi_{1i} ln\left(\frac{M}{P}\right)_{t-i} + \sum_{i=0}^{k} \beta_{1i} ln\, \mathrm{r}_{t-i} + \sum_{i=0}^{k} \theta_{1i} ln(\mathrm{r}^* + \mathrm{e}^e)_{t-i} + \sum_{i=0}^{k} \lambda_{1i} ln\, \mathrm{e}^e{}_{t-i} + \sum_{i=0}^{k} \phi_{1i} lny_{t-i} + \mu_t \qquad (4.3)$$

The orders of the lags in the ARDL model are selected by either the Akaike Information criterion (AIC) or the Schwarz Bayesian criterion (SBC), before the selected model is estimated

by ordinary least squares. The ARDL specification of the short-run dynamics can therefore be derived by constructing an error correction model (ECM) of the following form:

$$\Delta ln\left(\frac{M}{P}\right)_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i} \Delta ln\left(\frac{M}{P}\right)_{t-i} + \sum_{i=0}^{k} \beta_{2i} \Delta ln \mathrm{r}_{t-i} + \sum_{i=0}^{k} \theta_{2i} \Delta ln(\mathrm{r}^* + \mathrm{e}^e)_{t-i} + \sum_{i=0}^{k} \lambda_{2i} \Delta ln \mathrm{e}^e_{t-i} + \sum_{i=0}^{k} \phi_{2i} \Delta ln y_{t-i} + \Psi ECT_{t-1} + \vartheta_t \quad (4.4)$$

where ECT_{t-1} is the error correction term, defined as

$$ECT_t = ln\left(\frac{M}{P}\right)_t - \alpha_1 - \sum_{i=1}^{k} \varphi_{1i} ln\left(\frac{M}{P}\right)_{t-i} - \sum_{i=0}^{k} \beta_{1i} ln \mathrm{r}_{t-i} - \sum_{i=0}^{k} \theta_{1i} ln(\mathrm{r}^* + \mathrm{e}^e)_{t-i} - \sum_{i=0}^{k} \lambda_{1i} ln \mathrm{e}^e_{t-i} - \sum_{i=0}^{k} \phi_{1i} ln y_{t-i} \quad (4.5)$$

All coefficients of the short-run equation are coefficients relating to the short run dynamics of the model's convergence to equilibrium, and its coefficient represents the speed of adjustment. The statistical significance of the error correction term indicates that deviations due to shocks to the system are temporal and the system gravitates to a long-run equilibrium state. This is another effective way of establishing long-run relationship among the variables as argued by Kremers et al. (1992).

In terms of the direction of long-run coefficients, income elasticity is expected to be positive while domestic interest rate is expected to carry a negative coefficient. However, the coefficients of the foreign variables - exchange rate and foreign interest rates cannot be determined *a priori*. The two are best determined empirically because they could be positive or negative depending on the behaviour of economic agents.

Although the ARDL has the advantage of combining both *I*(1) and *I*(0) variables and does not necessarily require testing for unit roots, it is necessary to ensure that none of the variables included follows an I(2) process. In this study, three different tests are employed – the Phillips-Perron (PP) test (Phillips & Perron, 1988), the KPSS test (Kwiatkowski et al., 1992) and the Zivot–Andrew (ZA) test (Zivot & Andrews, 2002). Each of these three tests has some special

features that enhance robustness. The PP test is chosen over the Augmented Dickey–Fuller (ADF) test proposed by Dickey and Fuller (1979) because it makes use of non-parametric methods to adjust for serial correlation and endogeneity of regressors. According to Hamilton (1994), it also allows for the possibility of heteroskedastic error terms. The KPSS test is well-known for its stationary null hypothesis. The ZA test also allows for unknown breaks in the deterministic terms of the time series, and has a null hypothesis of a unit root without a structural break as against the alternative of trend stationary process with a structural break in the trend function at an unknown time.

4.3. Results and discussion

The results of the tests reported in Table 4.1 indicate that, in general none of the variables is *I*(0) in levels. Also, all the variables become stationary after first differencing (that is, each series follows an *I*(1) process). This is a confirmation that none of the variables is I(2).

Table 4.1: Unit root tests

Levels Variable	*ZA intercept*	*ZA trend*	*KPSS constant*	*KPSS trend*	*PP constant*	*PP trend*
real M1	-2.76 (1977)	-2.55 (1984)	0.45	0.23**	0.61	-0.24
real M2	-3.84 (1977)	-2.89 (1985)+	0.68**	0.11	-1.77	-2.56
real M2+	-5.58** (1993)	-3.16 (1978)	0.75**	0.15**	-0.79	-2.62**
real income	-2.74 (1975)	-2.71 (1984)	0.93**	0.24**	3.11**	0.54
exchange rate	-4.92** (1983)	-4.17 (1985)	0.21	0.19**	-3.90**	-3.87
return	-4.39 (1983)	-4.18 (1985)	0.20	0.19**	-3.75**	-3.69**
interest rate	-3.51 (1999)	-3.89 (1996)	0.47**	0.18**	-1.58	-1.31
foreign interest rate	-3.53 (1978)	-4.84* (1982)	0.39	0.22**	-1.36	-1.72
real M1	-7.26**	-7.44**	0.48**	0.09	-5.84**	-6.43**
real M2	-7.83**	-7.96**	0.09	0.09	-7.51**	-7.43**
real M2+	-8.07**	-8.62**	0.08	0.06	-9.22**	-9.16**
real income	-6.58**	-6.88**	0.59**	0.15**	-4.65**	-5.39**
exchange rate	-6.38**	-6.44**	0.36	0.34**	-15.65**	-18.45**
return	-6.72**	-6.71**	0.42	0.37**	-15.58**	-18.89**
interest rate	-10.32**	-10.91**	0.19	0.09	-8.38**	-8.47**
foreign interest rate	-6.28**	-6.39**	0.30	0.18**	-4.95**	-8.68**

Note: In parentheses are break dates for the levels series as suggested by the Zivot-Andrew test. Critical values at 5% significance level are KPSS: 0.463 & 0.146; PP: -2.929 & -3.499; ZA: -4.93 & -4.42. ** is used to indicate significance at the 5% level.

To explore evidence of long-run relationship between real monetary aggregates and its determinants, the ARDL bounds test approach and Saikkonen-Lutkepohl cointegration approaches are employed. The Saikkonen-Lutkepohl cointegration test accounts for possible structural break(s) in the data generating process (see, Saikkonen & Lütkepohl, 2000a, 2000b;

2000c). Table 4.2 presents the results from the tests for cointegration. Generally, the results of the ARDL indicate the rejection of the null hypothesis of no cointegration when real money is normalised in each of the models estimated given that the calculated *F*-statistics exceed the upper bound critical values at the 5% significance level. The Johansen Trace as well as the Saikonnen and Lutkepohl tests confirm these results. There is therefore a strong evidence of a long-run steady state relationship between real narrow money demand and its covariates, which is suggestive that real income, domestic interest rates, foreign interest rates, and expected exchange rates are long-run determinants of money demand in Ghana.[25]

Table 4.2: Results of cointegration tests

	ARDL		*Johansen Trace*[26]		*Saikkonen & Lutkepohl*	
Dependent variable	constant	none	constant	both	constant LR	both LR
Real m1	4.44** [0.003]	1.86 [0.122]	104.80**	119.51**	86.69**	83.48**
Real M2+	3.23** [0.015]	2.67** [0.036]	102.71**	115.49**	85.92**	79.37**

Notes: The ** indicates significance at the 5% level. Critical values for Johansen Trace and S&L tests at the 5% levels are 15.49 and 4.13 respectively.

[25] In the case where the *F*-statistics could not establish evidence of cointegration, the ECT estimated based on an error correction model was used as a confirmatory test. This follows the argument of Kremers et al. (1992) that the finding of a negative and significant lagged error correction term (ECT) provides a useful and relatively more efficient way to establish cointegration. Based on this approach, reliance is placed upon the significance of the ECT in establishing evidence of cointegration by Chowdhury (2011); Baharumshah et al. (2008); Bahmani-Oskooee (2001); Banerjee et al. (1998); among others.

[26] The Trace statistics is one of the two test statistics of the VAR-based cointegration tests developed in Johansen (1991, 1995). The critical values are taken from MacKinnon, Haug, and Michelis (1999) as reported by Eviews. The trace statistic tests the null hypothesis of *r* cointegrating relations against the alternative of *r+1* cointegrating relations.

4.3.1. Evidence of currency substitution (CS)

In this section, the money demand function is modelled with interest rate and any one of foreign variables – *interest rate differential*, *foreign interest rate* or *expected exchange rate* as a measure of currency substitution by following the approach of Bordo and Choudri (1992). Under this estimation, there is no distinction between currency substitution and capital mobility so that a negative and statistically significant effect of any of them is evidence of currency substitution. The results of the long-run estimates is reported in Table 4.3. The domestic interest rate variable is statistically insignificant in the broad money demand function and is consistent with the evidence established by Dagher and Kovanen (2011) for Ghana. The exchange rate variable is carrying a negative sign albeit insignificant in the broad money demand function. The two returns variables – *interest rate differential* and *foreign interest rate* – are negatively signed and statistically significant at least at the 10% significance level. This provides evidence of substitution of the domestic currency in Ghana in both the narrow money and broad money definitions. Similar findings have been reported by Dagher and Kovanen (2011) and Kovanen (2011). However, as argued earlier, this evidence does not clearly provide a distinction between currency substitution and capital mobility.

4.3.2 Using Cuddington's model

We argue that, there is evidence of currency substitution in the M1 demand function as the coefficient for the currency substitution variables *(interest rate differential, expected exchange rate*, *foreign interest rate, and expected returns)* are negative and statistically significant at the 1% level. However, this evidence does not distinguish between capital mobility and currency substitution as argued by Cuddington (1983) – it cannot disentangle the effects on money demand due to capital mobility from currency substitution. Therefore, we specify another model that can establish this distinction as explained in the empirical model.

Table 4.3: Long-run estimates based on currency substitution models

Models		ARDL/M1	DOLS/M1	FMOLS/M1	ARDL/M2+	DOLS/M2+	FMOLS/M2+
Model 1	*y*	1.00	1.05	0.99	0.16	0.17	0.15
	r	-10.22	-11.92	-11.12	-0.28 [0.34]	-0.78 [0.14]	-0.37
	rd	-7.09	-8.86	-7.88	-0.66** [0.04]	-1.26** [0.03]	-0.78* [0.06]
	c	-5.53	-5.84	-5.37	-1.37	-1.4	-1.26
Model 2	*y*	1.23	1.26	1.25	0.19	0.19	0.17
	r	-3.07	-3.06	-2.94	0.33	0.44 [0.02]	0.42
	e^e	-0.49	-0.63	-0.89	0.00 [0.92]	-0.03 [0.63]	-0.02 [0.52]
	c	-7.89	-8.12	-7.98	-1.66	-1.76	-1.55
Model 3	*y*	1.00	1.05	0.99	0.16	0.17	0.15
	r	-3.13	-3.06	-3.24	0.38	0.48	0.44
	r^*	-7.09	-8.86	-7.88	-0.66** [0.04]	-1.26** [0.03]	-0.78* [0.06]
	c	-5.53	-5.84	-5.37	-1.37	-1.4	-1.26
Model 4	*y*	1.44	1.14	1.21	0.14	0.19	0.17
	r	-3.15	-2.60	-3.05	0.70	0.45	0.43
	ret	-0.67	-1.00	-0.71	-0.07 [0.22]	-0.04 [0.46]	-0.03 [0.36]
	c	-6.21	-7.01	-7.63	-1.58	-1.69	-1.51

Notes: These models include real money, real income, domestic interest rate and a "*portfolio variable*" - interest rate differential (*rd*), expected exchange rate (e^e), foreign interest rate (r^*), and returns (*ret*)- as right-hand side variables to capture currency substitution. *c* is a constant. *P*-values are in parenthesis. All the figures without p-values are significant at 1% level. ** and * indicate significance at 5% and 10% levels respectively.

4.3.2. Demand for narrow money

The results presented in Table 4.4 indicate that the income elasticity for narrow money is close to one. This is consistent with the evidence provided by Ghartey (1998a) and Ghartey (1998b) for Ghana and Jamaica, respectively. All the other variables are as well statistically significant. The domestic interest rate also carried the expected negative sign. This implies that, as interest rates increase the opportunity cost of holding money increases that causes agents to reduce the demand for narrow money. The return on foreign currency bonds is negative while the exchange rate variable is positive. The implication is that the cost of borrowing effect as argued by Marquez (1987) and Bahmani-Oskooee and Ng (2002) is not valid. Rather, an increase in the foreign returns raises the attractiveness of foreign currency bonds that encourages residents to

substitute foreign currency bonds for domestic currency assets in their portfolio. This leads to a reduction in the demand for domestic money balances (that is, capital mobility effect). In addition, the fact that the exchange rate variable is positive indicates that a depreciation of the Ghanaian currency leads to high demand for domestic money balances. Although this is consistent with the wealth effect of Bahmani-Oskooee and Techaratanachai (2001), Bahmani-Oskooee and Rhee (1994) and Arango and Nadiri (1981), it is not what we observe in reality for Ghana.

4.3.3 Demand for broad money

In the model for broad money demand reported in Table 4.4, all the variables are statistically significant at least at the 10% level. The income elasticity is small but significant at the 1% level. The small income elasticity for demand for M2 has been recorded in some previous studies. Andoh and Chappell (2002) find the income elasticity for M2 in Ghana as 0.25, albeit insignificant. Dagher and Kovanen (2011) also find the elasticity of demand for money to be 0.25, whereas in the case of Bahmani-Oskooee and Gelan (2009) it was found to be 0.36 when the real effective exchange rate was used a determinant of money demand. There is a positive relationship between return on domestic interest rates and money demand. Hendry and Ericsson (1991) explain this by arguing that broad money comprises some interest-bearing form of money and thus makes it more attractive as interest rates go up. Also, whereas the exchange rate variable is still positive, the foreign returns variable is negative. Mannah-Blankson and Belnye (2004) offered no explaination when a depreciation of the cedi could caused an increase in demand for money in Ghana, although the positive relationship supports the wealth effect of Arango and Nadiri (1981).

There is evidence of a positive impact of deposit rates on the demand for M2. Hence, instead of reflecting the opportunity cost of holding domestic money, the fact that M2 also includes

interest-bearing assets seems to dominate. *A priori,* the deposit rate can be expected to have a different impact on the demand for broad and narrow monetary aggregates, respectively. As broad monetary aggregates comprise also interest-bearing deposits, demand for these aggregates may rise in response to an increase in interest rates (Buch, 2001; Hendry & Ericsson, 1991). Narrow monetary aggregates, in contrast, would be expected to have a negative relationship with interest rates. The measure of currency substitution is statistically significant in both the narrow and broad money demand function but it did not carry the expected negative sign. Thus, we conclude that, there is no evidence of currency substitution. Although this finding is inconclusive due to high multicollinearity problems, it questions the empirical and theoretical relevance of currency substitution in Ghana similar to the findings of Cuddington (1983).

Table 4.4: Long-run estimates based on Cuddington's model

dependent	ARDL/M1	DOLS/M1	FMOLS/M1	ARDL/M2+	DOLS/M2+	FMOLS/M2+
y	0.99** [0.00]	1.04** [0.00]	1.03** [0.00]	0.16** [0.00]	0.16** [0.00]	0.13** [0.00]
r	-2.68** [0.00]	-2.69** [0.00]	-2.75** [0.00]	0.37** [0.00]	0.46** [0.00]	0.53** [0.00]
$r*+e^e$	-6.17** [0.00]	-7.44** [0.00]	-6.64** [0.00]	-0.64 [0.05]	-1.73** [0.02]	-1.19** [0.01]
e^e	5.77** [0.00]	7.01** [0.00]	6.19** [0.00]	0.65** [0.05]	1.80** [0.02]	1.18** [0.02]
c	-5.43** [0.00]	-5.78** [0.00]	-5.73** [0.00]	-1.41** [0.00]	-1.35** [0.00]	-1.11** [0.00]

Note: ** is used to indicate rejection at the 5% significance level.

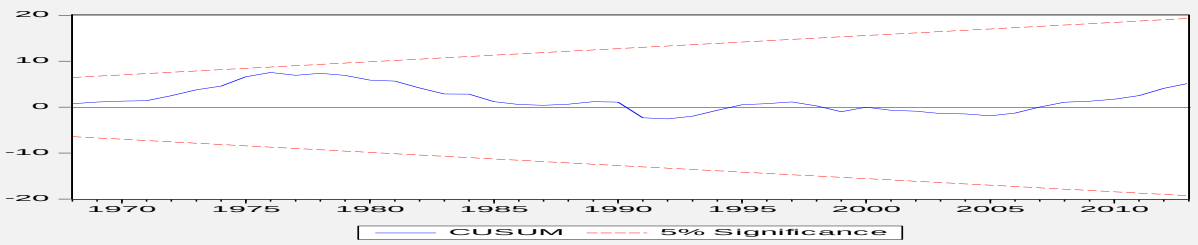
4.3.4. Diagnostic tests

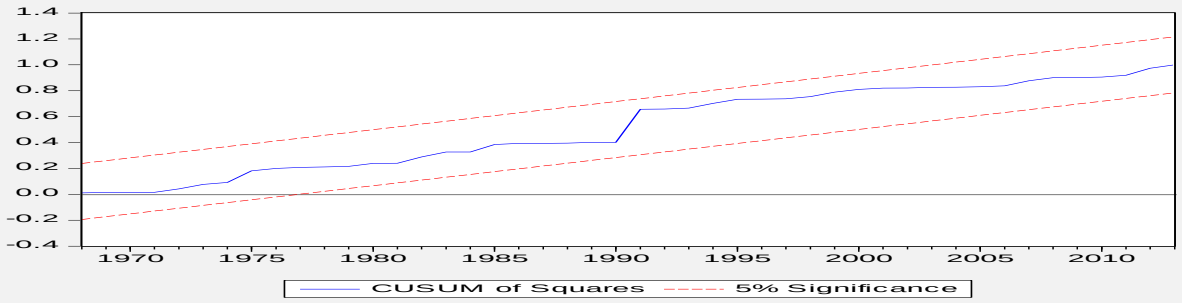
Finally, the stability of the estimates is examined by following Pesaran and Pesaran (1997). We apply the CUSUM and CUSUMSQ proposed by Brown, Durbin, and Evans (1975). The tests are applied to the residuals of all three models in Table 4.3. Figure 4.1 below shows a graphical representation of the CUSUM and CUSUMSQ plots applied to the ARDL models of M1 and

M2+ respectively. Neither CUSUM nor CUSUMSQ plots cross the critical bounds, indicating no evidence of any significant structural instability. Similar results followed when the tests were applied to the other models.

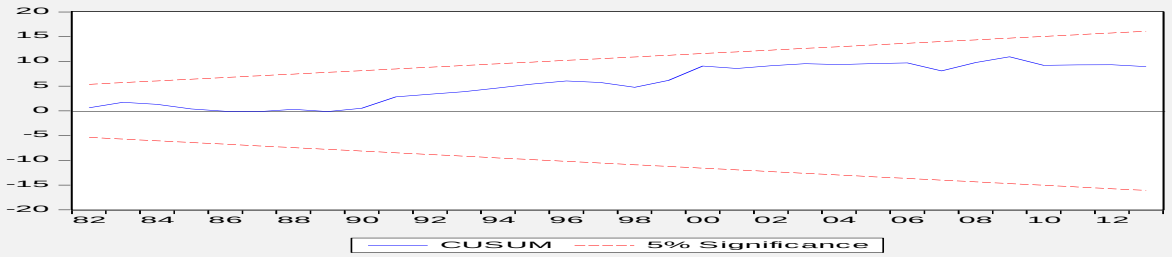
Figure 4.1: CUSUM and CUSUM Square tests

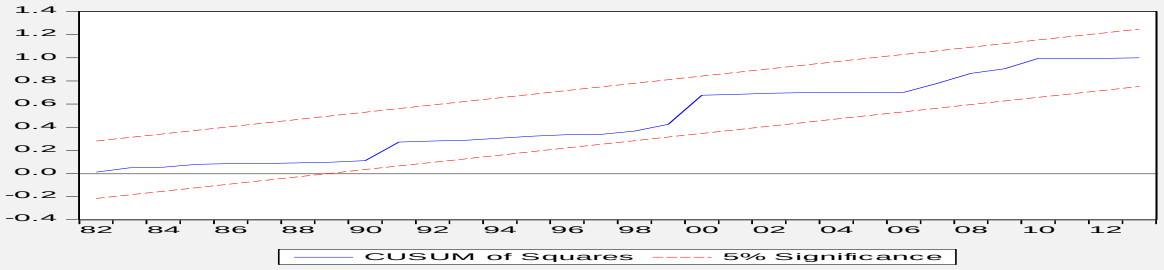
Stability test for M1





Stability test for M2+





4.4. Conclusion

This study has investigated the stability of the domestic money demand function in Ghana for the period 1960 – 2013. It follows the portfolio balance approach that accounts for the presence of currency substitution and capital mobility. The evidence points out the significance of foreign variables (foreign interest rates and exchange rates) in a long-run relationship between real money balances and real income, domestic interest rates, foreign interest rates and exchange rates. The results reveal that capital mobility and currency substitution are significant factors in the domestic money demand dynamics.

The results highlight that, the income elasticity for narrow money is close to one but less than unity for broad money. The coefficient of the interest rate variable is negative for narrow money but positive for broad money pointing out differences in the definition of the two categories of money as explained by Hendry and Ericsson (1991) and Buch (2001). Also, the coefficient for returns on foreign bonds is negative for both narrow and broad monetary aggregates. The validity of foreign interest rate and/or the expected depreciation of the domestic currency in the long-run money demand equation capture the existence of capital mobility. The implication is that domestic agents use foreign currencies together with the domestic currency, although the domestic currency remains the legal tender for domestic transactions.

The evidence indicates that, the degree of openness (trade as a share of GDP) is quite high in Ghana and that economic agents' respond to differentials in rates of return. A high degree of capital mobility suggests that monetary and financial developments in the international markets exert strong influence on the domestic economy, has important implications for fiscal and monetary policies as well as magnifying the adverse consequences of exchange rate fluctuations. The trend affects the extent to which fiscal policy crowds out private investment, how currency

depreciation affects real output, and the ability of monetary policy to affect aggregate demand; which poses critical challenge for their combined impacts on macroeconomic stability in Ghana.

The results put up important recommendations for macroeconomic policy in Ghana. Especially when economic agents and investors expect a depreciation of the domestic currency it reflects in capital outflows or switching between currencies which also leads to high domestic interest rates. The high real interest rates generated by that consequently would have adverse implications for the level of economic activity and long-run growth prospects. In line with Haque and Montiel (1991), the evidence of high capital mobility coupled with expectations of currency depreciation can be useful in explaining the inadequate private investment in highly indebted countries such as Ghana. Developments in financial and monetary positions in the external sector are important for modelling money demand behaviour in Ghana and as a result, for the design and implementation of monetary and exchange rate policies.

In the light of the above evidence, effective monetary and exchange rate policies would be possible if monetary authorities take into account developments in the international environment. Our results suggest that conducting an independent monetary policy would be challenging, especially when an increase in returns on U.S. bonds can have implications for domestic money holdings. Since monetary authorities in Ghana cannot have control over interest rates in the U.S., the effectiveness of its policies would become affected eventually. Moreover, because the domestic money demand is responsive to international variables, they become less stable as the transmission of external shocks is possible through returns on foreign currency.

CHAPTER FIVE

DOLLARIZATION AND EXCHANGE RATE VOLATILITY IN GHANA

5.1. Introduction

Major fluctuations associated with exchange rates continue to be a concern for academics, financial analysts, and policy makers due to its importance for macroeconomic management. Such developments in the foreign exchange market hold implications for the welfare of households, firms' profitability, price stability, and the susceptibility of the general economy (Lizondo & Montiel, 1989; Pindyck, 1982; Towbin & Weber, 2011; Setzer, 2006). The implications of exchange rate movements for security valuation, investment analysis, profitability, and risk management are enormous. In addition, exchange rate dynamics play a significant role in international trade and the degree of external sector competitiveness of the economy. The depreciation of the domestic currency has some implications for the path of fiscal position and the trade balance. Persistent depreciation increases the burden of servicing external debt, necessitating issuance of new debt, which further increases the burden of future debt-servicing (Tille, 2003). Also, for certain values of physical quantities (volume) of imports and exports, depreciation of the domestic currency increases the value of imports measured in domestic currency units over exports. If import demand and export supply elasticity are sufficiently low, then this effect is likely to dominate the demand and switching effect that currency depreciation is expected to cause in order to restore equilibrium in the trade position (Giovannini, 1988; Chowdhury, 1993; McKenzie & Brooks, 1997; Dell'Ariccia, 1999; McKenzie, 1999).

A major challenge in Ghana since the adoption of flexible exchange rate regime in 1986 has been the persistent depreciation of the Ghanaian cedi against most of the major international currencies. The cedi, which at the time of the most recent redenomination in July 2007 was exchanged at less than GH¢0.95 for US$1.00 has experienced a continuous downward trend, reaching GH¢3.52/US$1.00 in 2014. Over the first nine months of 2014, the inter-bank

exchange rate market recorded a depreciation of 31.19 per cent against the U.S. dollar, compared to a depreciation of 4.12 per cent recorded during the corresponding period in 2013 (Terkper, 2014). According to Terkper (2014), the Ghana cedi also depreciated by 29.32 per cent and 23.63 per cent against the pound sterling and the Euro, respectively in the same period, and that compared with 16.73 per cent and 20.05 per cent depreciations respectively, against those currencies at the end of 2013, with higher depreciation in the black market.

This rapid trend of depreciation of the cedi has attracted a lot of concern over the past few years. The negative implications of the fragile currency forced the Bank of Ghana to implement some foreign exchange rules in February 2014 in a bid to avert further deterioration of the currency. One of the arguments put forward by the Bank of Ghana for the implementation of foreign exchange restrictions was the suspicion that the rising trend of dollarization in the economy was the cause of the fall of the Ghanaian cedi. There is certainly some theoretical underpinnings and empirical evidence in the literature that dollarization leads to exchange rate volatility. Unfortunately, however, the directives had limited success which was partly attributed to the limited empirical research undertaken on Ghana. The debate on the relationship between dollarization and exchange rate volatility has not settled due in part to the differing evidence which has usually been based on the structure of an economy, the type of exchange rate regime, its monetary policy, and the extent of dollarization in that economy.

It has been argued that, the extent to which dollarization impacts on macroeconomic fundamentals can depend on the form of dollarization that exists in a given economy, especially when comparing *full* dollarization and *partial* dollarization. For monetary zones such as the Euro area that are fully dollarized, there is evidence of a decline in exchange rate volatility by Schnabl (2007), Bartram and Karolyi (2006), and Clark et al. (2004). Savvides (1996) also shows that exchange rate volatility is lower in the Franc zone than non-Franc zone. Others studies including

Akofio-Sowah (2009), Barrell et al. (2009), Lange and Sauer (2005), Bogetic (2000), and others; have also shown that full dollarization minimizes the volatility of exchange rates particularly in Latin American countries. However, evidence based on partially dollarized countries by Mengesha and Holmes (2013) for Eritrea, Yinusa (2008) for Nigeria, Akcay et al. (1997) for Turkey and Calvo and Carlos (1996) suggest that an increase in dollarization increases exchange rate volatility. It has been argued that dollarization is the main cause of instability in flexible exchange rates and has been a significant destabilizing force in the world economy (see, for instance, Willett & Banaian, 1996; McKinnon, 1982, 1993; Bofinger, 1991). According to McKinnon (1996), the concept of international dollarization is useful for explaining why floating exchange rates have been so volatile.

This study empirically explores the effects of dollarization on exchange rate volatility in Ghana over the floating exchange rate regime using exponential GARCH (E-GARCH) modelling approach. Although the issue of dollarization has usually been linked to exchange rate volatility in developing countries practising floating exchange rates, empirical evidence in Africa is still limited. The subject is expected to be more engendering in Africa considering the extent of openness, the rising trend of foreign currency demand, and the rate at which exchange rate instability has strangled most productive sectors of import dependent economies in the continent. It is an important research endeavour since broadening our understanding of the relationship between dollarization and exchange rate fluctuations would be very useful for monetary and fiscal policymaking, academic research, risk management practices, and investment analysis. To advance our intention to capture the dynamic interactions between the dollarization and exchange rate variables, the diagonal VECH multivariate GARCH model is employed. The M-GARCH modelling technique models volatility co-movements and transmission effects among the variables.

The models are robust in capturing the effects of dollarization in both the mean and the time-varying variance of exchange rate depreciation. Consistent with the behaviour of the exchange rate process exhibiting excess kurtosis, the asymmetry is captured by assuming a flexible structure for the underlying data generating process in the model (see, Nelson, 1991). The results provide evidence of a positive effect of dollarization on exchange rate volatility, suggesting that as the demand for foreign currencies becomes more extensive, the cedi/dollar exchange rate becomes more volatile.

The remainder of the chapter is structured as follows: section 5.2 is a historical review of exchange rate policies in Ghana. Section 5.3 is a description of the data and the methodology employed. Section 5.4 is the presentation of the results and analysis and section 5.5 is the conclusion and policy prescriptions for ensuring stability of exchange rates in a dollarized environment.

5.2. A historical review of exchange rate policies in Ghana[27]

Although Ghana inherited huge foreign exchange reserves from the colonial era, the massive industrialization and modernization programme implemented by the government in the early 1960s depleted the country's external reserves and Ghana began to see the signs of foreign exchange constraints (see, Sowa & Acquaye, 1998). The first Exchange Control Act was passed in 1965 to regulate the foreign exchange market. The colonial economy prior to 1983 maintained a controlled fixed exchange rate regime characterized by surrender laws, foreign exchange rationing and currency inconvertibility (see Mumuni & Owusu-Afriyie, 2004 and Gyimah-Brempong, 1992). Under this regime, exporters were required by law to surrender all their foreign exchange earnings to the Bank of Ghana (BoG) at the fixed official rate, and the purchase of foreign exchange for capital transaction was illegal.

[27] For a detailed history of exchange rate reforms in Ghana, see Dordunoo (1994b).

The move from fixed exchange rate system to flexible exchange rates (or market-determined) system has seen a number of episodes. Major features that characterized Ghana's foreign exchange market in the years before the ERP included overvalued official exchange rate, a flourishing black market, and the allocation of official foreign exchange based on import licensing arrangements. With the launching of the Structural Adjustment Programme (SAP) and the ERP from 1983 to 1986, the government made a series of devaluations of the cedi. In an attempt to remove these imbalances in the system and gradually shift to flexible regimes, the cedi was mostly devalued to realign the domestic currency to other currencies, boost exports, and reduce the deficit in the balance of payments. In particular, the cedi was devalued in stages from ¢2.75: US$1.00 in 1983 to ¢90.00: US$1.00 by the third quarter of 1986. The attempt to encourage traditional exports brought about an exchange rate policy characterized by a scheme of *bonuses* on exports (exchange receipts) and *surcharges* on imports (exchange payments) between April and October of 1983.

In September 1986, an auction market system was introduced which resulted in a two-tiered exchange rate system. There was a fixed exchange rate system (called window 1 or first-tier), and a flexible exchange rate system (called window 2). The Bank of Ghana was responsible for setting the rates for window 1, which was intended for official transactions. Traditional exports, imports of crude oil, essential raw materials, basic foodstuffs, and capital goods were also based on the first-tier rate. The window 2 rate was basically applied to non-official foreign exchange transactions, non-traditional exports and all other imports. The rate for the second-tier was determined through a weekly auction conducted by the Bank of Ghana. This indicates that, with the exception of foreign exchange earnings from exports of cocoa, residual oil, imports of petroleum products, essential drugs, and service payments on government debt contracted

before 1986 that followed the fixed rate, all foreign transactions that went through the official banking system were subjected to the auction rate.

In February 1987, the two windows were unified and the auction market was applied to all officially-funded transactions. The dual-retail auction was adopted and was based on the marginal pricing mechanism which required successful bidders to pay the marginal price. A second auction - the Dutch auction - was introduced and under it, successful bidders were supposed to pay the bid price. At the same time, the incorporation of customer goods into the auction market was announced, and by 1988 it was fully implemented. In the latter part of 1988, a policy for the establishment of privately-owned foreign exchange bureaus was introduced in an attempt to absorb the parallel market into the legal foreign exchange market.

In March 1990, the wholesale auction was introduced to replace the weekly retail auction. Under this system, a composite exchange rate system was operated, namely the inter-bank and a wholesale system. Under the wholesale system, eligible Forex bureaus and authorized dealer banks were allowed to purchase foreign exchange from the Bank of Ghana for sale to their end-user customers and also to meet their own foreign exchange needs. The merger of the auction and bureaus rates narrowed the difference between the official and parallel market rates to less than 10%. This attempt accelerated the elimination of incentives for trade malpractices that the existence of the two rates provided. Since then, the flexible exchange rate policy has continued to be the exchange policy in Ghana in a more liberalized market mechanism. The free-market adjustment mechanism has allowed prices to be set through the interplay of market (demand and supply) forces, and promoted export-oriented growth. This has created greater incentives for export led activities, the switch of demand from imports to domestic products and ensures that the exchange rate is set at a competitive level for exports.

The transition period 1983 to 1992 required the fulfilment of some operational, institutional and technical requirements including the attainment of fiscal discipline, development of a better regulated and supervised financial sector, as well as a deeper money market with market determined interest rates (Sanusi, 2010; Duttagupta, Fernandez, & Karacadag, 2004). Successful exit from a peg requires (i) a sufficiently deep and liquid foreign exchange market, (ii) formulating an intervention policy consistent with the new regime, (iii) establishing an alternative nominal anchor in the context of the new policy framework, (iv) building the capacity of market participants to manage exchange rate risks and supervisory capacity to regulate and monitor them (see Agenor, 2004; and Duttagupta et al., 2004).

It was also believed that, flexible exchange rates would make adjustments somehow automatic and enhance external competitiveness of the economy. Again, a flexible exchange rate regime was meant to eliminate the need for devaluations. The result of all these policy reforms is that the nominal exchange rate depreciated from 2.75/$ in April 1983 to about 2,250/$ by December 1997, and further to 9,130.42/$ by December 2005. Over the period of implementing the above exchange rate policies, the parallel market premium, which reached 1,718.18% in 1981, was almost completely eradicated to 1.97% by 1997.

5.3. Data and methodology

5.3.1. Univariate GARCH model specification

It has become common practice in a large body of the finance literature that attempt to model volatility patterns of financial and economic time series to make use of GARCH models as proposed by Engel (1982), Bollerslev (1986) and Taylor (1986) or one of its variants such as the integrated GARCH (IGARCH) originally described in Engle and Bollerslev (1986), exponential GARCH (EGARCH) by Nelson (1991), power ARCH (PARCH) generalized in Ding, Granger and Engle (1993), threshold GARCH (TGARCH) proposed by Zakoian (1994) and Glosten,

Jagannathan and Runkle (1993), and component GARCH (CGARCH), among others. These techniques are specifically designed to model and forecast conditional variances. The variance of the dependent variable is modelled as a function of past values of the dependent variable and independent or exogenous variables.

The EGARCH model allows for asymmetric shocks to the volatility in which the variance responds exponentially to shocks and forecasts of conditional variance are guaranteed to be nonnegative. Akcay et al. (1997) and Mengesha and Holmes (2013) have adopted the EGARCH-M (1, 1) to model exchange rate volatility in Turkey and Eritrea respectively, by accounting for the effect of currency substitution or currency substitution in the conditional variance equation. Both studies include the ARCH-M term as suggested by Engle, Lilien, and Robbins (1987). The ARCH-M model is often used in financial applications where the expected return on an asset is related to the expected asset risk. The estimated coefficient on the expected risk is a measure of the risk-return trade-off.

According to Akcay et al. (1997), the model is specified as follows:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \ldots\ldots\ldots + \alpha_p x_{1-p} + \delta \ln h_t + \mu_t \qquad (5.1)$$

$$\mu_t = \sqrt{h_t} \times v_t$$

$$\ln h_t = \gamma + \psi z_t + \sum_{i=1}^{r} \beta_i \ln h_{t-1} + \sum_{j=1}^{m} \theta_j \left\{ \left| v_{t-j} \right| - E\left| v_{t-j} \right| + \aleph v_{i-j} \right\} \qquad (5.2)$$

where x_t is the exchange rate deprecation and z_t is a proxy of dollarization. μ_t is the random error term and v_t is independent, identical distribution (i.i.d.) with zero mean and unit variance.

$\alpha_0.....\alpha_p, \delta, \gamma, \psi, \beta_i, \theta_j, E, \aleph$ are the parameters to be estimated from the model. $\ln h_{t-1}$ is the logarithm of conditional variance at time *t*-1. $|v_{t-j}|$ stands for the absolute value of the residuals of the previous period. A modification on the above model has been made to suit this study. Instead of using exchange rate depreciation as in the model above, the return on exchange rate has been used.

Slight modification of this model was made by changing the independent variable of the mean equation and also changing the variance equation. Specifically, the return on the exchange rate of the previous years was excluded from the mean equation and log of the conditional variance alone has been included. In the variance equation the presentation of the error term has also been changed. The modifications of the equations are shown below.

$$\varepsilon_t = \alpha + \phi \ln \sigma_t^2 + \mu_t \tag{5.3}$$

$$\ln \sigma_t^2 = \omega + \delta h_t + \varphi \frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \psi \ln \sigma_{t-1}^2 \tag{5.4}$$

where ε_t is the return on exchange rate (e) calculated as $\ln e_t - \ln e_{t-1}$. $\ln \sigma_t^2$ is the natural logarithm of the conditional variance, u_t is a random error term, h_t is a measure of dollarization. The structure of the error term is assumed to have a generalized error distribution; $\alpha, \phi, \omega, \delta, \varphi, \gamma, \psi$ are the parameters to be estimated, where α represents the conditional mean. γ captures the asymmetric effects of the positive and negative shocks on exchange rate volatility. If γ is statistically significant and negative, it indicates that a positive shock will have different effect as the negative shock of the same level in the exchange rate volatility. If it is statistically

insignificant, however, a positive shock will have the same effect as a negative shock in the exchange rate volatility.

The parameter φ determines the size effect of the shock on volatility. The impact of the lagged conditional variance is captured by ψ . δ determines the effect of dollarization on exchange rate volatility. If the parameter δ is positive and statistically significant, it would imply that an increase in dollarization increases the exchange rate volatility in the economy. If it is negative and statistically significant, however, it would imply that an increase in dollarization decreases exchange rate volatility in the economy. On the other hand, if it is negative or positive yet statistically insignificant, then it indicates that dollarization has no effect on exchange rate volatility in the economy. The effect of the conditional variance on exchange rate returns is determined by ϕ .

5.3.2. Multivariate GARCH modelling

We augment the EGARCH estimation with a Diagonal VEC multivariate GARCH (DVEC-MGARCH) model proposed by Bollerslev, Engle, and Wooldridge (1988), which is an extension of the univariate GARCH framework to capture dynamic interactions of the variables under consideration. The proponents developed a formulation of H_t whereby each element of H_t is a linear function of the lagged squared errors and cross products of errors and lagged values of the elements of H_t .

The general definition of VEC (1 1) model is:

$$h_t = c + A\eta_{t-1} + Gh_{t-1} \qquad (5.5)$$

where

$h_t = vech(H_t)$ and $\eta_t = vech(\in_t \in_t^{'})$

and vech (.) denotes the operator that stacks the lower triangular portion of a NXN matrix as a N(N + 1)=2 X 1 vector. A and G are square parameter matrices of order (N + 1)/N=2 and c is a (N + 1)/N=2 x 1 parameter vector.

The diagonal VEC model was proposed by imposing some simplifying assumptions in order to overcome the problem with the large number of parameters. Bollerslev et al. (1988) suggested the DVEC model based on equation (5.5) in which the *A* and *G* matrices are assumed to be diagonal: each element h_{ijt} depending only on its own lag and on the previous value of $\in_{it} \in_{jt}$. This restriction reduces the number of parameters. But even under this diagonality assumption, large scale systems are still highly parameterized and difficult to estimate in practice. Necessary and sufficient conditions on the parameters to ensure that the conditional variance matrices in the DVEC model are positive definite almost surely are most easily derived by expressing the model in terms of Hadamard products (denoted by $\odot$).[28]

Following this is a class of MGARCH models proposed by Bollerslev (1990) in which the conditional correlations are constant. These models have restrictions that reduce the number of unknown parameters and make the conditional covariances proportional to the product of the corresponding conditional standard deviations. The Constant Conditional Correlation (CCC) model is defined as:

$$H_t = D_t R D_t = (\rho_{ij} \sqrt{h_{iit} h_{jjt}}) \qquad (5.6)$$

where

$$D_t = diag(h_{iit}^{1/2} \ldots h_{NNt}^{1/2})$$

[28] If A = (a_{ij}) and B = (b_{ij}) are both mxn matrices, then A $\odot$ B is the mxn matrix containing element-wise products ($a_{ij} b_{ij}$).

In this model, h_{iit} can be defined as any univariate GARCH model, and $R = \rho_{ij}$ is a symmetric positive definite matrix with ones on the diagonal [$\rho_{ii} = 1, \ \forall i$]. *R* is the matrix containing the constant conditional correlations ρ_{ij}.

The original CCC model has a GARCH(1,1) specification for each conditional variance in D_t:

$$h_{iit} = \omega_t + \alpha_i \in_{i,t-1}^2 + \beta_i h_{ii,t-1} \quad i = 1,...,N \tag{5.7}$$

Ht is positive definite if and only if all the *N* conditional variances are positive and *R* is positive definite. The unconditional variances are easily obtained, as in the univariate case, but the unconditional covariances are difficult to calculate because of the nonlinearity in equation (5.5).

The conditional correlations are thus the off-diagonal entries in the matrix above, and are assumed to be constant over time. The assumption that the conditional correlations are constant over time may seem a bit unrealistic in many empirical applications. Basing on this argument, Engle (2002) and Tse and Tsui (2002) propose a generalization of the CCC model by making the conditional correlation matrix time dependent. The model is therefore called a dynamic conditional correlation (DCC) model. An additional difficulty is that the time dependent conditional correlation matrix has to be positive definite $\forall i$. The DCC model guarantees this under simple conditions on the parameters.

The DCC-MGARCH models proposed by Engle (2002) and Engle and Sheppard (2001) is defined as in equation (5.5) where

$$R_t = diag(\mathrm{q}_{11,t}^{-1/2} ....\mathrm{q}_{NN,t}^{-1/2})\,\mathrm{Q}_t\, diag(\mathrm{q}_{11,t}^{-1/2} ....\mathrm{q}_{NN,t}^{-1/2}) \tag{5.8}$$

5.3.3. Data description and sources

Monthly data on exchange rate (defined as national currency per U.S. dollar) from 1990:M1 to 2015:M3. The period under consideration covers the period of flexible exchange rate regime in Ghana. The real exchange rate is determined by deflating the nominal exchange rates as follows:

$$q_t = e_t + p_t^f - p_t^d \tag{5.9}$$

where q_t, e_t, p_t^f and p_t^d are the real exchange rate, nominal exchange rate, foreign price and domestic price levels respectively at time *t*. All the variables are defined in logarithm form. The consumer price index in Ghana and that of the U.S. (for all cities) are used to generate the price levels. The measure of dollarization follows the usual definition as the monthly foreign currency deposits in the banking sector as a share of broad money supply. Since the foreign currency deposit is measured in U.S. dollars, the figures have been multiplied by the nominal exchange rate to make the equivalent comparable to the monetary aggregate which is measured in domestic currency. With the exception of foreign currency data which was collected from the Research Department of the Bank of Ghana, the rest were extracted from the International Financial Statistics database (International Monetary Fund, 2015).

5.4. Results and discussion

5.4.1. Time series properties

We begin the analysis by exploring the properties of the data under consideration. The descriptive (summary) statistics reported in Table 5.1 indicate that both the nominal and real exchange rates have positive mean returns. The standard deviation is relatively higher for the nominal exchange rate in levels. In terms of distributional properties, both nominal and real exchange rates are positively skewed, with positive kurtosis in excess of the threshold of 3. This

implies that the returns have fatter tails as compared to a normally distributed variable. The Jarque-Bera (JB) test rejects the normality assumption for the returns of both nominal and real exchange rates. The departure from this normality assumption suggests that there is a possibility of dependence in the data generating process. The LBQ also rejects the null hypothesis that all autocorrelations up to the 12th lag are jointly zero. Both tests give clues to second moment dependence.

Table 5.1: Descriptive statistics of levels and first differences

	bilateral		*effective*	
	nominal	*real*	*nominal*	*real*
Mean	0.12	0.00	-0.01	-0.00
Std. Dev.	0.02	0.03	0.03	0.03
Skewness	2.35	1.43	-1.19	-0.77
Kurtosis	9.77	9.66	5.73	5.34
Jarque-Bera	855.06** [0.00]	660.47** [0.00]	164.70** [0.00]	98.77** [0.00]
Ljung-Box Q (12)	323.96** [0.00]	149.28** [0.00]	122.61** [0.00]	78.86** [0.00]

Notes: Probabilities for JB and LBQ tests are reported in parenthesis. ** indicate rejection at the 5% significance level

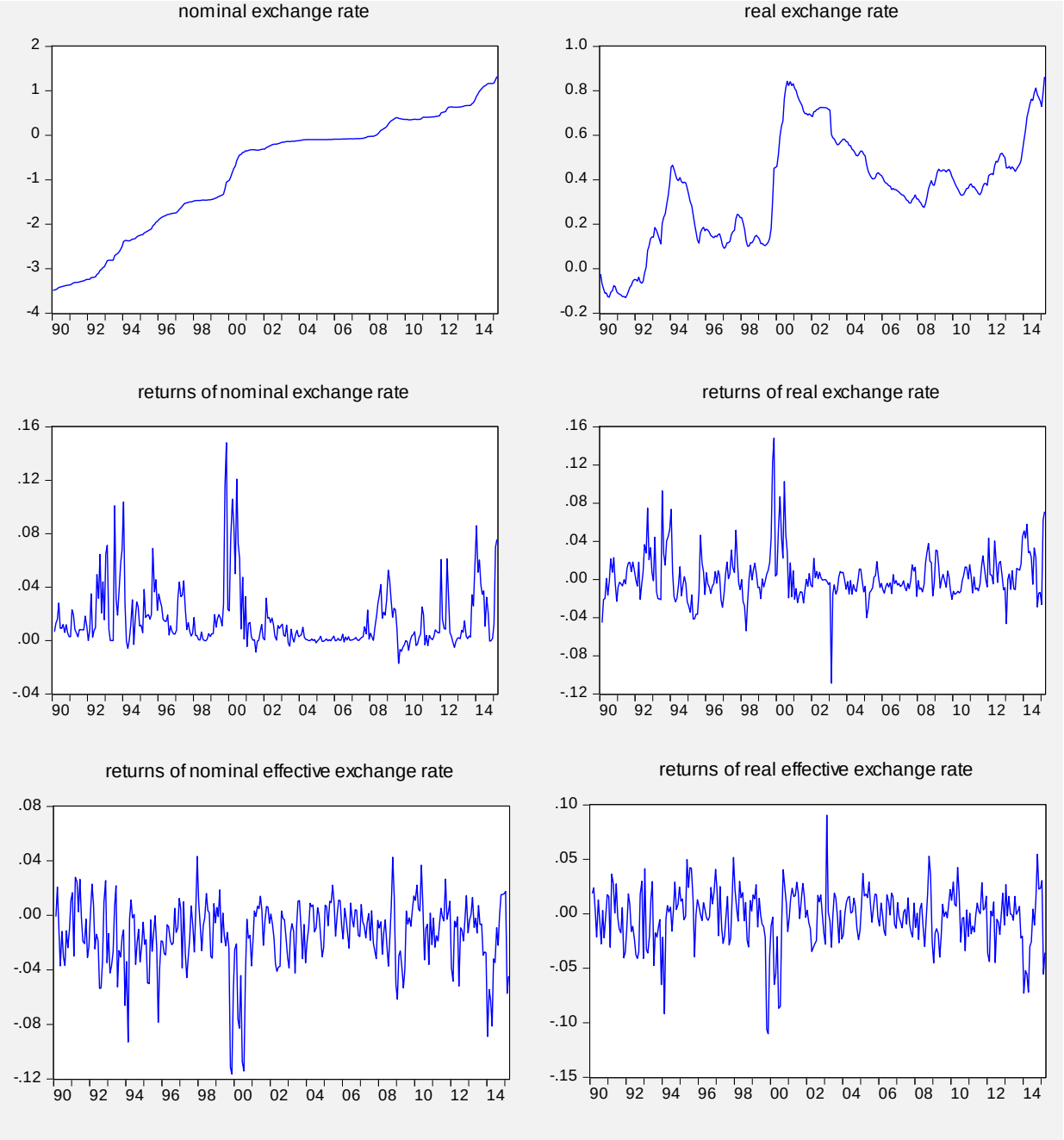
Table 5.2 is the results of tests for integration and stationary properties using the ADF, PP and KPSS tests. Both ADF and PP have a null hypothesis of unit root, whereas the KPSS test has a null of a stationary data generating process. In the case of ADF and PP, we reject the null if the test statistics is more negative than the critical values, whereas in the case of KPSS we shall fail to reject the null of stationary series if the test statistics is found to be less than the 5% critical value. We find that the returns of both the nominal and real series are integrated of order 0. This means that the returns series follow a mean-reverting process as can be deduced from the graphs in Figure 5.1.

Table 5.2: Unit root and stationary tests

Test	*ADF*		*PP*		*KPSS*	
	levels with intercept	*levels with trend*	*levels with intercept*	*levels with trend*	*levels with tend*	*levels without trend*
Levels of series						
nominal exchange rate	-0.89 [0.79]	-1.96 [0.62]	-1.36 [0.60]	-1.52 [0.82]	2.00*	0.45*
real exchange rate	-1.39 [0.59]	-1.91 [0.65]	-1.39 [0.59]	1.96 [0.62]	0.92*	0.22*
real effective exchange rate	-1.35 [0.61]	-2.53 [0.32]	-1.30 [0.63]	-2.51 [0.32]	1.45	0.09
dollarization	-4.70* [0.00]	-4.24* [0.00]	-7.19* [0.00]	-7.44* [0.00]	1.08*	0.36*
Returns						
nominal exchange rate	-4.23* [0.00]	-4.22* [0.00]	-8.95* [0.00]	-8.91* [0.00]	0.24	0.11
real exchange rate	-9.42* [0.00]	-9.40* [0.00]	-9.67* [0.00]	-9.66* [0.00]	0.08	0.08
nominal effective exchange rate	-9.89* [0.00]	-9.90* [0.00]	-10.05* [0.00]	-10.05* [0.00]	0.14	0.07
real effective exchange rate	-11.06* [0.00]	-11.04* [0.00]	-11.22* [0.00]	-11.21* [0.00]	0.05	0.05
dollarization	-9.26* [0.00]	-9.52* [0.00]	-21.91* [0.00]	-22.78* [0.00]	0.88*	0.27*

Notes: P-values are in parenthesis. * indicate rejection at the 5% significance level. Critical values for ADF & PP are -2.87 (with intercept) and -3.43 (with intercept & trend). The critical values for KPSS are 0.46 (with intercept) and 0.15 (with intercept & trend).

Figure 5.1: Graph of exchange rate and returns



5.4.2. Estimates of EGARCH models

The EGARCH estimates are presented in Table 5.3. The estimate for the conditional variance (ϕ) is positive and significant at least at the 5% level for the bilateral nominal exchange rates. The positive sign suggests that an increase in the conditional variance will increase the returns (depreciation) series itself. Consistent with the findings of Akcay et al. (1997) and Mengesha and

Holmes (2013), it indicates that the more volatile the exchange rate, the weaker the value of the domestic currency. In the case of the effective exchange rates, the parameter is positive, but not statistically significant to influence the direction of movement.

In the case of the variance equation, the estimate for δ is both positive and statistically significant for the nominal bilateral exchange rates, but not for the real and effective exchange rates. This result suggests that an increased reliance on foreign currency leads to a high volatile nominal bilateral exchange rates. This finding is consistent with the theoretical predictions of Girton and Roper (1981) and empirical findings of the majority of the literature on the impact of partial dollarization on exchange rate volatility.

5.4.2.1. Persistence (Ψ)

The parameter Ψ is used to capture the impact of the lagged conditional variance. It is a measure of persistence or *long memory* in the variance. According to the estimates, it is positive and statistically significant throughout although with marginal differences in magnitudes. The estimates are large and close to 1, suggesting that the variance moves slowly through time. As a measure of persistence it implies that a movement in the conditional variance away from its long-run mean lasts a long time. This evidence of long memory indicates that the volatility is mean-reverting, albeit it possesses a hyperbolic decay characteristic which takes a long time to establish equilibrium. The estimate for the real exchange rate is slightly lower, although closer to 1 than 0.

5.4.2.2. Leverage effect (γ)

A stylized fact in financial markets is that a downward movement is usually followed by higher volatility. This feature which was first suggested by Black (1976) for stock returns posits that price movements are negatively correlated with volatility such that predictable volatility is higher after negative shocks than after positive shocks of the same magnitude. Black (1976) attributed

asymmetry to leverage effects. The feedback hypothesis is also applied whereby in the case of foreign exchange market, a shock which increases the volatility of the market increases the risk of holding the currency (Longmore & Robinson, 2004).[29]

Our estimates of γ does not support this notable characteristic of equity markets for the bilateral exchange rates. There is evidence of symmetric volatility, such that past positive and negative shocks of the same magnitude have similar effects on future volatility. On the other hand, past positive and negative shocks of the same magnitude have disparate effects on future volatility for the effective exchange rates.

Table 5.3: Results of E-GARCH estimation and diagnostics

Parameters	*Nominal exchange rate*	*Real exchange rate*	*Nominal effective exchange rate*	*Real effective exchange rate*
α	-2.78** [0.00]	4.63 [0.25]	-27.87 [0.17]	-23.77 [0.15]
ϕ	0.00** [0.00]	-0.00* [0.07]	0.00[0.67]	0.01 [0.16]
Lag1	0.59** [0.00]	0.43** [0.00]	0.36** [0.00]	0.31** [0.00]
Lag 2	0.15** [0.00]	na	-0.12 [0.08]	-0.08 [0.22]
ω	-0.48** [0.00]	-0.88** [0.02]	-1.77** [0.01]	-2.71** [0.00]
φ	0.02 [0.70]	0.19** [0.02]	0.11 [0.21]	0.21 [0.07]
γ	0.61** [0.00]	0.12** [0.03]	-0.14** [0.02]	-0.15** [0.04]
Ψ	0.94** [0.00]	0.92** [0.00]	0.80** [0.00]	0.69** [0.00]
δ	0.12** [0.00]	-0.06 [0.26]	-0.08 [0.23]	-0.12 [0.21]
GED Parameter	0.73** [0.00]	0.90** [0.00]	1.40** [0.00]	1.36** [0.00]
DW	1.6310	1.8474	1.8921	2.0574
AIC	-6.0783	-5.2438	-4.8954	-4.7159
SBC	-5.9549	-5.1330	-4.7720	-4.5925
HQC	-6.0290	-5.1995	-4.8460	-4.6665
LL	921.75	798.20	744.32	717.39
ARCH (12)	0.08 [1.00]	0.14 [1.00]	0.12 [0.73]	0.55 [0.88]
Q^2 (12)	1.12 [1.00]	1.83 [1.00]	9.92 [0.62]	7.29 [0.84]
Q^2 (24)	12.59 [0.97]	4.21 [1.00]	20.33 [0.68]	11.08 [0.99]
Q^2 (36)	18.18 [0.99]	5.62 [1.00]	25.62 [0.99]	21.32 [0.98]

Notes: ** indicate significance at 5% level. Probabilities are in parenthesis. LL is log likelihood; DW is Durbin Watson test statistics; AIC, SBC, and HQC are Akaike, Schwarz, and Hannan-Quinn Information Criteria; ARCH is ARCH test for heteroskedasticity.

[29] Empirical evidence on leverage effects can be found in Nelson (1991); Gallant, Rossi and Tauchen (1992, 1993); Campbell and Kyle (1993); and Engle and Ng (1993).

5.4.2.3 Residual diagnostics and robustness checks

To check the adequacy of the model and ensure that it is well-specified, we report the Ljung-Box Q statistics on the squared standardized residuals of the estimated EGARCH-M model in Table 16. The results establish that the specification of the variance equation is correctly done since all *Q*-statistics are not significant. This indicates that there is no ARCH remaining in the variance equation. The ARCH LM test based on Lagrange multiplier tests confirm that there is no ARCH left in the standardized residuals.

5.5 Estimates of DVEC-MGARCH model

The estimates of the DVEC-MGARCH are presented in Table 5.4. The estimates of the ARCH and GARCH terms are significant for the different exchange rate variables. This suggests that the influences of past squared innovations and volatilities on the current volatility are significant. The sum of the lagged ARCH and GARCH coefficients in the dollarization equation are 0.95, 0.96, 0.89, and 0.95 for nominal bilateral, real bilateral, nominal effective and real effective exchange rates respectively. These values are very close to unity, supporting the assumption of covariance stationarity and the volatility persistence in the data albeit slowly. This provides evidence of long-memory.

Table 5.4: Parameter estimation for the diagonal VECH (1, 1) equation

	Mean equation		*Variance equation*										
	DI	*XR*	*C1*	*C2*	*A1*	*B1*	*A1+B1*	*A2*	*B2*	*A2+B2*	*LL*	*AIC*	*SIC*
ner	-0.0001	0.0066*	0.0003*	4E-5*	0.209*	0.739*	0.948	0.463*	0.571*	1.034	1193.3	-7.829	-7.694
real	0.0001	-0.0002	0.0002*	0.0002*	0.218*	0.742*	0.961	0.456*	0.290*	0.747	1131.2	-7.418	-7.283
neer	0.0001	-0.010*	0.0002*	0.0002*	0.227*	0.665*	0.893	0.202*	0.563*	0.766	1117.9	-7.330	-7.195
reer	0.0019	0.0005	0.0002*	0.0002*	0.169*	0.780*	0.949	0.263*	0.431*	0.695	1097.0	-7.192	-7.057

Notes: * denotes significance at 5% level. LL is log likelihood, AIC is Akaike information criterion, and SIC is Schwarz information criterion. A1 is the coefficient matrix for the ARCH term and B1 is the coefficient matrix for the GARCH term. M, A1, and B1 are all specified as indefinite matrices.

Figure 5.2 displays the time-varying conditional correlation between dollarization and exchange rates from 1990 to 2015. The figures give information regarding the direction and magnitude of the association between the variables. Apart from few instances of weak negative correlation, the conditional correlation between dollarization and nominal bilateral exchange rates has been positive, reaching as high as almost 0.73 in May 2001. The average has been 0.33 for the period January 2014 to March 2015. For the real bilateral exchange rates, the conditional correlation was negative for 1990 and first three quarters of 1991. Apart from this, there were few occasions of negative correlation. The highest positive correlation was 0.65 for November 2000, and the average has been 0.35 since January 2014. As for the nominal and real effective exchange rates, apart from a few positive correlations in the early years of the study period, the rest have been generally negative. Generally, we argue that there have been upward trends in conditional correlation with respect to the bilateral exchange rates. This suggests that the relationship between bilateral exchange rate and dollarization has been relatively stronger in recent years, although somehow volatile. Figure 5.3 also presents the conditional covariances.

Figure 5.2: Plot of the conditional correlations from January 1990 to March 2015

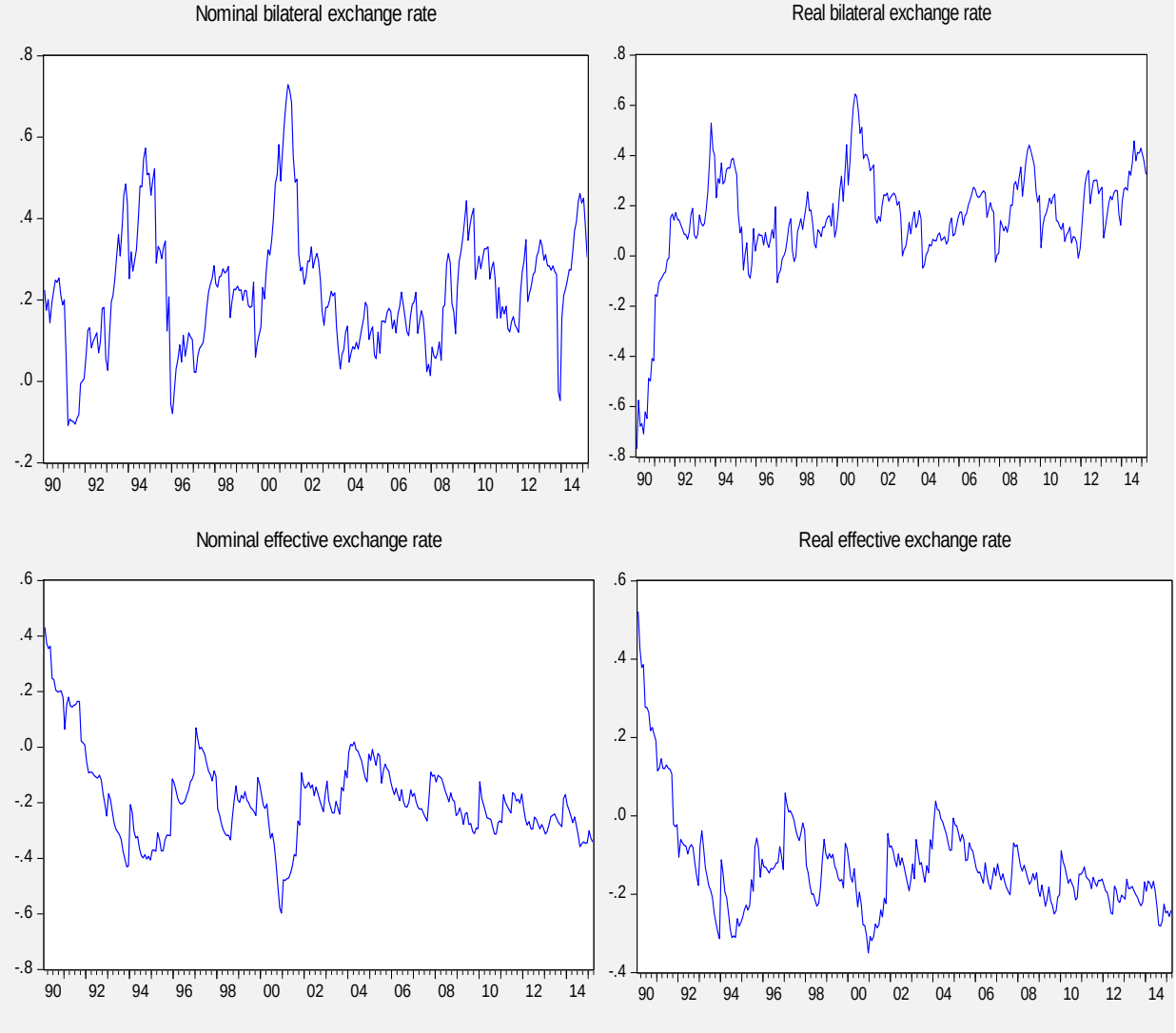
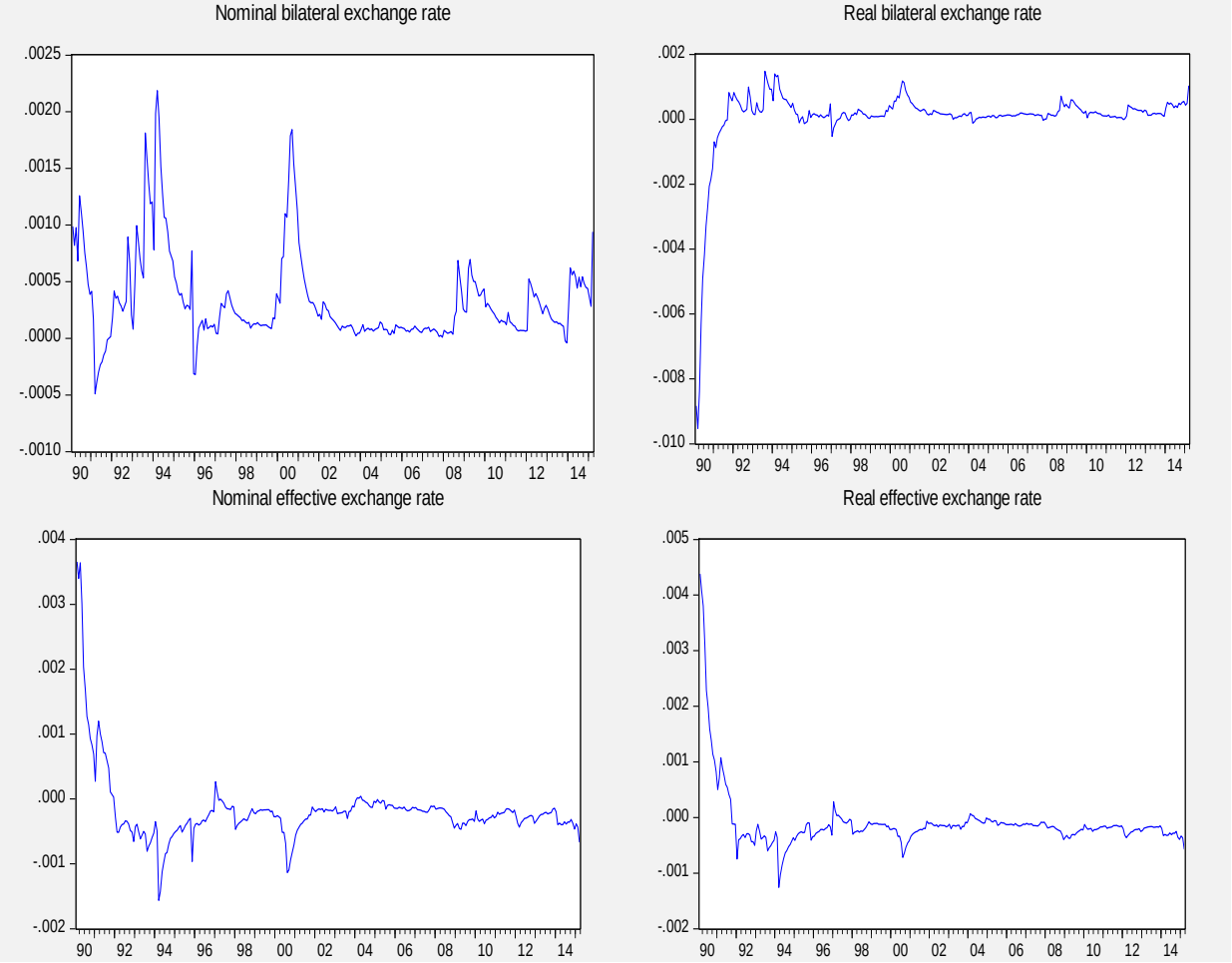


Figure 5.3: Plot of the conditional covariances from January 1990 to March 2015



5.6. Conclusion

This paper has considered the role of dollarization in the high variability of exchange rates experienced in Ghana since the adoption of the flexible exchange rate regime as part of the economic reforms in the 1980s. The study fills important gaps and makes a contribution to the limited literature on the subject in Africa by specifying a model that accounts for conditional heteroscedasticity, persistence, and asymmetry in the volatility process of the foreign exchange market.

The results point out important stylized facts such as symmetric, leptokurtic and persistence behaviour in the dynamics of nominal and real exchange rates. Also, we find that the more

volatile the cedi/dollar exchange rate, the lower the value of the nominal cedi/dollar exchange rate becomes. This implies that the volatile behaviour of the exchange rate makes the cedi weaker, which also leads to loss of confidence in the domestic currency as a store of value, as a unit of account, and eventually as a means of settlement. On the other hand, a more stable exchange rate strengthens the cedi, and therefore its credibility is enhanced. On the effects of dollarization on exchange rate instability, there is evidence that volatility in the nominal bilateral exchange rates increases with increasing trend of dollarization. The meaning of this is that, the increased demand for, and use of foreign currency in the Ghanaian economy exerts downward pressure on the demand for the domestic currency, which invariably propagates further depreciation of the cedi.

Other policy measures aimed at developing the financial markets in Ghana can provide alternative hedges against the erosion of wealth propagated by high inflationary trends and currency depreciation. Also, it is imperative to reduce the high dependence on imported products. The tastes and preferences of Ghanaians for foreign products should be discouraged by promoting the competitive position of local industries that can produce quality products at competitive prices.

CHAPTER SIX

DOES DOLLARIZATION AFFECT INFLATION IN GHANA?

6.1. Introduction

The dynamics of inflation in Ghana has continued to be a source of concern for governments and monetary policymaking authorities. Since its independence in 1957, the inflationary experience has evolved through several episodes. This has engendered a lot of apprehension not only because there is a need to maintain macroeconomic stability, but also the fact that uncertainties springing from inflation impose some welfare implications for economic activity as well as households and firms. Ghana's inflation averaged 4.6% in the early 1960s and then more than tripled to about 18% by 1966. It eventually reached an all-time record of 123% in 1983. Following the adoption of the neoliberal Economic Recovery Programme (ERP) in 1983, average annual inflation plummeted to 39.7% in 1984 and further reduced to 10.3% in 1985. Averagely, the rate hovered around 27% during the first two decades of stabilization. From 2004, the economy has been characterized by some periods of single digit inflation. Inflation rates lowered to near 10% in 2006 and was somehow stabilized until late 2007. With a rate of 20.7% in June 2009, the downward inflationary trends continued into single digits until 2012, where the trend reversed. Alagidede, Coleman, and Adu (2014) refer to this period as the *moderation phase*[30].

Current data from the Ghana Statistical Service (GSS) has indicated that inflation has again assumed an upward trajectory reaching 17% in December 2014 (GSS, 2015). This has engendered another round of debate on the true triggers of inflationary dynamics in the

[30] The Centre for Economic Policy Analysis (CEPA) in 2009 attributed the downward inflationary trends to factors including the aid inflows as well as debt relief and cancellations associated with the Heavily Indebted Poor Countries (HIPC) and Multilateral Debt Relief Initiative (MDRI), and inward private foreign direct investments. According to Marbuah (2011), the downward trend could be due to the ability of the inflation targeting framework adopted by the monetary authorities in Ghana since May 2007 to anchor inflationary expectations. See, *inter alia,* Alagidede et al. (2014), Adu and Marbuah (2011), Ocran (2007) for a more detailed analysis.

economy. Policymakers and academics alike have sought to unravel the mystery characterizing the movement of domestic prices. Away from the usual demand and supply shocks, the monetary authorities have lately considered the rising trend of dollarization in the economy. The concern of dollarization has become very pressing which forced the Bank of Ghana to revert to some foreign exchange restrictions in February 2014 rooted in the Foreign Exchange Act 2006 (Act 723).

From the theoretical perspective, there have been some explanations on how dollarization could lead to inflation. There are basically three channels through which inflation tends to increase with increasing trend of dollarization. First, an increase in dollarization signifies an increase in demand for foreign currency and a decreased demand for domestic currency. This leads to a depreciation of the domestic currency which increases the foreign demand for domestic goods and pushes up prices of domestic goods. The depreciation of the exchange rate also increases the cost of imported goods, which eventually feeds into the rate of inflation. Second, as suggested by Rojas-Suarez (1992) and Bahmani-Oskooee and Domac (2003), the level of the monetary base declines as residents substitute more domestic currency for foreign currency. Since the fall in the level of monetary base signifies loss of *seigniorage* on the part of government, monetary authorities respond by increasing money supply and raise revenue from inflation tax, which leads to increasing price levels in the economy. Third, another argument is based on the conventional view that dollarization imposes some complications on monetary authorities' control of inflation and hence the ineffectiveness of the monetary policy in terms of achieving its inflation targets (see, Levy-Yeyati, 2006; Zamaroczy & Sa, 2003; Balino et al., 1999). The theory predicts that due to the high instability of money demand often induced by the high rates of dollarization, forecasting, and control of inflation becomes more difficult and challenging.

Despite its popularity, there is substantial controversy and mixed empirical evidence in the assessment of the effects of dollarization in emerging and transition economies. Although a number of studies have explored the dynamics of inflation in Ghana, the role of dollarization remain unexplored. This leaves an important gap in the literature which this paper seeks to fill. This study empirically investigates the subject of dollarization in emerging economies, with a focus on the effects on inflation and its associated uncertainties in Ghana. The analysis covers January 1990 to December 2013, and distinguishes between the periods before the adoption of inflation targeting in May 2007 and after. Its cardinal aim is to capture the role of dollarization in the dynamics of inflation by distinguishing between episodes when the Bank of Ghana became committed to an explicit inflation targeting monetary policy regime.

The contribution of the study is both empirical and methodological. To the best of the knowledge of the authors, it is the first study that considers the role of dollarization within the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) framework in Ghana. The empirical estimation offers some advantage in modelling and forecasting volatility. The model assumes that if there is any instability induced by dollarization on inflation then it would affect both the mean and the time varying variance of inflation uncertainty. This assumption is explored by specifying an EGARCH-in-Mean model. The EGARCH model is again able to account for asymmetric response of inflation to shocks (see Black, 1976). The asymmetric feature of this model serves as alternative to the standard GARCH (1 1) in terms of flexibility. Another contribution is the use of a dummy variable to capture how the inflation targeting has affected inflation volatility (uncertainty) with the help of a proxy. The monetary policy framework has been perceived to be a standard operating process for central banks that seek to achieve low and stable rates of inflation. We hypothesise that the implementation of IT regime may have some impact on the volatility and persistence of inflation in Ghana. The investigation questions whether the implementation of the regime caused a structural change

(break) in the volatile behaviour of inflation. Consistent with Grier and Perry (2000) and Fountas (2001), time varying conditional variance of inflation is used as a measure of inflation uncertainty. Finally, the study captures the inflation – inflation uncertainty relationship, and quizzes whether the adoption of the monetary regime has influenced the dynamics of the nexus. This is achieved by specifying a Granger-causality test based on a Vector Autoregression (VAR) model.

The results indicate that dollarization does not feed through inflation directly albeit the persistence dynamics of inflation has changed over the period. There is evidence that, although there is no significant impact on the inflation volatility, inflation targeting affects the inflation-inflation uncertainty relationship in Ghana. The dynamics of inflation volatility and asymmetries presents crucial implications which are discussed to guide policymaking.

The remainder of the work follows this structure. Section 6.2 presents a review of studies on the causes of inflation in Ghana. The section also contextualizes the role of dollarization in the dynamics of inflation based on existing empirical evidence. In Section 6.3, the EGARCH modelling technique is presented. The properties of the data, descriptive statistics, and data sources are presented in this section. Section 6.4 covers the estimations and analysis of results. Section 6.5 discusses the implications of the results and recommends options for policymakers.

6.2. Data and model specification

6.2.1. Data source and description

The key variable under study is the rate of inflation (denoted π_t). It is calculated as the log difference of monthly Consumer Price Index (CPI). The inflation (π_t) is calculated as $\pi_t = (p_t - p_{t-1})/p_{t-1}$, where p_t is log form of CPI at time t. The data covers January 1990 to December 2013. The pre-inflation targeting period (1990M1 – 2007M5) is separated from the post-targeting

period (2007M6 – 2013M12), which indicates that the number of observations for the pre-IT is far more than that of the post-IT. The measure of dollarization index was the ratio of foreign currency deposits (FCD) in broad money. In capturing the percentage of foreign currency in broad money, the two series were converted into a common currency by using the exchange rates. This ensures that we do not find the ratio of two series in different currencies. The proportion of FCD in broad money continues to be the most commonly used approach to measure the degree of dollarization in an economy where there have been less restriction on foreign currency holdings in domestic and offshore accounts (see Clements & Schwartz, 1993; Agenor & Khan, 1996; Rennhack & Nozaki, 2006; Sahay & Vegh, 1996; Savastano, 1996). However, this measure of foreign currency deposits is considered the lower bound measure of dollarization since data on foreign currency in circulation or held by households as cash and foreign currency deposits held in offshore accounts by residents is difficult to account for. The monthly consumer price index and exchange rates are extracted from the International Financial Statistics database published by the International Monetary Fund, whereas data for foreign currency deposits is sourced from the Bank of Ghana.

6.2.2. Methodology

The Autoregressive Conditional Heteroskedasticity (ARCH) models, which are specially schemed to model and forecast conditional variances, were introduced by Engle (1982) and generalized as GARCH (Generalized ARCH) by Bollerslev (1986) and Taylor (1986). The model has the variance of the dependent variable as a function of past values of the dependent variable and other independent or exogenous variables. The GARCH models have gained much popularity and widespread application in econometrics, especially in modelling and forecasting financial time series. According to Alexander and Lazar (2006) and Drakos, Kouretas, and Zarangas (2010), the models have become very relevant in the dynamic volatility models because of their ease of application and the ability to check robustness through diagnostic analysis.

With no regressors in the mean and variance equations, the basic structure of the standard GARCH (1, 1) is given by

$$y_t = \mu + \varepsilon_t \tag{6.1}$$

where $\varepsilon_t = v_t \sigma_t$ $v_t \sim N(0,1)$

and

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \tag{6.2}$$

σ_t^2 denotes the conditional variance since it is a one-period ahead estimate for the variance calculated on any past information thought relevant. There are some limitations in the GARCH model such as the non-negativity and inequality constraints. They also do not account for asymmetries or leverage effects and direct feedback between the conditional mean and the variance. Although, the standard GARCH model can effectively detect volatility clustering and thick tail returns, it lacks the capacity to capture the leverage effect since the conditional variance is a function only of the magnitudes of the past values and not their sign.

Since its introduction, several attempts have been made to strengthen the forecasting power of the models which have led to a lot of variants such as the integrated GARCH (IGARCH) (Engle & Bollerslev, 1986), exponential GARCH (Nelson, 1991), power ARCH (PARCH) (generalized in Ding, Granger & Engle, 1993), threshold GARCH (TGARCH) (Zakoian, 1994; Glosten, Jagannathan & Runkle, 1993), and component GARCH (CGARCH), among others. Some of these recent models have the ability to capture asymmetries in the volatility of time series. These include the EGARCH, TARCH, GJR-GARCH, and Asymmetric Power ARCH (APARCH).

In this study different models were estimated but we selected the most robust estimates based on log likelihood and information criteria were the EGARCH-M model. The EGARCH-M model includes conditional variance in its mean equation in line with Engle, Lilien and Robins (1987). Contrary to the standard GARCH estimation, EGARCH models do not impose any restrictions on the parameters in the model and produces a positive conditional variance irrespective of the signs of the estimated parameters. According to Alexander (2009), EGARCH models have proven superior compared to other opposing conditional variance models.

To be able to capture the effect of dollarization on the conditional variance of inflation in Ghana, the following EGARCH model is specified consistent with Akcay et al. (1997) and Mengesha and Holmes (2013):

$$\pi_t = c + \alpha_1 \pi_{t-1} + \alpha_2 \pi_{t-2} + ... + \alpha_p \pi_{t-p} + \delta \ln d_t + u_t \tag{6.3}$$

$$u_t = \sqrt{d_t}.v_t$$

$$\ln d_t = \gamma + \psi z_t + \sum_{i=1}^{r} \beta_i \ln d_{t-i} + \sum_{j=1}^{m} \theta_j \{ |v_{t-j}| - E|v_{t-j}| + \aleph v_{t-j} \} \tag{6.4}$$

where π_t is the inflation rate at time *t*, v_t is *i.i.d* with mean and unit variance of zero, and d_t is the dollarization index at *t*.

$$\ln \sigma_t^2 = \omega + \delta d_t + \varphi \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}^2}} \right] + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \psi \ln \sigma_{t-1}^2 \tag{6.5}$$

where σ_t^2 is the conditional variance measured as the one-period ahead estimate for the variance calculated on any past information. z_t is the standardized residual. ψ is a conditional density function and ν denotes a vector of parameters needed to specify the probability distribution. The parameters $\omega, \varphi, \gamma, \psi$ are to be estimated by the model. Since the EGARCH models $\ln \sigma_t^2$ then σ_t^2 becomes positive even with the parameters as negative. The φ represents a magnitude or size of the GARCH effect of the model. ψ measures the persistence in conditional volatility irrespective of what happens in the market. When the size of ψ is larger, it suggests that the volatility would be more persistent and a shock in the volatility would take longer to die out. γ measures the asymmetry or the leverage effect. For $\gamma = 0$, the model is classified as symmetric. When $\gamma < 0$ it implies that positive shocks (good news) generate less volatility than negative shocks (bad news), and when $\gamma > 0$, it connotes that negative innovations pose less volatility than positive innovations.

In the specification of conditional variance of the EGARCH (1, 1), the error distribution plays a very relevant role. Three different assumptions: Gaussian (normal), Student's *t* or generalized error distribution is available. These come with different assumptions. Under a Gaussian standard normality assumption, the EGARCH model considers volatility clustering, albeit not sufficient to capture all the leptokurtosis that exist in the series. The skewness and kurtosis test in the standardized residuals discuss in the previous section indicated that it is inappropriate to assume conditional normality in the error distribution. The frequency of very low and very high returns observed predicts that the error process for the inflation data is better characterized by a fatter-tailed distribution. The student's *t*-distribution EGARCH model assumes the conditional distribution of market shocks is *t*-distributed. As proposed by Nelson (1991), the generalized error distribution (GED) is normalized to have zero mean and unit variance for the distribution function of error term as follows:

$$l_t = -\frac{1}{2}\ln\left(\frac{\Gamma(1/r)^3}{\Gamma(3/r)(r/2)^2}\right) - \frac{1}{2}\ln\sigma_t^2 - \left(\frac{\Gamma(3/r)(y_t - X_t^*\theta)^2}{\sigma_t^2\Gamma(1/r)}\right)^{r/2} \quad (6.6)$$

The parameter r determines the thickness of the tails. The distribution is a standard normal if $r = 0$, and fat-tailed or thicker than normal if $r > 0$, and the tails are thinner than the normal if $r > 0$.

Ghana has practised fully-fledged inflation targeting for almost a decade so it noteworthy we investigate how successfully inflation targeting has anchored expectations and suppressed inflation persistence. On this count, incorporating a measure of inflation expectations would have been a more appropriate approach to determine this effect. However, because inflation expectations are not directly observable, efforts to measure it have remained biased. The ability of the central bank to forecast inflation efficiently hinges on how accurately inflation expectations can be measured. Surveys have usually focused on markets in the economy where inflation expectations play a central role. A study by Mankiw et al (2003) shows that there are significant departures of survey data from households, businesses, and professional forecasters from rationality, including substantial disagreement about expected future inflation, autocorrelated forecast errors, and insufficient sensitivity to macroeconomic news. In emerging economies, however, deriving market-based inflation expectations from inflation-linked financial securities as well as attitudes toward inflation risk has proven difficult.

Due to the above limitations associated with measurement of expectations, this study develops a dichotomous dummy variable to capture the effect of inflation targeting on inflation volatility. Dummy variables are useful because they enable us to use a single regression equation instead of separate equation models for the pre-IT and post-IT subgroups. The variable consists of 0 for

the period before the adoption of inflation targeting and 1 for the inflation targeting regime. A statistically significant coefficient of this proxy will indicate how relevant inflation targeting has been.

6.3. Results and discussion

6.3.1. Time series behaviour of inflation

We investigate changes in the time series properties of inflation prior to the inflation targeting monetary and after its adoption. From the summary statistics reported in Table 6.1, the mean/average of the pre-IT inflation is almost twice of the mean of the post-IT inflation. The pre-IT mean inflation is about 178 % more volatile than the post-IT period. It suggests that inflation has generally reduced after the adoption of the IT regime. Also, the range (defined as the difference between the maximum and minimum inflation rates) is less in the post-IT (3.59) compared to the pre-IT rates (8.48). The standard deviation is also less for the post-IT period. We observe that the skewness for the period before IT indicates some asymmetry around the mean, whereas the kurtosis points to some peakedness relative to the normal. These suggest some deviation from the normality assumption as indicated by the large statistics for the Jarque-Bera (JB) in both the full sample and the pre sample.

The JB test for normality, however, indicates that the period after the IT has a normal distribution unlike the pre-IT period. The pre-IT series is slightly *leptokurtic*. The figures suggest that there is a significant volatile behaviour of month-on-month inflation in Ghana, both before and after the inflation targeting, however slightly less volatile in the post-IT period. The number of observations in the post targeting sample is only 38 % of the number of observations in the pre sample. Figure 6.1 contains graphs of the inflation in Ghana for the period 1990 to 2013 and two separate graphs for the pre-inflation targeting and post-inflation targeting regime.

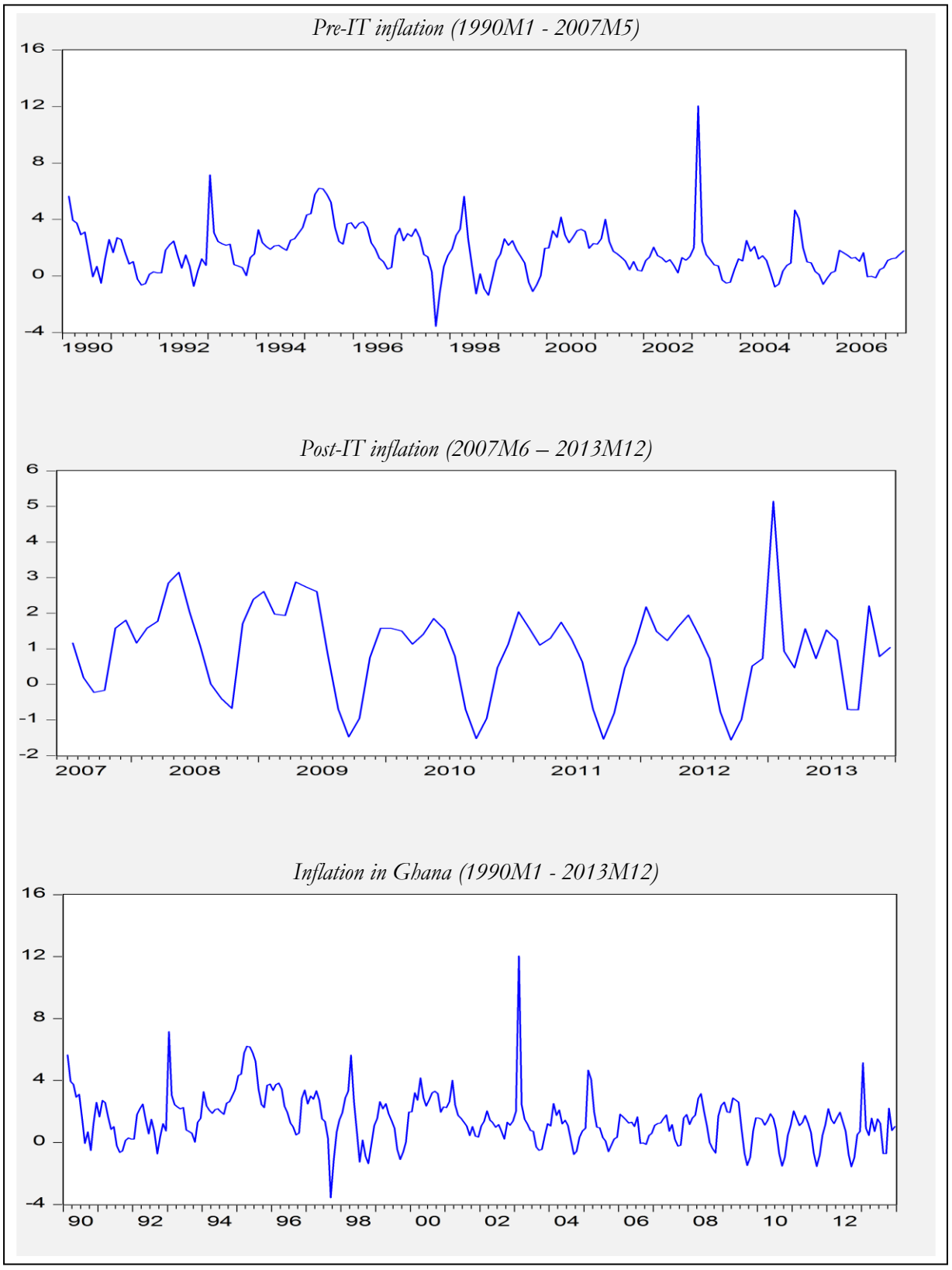
Table 6.1: Summary statistics for inflation

Statistic	*1990M1 – 2013M12*	*1990M1 – 2007M5*	*2007M6 – 2013M12*	*Ratio (Φ)*[31]
Mean	1.50	1.71	0.96	1.78
Median	1.38	1.50	1.15	1.30
Maximum	12.04	12.04	5.14	2.34
Minimum	-3.56	-3.56	-1.56	2.28
Std. Dev.	1.63	1.72	1.26	1.37
Skewness	1.28	1.37	0.01	137
Kurtosis	9.10	9.12	3.46	2.64
Jarque-Bera	524.93** [0.00]	391.10** [0.00]	0.69 [0.70]	N/A
Observations	287	208	78	2.67

Note: ** indicate rejection at the 5% significance level

[31] Following Hudson and Mosley (2008), we divide the statistics for the before and after periods as a measure of relative variability or volatilities

Figure 6.1: Graphical representation of inflation (1990M1 - 2013M12)



We consider the long memory and persistent behaviour of inflation by using unit root and fractional integration techniques. Coleman (2012) assesses the impacts of regional and sectoral inflation persistence and provides findings of asymmetries in inflation persistence in Ghana. The evidence suggested that some regions and sectors are more likely to feel the impact of inflationary shocks than others, and the attendant welfare losses are likely to be high for those regions and sectors with high inflation persistence. Alagidede et al. (2014) updates the study to cover up to the first quarter of 2014 and provides similar evidence.

We employ their approach to measure the properties of the inflation series for the pre and post inflation targeting periods. The Geweke and Porter-Hudak (GPH, 1983) approach estimate of the fractional differencing estimator, *d*, is based on a regression of the ordinates of the log spectral density on trigonometric function. The technique makes use of nonparametric spectral regression model to estimate *d* without categorical specification of the "*short memory*" or ARMA parameters. In order for the *d* estimate to fall within the range [-0.5, to 0.5] interval, the series is usually differenced.

The modified log periodogram regression estimator which was proposed by Phillips (1999a, 1999b), is a modified form of the GPH. The approach addresses a weakness of the GPH estimator and estimates the *d* by modifying the dependent variable to return the distribution of *d* under the null hypothesis that $d=1$ and the estimator gives rise to a test statistic for $d=1$. Given that the GPH estimator may be problematic against $d>1$ alternatives where *d* exhibits asymptotic bias toward unity, Phillips' approach distinguishes unit-root behaviour from fractional integration. This test is more efficient against both $d>1$ and $d<1$ options.

The unit root results presented in Table 6.2 contains results for unit root tests and estimates of fractional integration parameter. The results indicate that the series are $I(0)$, as the null

hypothesis of $I(1)$ is rejected except for few instances. The ADF test fails to reject the null of $I(1)$ for the post-IT inflation series. In the case of the long memory estimations, the two methods give the same estimate for the pre-IT series whereas a marked difference exists in the estimates for the post-IT period. The GPH estimate is almost half of the other estimate. However, based on the unit root, it can be concluded that the series are $I(0)$ in general. These tests fail to distinguish series that are $0 < d < 1$.

The GPH and modified log periodogram tests provide evidence of long memory and persistence in the series. The presence of stationary long memory portrays autocorrelations that take far longer to decay than the exponential rate associated with "short memory" processes. Thus, the series cannot be classified as either I(*0*) nor I(*1*) process; but rather an I(*d*) process. The implication of this finding is that the data generating processes of inflation are associated with persistence and may be predictable at long horizons.

Table 6.2: Tests of integration

Test	*1990M1 – 2013M12*	*1990M1 – 2007M5*	*2007M6 – 2013M12*
ADF_1	-8.07 (0)	-6.93 (0)	-1.20 (1)
ADF_2	-8.34 (0)	-6.98 (0)	0.42 (1)
PP_1	-7.89 (0)	-7.01 (0)	-4.42 (0)
PP_2	-7.93 (0)	-7.08 (0)	-4.41 (0)
$KPSS_1$	0.83 (1)	0.35 (0)	0.13 (0)
$KPSS_2$	0.07(0)	0.10 (0)	0.04 (0)
GPH	0.33** [0.00]	0.50** [0.00]	0.32** [0.00]
Modified LogPeriodogram	0.51** [0.00]	0.50** [0.00]	0.61** [0.00]

Notes: The subscript 1 represent tests with constant only whilst the subscript 2 indicates tests with both constant and trend. The ADF and PP tests have H0 of unit root whereas the KPSS has H0 of stationary series. Whereas the unit root and stationary tests distinguish between I(0) and I(1) processes, the long memory tests reports the *d* as a real number. For ADF and PP, the null of unit root is rejected if the statistics is less than the critical values. For KPSS, the null of stationary series is not rejected if the statistics is smaller than the critical values. Values in ( ) are the levels of integration, I(0) or I(1). For the long memory tests, the values in parenthesis are *p*-values and ** indicate significance at 5% level.

6.3.2. Modelling inflation volatility

Before we consider the effects of dollarization the behaviour of inflation is modelled using the EGARCH methodology. We explore the behaviour of inflation in the two sample periods and also by capturing the effects of inflation targeting and dollarization in the variance equation. The results are presented in Table 6.3. The estimates of volatility of inflation yield quite interesting results. The signs of most of the coefficients conform to *a priori* expectations. The results indicate that past inflation gives expectations of inflation and therefore lead to high volatility of inflation. The magnitude or size effect is also significant and positive. This is consistent with the finding of Ocran (2007) that past inflation is a significant determinant of inflation. Also, the coefficient of persistence is not significant but the estimates are small and very close to zero. Furthermore, although insignificant at the 5% level, there are signs of asymmetry or leverage effect since the sign of γ is negative throughout. This suggests that bad news (negative shocks) is likely to create more volatility than good news of the same magnitude. In other words, the effect of a shock upon the volatility is asymmetric, meaning that the impacts of positive lagged residuals and of negative lagged residuals are different. Thus, inflation has the tendency to respond to negative news than positive news of the same magnitude.

Table 6.3: Estimates of EGARCH-M (1, 1) model of inflation

	Inflation (no regressor)			*Inflation targeting*			*Dollarization*		
Parameter	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*
ϕ	0.02**	0.01**	0.03	0.01**	0.01**	0.07	0.01**	0.01**	0.05
	[0.02]	[0.01]	[0.41]	[0.00]	[0.01]	[0.05]	[0.02]	[0.00]	[0.08]
$\pi_{\tau-1}$	0.76**	0.80**	0.52**	0.76**	0.80**	0.53**	0.75**	0.80**	0.55**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
ω	-8.64**	-8.25**	-9.74**	-7.97**	-8.25**	-8.65**	-8.20**	-7.19**	-8.37**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
φ	0.29**	0.51**	0.23	0.31**	0.51**	0.09**	0.34**	0.33**	0.12
	[0.02]	[0.01]	[0.44]	[0.00]	[0.00]	[0.02]	[0.03]	[0.00]	[0.06]
γ	-0.10	-0.23	-0.10	-0.10	-0.23	-0.03	-0.12	-0.10	-0.04
	[0.14]	[0.08]	[0.48]	[0.10]	[0.08]	[0.14]	[0.10]	[0.13]	[0.17]
Ψ	0.08	0.13	0.02	0.15	0.13	0.10**	0.13	0.24	0.13
	[0.61]	[0.54]	[0.92]	[0.32]	[0.54]	[0.00]	[0.42]	[0.12]	[0.55]
δ				0.01			0.28	-11.34	0.38
	n/a	n/a	n/a	[0.96]	n/a	n/a	[0.94]	[0.11]	[0.71]
	0.06**	0.06**	4.60**	1.00**	0.06**	1.16**	1.01**	0.89**	4.46**
Distribution	[0.00]	[0.00]	[0.04]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.02]
AIC	-6.41	-6.40	-6.49	-6.40	-6.40	-6.51	-6.40	-6.40	-6.52
SBC	-6.31	-6.27	-6.25	-6.29	-6.27	-6.26	-6.28	-6.26	-6.24
HQC	-6.37	-6.34	-6.40	-6.35	-6.34	-6.41	-6.35	-6.34	-6.41
LL	924.25	669.90	257.97	924.23	669.90	258.54	924.15	671.39	259.92
DW	1.94	2.04	1.75	1.95	2.04	1.74	1.96	1.99	1.72
	0.07	0.06	0.09	0.06	0.06	0.07	0.06	0.06	0.10
ARCH	[0.80]	[0.80]	[0.77]	[0.80]	[0.80]	[0.79]	[0.80]	[0.81]	[0.76]
	0.62	0.61	6.59	0.62	0.61	8.49	0.62	0.59	9.32
$Q^2(12)$	[1.00]	[1.00]	[0.88]	[1.00]	[1.00]	[0.74]	[1.00]	[1.00]	[0.67]
	4.05	4.15	7.81	4.018	4.15	9.78	4.05	2.98	10.63
$Q^2(24)$	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[0.99]
	4.60	4.72	9.29	4.55	4.72	11.58	4.58	3.47	12.27
$Q^2(36)$	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]

Notes: The sample periods are 1 (1990M1 – 2013M12), 2 (1990M1 – 2007M5) and 3 (2007M6 – 2013M12). ** indicate significance at 5% level. δ is a regressor in the variance equation. In the first bloc there is no regressor whereas there is a proxy for inflation targeting and dollarization in the second and third blocs respectively. The generalised error distribution is used for 1 and 2 whereas Student's *t* distribution is used for 3. AIC, SBC and HQC are the information criterion for Akaike, Schwarz, and Hannan-Quinn respectively. LL represents log likelihood and DW is the Durbin-Watson statistics.

6.3.3. Effects of inflation targeting (IT) on inflation

In this section we build on the usual hypothesis that the implementation of IT regime may have anchored expectations and reduced persistence of inflation in Ghana.[32] As explained in the methodology, the effect of IT on the volatility of inflation is modelled by testing the significance of the dummy variable as a regressor in the variance equation of the full sample. Secondly, the volatility pattern of the inflation is modelled for two separate samples (pre- and post-IT) to determine the difference in the behaviour of inflation. The results indicate that the proxy variable is not statistically significant. Due to this, we argue that there is not much difference in the estimates in the model for inflation without regressors. The only difference that is reported here is the coefficient of persistence which becomes significant after the adoption of the IT. However, the estimate is small and very close to zero.

Our finding that inflation targeting has not been significant in the dynamics of inflation is not consistent with a study by Kyereboah-Coleman (2012), which reports of a considerable significant improvement in the impact of the inflation targeting monetary policy on inflation and the persistence of inflation in recent years. However, the short period (less than 2 years) covered by the study (post implementation of the fully fledged inflation targeting regime), makes it quite difficult to conclude on the effect of the framework on inflation. We envisaged that inflation targeting would impact on the expectations formation process and bring about lower rates of inflation. The lack of evidence to support the role of inflation targeting in the volatility of inflation could be linked to myriad of challenges associated with the implementation of inflation targeting framework in Ghana. These include issues of fiscal dominance, undeveloped financial markets, and increased exposure to external shocks (due to oil price fluctuations, terms of trade shocks, currency depreciation, and terms of trade shocks). Unsustainable fiscal policies break the

[32] A proxy is used for inflation targeting. The months preceding the implementation of IT (that is, from 1990:01 to 2007:05) take 0 and the months after the IT (2007:06 to 2013:12) take on 1.

connection between inflation expectations and inflation targets because economic agents believe the target would be too high to maintain. It has also been argued by Blanchard (2004) that, with a large public debt overhang a tighter monetary policy could lead to higher sovereign risk premia (by increasing the probability of default on debt), depreciation pressures, and higher inflation.

6.3.4. Effect of dollarization on inflation before and after IT

The effect of dollarization on inflation volatility is explored by taking into consideration the inflation targeting regime. This is based on the assumption that the adoption of the IT regime may have some impact on the time series behaviour of inflation and possibly on the dollarization-inflation relationship. Apart from testing the significance of the dollarization variable in the inflation model, we also make a comparison with the behaviour of inflation volatility without dollarization as a regressor and one with dollarization in the variance equation. The estimate of δ is not statistically significant in both periods. This indicates that dollarization has not played a significant role in the dynamics of inflation volatility in Ghana.

6.3.5. Direction of response and causal relationships

In this section we specify bivariate vector autoregression models to test the causal relationships between dollarization and inflation as well as between inflation and inflation uncertainty within the Granger causality framework (Granger, 1969). The contribution of this section is to determine the direction of the causality between the variables and whether the adoption of IT has brought about any changes in the relationship. If π_t is the rate of inflation and d_t is a measure of dollarization, a test within the VAR model is specified as follows:

$$\pi_t = \alpha + \sum_{i=1}^{n} \pi_{t-i} + \sum_{i=1}^{n} d_{t-i} + \varepsilon_t \tag{6.7}$$

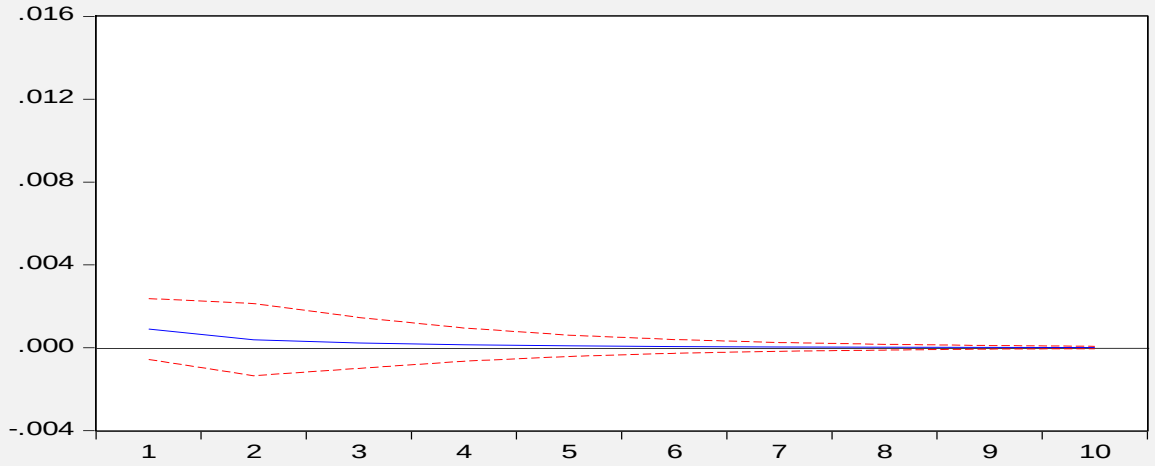
$$d_t = \alpha + \sum_{i=1}^{n} d_{t-i} + \sum_{i=1}^{n} \pi_{t-i} + \upsilon_t \tag{6.8}$$

where *a* represents the constant term in the Granger regression and *n* denotes the lag length selected for the analysis of causal relations. To be able to define the relevance of a variable in determining or forecasting the other variable(s), the Granger causality test employed. Equation *(6.7)* above tests the null hypothesis that dollarization does not Granger cause inflation, whereas equation *(6.8)* tests the null hypothesis that inflation does not granger cause dollarization.

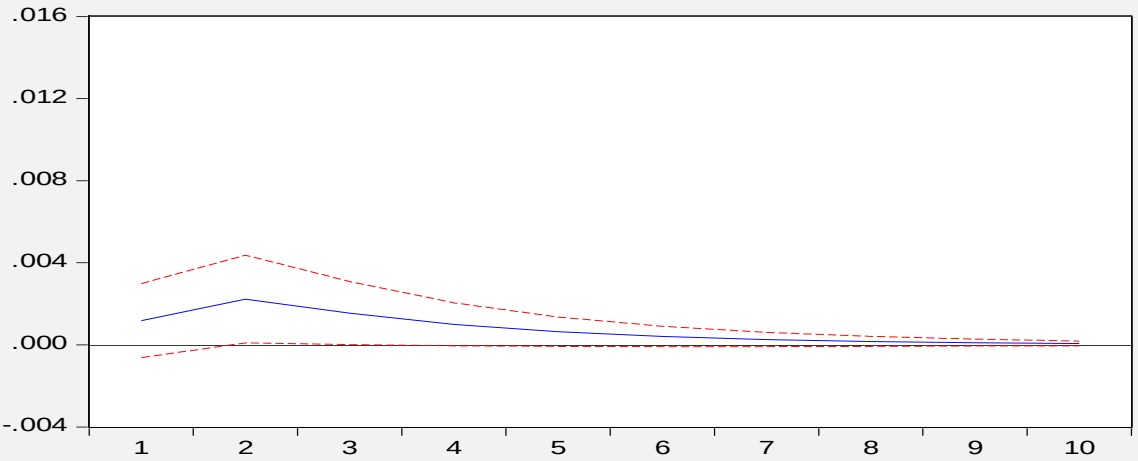
The results presented in Table 6.2 point out that inflation Granger causes dollarization after the inflation targeting regime but dollarization does not have any significant effect on inflation in both the pre and post inflation targeting periods. This confirms the impulse response functions in Figure 6.2. The response of inflation to dollarization is not statistically significant as the confidence intervals are in different regions indicating that a one standard deviation positive shock to dollarization does not lead to a rise in inflation. On the other hand, an innovation in inflation Granger causes dollarization. Both the EGARCH and Granger causality fail to provide evidence that dollarization has actually contributed to increasing inflation in Ghana. This finding is consistent with similar findings by Zamaroczy and Sa (2003) and Alvarez-Plata and Garcia-Herrero (2008) for Bolivia, Cambodia, Lao P.D.R., and Vietnam.

Figure 6.2: Response of inflation to Generalized One S.D. Innovations in dollarization

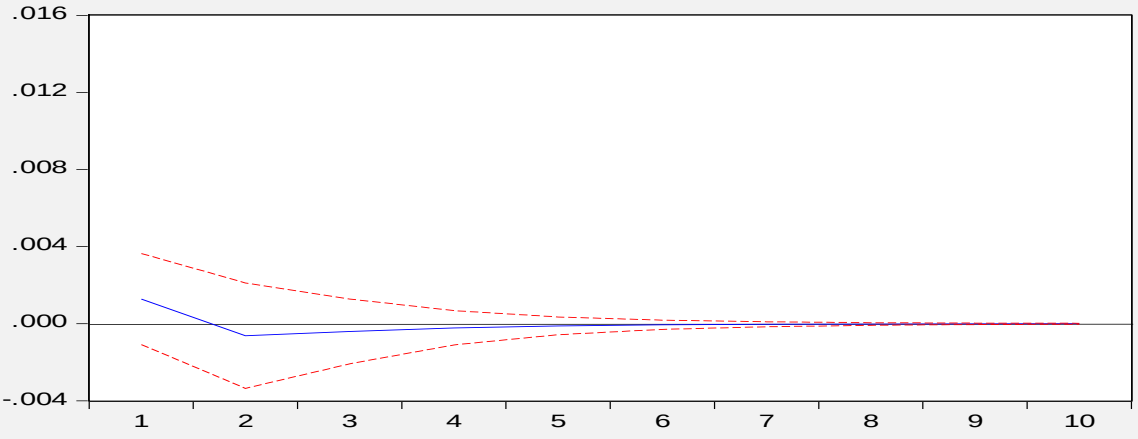
Full sample (1990M1 - 2013M13)



Pre inflation targeting period (1990M1 - 2007M5)



Post inflation targeting period (2007M6 - 2013M12)



6.3.6. The relationship between inflation and inflation uncertainty

The adoption of IT could have effect on both inflation expectations and inflation uncertainty. A test is performed for the relation between inflation and inflation uncertainty by first using EGARCH (1, 1) model to extract a time-varying inflation uncertainty. The estimate of the inflation uncertainty is then used in Granger causality models to ascertain the causal relation between inflation and the uncertainty measure. If π_t is the rate of inflation and μ_t is used to represent inflation uncertainty (or the conditional variance extracted from the EGARCH model), Granger-causality tests are specified within the bivariate vector autoregression (VAR) model similar to equation (6.7) and (6.8) above. The results in Table 6.4 suggest a bidirectional linkage among inflation uncertainty and inflation following the adoption of the fully-fledged inflation targeting regime. Thus, notwithstanding the commitment of the Central Bank to target inflation, the causality running from inflation to inflation uncertainty (high expectations) strongly exists. Karahan (2012) find that inflation in Turkey has not decreased the inflation uncertainty enough although the Bank of Turkey has adopted an inflation targeting monetary policy framework.

There is evidence of bidirectional causality between inflation and inflation uncertainty after the adoption of the inflation targeting regime. This evidence provides support for attempts by monetary authorities to tame inflation uncertainty through restrictive monetary policy actions in its bid to generate lower levels of inflation in Ghana. This feedback causality between inflation and inflation uncertainty indicates that both variables are important in the formation of the other. This provides support for both the Friedman-Ball hypothesis (see, Friedman, 1977; Ball, 1992) and Cukierman and Meltzer hypothesis (Cukierman & Meltzer, 1986). This evidence provides the impetus behind the adoption of IT, which is to ensure price stability. Similar findings have emerged in Karananos, Karanassou, and Fountas (2004) for USA, Jiranyakul and Opiela (2010) for ASEAN-5 countries, Balicilar, Ozdemir, and Cakan (2011) for G3 countries (USA, Japan and UK), Chowdhury (2014) for India, Valdovinos and Gerling (2011) for some

countries in the West African Economic and Monetary Union (WAEMU) – Benin, Senegal, and Togo, Barimah and Amuakwa-Mensah (2012) and Barimah (2014) for Ghana.

Table 6.4: Granger causality tests (inflation-dollarization and inflation-inflation uncertainty)

Hypothesis	*1990M1 – 2013M12*	*1990M1 – 2007M5*	*2007M6 – 2013M12*
Dollarization does not Granger Cause inflation	0.07 [0.79]	2.71 [0.10]	1.39 [0.24]
Inflation does not Granger Cause dollarization	7.52** [0.01]	2.68 [0.10]	12.43** [0.00]
Inflation does not Granger Cause Uncertainty	2.32 [0.10]	0.95 [0.33]	3.88** [0.02]
Uncertainty does not Granger Cause Inflation	3.66** [0.02]	1.57 [0.21]	3.61** [0.03]

Notes: ** indicates rejection of the null hypothesis at the 5% significance level. The number of lags was selected by the AIC as 2, 1, and 2 for the full (1990M1 – 2013M12), pre (1990M1 – 2007M5) and post (2007M6 – 2013M12) samples, respectively.

6.4. Conclusion and policy recommendations

The study empirically investigates the subject of dollarization and inflation targeting in Ghana, focusing on the effects on inflation and inflation uncertainty within an exponential GARCH model. The study covers January 1990 to December 2013, and distinguishes between the periods before the adoption of inflation targeting in May 2007 and after. Its cardinal aim is to capture the role of dollarization in the dynamics of inflation by distinguishing between episodes when the Bank of Ghana became committed to an explicit inflation targeting monetary policy regime. Inflation over the study period has experienced major inflationary shocks generally emanating from fuel price hikes, upward adjustment of public sector wages, food supply shocks, and exchange rate instability.

The role of high inflation inertia in the economy is evinced by the effect of past inflation and inflation uncertainty on volatility. The high inflation expectations are built on the doubt

entertained by firms and households about the ability of the government and Bank of Ghana to maintain price stability in the economy. The implication of this finding is that economic agents continue to have expectations of inflation due to the past experiences of inflationary episodes. This emphasises the call on monetary authorities to keep inflation low, stable, and predictable. There is a need for the Bank of Ghana to ensure quick, effective, and efficient policy response to inflationary shocks in order to reduce inflation and curb its effect on inflation uncertainty. Furthermore, the forecasting ability of the Bank of Ghana needs to be improved to boost the confidence in its predictions of inflation and its determinants. Adequate publicity and communication of the monetary policy stance and inflation forecasts is imperative as part of the transparency and accountability requirement of inflation targeting regime. This helps in rationalizing as well as anchoring economic agent's inflation expectations. The Bank of Ghana should strive to minimize the variance between inflation targets and actual inflation levels in order to boost economic agent's belief in monetary policy stance.

On the lack of evidence of dollarization in the dynamics of inflation volatility, two important caveats emerge. The role of dollarization cannot be ruled out completely from the dynamics because of the possibility that dollarization works through other channels such as the exchange rate pass-through to affect prices rather than affecting it directly. Although the analysis is an effective approach to test the relationship between dollarization and inflation, it is also important to note that inflation is a very complex phenomenon for its behaviour to be predicted by a single variable. There are other important predictors of inflation that are not covered in the present study. Most importantly, the measure of dollarization in the analysis does not give the full magnitude of dollarization in the Ghanaian economy due to lack of data on foreign currency in circulation, foreign currency loans, and foreign currency deposits in offshore accounts by domestic residents. The evidence that inflation affects dollarization provides some support to the assertion held by many economist that dollarization is a consequence of weakened

macroeconomic fundamentals and not as a direct cause of inflation although there are likely some feedback effects in some instances. The widespread assumption that bringing down dollarization will not necessarily bring about disinflation or stable rates of inflation holds implications for monetary authorities. Focusing on de-dollarization as a strategy to control inflation in Ghana may seem diversionary, granting there is no disagreement with the importance of curbing the rising trend of dollarization in the Ghanaian economy.

CHAPTER SEVEN

DOLLARIZATION AND MONETARY POLICY IN GHANA

7.1. Introduction

The quest to explore the theory and empirics of the effects of monetary policy shocks on real economic activity and inflation remains attractive to macroeconomists and monetary policymakers. The relentless effort to always provide fresh evidence is partly accredited to the significant role of monetary policy in attaining macroeconomic stability. In addition, such attempts unfold an understanding of the stance of monetary policy is at a particular point in time, and also the mechanisms, timing and effect of policy innovations on the economy to guide central banks on how to set policy instruments (Boivin, Kiley, and Mishkin, 2010; Bernanke & Mihov, 1998). In the ever-changing internationalised economy, monetary authorities in developing economies have increasingly become exposed to numerous challenges in their efforts to achieve price and financial stability.

Developments in the global economy since the breakdown of the Bretton Woods system in the early 1970s have culminated in the widespread switch to floating exchange rates and the adoption of inflation targeting monetary policy for most central banks. Ghana is not an exception to these policy shifts aimed at achieving and maintaining price stability. The Ghanaian economy has historically suffered from high and persistent inflation, volatile and incessant depreciation of its currency, shallow and underdeveloped financial markets; coupled with profligate public expenditure and the attendant recurring budget deficits and soaring public debt levels. The Bank of Ghana adopted an inflation targeting monetary policy framework in May 2007[33] in its bid to achieve macroeconomic stability. The ability to implement such a forward-

[33] Loosely speaking, the inflation targeting regime started with the promulgation of the Bank of Ghana Act 2002 (Act 612) although the regime was officially adopted in May 2007. The period between 2002 and May 2007 served as a preparatory stage for the adoption of the fully-fledged inflation targeting regime.

looking inflation targeting framework makes it imperative to acknowledge and appreciate the lags associated with monetary policy, and the time it takes to impact on the real economy and eventually to inflation.

The past few years have witnessed the attention of the central bank of Ghana shifted to the increasing demand and use of foreign currencies (usually the U.S. dollar) for domestic transactions. The trend has been linked to the rapid depreciation of the local currency against major international currencies, increase in international trade, significant changes in the way its financial markets operate, liberalization and integration of markets, unbridled openness, and removal of capital controls. The issue has gained currency in Ghana and has triggered an unending debate on the effectiveness of the central bank to stem the trend of dollarization and achieve monetary policy targets. There have been arguments as to what the implications of dollarization for monetary policy are. There is a body of knowledge that suggest that dollarization complicates the transmission mechanism of monetary policy and hence its effectiveness (see for example, Acosta-Ormaechea & Coble, 2011; Alvarez-Plata & Gracia-Herrero, 2008; Horvath & Maino, 2006; Dabla-Norris & Floerkemeier, 2006; Ize & Levy-Yeyati, 2005; Zamaroczy & Sa, 2003; Balino et al., 1999). Although this issue has engendered an on-going debate in Ghana, no systematic scrutiny has been undertaken to ascertain whether dollarization complicates or enhances the effectiveness of the transmission mechanisms and thereby the effectiveness of monetary policy. The following questions remain unanswered: How does dollarization affect the channels of monetary policy transmission in Ghana? How does the monetary authority respond to shocks to dollarization? How can the Bank of Ghana ensure an effective monetary policy against the backdrop of rising dollarization in the Ghanaian economy?

The present study seeks to provide answers to the above questions using monthly data covering the period January 2000 to March 2015 within a Structural Vector Autoregression (SVAR)

models. We contribute to the ongoing empirical challenge on monetary transmission in emerging economies, and also fill a gap in the literature. A novelty of this study is the use of monthly dataset because all the existing studies on Ghana make use of quarterly or annual time series. We also examine the effectiveness of monetary policy transmission mechanism before and after the adoption of inflation targeting, which has not been covered in the literature on Ghana due to lack of data. Besides, we augment the monetary transmission mechanism with a money demand function for foreign currency (dollarization). The proxy for dollarization is incorporated in the model to represent how prices, output, and interest rates affect the behaviour of dollarization. The model also enables us to ascertain the effects of dollarization on monetary policy and how monetary authorities can mitigate the negative effects of dollarization on macroeconomic stability.

As a foreshadow of the findings, we establish that the credit and exchange rate channels dominate in the transmission mechanism, with the former assuming a more significant role in the post-inflation targeting period. The high demand for foreign currency is also confirmed to be a response to instability in the macroeconomic fundamentals rather than being the cause of the instability.

The remainder of the paper is structured as follows: Section 7.2 is on data description and sources. Section 7.3 is estimation technique. Section 7.4 is the presentation of results and analysis whilst section 7.5 presents the conclusion and policy implications.

7.2. Data description and sources

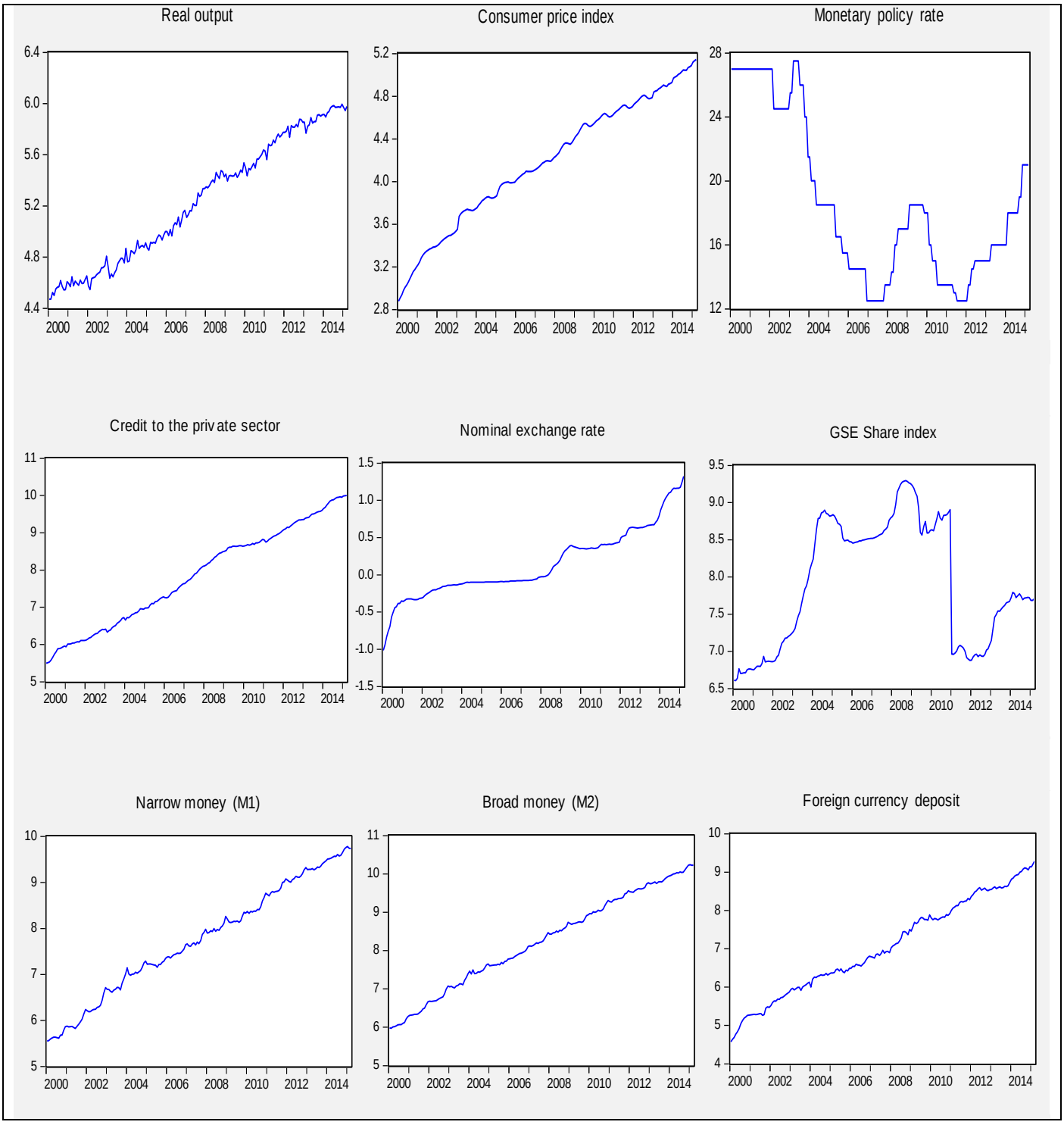
The data used in the study are real output (*y*), price level (*p*), commercial bank credit (*cr*), stock price (*sp*), nominal exchange rate (*xr*), dollarization index (*dr*), and monetary policy rate (*mp*). The selection of the variables reflects their importance in the policy transmission process. The

variables represent the various stages of the monetary transmission mechanism with the output and price level representing the target variables or policy goals, with the interest rate serving as the monetary policy instrument. The rest of the variables – credit, stock price, and exchange rate – are the intermediate variables that cater for the bank lending, asset price and exchange rate channels of monetary policy transmission mechanism. By definition, the nominal exchange rate is the price of U.S. dollars in local currency units such that a rise in the trend (positive shock) indicates a depreciation of the Ghanaian currency against the U.S. dollar, whereas a fall (negative shock) reflects an appreciation. The monetary policy (interest) rate is the operating instrument of the Bank of Ghana. An increase in the rate (positive shock) represents a contractionary policy position whereas a drop (negative shock) signifies an expansionary stance. A novelty in the literature is the inclusion of a proxy for financial dollarization in the model. Including this variable in the model makes it possible to capture the effects high demand for foreign currency deposit on monetary policy effectiveness. The foreign currency deposit variable replaces money supply in the model and suffices the money (foreign currency) demand function of the monetary transmission model. In this framework, the dollarization variable traces the determinants of demand for foreign currency and its role in the transmission channels. All the variables (except the interest rate) are expressed in natural logarithm for ease of comparison. The graphs of the various variables are illustrated in Figure 7.1. The description of the data and sources has been provided in Table 7.1.

Table 7.1: Data description and sources

Variable/proxy	*Description*	*Source*
Real output	Composite Index of Economic Activity	Research Department (BOG)
Price level	Consumer Price Index (index=2010)	International Financial Statistics (IMF)
Bank credit	Commercial banks credit to the private sector	Research Department (BOG)
Asset price	Ghana Stock Exchange All Share Index	Research Department (BOG)
Exchange rate	Nominal GHS/USD exchange rate	International Financial Statistics (IMF)
Dollarization	Foreign currency deposit divided by total deposit	Research Department (BOG)
Interest rate	Monetary policy rate	Research Department (BOG)
Foreign currency deposit	Total foreign currency deposit	Research Department (BOG)
Total deposit	Total deposit in the banking sector	Research Department (BOG)
Narrow money	Narrow money = Currency in circulation + Demand Deposits	Research Department (BOG)
Broad Money	M2 = M1 +Time Deposits	Research Department (BOG)
Broad money	M2+ = M2 + Foreign Currency deposits	Research Department (BOG)

Figure 7.1: Graphical Illustration of data



From the graphical presentation in Figure 7.1 above, we can observe that the variables have generally experienced an upward trend, except for the monetary policy rate that is characterized by some dramatic moves. The monetary policy instrument experienced a continuous reduction

from 27 percent in January 2000 and reached its lowest rate of 12.50 percent in December 2006. This rate was maintained for almost a year before rising again to reach 18.50 percent for the period February 2009 to September 2009. From there it started to drop again and reached 12.50 percent in July 2011. It was again maintained for another six months before it started rising again to 22 percent in May 2015. The share price also experienced some unusual downturns and reached its lowest in December 2011 before picking up again. The nominal cedi/dollar exchange rate has experienced continuous depreciation. In 2007 there was a redenomination of the domestic currency which slashed four zeros off the former currency. At the time of this exercise 1 U.S. dollar was exchanged for less than 1 Ghana cedi. Currently, as much as 4 Ghana cedi is required to exchange for 1 U.S. dollar suggesting that the domestic currency has fallen way below the dollar.

Table 7.2 presents the summary statistics of the variables. The Jarque-Bera test indicates that all the variables deviate from the normal distribution assumption. In terms of skewness, the real output, the monetary policy rate, and the exchange rate variables are positively skewed whilst the rest are negatively skewed. For the kurtosis, all the variables are positive and range between 1 and 3.

Table 7.2: Descriptive statistics

Statistics	*Real output*	*Prices*	*Policy rate*	*Exchange rate*	*Stock price*	*Broad money*	*Credit*	*FCD*
Mean	5.235	4.176	18.57	0.143	7.913	8.228	7.830	7.054
Median	5.273	4.191	17.00	-0.066	7.772	8.217	7.912	6.887
Maximum	5.994	5.143	27.50	1.321	9.295	10.23	10.00	9.293
Minimum	4.472	2.877	12.50	-1.014	6.606	5.973	5.499	4.574
Std. Dev.	0.482	0.591	5.035	0.453	0.843	1.243	1.315	1.244
Skewness	0.043	-0.299	0.618	0.484	-0.027	-0.136	-0.053	-0.005
Kurtosis	1.591	2.062	1.970	2.992	1.488	1.853	1.704	1.866
Jarque-Bera	15.19* [0.001]	9.442* [0.009]	19.76* [0.000]	7.158* [0.027]	17.45* [0.000]	10.59* [0.005]	12.89* [0.002]	9.794* [0.007]

Note: P-values for the Jarque-Bera tests are in parenthesis. * indicates rejection of the null hypothesis at the 5 percent significance level

Table 7.3 reports the unit roots results. The findings suggest that the variables are integrated of order one barring few instances. With this result, the variables can either be used in levels or as first differences.

Table 7.3: Unit root tests

Variable	ADF_C	ADF_T	PP_C	PP_T	NG_C	NG_T
Real output	-0.32	-2.35	-0.39	-4.43*	1.50	-8.39*
Prices	-2.13	-3.88*	-2.75	-4.04*	1.39	-2.39
Policy rate	-1.71	-0.58	-1.68	-0.44	-0.80	-2.50
Exchange rate	0.67	-0.97	-0.64	-2.24	1.93	-5.31
Stock price	-1.72	-1.54	-1.80	-1.62	-1.12	-2.26
Broad money	-1.73	-2.31	-1.85	-2.42	0.57	-11.65*
Credit	-0.95	-1.54	-0.86	-1.81	-1.54	-4.09
FCD	-0.98	-3.84*	-1.00	-3.90*	1.67	-6.52

Note: FCD stands for foreign currency deposits. Critical values for ADF and PP are 1% (-3.47), 5% (-2.88) and 10% (-2.58). Under the Ng-Perron test, we report the MZa test which has critical values as 1% (-13.80), 5% (-8.10) and 10% (-5.70). Tests with subscript C indicate inclusion of *constant*, whereas the subscript T indicates including *constant and trend.*

After confirming the order of integration of the variables we can proceed to either perform the test with the variables in levels or transform them into stationary processes by taking the first differences. An argument by Sims, Stock, and Watson (1990) that has received widespread application in the literature is that hypotheses based on the VAR estimates can be undertaken without taking the first differences of the variables. Some studies (for example, Piffanelli (2001), Dungey & Pagan (2000), Kim & Roubini (2000), Bernanke & Mihov (1998), among others) employ regressors in levels for SVAR models. The authors have advanced strong arguments that, unlike specifications in differences that create inconsistencies if there is cointegration among the variables, specifications in levels yield consistent estimates when cointegration exists.

According to Ericsson (1997), since estimating a VAR model in first differences throws away information about cointegration, it leads to model misspecification. According to Ramaswamy and Slok (1998), failure to allow an implicit cointegration relationship may bias impulse

responses and other forecasting properties. The impulse response functions produced from VECM is likely to imply that the impacts of the shocks are permanent, whereas the modelling the unrestricted VAR in levels allows the data to work out whether the effects of the shocks are permanent or transitory. Most empirical analysis of the monetary policy transmission mechanisms have been conducted by estimating the VAR models in levels. Therefore, estimating a VAR model in levels makes it easy to do a straightforward comparison with the other literature that used this technique (see Bernanke & Blinder, 1992; Cushman & Zha, 1997; Christiano et al., 1996; Leeper, Sims, & Zha, 1996; Clements, Kontolemis, & Levy, 2001; Petursson, 2001; Dabla-Norris & Floerkemeier, 2006; Poddar, Khachatryan, & Sab, 2006; Samkharadze, 2008; Tsangarides, 2010; among others).

7.3. Estimation methodology

7.3.1. Structural vector autoregression (SVAR) model

The modelling technique employed in this study follows the approach of Ngalawa and Viegi (2011) in exploring the effectiveness of monetary policy in Malawi. However, we use different variables and modify the assumptions regarding monetary policy implementation and effects to suit the monetary policy regime in Ghana. A structural-based VAR model is used to characterise the monetary transmission mechanism in Ghana as follows:

$$Ay_t = \Omega + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + ... + \Phi_k y_{t-k} + Bu_t \qquad (7.1)$$

The parameters of the model are defined as follows: A is an invertible $(n \times n)$ matrix describing contemporaneous interactions among the variables; B is a $(\mathrm{m} \times m)$ matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on at least two endogenous variables in the system; k denotes the order of the VAR model; $y_t = (y_{1t}, \mathrm{y}_{2t}, ..., y_{kt})$ is a $(\mathrm{m} \times 1)$ random

vector of endogenous variables; Ω is a $(\mathrm{m}\times m)$ vector of constants; Φ_i is a $(\mathrm{m}\times m)$ matrix of coefficients of lagged endogenous variables for all 1,2,3,….,*p*; and u_t are uncorrelated orthogonal white noise process.

The above VAR process is converted to the following reduced-form VAR of order *k* by dividing through by A:

$$y_t = \Psi_0 + \sum_{i=1}^{k} \Psi_i y_{t-i} + \varepsilon_t \qquad (7.2)$$

where $\Psi_0 = \frac{\Omega}{A}$; $\Psi_i = \frac{\Phi_i}{A}$; and $\varepsilon_t = \frac{Bu_t}{A}$ with $\varepsilon_t \sim (0, I_k)$. The $\Psi_i's\ (i = 1,...,\mathrm{k})$ are $(\mathrm{m}\times m)$ coefficient matrices, and B is a structural form parameter matrix. The ε_t represents orthogonal structural shocks and relate to the model residuals in the form of linear equations. Once estimates of the reduced-form VAR in equation (7.2) are known, the estimated residuals of this model are separated from the structural economic shocks by imposing restrictions on the parameters of A and B matrices as follows:

$$\varepsilon_t = A^{-1}Bu_t \quad \text{or} \quad A\varepsilon_t = Bu_t \qquad (7.3)$$

From this model identifying restrictions are imposed on A and B based on the orthogonality assumption of the structural innovations, $E(u_t, u_t') = 1$ as well as the constant variance-covariance matrix of the reduced-form model residuals, $\sum = E(\varepsilon_t, \varepsilon_t')$ to yield this equation:

$$A\sum A' = BB' \qquad (7.4)$$

In this model A and B are both $(m \times m)$ matrices. This suggests that there are a total of $2m^2$ unknown elements in the structural form matrices and a maximum of $m(m+1)/2$ identifiable parameters in the matrices. Therefore, to achieve the exact identification, at least $2m^2 - m(m+1)/2$ or $m(3m-1)/2$ additional restrictions are required (see Breitung, Bruggemann, & Lutkepohl, 2004). The just (exact) identified model of Sims (1980) entails recursive factorization based on Cholesky decomposition of matrix A. In that system of identification, structural shocks depend on the ordering of the variables. Although a number of studies have applied the recursiveness assumption, Christiano, Eichenbaum, and Evans (1998) argue that the approach is controversial. Stock and Watson (2001) question the approach because it assumes that changing the order of the variables changes the VAR equations, residuals, and coefficients such that there are a number of possible recursive VARs. There are also some doubts with the approach in case a simultaneity problem exists among the variables. The approach used in this study is based on the structural factorization which is founded on relevant economic theory in the imposition of restrictions on matrices A and B. Due to some weaknesses of the recursive factorization, the structural factorization VAR approach has become one of the most widely employed in the identification of monetary policy shocks (see, for example, Sims and Zha, 2006; Bernanke & Mihov, 1998; Leeper et al., 1996; Bernanke, 1986; Sims, 1986). As mentioned earlier, this approach assumes orthogonality of the structural innovations.

7.3.2. Structural identification for composite model

The inflation targeting monetary policy regime in Ghana works with one policy instrument, intermediate variables which represent the monetary transmission channels, and price stability as policy goal (target). However, because the mandate as enshrined in the Bank of Ghana Act 2002 (Act 612) suggests that the Bank supports the general economic policy in promoting economic

growth, we assumed that real output is a secondary target of the Central Bank. In the IT regime, monetary shock is measured by innovations in interest rate. An increase in the monetary policy rate indicates tighter (or contractionary) position, whereas a reduction is an expansionary monetary policy stance. We impose restrictions on the structural (contemporaneous) parameters and no restriction imposed on the lagged parameters so that reasonable economic arguments could be deduced from the estimates of the model.

Based on equation (7.4) above, different models are employed to analyse the mechanism through which monetary policy actions transmit to the real economy. The following structural shocks are identified for the full model which includes all the variables:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & a_{56} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & 0 & 1 & 0 \\ a_{71} & a_{72} & a_{73} & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} u_t^y \\ u_t^p \\ u_t^{mp} \\ u_t^{cr} \\ u_t^{sp} \\ u_t^{xr} \\ u_t^{dr} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} \end{bmatrix} \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^p \\ \varepsilon_t^{mp} \\ \varepsilon_t^{cr} \\ \varepsilon_t^{sp} \\ \varepsilon_t^{xr} \\ \varepsilon_t^{dr} \end{bmatrix} \quad (7.5)$$

The model presents seven (7) different equations with each variable serving as dependent variable. The first equation suggests that real output displays a sluggish response to all the variables in the system. This implies that if there is an effect of any of the variables on output it is not contemporaneous but does so with a lag. This is because firms' decision to either increase capacity or utilize the existing capacity takes time. The second equation assumes that consumer prices respond contemporaneously to shocks emanating from output, but responds sluggishly to the other variables in the system. In these two equations we argue that output and consumer prices are sluggish in responding to shocks due to inherent inertia and planning delays as maintained by some studies (see Cheng, 2006; Bernanke & Mihov, 1995). We order the monetary policy instrument as the third variable to denote the reaction function of a forward-looking

Central bank. This reaction function is based on the assumption that the Bank of Ghana responds contemporaneously to output and inflationary pressures in order to achieve price stability. This forms the standard monetary policy model with no intermediary variables or channels. The rest of the model captures equations for the intermediate variables. In order to evaluate the transmission of policy decisions to the policy goals, we impose further restrictions on the intermediate variables.

The fourth equation contains credit to the private sector as a representative of the credit channel. It presents the response of commercial banks' credit decisions to monetary policy actions. The restriction in this equation hypothesizes that credit responds to policy action and transmits the shocks to output and price developments through firms and household decisions. When there is a change in monetary policy rate or bank reserve requirement, commercial banks are expected to respond quickly and reflect this in their lending behaviour. Also, as an open economy that has trading arrangements with other countries, the exchange rate is regarded as a very important variable in the transmission of shocks. Due to the high import content in the economy, we hypothesize that exchange rates respond to shocks originating from output, consumer prices, credit, as well as monetary policy. The variable is also supposed to capture shocks from the external sector of the economy.

The exchange rate variable has been extensively modelled to contemporaneously receive shocks from other macroeconomic variables in the extant literature on structural VAR. This is based on the hypothesis that, as a forward-looking asset price variable, movements in the exchange rate is expected to reflect the contemporaneous effect of variations in the other variables (see Cheng, 2006; Becklemans, 2005; Piffanelli, 2001; Kim & Roubini, 2000). The sensitivity of exchange rates to movements in macroeconomic fundamentals in the economy of Ghana is consistent with this postulation. Furthermore, allowing for the high import component in the structure of

Ghana's economic process provides support for the assumption that the exchange rate responds contemporaneously to the other variables in the system. Additional restrictions imposed on the model hinge on the hypothesis that whenever the Bank of Ghana induces a contractionary policy shock it increases interest rate, which leads to an initial appreciation of the domestic currency, and causes a reduction in output, prices, and bank credit. Again, since the share price is also a financial variable it is quick to react to macroeconomic fluctuations. Assuming that it reacts contemporaneously to shocks due to the other variables in the system allows us to ascertain the effects of domestic macroeconomic factors on movements in the price of shares on the GSE.

The vector of endogenous variables used in the baseline/generic model is $y_t'=(y, p, mp)$ and the structural identification is presented as below.

$$\begin{bmatrix} 1 & 0 & 0 \\ a_{21} & 1 & 0 \\ a_{31} & a_{32} & 1 \end{bmatrix} \begin{bmatrix} u_t^y \\ u_t^p \\ u_t^{mp} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 \\ 0 & b_{22} & 0 \\ 0 & 0 & b_{33} \end{bmatrix} \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^p \\ \varepsilon_t^{mp} \end{bmatrix} \qquad (7.6)$$

The assumption employed in this model is that monetary policy responds variations in output and consumer price levels, which triggers a policy response function assumed to cause the expected effects in the policy goals. The model comprising the three variables permits us to present how monetary authorities respond to deviations in the monetary policy goals and also ascertain how their actions transmit to the target variables directly. This models pre-empts how effective monetary policy would be if the channels of transmission are ineffective or non-existent.

Following this, the study advances to assess the effectiveness of three dominant transmission channels: the bank lending/credit channel, the asset price channel, and the exchange rate channel. We do not include lending rates in the model to capture the role of the interest rate

channel. The interest rate view holds that monetary policy decisions to increase short-term nominal interest rates translates into an increase in the real rate of interest and cost of capital, which forces firms and households to cut investment and consumption. All else held constant, this constraint is expected to lead to a fall in real output and subsequently employment[34]. Although this channel is not explicitly captured, we assume that the cost of lending reflects in the demand for loanable funds as incorporated in the volume of credit advanced to the private sector. The balance sheet channel posits an increase in firms' cost of credit and deterioration of firms' balance sheet due to imperfections or frictions in financial and markets as advanced by Bernanke and Gertler (1995), is also not evaluated due to data constraints. According to this view, interest rate hikes create high costs of servicing debt for firms, reduces the capitalized value of non-current assets, and thereby results in declining rates of productivity (output) and employment.

The first channel we examine is the bank lending or credit channel developed by Bernanke and Blinder (1992, 1988). According to this model, interest rate and reserve requirement decisions of monetary authorities reflect in the amount of credit granted by financial institutions, which also affects aggregate economic activity through investment and consumption decisions of firms and households. This model assumes that, a change in the stance of the monetary authorities reflects in the reserve position of commercial banks, which in turn causes a change in the amount of loanable funds available. In this sense, a drop in loanable funds would inhibit the capacity of commercial banks and other financial institutions to advance credit, and therefore occasions an adverse effect on economic activity. To capture the role of bank credit in the transmission mechanism we plug in credit to the private sector and transform the model to a bank lending or

[34] This channel also lies at the heart of "New Keynesian" macro models developed by Clarida, Galí, and Gertler (1999), Rotemberg and Woodford (1997), Bernanke and Gertler (1995), among others.

credit channel model with a vector of four endogenous variables $y_t'=(y, p, mp, cr)$ as presented in the following model.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ 0 & 0 & a_{43} & 1 \end{bmatrix} \begin{bmatrix} u_t^y \\ u_t^p \\ u_t^{mp} \\ u_t^{cr} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^p \\ \varepsilon_t^{mp} \\ \varepsilon_t^{cr} \end{bmatrix} \quad (7.7)$$

The second channel we consider is the asset price channel. The channel functions through the Tobin's *q* theory of investment (Tobin, 1969) and the wealth effects on consumption (Mishkin, 1995). According to the proponents, a contractionary monetary policy through interest rates hikes, leads to a drop in share prices which reduces Tobin's *q* and wealth of firms and individual investors. This reduction in wealth reduces firm investment and consumption, which consequently causes a dip or shrink in real output and employment. The asset price channel is examined by including the proxy for the share price in the model to form the following SVAR model, $y_t'=(y, p, sp, mp)$.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} u_t^y \\ u_t^p \\ u_t^{mp} \\ u_t^{sp} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^p \\ \varepsilon_t^{mp} \\ \varepsilon_t^{sp} \end{bmatrix} \quad (7.8)$$

The last channel to assess is the exchange rate channel. This channel is considered an important element in conventional open-economy models and has been identified as an effective channel in most developing countries. It represents how changes in interest rates and/or direct foreign exchange market intervention feeds into exchange rate movements via the uncovered interest rate parity condition. The advocates hold that, prices of imported goods and volume of imports and exports move according to exchange rate dynamics, which in turn influences economic

activity (see, Taylor, 1995; Obstfeld & Gertler, 1995). Based on this hypothesis, when the Bank of Ghana raises the domestic interest rate as against foreign rates, it generates incentives to demand domestic currency, which leads to an initial appreciation of the domestic currency, a reduction in net exports, and consequently to a general fall in the level of economic activity. Also, when exchange rates increase (depreciates) it feeds into prices of imported goods and the volume of imports which in effect causes increase in prices. Due to the high dependence on imported goods in Ghana, the exchange rate has been hypothesized to have important effects on output and price levels. However, whether monetary policy is effective in controlling exchange rates remains an empirical quest. Based on the earlier assumptions, the four-variable model $y_t'=(y, p, mp, xr)$ including nominal exchange rate is presented below.

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} u_t^y \\ u_t^p \\ u_t^{mp} \\ u_t^{xr} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^p \\ \varepsilon_t^{mp} \\ \varepsilon_t^{xr} \end{bmatrix} \quad (7.9)$$

The analysis entails estimating an unrestricted VAR based on which an optimal lag structure is determined. In order to do this we follow the established information criteria as discussed in Lutkepohl (1991, pages 125–126) such as Akaike (AIC), Hannan-Quinn (HQC), and Schwarz (SIC) to select the appropriate or optimal lag length for the estimation. Whereas the AIC and HQC suggest a lag order (length) of three, the SIC recommends two lags. We follow the SIC in the estimation. At the chosen lag, we test whether the VAR satisfies the stability condition by ensuring that, the modulus of all the inverse roots of the characteristic autoregressive polynomial lie within the unit circle. To buttress the constancy of the model, a VAR lag exclusion Wald test is conducted to confirm that all the endogenous variables are significant, independently and jointly, at each of the lag lengths. This diagnostic analysis is done to establish the reliability of the

model to produce valid estimates and forecasts. Once this has been achieved the structural factorization procedure would be followed to impose the necessary restrictions to form the structural VAR models based on which further analysis such as impulse response and variance decomposition would be made.

We first consider the responses of monetary policy to structural one standard deviation innovations in prices and output over a 60-month (5-year) horizon, along with the responses of prices and output to their own shocks. On the horizontal axis is the time scale in months and the analytic confidence intervals obtained from the variance-covariance matrices represented by dashed lines. The significance of the innovation is established when the two dashed lines fall on the same side of the axis. This suggests that when both lines fall below the baseline (lower part) it implies a significantly negative impulse response. Conversely, having both lines above the baseline (upper part) suggests a significantly positive impulse response function. Furthermore, we decompose the dynamics of the dependent variable and analyse the contribution of the regressors to the variation process. While impulse response functions trace the effects of a shock to one endogenous variable on the other variables in the system, variance decomposition separates the movements in the variable into shocks due to itself and shocks due to the other variables. Thus, the forecast error variance decomposition provides information about the relative importance of a random innovation to the regressors. It indicates the proportion of the movements due to its "own" shocks and shocks due to the other variables.

The analysis in this section is based on different experimental models to investigate the effects of monetary policy on the economy, the response of monetary policy to dynamics of the macroeconomic environment, and the effectiveness of the various channels of the policy transmission mechanism. In the first stage we build a three-variable baseline model to characterize the interaction between the monetary policy instrument and monetary policy targets

or goals (prices and output levels). As discussed earlier, since the restrictions imposed on the full/composite model were made to capture the role of the intermediate variables, the next stage of the analysis would be dedicated to evaluating the potency of the intermediate variables in serving as a conduit for policy shocks to the target variables using a reduced model that includes only one intermediate variable in turn. Finally, all the variables are encompassed in a composite SVAR model and the interactions between them are scrutinized. In the composite SVAR system, constraints would be executed on the contemporaneous (structural) factors to assess the effectiveness of monetary policy before and after the adoption of the inflation targeting policy regime. Also, the effect of dollarization on monetary policy would be explored by plugging in the proxy for dollarization in the full model.

7.4 Assessing the interaction of monetary policy and target variables

7.4.1. Effects of monetary policy on policy targets

The profiles of output and consumer prices in response to structural one standard deviation innovation in monetary policy are presented in Figure 7.2. The responses of both variables to monetary policy shocks are insignificant throughout the 60-month horizon. In terms of direction, the price variable rises to a shock in monetary policy initially. The rise in price is counterintuitive because we expect prices to fall to a contractionary monetary policy innovation in an inflation targeting framework. The rise in price level, although insignificant, reaches a peak of 0.18% in 5 months and begins to drop to a negative in 20 months. The response of output to policy shocks has been flat and statistically insignificant, which suggests that monetary policy does not affect output directly.

The initial rise in prices to policy tightening is what is commonly called *price puzzle* in the literature (see, *inter alia*, Clarida & Gertler, 2001; Bernanke & Mihov, 1997; Sims, 1992). The puzzle is common in empirical modelling of monetary transmission mechanisms and a number

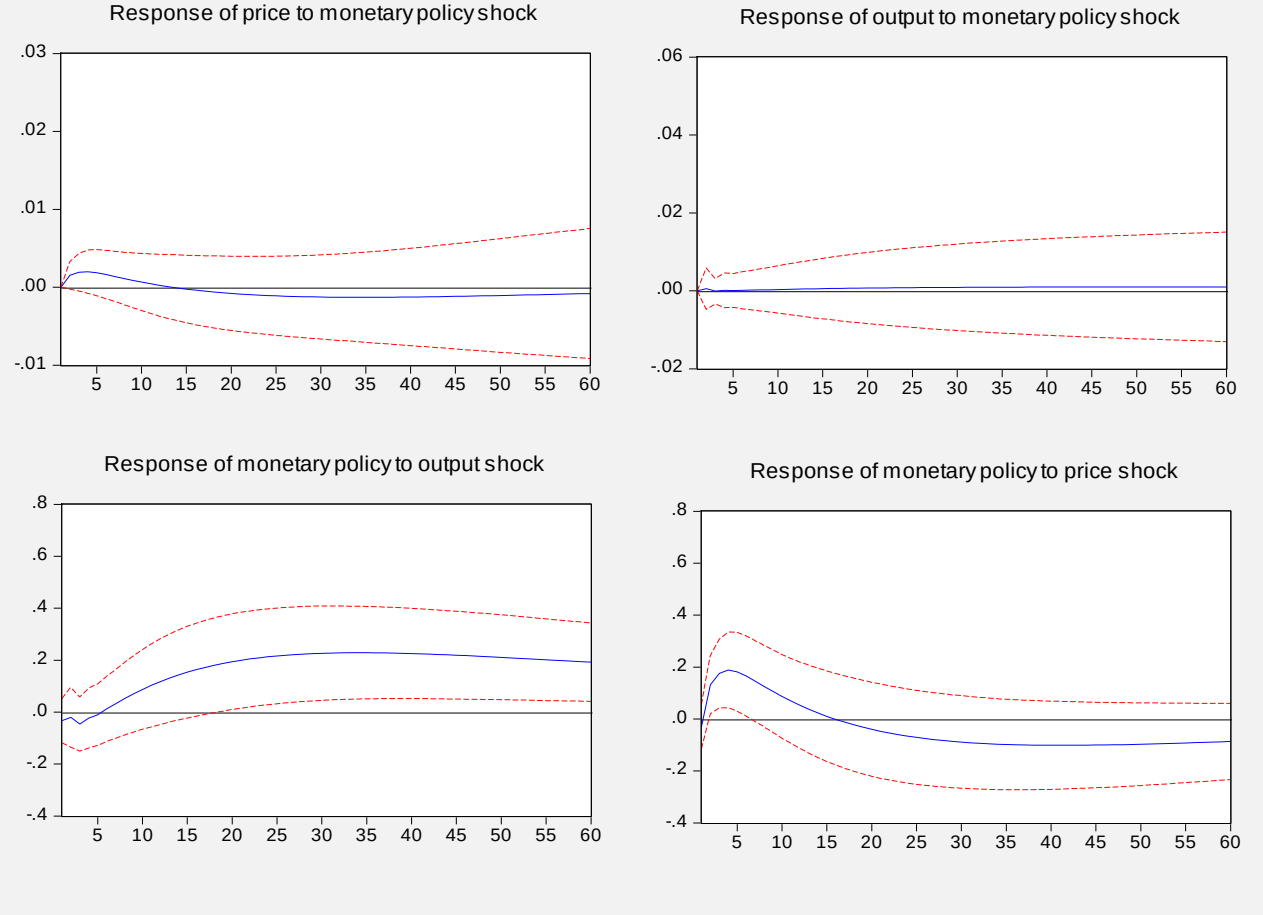
of explanations have been offered to explain this. One explanation that has been maintained for this phenomenon is the exclusion of important variables in the specification. In order to tests the hypothesis based on this argument, Sims (1992) included a lot of variables including exchange rates and commodity prices in his models to account for unanticipated future inflation but still reported the price puzzle. Others have argued that the incidence of price puzzle is due to the use of incorrect operating instrument. Following this line of argument, other studies also incorporated some other variables in the model to curtail the price puzzle but to no avail. Going by this evidence, we argue that monetary policy has been ineffective in controlling prices and further implies that monetary policy has not been successful in achieving price stability.

7.4.2. Response of the Central Bank to shocks in target variables

After evaluating the effects of the monetary policy instrument on policy targets, we also present how the Bank of Ghana responds to shocks emanating from target variables. It can be observed from Figure 7.2 that, when there is an unexpected 3.6% shock in output it leads to a 0.7% drop in monetary policy in the first month. Following this however, the position of the monetary authorities shift to a contractionary stance which becomes significant after 15 months and rises to a peak in 22 months before it begins to drop. From the response functions, it is observed that an unexpected shock equal to 3.6% in output leads to an insignificant decline in prices initially, but rises and becomes significant within 10 months. It stays above the baseline until almost 40 months before it becomes insignificant. This rise in prices to output shocks could also trigger a positive response from monetary policy authorities to the innovation in an attempt to obviate possible negative consequences of price volatility. The response of monetary authorities to an unanticipated shock in price equivalent to 1.2% is quite benign although positive and significant until it reaches a peak in the third month and drops again. This is in accordance with our expectation of a central bank mandated to ensure price stability. This behaviour is somehow counterintuitive as output is also mentioned as a secondary target of the Bank. Nevertheless, the

fact that the Bank of Ghana is practising a fully-fledged inflation targeting regime makes it difficult for us to criticize the Bank for seeking to curtail inflationary pressures induced by economic growth in order to achieve its legal mandate.

Figure 7.2: Impulse responses of monetary policy to target shocks



Following the impulse response functions, we analyse the relative importance of each structural innovation in contributing to movements in the variables under consideration. The structural forecast error variance decomposition is presented for each of the three variables in the model over a 60-month horizon in Table 7.4. The output variable accounts for larger percentages of deviations in both prices (41%) and the monetary policy variable (49%) at the 5-year horizon. The activities of monetary authorities have focused more on output developments. This suggests that monetary policy works through output to cause price stability. On the other hand, we can

argue that, the effects of developments in monetary policy and prices on output have been less pronounced.

Table 7.4: Variance decomposition for baseline SVAR model

	Standard error	*y*	*p*	*mp*
	Variance decomposition of output			
1	0.0363	100.00	0.0000	0.0000
6	0.0626	99.489	0.4105	0.0996
12	0.0767	99.369	0.3590	0.2713
24	0.0889	96.529	1.9588	1.5111
36	0.0951	91.504	5.0817	3.4140
48	0.0996	86.057	8.5333	5.4087
60	0.1034	81.123	11.675	7.2004
	Variance decomposition of prices			
1	0.0121	3.2841	96.715	0.0000
6	0.0410	1.5653	97.619	0.8155
12	0.0550	6.0867	93.026	0.8870
24	0.0722	25.269	74.141	0.5890
36	0.0844	36.777	62.293	0.9292
48	0.0929	40.967	56.986	2.0465
60	0.0991	41.497	54.878	3.6235
	Variance decomposition of monetary policy			
1	0.5608	0.0178	0.4822	99.499
6	1.3155	3.2130	4.2237	92.563
12	1.8788	15.771	2.3134	81.914
24	2.7109	35.377	3.2113	61.411
36	3.1950	43.829	4.6116	51.559
48	3.4358	47.509	5.2933	47.196
60	3.5445	49.197	5.5440	45.258

The combined effect of shocks to the two variables in the movement of output was less than 1% within the first year. Output shocks, on the other hand, account for over 81% of its own deviations in the 5 years as monetary policy and prices combined account for only 18% of the fluctuations in output within the same period. The reason for this evidence could be that there are other important variables that explain real economic activity better that have not been captured in the model. Output variations could not be attributed to monetary developments.

7.4.3. Effectiveness of monetary transmission channels

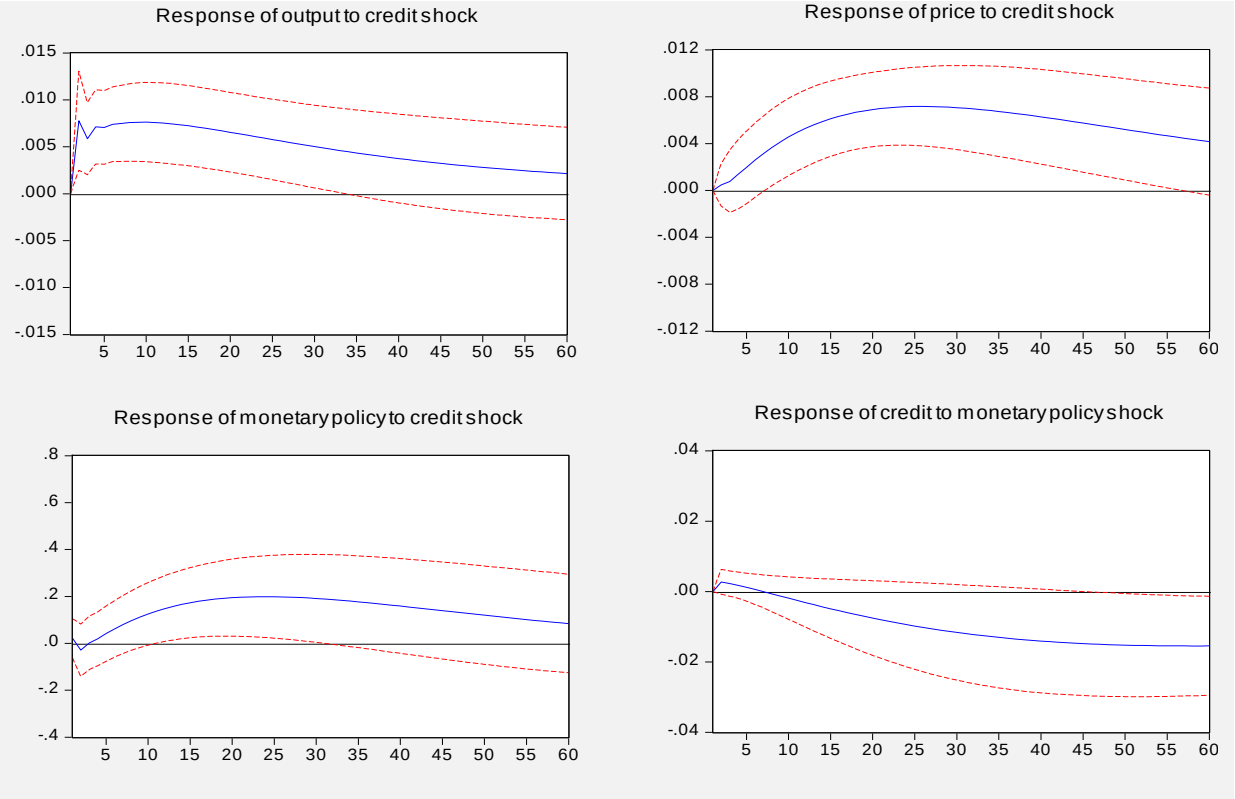
7.4.3.1. Credit channel

In this model, we analyse the effects of monetary policy on bank credit and also consider the effects of credit to the private sector on price and output developments. Figure 7.3 presents the impulse responses derived from the credit channel model. According to the structural impulse response functions, a structural one standard deviation innovation in monetary policy leads to a delayed decline in credit. Albeit insignificant, it remains below the baseline from five months to the end of the study horizon, suggesting that, consistent with the economic theory a contraction in the monetary policy causes a decrease in the capacity of commercial banks to offer credit. An unexpected 2.30% increase in bank credit leads to an increase in both real output and price levels. The rise in price to credit shocks becomes statistically significant after seven months, reaches a peak in 26 months before it drops, whilst lingering above the baseline for some time. This positive reaction of prices to bank credit is common within the extant studies.

On the other hand, there is an instantaneous significant response of output reaching a peak at 10 months before it begins to drop. However, it remains above the baseline until almost three years before it drops below the baseline. The statistically significant increase in output to credit shocks is consistent with the import of the bank lending (credit) channel that a rise in bank lending boosts economic activity by means of increasing firm investment and household consumption.

These findings point out the strength of the credit channel in the transmission of monetary policy in Ghana.

Figure 7.3: Impulse response for the credit channel model

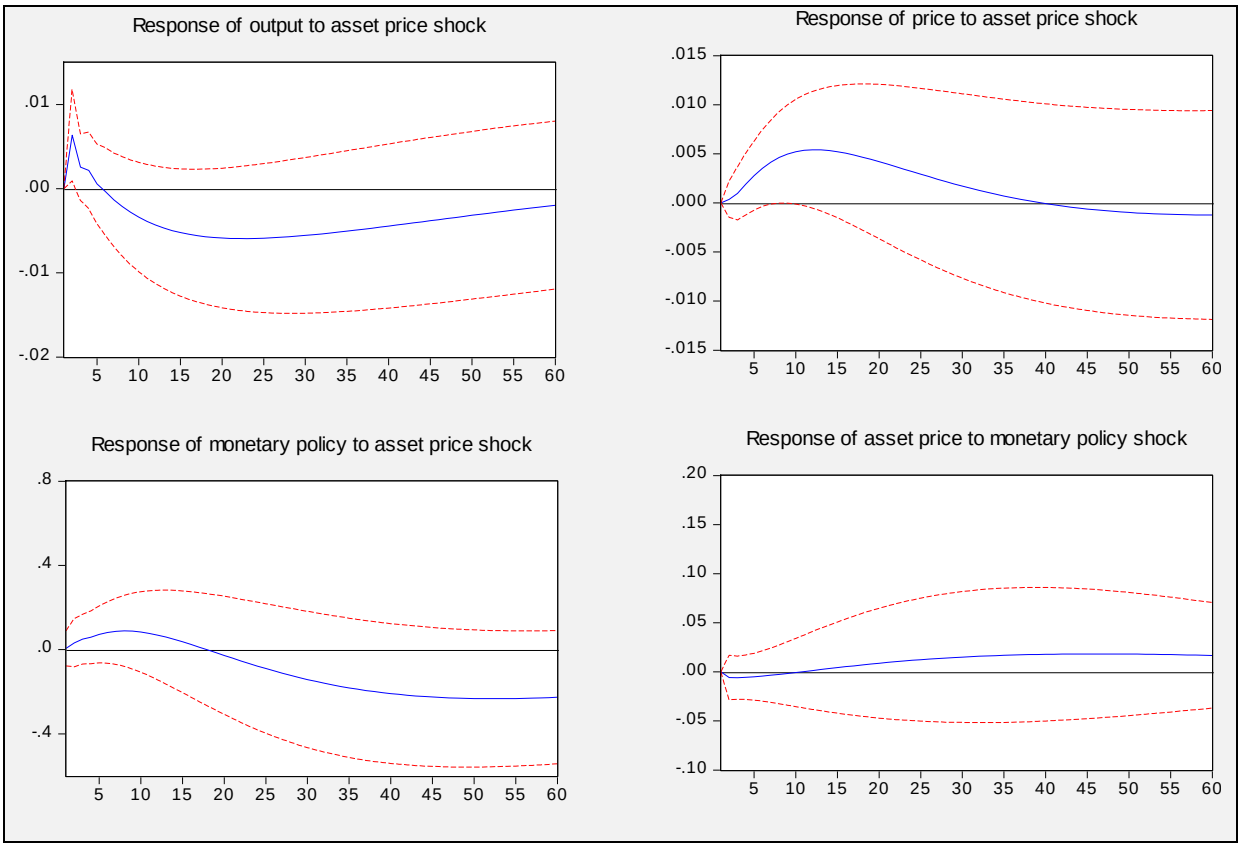


7.4.3.2. Asset price channel

This model enables us to evaluate the effects of monetary policy on asset prices and also ascertain the effectiveness of the asset price channel to transmit monetary policy changes to prices and real output. Figure 7.4 is the impulse response functions derived from the asset price channel model. It is found from the structural impulse response functions that a structural one standard deviation innovation in monetary policy leads to a gentle drop in share prices initially albeit statistically insignificant. On the response of output to share price shock, there is an initial instantaneous significant jump in the behaviour of output to an unexpected asset price shock equivalent to 15.73%. It attains a peak within 3 months after which it loses its statistical

significance as it drops drastically to the baseline within 5 months. This indicates that the positive response of output to share price is not persistent. The response of price to asset price shock which is also insignificant persists and stays above the baseline for over three years before it drops below the baseline. Since the transmission of shocks to output and price development is observed to be generally statistically insignificant, we can argue that the asset price channel is not effective in the Ghanaian setting.

Figure 7.4: Impulse response of the asset price channel model



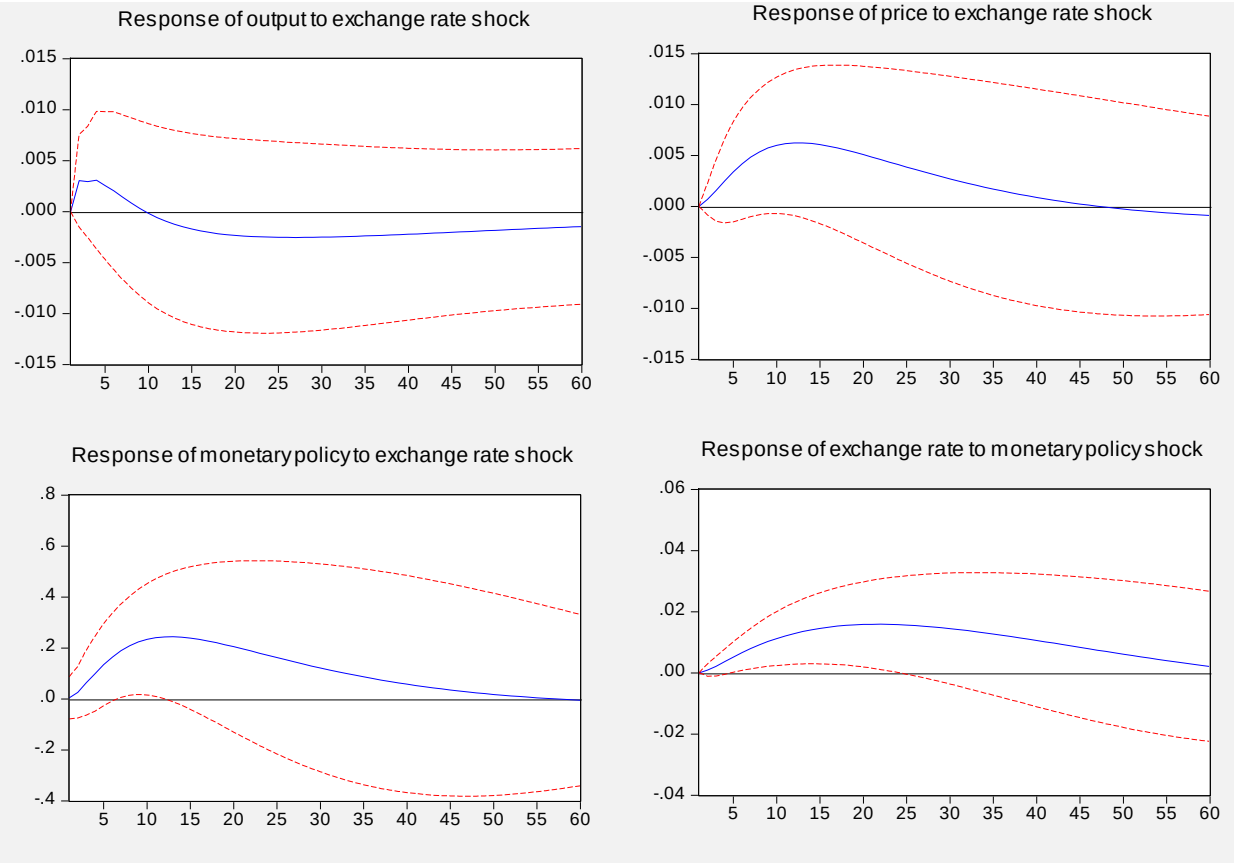
7.4.3.3. Exchange rate channel

When the Bank of Ghana sets its interest rates above its foreign counterparts, it leads to an initial appreciation of the domestic currency due to the stickiness of price adjustments. We therefore expect that an effective exchange rate channel should manifest in a fall in the exchange rate due

to contractionary monetary policy shocks. Due to the high dependence on imported goods in Ghana, we expect the exchange rate to have important effects on output and price levels. However, whether monetary policy is effective in controlling exchange rates remains an empirical quest.

The structural impulse response functions based on the exchange rate channel model is presented in Figure 7.5. The findings indicate that the monetary authority responds to exchange rate shocks by increasing the monetary policy rate. Contrary to our intuition and expectation, nominal exchange rate rises to a contractionary monetary policy position. This upswing becomes statistically significant within 5 months, persists for about two years before dropping to negative levels. This is another puzzle in the literature. The depreciation of the exchange rate to monetary policy shocks is consistent with the exchange rate puzzle reported by Grill and Roubini (1993) and the exchange rate overshooting model of Dornbusch (1976). On the other hand, the response of monetary policy to exchange rate depreciation has been a contractionary stance albeit generally insignificant. This suggests that the Bank of Ghana is more concerned about the pass-through effects of nominal exchange rates to inflation due to the considerable number of foreign goods in the domestic CPI basket.

Figure 7.5: Impulse response of the exchange rate channel model



7.4.4. Effectiveness of monetary policy through the transmission channels

In order to evaluate the effectiveness of the various transmission channels, we consider the contribution of monetary policy to the intermediate variables and the importance of each of the channels to output and price developments or how each intermediate variable affects output and prices. The variance decompositions of the variables are presented in Table 7.5 below. On the significance of monetary policy to variations in the intermediate variables, the results suggest that 23 percent of movements in credit to the private sector can be explained by variations in the monetary policy variable at the end of the 60 months. Also, approximately 12 percent of variations in exchange rate can be explained by monetary policy actions. The above evidence depicts the significance of the credit and exchange rate channels in the transmission mechanism.

On how shocks are transmitted from the intermediate variables to target variables, we consider the significance or contribution of these variables to developments in prices and output. The results of the variance decomposition indicate that, the credit channel tracks a higher percentage of variations in both prices and output. Approximately, 20 percent of movements in output can be explained by credit to the private sector shocks, whereas asset price shocks contribute an average of 10 percent to output variations. On price dynamics, about 32 percent of variations can be explained by shocks emanating from the credit variable. An important observation is the role of money supply in price dynamics. Considering the finding that money supply explains over 40 percent of the variations in the price level is explained by money supply, we posit that money supply still contains important information about prices. Although, the contribution of monetary policy to money supply has reduced significantly in the recent years because of the inflation targeting regime, monetary supply has a very high contribution to price development.

In conclusion, we find that based on the relative contribution of the monetary variable to output and prices, monetary policy happens to be more effective under the credit channel. Under the credit channel, monetary policy explains 17.67% of output variations and 13.64% of price dynamics over the 60-month horizon. At the same time, among the channels, credit contributes the highest to output and prices accounting for 20.32% and 32.90% of variations respectively over the forecast horizon.

Table 7.5: Contribution of monetary policy to the intermediate variables

	Contribution of monetary policy to the intermediate variables				
Horizon	*cr*	*sp*	*xr*	*m2*	*dr*
1	0.000000	0.000000	0.000000	0.000000	0.000000
6	0.424496	0.101381	1.932095	0.846217	8.608583
12	0.457304	0.068885	6.322019	0.566058	15.01260
24	3.623358	0.240999	11.64163	0.332454	17.40907
36	9.655883	0.784261	12.72474	0.239722	17.21619
48	16.56395	1.453773	12.34579	0.212779	16.91695
60	22.60684	2.056563	11.70208	0.227058	16.74565
	Contribution of other channels to output variations				
1	0.000000	0.000000	0.000000	0.000000	0.000000
6	7.740434	1.558491	1.002425	0.346548	0.266340
12	13.13518	2.343633	0.752245	0.544124	0.371283
24	19.30599	7.240081	1.280392	1.813986	1.073590
36	21.30555	10.21918	1.957441	3.974601	1.952430
48	21.22957	11.05912	2.303583	6.488015	2.769555
60	20.32424	10.83930	2.392857	8.908007	3.442574
	Contribution of other channels to price development				
1	0.000000	0.000000	0.000000	0.000000	0.000000
6	0.858044	1.547370	2.345885	14.30075	1.002663
12	5.350831	5.694986	7.828808	38.52868	3.719276
24	19.82205	7.672415	10.32993	46.98407	5.901350
36	28.96684	6.315021	8.398034	42.92033	6.518471
48	32.12217	5.308035	6.911497	39.01132	6.949037
60	32.08557	4.808179	6.104124	36.73712	7.348656

7.4.5 Inflation targeting and monetary transmission mechanism

In this section, the effectiveness of monetary policy is assessed by distinguishing between the period before the adoption of the IT regime and the period after the regime. The effect of dollarization on the transmission mechanism is also captured by including the foreign currency

deposit variable in the full model and also for the two sub-periods. In the post-IT regime, we can argue that monetary policy has been less effective in influencing the intermediate variables considering how policy actions transmit to the intermediate variables, and finally through to the target variables. During this period, although there has been record single digit inflation, exchange rate has continued to depreciate even after the redenomination in July 2007. The dwindled influence of monetary policy on prices presents some evidence that the single digit achieved in recent years is attributable to factors other than movements in the monetary policy rate. Alternatively, it could suggest that the single digit experienced in recent years could not be accredited to the influence of monetary policy shocks. Again, it is evident that monetary policy has not contributed much to the volatility of exchange rates in recent years. This establishes the contentious disconnection between inflation and exchange rates experience in the post-IT regime. The analysis is based on the variance decomposition reported in Table 7.6 and 7.7 for the period before and after inflation targeting respectively.

Considering the relevance of the monetary policy variable, we argue that monetary policy has contributed significantly to movements in dollarization in both periods. At the 5-year horizon, monetary policy contributed approximately 20 percent and 14 percent respectively to dollarization in the pre and post-IT periods. We argue that, although monetary policy did not contribute much to credit in the period before IT, it became more significant in the period after the IT and accounted for about 16 percent in 48 months. In the case of share price, monetary policy contributed about 13 percent in 12 months before dropping to lower levels.

7.4.5.1. Effects of credit

The contribution of credit on all the variables has been notable in both periods. However, the significance became more pronounced in the post-IT regime, suggesting that the credit channel has been very strong in the monetary transmission process. In the pre-IT period, credit

contributed almost 40 percent of the movements in real output and almost 25 percent in price development over the 5-year horizon. Interestingly, 20 percent of the movement in dollarization was accounted for by credit to the private sector and 15 percent of share price at the same horizon. Apart from reducing its contribution to output to about 15 percent, credit became more significant in the dynamics of the other variables during the IT regime. At the 24-month horizon, credit explained 42 percent of the movement in prices. This reduced to 20 percent at the 5-year horizon. It contributed approximately 15 percent, 31 percent, 27 percent, 48 percent, and 53 percent to the changes in real output, monetary policy, share price, exchange rates, and dollarization respectively. Considering the impulse response function for the post-IT period, we claim that a structural one standard deviation innovation in credit leads to a significant rise in all the variables. This confirms that the credit channel has become very robust in transmitting policy shocks to the economy during the IT framework. The significant contribution of credit to dollarization is signalling high rate of liability dollarization as a component of credit. Credit shocks lead to statistically significant depreciation of the exchange rate which stays above the baseline for over 4 years. The significant contribution of credit to prices (together with the significant role of money supply in pricing dynamics) tends to posit that inflation in Ghana is a monetary phenomenon as argued in some earlier studies (see a recent survey by Adu and Marbuah, 2011).

7.4.5.2. Effects of exchange rate

The effectiveness of the exchange rate channel has become more pronounced during the IT period. In the pre-IT period, the highest contribution from exchange rate was approximately 6 percent to real output at the 48 months horizon. In the post-IT period, exchange rate has become very instrumental in the movements of the other macro variables. At the 5-year horizon, exchange rate explained 35 percent, 27 percent, 14 percent and 30 percent to real output, prices, credit, and share price respectively. This suggests that the IT regime has not been effective in

curtailing the pass-through effects of the exchange rates. However, according to the impulse response functions, prices fall in response to a one standard deviation exchange rate shock. This also confirms that there is a disconnection between prices and exchange rates in the post-IT era. For the longer period that inflation remained a single digit, the currency continued to be very volatile which raised some doubts about the effectiveness of monetary policy in ensuring stable prices. Also, a shock to exchange rate leads to declining levels of credit to the private sector and an increase in dollarization. Contrary to our expectations output falls and stays below the baseline throughout the forecast horizon in response to credit shock. This suggests that attempts to boost trade competitiveness by depreciating the currency would not yield fruitful outcomes in Ghana.

7.4.5.3. Effects of share price

In the pre-IT era, stock price explained 25 percent and 21 percent to monetary policy and exchange rates, respectively over the 5-year horizon. Within the same horizon, it explained 10 percent of output variations. Its contribution to prices, credit, and dollarization was very minimal. Comparing the two periods, one could infer that the role of stock price movements has diminished since the adoption of the IT framework, as the contribution to variations in the other variables has been generally less.

7.4.5.4. Effects of dollarization

From the results of the variance decomposition, the contribution of dollarization has diminished in the post-IT era. This can be evidence that monetary authorities have paid attention to the effects of high rate of dollarization in the IT regime. With the exception of real output and credit, dollarization was very important in the movement of all the other variables for the pre-IT period. It contributed up to 38 percent of price and exchange rate variations in 12 months. At

the same horizon, dollarization contributed 21 percent of the variation in share price and almost 10 percent in the monetary policy variable.

Table 7.6: Before inflation targeting (2000m01 – 2007m05)

Period	*y*	*p*	*mp*	*cr*	*sp*	*xr*	*dr*
	Contribution of monetary policy						
1	0.000000	0.000000	99.15638	0.628669	2.003532	0.416411	0.000000
12	18.43942	0.363292	52.12684	1.477172	0.637974	8.980103	9.801354
24	21.85808	2.072465	48.55376	1.774135	3.674719	13.71599	15.82897
48	17.80208	5.937574	38.94996	1.260974	13.32592	11.70778	18.75174
60	14.24673	7.063053	31.29438	1.139361	17.90199	9.849871	20.21814
	Contribution of credit						
1	0.000000	0.000000	0.000000	99.36598	0.617788	6.456888	0.000000
12	25.50851	2.257135	11.94310	87.85295	7.125298	1.375379	9.801354
24	25.88733	9.582161	8.812507	80.16486	13.80832	1.144383	15.82897
48	33.55397	19.87794	8.747739	72.44663	16.29726	6.821715	18.75174
60	39.72539	24.21160	13.26007	69.33785	15.34006	12.29073	20.21814
	Contribution of exchange rates						
1	0.000000	0.000000	0.000000	0.000000	0.000000	89.25012	0.000000
12	3.785509	0.555532	0.316241	0.999083	0.018143	46.54629	0.076667
24	5.498636	1.330732	0.688948	1.850970	0.007543	37.60180	0.756270
48	5.964240	3.136017	1.288209	2.668029	0.078993	26.77560	2.328102
60	5.764080	3.798255	1.333733	3.000235	0.194106	21.92460	2.981976
	Contribution of stock prices						
1	0.000000	0.000000	0.000000	0.000000	95.98919	1.729116	0.000000
12	0.277743	0.017542	3.327866	0.003499	65.87916	2.878905	0.076667
24	2.417701	0.048228	8.435811	0.003523	40.21675	8.596855	0.756270
48	8.339407	0.369262	21.45195	0.026650	19.47636	19.38077	2.328102
60	10.30648	1.079641	24.67391	0.026458	15.10156	20.58072	2.981976
	Contribution of foreign currency deposits						
1	0.000000	0.000000	0.000000	0.000000	0.000000	1.493997	97.99125
12	0.320132	37.94697	9.524337	2.574062	21.45718	38.28776	82.93257
24	1.004837	38.32377	8.336175	1.774312	36.82756	34.48246	68.20475
48	0.938949	28.60837	8.098670	1.922544	40.93183	30.89066	51.54708
60	1.040579	24.06764	12.16436	2.704454	39.03819	31.56729	44.99551

Table 7.7: After inflation targeting (2007m06 – 2015m03)

Period	*y*	*p*	*mp*	*cr*	*sp*	*xr*	*dr*
	Contribution of monetary policy						
1	0.000000	0.000000	98.45576	2.310316	1.226271	0.872978	0.599663
12	9.358820	0.969633	53.12220	3.012771	13.33005	0.197072	1.507188
24	9.393373	1.237377	31.95296	10.36477	12.20342	0.401203	5.685857
48	3.667197	7.226854	29.80216	16.07148	6.711682	2.069915	11.76475
60	2.361287	6.535456	28.63974	13.79473	4.579500	2.743141	13.78207
	Contribution of credit						
1	0.000000	0.000000	0.000000	97.65345	6.292307	9.921064	0.000000
24	4.606034	41.99387	29.99140	83.27057	11.77903	43.12008	33.49201
36	7.910487	42.48650	31.16780	69.72347	11.33701	46.47150	45.83127
48	11.61113	30.34130	30.60015	53.84354	18.51294	47.64533	51.20304
60	14.85342	20.41483	30.57351	40.33709	26.54827	48.09454	52.62719
	Contribution of exchange rates						
1	0.000000	0.000000	0.000000	0.000000	0.000000	65.90440	0.000000
6	10.67772	0.024356	0.019827	0.062764	1.429500	58.70415	0.974574
36	32.20430	10.86525	0.506563	3.775672	24.16772	29.83351	4.704926
48	33.50129	19.99924	1.205871	8.508694	29.44292	28.17906	3.951381
60	34.79156	26.93099	2.026209	14.37337	29.56117	27.78108	3.404769
	Contribution of stock prices						
1	0.000000	0.000000	0.000000	0.000000	90.74273	0.006117	0.000000
24	6.347195	1.448418	8.502767	1.342273	37.45272	7.415376	5.386774
36	8.051556	1.129049	8.026808	1.492428	30.19841	7.573321	3.999001
48	8.489437	2.408813	8.085362	2.648084	23.41212	7.329726	3.260014
60	8.515442	4.654407	8.317369	4.037010	18.34967	7.068847	2.783933
	Contribution of foreign currency deposits						
1	0.000000	0.000000	0.000000	0.000000	0.000000	15.17675	95.56028
24	5.739056	2.046226	0.202389	0.460517	11.17662	6.944392	34.93058
36	6.227207	3.902680	0.340845	1.266461	12.18472	5.517849	24.31656
48	6.462944	5.723406	0.490230	2.331038	10.82698	5.007007	19.11349
60	6.674461	6.691742	0.616013	3.499332	8.867078	4.831861	16.31827

The post-IT regime gives a completely different picture. The highest contribution of dollarization is 15 percent to changes in exchange rate. At the 12 months horizon, dollarization

contributes 10 percent of the variations in both share price and exchange rates. The contribution to the remaining variables is minimal. The Bank of Ghana has been on course in the fight against dollarization during the IT period which has resulted in the benign contribution of dollarization. This finding suggests that the incessant depreciation of the cedi and rising levels of inflation could not be accredited to the increasing demand for and use of foreign currencies in the economy as also confirmed by the impulse response function for the pre and post-IT periods.

7.5 Conclusion and policy recommendations

In this chapter, we have examined the effectiveness of monetary policy in Ghana for the period January 2000 to March 2015. The effect of dollarization on monetary policy has also been considered and account is also made for the impact of the inflation targeting regime on monetary policy. The paper employed structural vector autoregressive models to investigate the effectiveness of the monetary policy transmission process in Ghana. The study makes a contribution to the debate on how the widespread use of foreign currencies in the economy affects the transmission of monetary policy actions and how they feed into economic activity. The variables used in the study are exchange rate, consumer price index, proxy for real output, monetary policy rate, credit to the private sector, stock price index, foreign currency deposit, and money supply.

The structural impulse response functions and forecast error variance decomposition, establish that the credit and exchange rate channels dominate in the transmission mechanism, with the former assuming a more significant role in the post-inflation targeting period. The high demand for foreign currency is also confirmed to be in response to instability in the macroeconomic fundamentals rather than being the cause of the instability. It is therefore incumbent on monetary authorities to boost the effectiveness of policy choices in order to guarantee stability of

prices and exchange rates as indispensible strategies in curtailing further weaknesses in the macroeconomic environment.

Based on the relative significance of the monetary policy variable to output and price variations, monetary policy happens to be more effective under the credit channel. Under the credit channel, monetary policy explained 17.67% of output variations and 13.64% of price dynamics over the 60-month horizon. At the same time, among the channels, credit contributed the highest to output and prices accounting for 20.32% and 32.90% of variations respectively over the forecast horizon. The effectiveness of the credit channel presents some interesting implications. It signifies the ability of the Central Bank to rely on commercial banks and other financial institutions to achieve monetary policy goals. The Bank of Ghana can use reserve requirements, moral suasion, and other strategies to control bank credit to households, private sector, as well as the government. However, the question of how responsive the financial sector is to variations in monetary policy actions remains an empirical question. The risk associated with granting credit facilities to the private sector in the Ghanaian economy has continued to be a restraining factor when you consider lending rates in Ghana. In this vein, it is recommended that the central Bank works out strategies that can make credit more attractive for the private sector.

Considering the percentage relevance of the monetary policy variable, we argue that monetary policy has contributed significantly to movements in dollarization in both periods. At the 5-year horizon, monetary policy contributed approximately 20 percent and 14 percent respectively to dollarization in the pre and post-IT periods. Also, the contribution of dollarization has diminished in the post-IT era. This can be evidence that monetary authorities have paid more attention to the effects of high rate of dollarization in the IT regime albeit with limited success.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS, AND POLICY RECOMMENDATIONS

8.1. Introduction

This last chapter of the thesis covers the summary, conclusions, and policy recommendations. The chapter begins by providing the summary of key findings, followed by the contributions made by the study, and the policy implications that can be drawn from the findings of the study. Finally, we suggest some possible directions for future research on the subject matter.

8.2. Summary and conclusions

This study sought to provide evidence on the determinants of dollarization and the consequences associated with the increasing trend on macroeconomic instability in Ghana. The issue has become widespread in emerging economies in the past few decades due to the extensive switch to floating exchange rates and the subsequent removal of capital controls as part of economic liberalization. The quest to explore this has become pertinent because, unlike in Latin America and Asia, the phenomenon has received poor attention in Africa and other emerging markets. It has been argued that this lack of attention for the African continent is partly due to unavailability of time series data.

A thorough review of the extant literature exposed a number of questions that required the attention of further research and empirical advances. Given the wide range of issues on the roots, the risks and the costs associated with dollarization, this thesis proposed to focus on the extent of dollarization in Ghana and its consequences on macroeconomic stability. Specifically, the thesis sought to find answers to the following empirical questions:

1. What are the key macroeconomic determinants of deposit dollarization in Ghana?
2. Is there evidence of currency substitution in Ghana?
3. What is the effect of financial dollarization on exchange rate volatility?

4. Does financial dollarization affect inflation in Ghana?
5. How can monetary policy function as an effective tool for macroeconomic stability in a dollarized economy?

8.2.1. Determinants of deposit dollarization

This empirical analysis based on the ARDL bounds testing and cointegration technique to investigate the macroeconomic determinants of deposit dollarization. The study confirmed the important role played by exchange rates and financial sector development in explaining demand for foreign currency in both the long-run and short-run. The evidence suggested that dollarization is generally driven by the loss of confidence in the cedi due to the deteriorating macroeconomic fundamentals and a desire by economic agents to hedge against inflation and exchange rate risks. We found that as high depreciation leads to high demand for foreign currency, highly developed financial markets would cause financial dollarization to decline. Thus, attempts aimed at ensuring low rates of inflation and stable exchange rates will help in reducing the demand for foreign currency.

8.2.2. Is there evidence of currency substitution in Ghana?

The essay explored the stability of money demand function in Ghana using data for the period 1960 – 2013 by following the portfolio balance approach that accounts for the presence of currency substitution and capital mobility. The evidence indicated the significance of foreign variables (foreign interest rates and exchange rates) in a long-run relationship between real money balances and real income, domestic interest rates, foreign interest rates and exchange rates. The results highlighted that, the income elasticity is close to one for narrow money, but less than unity for broad money. Also, the significance of foreign interest rate and/or the expected depreciation of the domestic currency in the long-run money demand equation signalled the existence of capital mobility.

8.2.3. Dollarization and exchange rate behaviour

This study sought to ascertain the effects of dollarization on the volatility of nominal and real Ghana cedi/U.S. dollar exchange rate for the period January 1990 to March 2015, using the exponential Generalized Autoregressive Conditional Heteroskedasticity (E-GARCH) and Diagonal VEC Multivariate GARCH models. First, we find that the returns of both the nominal and real series are integrated of order 0, suggesting spotlighting that the returns series follow a mean-reverting process. Again, the estimate for the conditional variance is positive and significant at least at the 5% level for the bilateral nominal exchange rates. This suggests that an increase in the conditional variance will increase the returns (depreciation) series itself. Further, there is evidence of a positive effect of dollarization on the volatility of nominal exchange rates.

8.2.4. Dollarization and dynamics of inflation

This essay carried out an empirical investigation of the effects of dollarization on inflation and inflation uncertainties in Ghana. The analysis covered monthly data from January 1990 to December 2013, and distinguished between the period before May 2007 and the period during which the Bank of Ghana became committed to an explicit inflation targeting monetary policy regime. There is evidence of persistence which suggests that, past inflation gives expectations of inflation and leads to high volatility of inflation. Also, we report that dollarization has not played a significant role in the dynamics of inflation volatility in Ghana for both the pre-IT and post-IT periods. Further, whereas inflation Granger causes dollarization after the inflation targeting regime, dollarization did not have any significant effect on inflation in both the pre and post inflation targeting periods. The findings suggested that there is a bidirectional linkage among inflation uncertainty and inflation following the adoption of the fully-fledged inflation targeting regime.

8.2.5. Dollarization and effectiveness of monetary policy

This paper employed structural vector autoregressive models to investigate the effectiveness of the monetary policy transmission process in Ghana for the period January 2000 to March 2015. The study made a contribution to the debate on how the widespread use of foreign currencies in the economy affects transmission of monetary policy actions and how they feed into economic activity. Using structural impulse response functions and forecast error variance decomposition, we established that the credit and exchange rate channels dominate in the transmission mechanism, with the former assuming a more significant role in the post-inflation targeting period. The high demand for foreign currency was also confirmed to be in response to instability in the macroeconomic fundamentals rather than being the cause of the instability. It therefore becomes incumbent on monetary authorities to boost the effectiveness of policy choices in order to guarantee stability of prices and exchange rates as indispensible strategies in curtailing further weaknesses in the macroeconomic atmosphere.

8.3. Conclusions and policy recommendations

The finding that financial development diminishes dollarization underscores the motivation to ensure well-developed financial markets in Ghana. Based on the finding that economic agents seek foreign currency deposits as a hedge, an effort directed towards developing a vibrant financial market with increased range of investment outlets becomes indispensable. Additional financial and banking sector reforms aimed at deepening and broadening the domestic financial markets would be a worthwhile endeavour to pursue. Advancing such strategies could provide alternative investment opportunities to foreign currency deposits in order to avert the challenges posed by under-developed capital markets and lack of competing investment instruments.

The excessive use of foreign currency as a medium of exchange in the domestic economy poses a lot of challenges to monetary policy management, firms, and individual households. The Bank

of Ghana has been commended by reversing the foreign exchange rules initiated in February 2014. Having done that, he Bank is implored to consider other appropriate policies that can curtail the trend of dollarization before the cedi is substituted for transactions. Ghana formally adopted the inflation targeting monetary policy framework in May 2007 which was expected to boost the credibility of the monetary authorities in ensuring macroeconomic stability. Achieving stable exchange rates and prices as well as developing the financial markets can enhance the chances of succeeding in that quest. Alternatively, the Government can resort to taxation on foreign currency transactions so as to enhance the effectiveness of the Ghana cedi as the legal tender for transactions, especially when the international transactions are of a speculative nature. The high proportions of foreign currencies in total deposits indicate that there is high exposure of banks to balance sheet risks. The banks, in their attempt to mitigate that risk, may have to import and maintain huge deposits of foreign currencies to meet the demands of their liabilities.

Therefore, hedging strategies aimed at mitigating the potential risk exposures inherent in the banks' balance sheets can be applied in the case of liability dollarization. For example, the banks should be encouraged to extend foreign currency denominated loans mostly to the tradables sector or hedge loans advanced to the non-tradables against exchange rate fluctuations with other derivatives such as forwards. Stringent collateral requirements must be put in place on foreign currency loans for other non-exporting borrowers. The Government can also apply prudential policies intended to lower banks' incentives to borrow and lend in foreign currency. For example, interest rates on foreign currency loans should be pegged higher than domestic currency denominated loans.

The findings support that a de-dollarization strategy is appropriate in the fight against the volatile trend of the currency. However, it is recommended that monetary authorities should employ market-based policies rather than the counter-productive forced de-dollarization strategies

resorted to in February 2014 which yielded limited results. Ensuring stability in macroeconomic fundamentals such as inflation and budgetary imbalances is pertinent to boost the credibility of government policies and invigorate confidence in the domestic currency to serve the functions of money.

The ability to control inflation requires the harmonization of fiscal and monetary policies in Ghana. This is because previous analysis of the intractable behaviour of inflation link periods of high inflation volatility to government policy changes, supply-side shocks, and lack of coordination between monetary and fiscal policies. While much is expected from the monetary policy authorities, there is need for fiscal policy response as well since both demand and supply shocks appear to contribute to rising levels of inflation in the economy. There is a need for proper coordination of the two major policies to effectively check the divergence and inconsistencies in policies so as to reduce inflation to desirable and productive levels. Adjustments in the prices of petroleum and utility prices which are usually due to volatility in the spot price of crude oil on the international market, erratic nature of natural gas supplies, increasing thermal component in the generation mix, fiscal imbalances, the deepening energy crisis, and exchange rate depreciation are likely to constantly push prices up. It is therefore a necessity on the part of the Bank of Ghana to incorporate all these mechanisms into the price formation process and develop appropriate forecasting tools to safeguard stability of inflation.

The unbridled degree of openness and dependence on imported products continues to be a matter of concern and demands the attention of policymakers in Ghana. The authorities should aim at reducing imports to correct trade and balance of payments imbalances. This could be achieved by targeting policies that increase the confidence in locally produced products. One reason for the high dependence on import has been Ghana's inability to satisfy the needs of consumers in terms of what is produced. Prices of goods produced in Ghana are usually higher

than those imported from abroad. There is the need for a concerted effort to promote the private sector to compete effectively. Also, attempts aimed at improving the per capita income of Ghanaians would in the end support poverty reduction strategies. Achieving high income would end up reducing the dependence on cheap imports and reduce import demand. Coupling this with controlled dependence on export of primary commodities like cocoa, timber, gold, and oil would strengthen the fiscal position of government and curtail further deterioration of the economy.

The effectiveness of the credit channel through the credit to the private sector indicates that the Bank of Ghana can somehow control inflation by controlling the credit issued by commercial banks and other financial institutions. Although the study did not capture the role of credit to the government, the findings suggest that availability of credit to the private sector is relevant in the quest to facilitate the effectiveness of monetary policy. There is a need for the government to cut its expenditure and minimize the public sector. Achieving this would relieve the Bank of Ghana off the usual budget financing trap. A more independent Central Bank would be more focused on strengthening the channels through which monetary policy actions transmit to the real economy rather than seemingly working to achieve the goals of the government.

More importantly, the laws that prohibit economic agents from pricing goods and services in foreign currencies and using foreign currencies as means of payment should be accurately enforced. On one hand, Ghanaians should show some commitment in achieving stability in the economy by using its own currency, whilst the government on the other hand deals with those who contravene the laws adequately. Other than the structure of the interest rates, the use of foreign currency for payment of goods and services in Ghana may not be an option at all. The commitment of the government in controlling the black market and consistent application of the

law would be crucial in ensuring that the domestic currency remains the legal tender and the only medium of transactions in the economy.

There is also an impetus for a relentless effort to meet the convergence criteria for the introduction of the common currency "*eco*", which is envisaged to be more credible and stronger than the individual currencies in the West African sub-region. Achieving this would not only automatically replace the individual currencies with a hard currency, but also strengthen the economies in responding to external shocks. In one breadth, the macroeconomic fundamentals attained to necessitate the introduction of the single currency would improve the confidence in the government and the Ghanaian economy. In another breadth the coordination and harmonization of policies that come with the common currency would also introduce some soundness in the economy. All these are expected to improve the overall outlook and performance of the economy.

8.4. Areas for further research

The rising demand and switch to use of foreign currencies in emerging economies has remained topical and interesting to both academia and practitioners alike. Although attempts have been made to uncover most important topics regarding dollarization and macroeconomic instability in Ghana, there abound opportunities for future contribution to the subject matter for Ghana, Africa, and other emerging markets as it was impossible to cover everything in this thesis. The nature of the subject matter and its relevance for both fiscal and monetary policymaking necessitates more empirical inquests as more and rich data become accessible.

The current research was limited by the unavailability of data to permit us to quantify the authentic level of dollarization in the Ghanaian economy. The dollarization index employed in this study – although has been used widely in the extant literature, does not cover all forms of

dollarization. It only captures financial dollarization since data for other forms was difficult to obtain. A more advanced measure of dollarization that incorporates all forms of dollarization would be required to ensure a more befitting judgment of its consequences for macroeconomic policymaking in Ghana. The ability of monetary authorities to adequately confront the matter hinges on a proper understanding of the various forms of dollarization in the economy as different strategies are required.

One crucial dimension that necessitates further research attention borders on the determinants of liability dollarization and how deposit dollarization induces that phenomenon. It would be very interesting to source primary data from traders and other economic agents such as government, households, and firms to ascertain the true causes of liability dollarization. Understanding this process would serve as signpost to the strategies necessary to curb the problems associated with the "original sin" syndrome. The question of optimal dollarization also necessitates further research attention. The ability to determine this optimal level would equip the monetary authority to control dollarization to support trading activities and proper functioning of the financial intermediation process.

Another important issue that warrants further empirical research is the effects of dollarization on fiscal imbalances. It has been argued that two sources of revenue to developing countries are seigniorage and inflation tax. Developing and estimating a model that captures how the rising demand for foreign currency affects government's fiscal position is interesting to serve as a guide for policymaking. The evidence points out that, the degree of openness (trade as a share of GDP) is quite high in Ghana and that economic agents respond to differentials in rates of return. A high degree of capital mobility suggests that monetary and financial developments in the international markets exert strong influence on the domestic economy. This has important implications for fiscal and monetary policies as well as magnifying the adverse consequences of

exchange rate fluctuations. The trend affects the extent to which fiscal policy crowds out private investment, how currency depreciation affects real output, and the ability of monetary policy to affect aggregate demand; which poses critical challenge for their combined impacts on macroeconomic stability in Ghana. It would thus be interesting to investigate the role of openness in the degree of dollarization in Ghana.

Another subject that implores attention is how to model the role of inflation targeting more explicitly. This study used a dummy variable as a proxy to capture the effect of inflation targeting on inflation volatility. Instead of using a dummy variable, attempts should be made to incorporate a concept of expectations. Also, future researchers can investigate the effects of the capital controls implemented by the Bank of Ghana in February 2014. Although the directives were reversed after six months of implementation, empirical evidence would provide policymakers and the general public with a lot of insights into the role of the Bank of Ghana.

This research also spotlights a need for similar studies to be carried out in other sub-Saharan African countries to confirm or refute the models emanating from this thesis. In spite of the methodological limitations associated with empirical research, the thesis provides results that are interesting for macroeconomic management from the perspective of emerging economies.

REFERENCES

Abradu-Otoo, P., Amoah, B., & Bawumia, M. (2003). *An Investigation of the Transmission Mechanisms of Monetary Policy in Ghana: A Structural Vector Error Correction Analysis*. Bank of Ghana Working Paper, WP/BOG-2003/02, Accra: Bank of Ghana.

Acosta-Ormaechea, S., & Coble, D. (2011). *Monetary transmission in dollarized and non-dollarized economies: The cases of Chile, New Zealand, Peru and Uruguay,* IMF Working Paper: WP/11/87, Washington, D.C.: International Monetary Fund. Retrieved from <http://www.imf.org/external/pubs/ft/wp/2011/wp1187.pdf>

Adam, A. (2013). Dollarization in a small open economy – The case of Maldives. *World Review of Business Research*, 3(3), 1–15.

Adam, C. (1992). On the dynamic specification of money demand in Kenya. *Journal of African Economies,* 1(2), 233-270.

Adam, C. (1999). Financial liberalisation and currency demand in Zambia. *Journal of African Economies,* 8(3), 268-306.

Adenutsi, D. E., & Yartey, C. A. (2007). Financial sector development and the macrodynamics of 'de facto' dollarization in developing countries: The case of Ghana. *West African Journal of Monetary and Economic Integration*, 7(2), 49-90.

Adu, G., & Marbuah, G. (2011). Determinants of inflation in Ghana: an empirical investigation. *South African Journal of Economics,* 79, 251-269.

Adu, G., Karimu, A., & Mensah, J. T. (2015). *An Empirical Analysis of Exchange Rate Dynamics and Pass-Through Effects on Domestic Prices in Ghana*. IGC Working Paper, London: International Growth Centre.

Agenor, P.-R. (2004). Orderly Exits from Adjustable Pegs and Exchange Rate Bands: Policy Issues and Role of Capital Flows. *Journal of Economic Policy Reform*, 7(2), 83-108.

Agenor, P.-R., & Khan, M. S. (1992). Foreign Currency Deposits and the Demand for Money in Developing Countries. Working Paper 92/1, Washington, D.C.: International Monetary Fund.

Agenor, P.-R., & Khan, M. S. (1996). Foreign currency deposits and the demand for money in developing countries. *Journal of Development Economics,* 50(1), 101-118.

Ahmad, N. (1970). *Deficit Financing, Inflation, and Capital Formation: The Ghanaian Experience, 1960-65*. MunicWelferunVerlag.

Akçay, O. C., Alper, C. E., & Karasulu, M. (1997). Currency substitution and exchange rate instability: The Turkish case. *European Economic Review,* 41(3-5), 827-835.

Akinlo, A. E. (2006). The stability of money demand in Nigeria: an autoregressive distributed lag approach. *Journal of Policy Modelling,* 28(4), 445-452.

Akofio-Sowah, N. A. (2009). Is there a link between exchange rate pass-through and the monetary regime: Evidence from Sub-Saharan Africa and Latin America. *International Advances in Economic Research,* 15(3), 296-309.

Alagidede, P., Coleman, S., & Adu, G. (2014). *A Regional Analysis of Inflation Dynamics in Ghana: Persistence, Causes, and Policy Implications*. IGC Working Paper, London: International Growth Centre.

Alami, T. H. (2001). Currency substitution versus dollarization: A portfolio balance model. *Journal of Policy Modelling,* 23(4), 473-479.

Alesina, A., & Barro, R. (2001). Dollarization. *American Economic Review*, 91, 381-85.

Alexander, C. (2009). *Practical Financial Econometrics*, New York: John Wiley & Sons.

Alexander, C., & Lazar, E. (2006). Normal Mixture GARCH (1, 1) Applications to Exchange Rate Modelling. *Journal of Applied Econometrics*, 21, 307-336.

Alvarez-Plata P., & Garcia-Herrero, A. (2008). *To dollarize or de-dollarize: Consequences for monetary policy*. DIW Discussion Paper No. 842, Berlin, German: Deutsches Institut für Wirtschaftsforschung of DIW, Institute for Economic Research.

Amoah, B., & Mumuni, Z. (2008). Choice of monetary policy regime in Ghana. *Bank of Ghana Working Paper Series*, WP/BOG-2008/07.

Andoh, S. K., & Chappell, D. (2002). Stability of the money demand function: evidence from Ghana. *Applied Economics Letters,* 9(13), 875-878.

Anoruo, E. (2002). Stability of the Nigerian M2 money demand function in the SAP period. *Economics Bulletin,* 14(3), 1-9.

Arango, S., & Nadiri, M. I. (1981). Demand for money in open economies. *Journal of Monetary Economics,* 7(1), 69-83.

Arestis, P. & Sawyer, M. (2008). New Consensus Macroeconomics and Inflation Targeting: Keynesian Critique, *Economia and Sociedade*, Vol. 17, (Special Issue), 631-656.

Arize, A. C., Darrat, A. F., & Meyer, D. J. (1990). Capital Mobility, Monetization, and Money Demand in Developing Economies. *The American Economist*, 34(1), 69-75.

Arteta, C. (2002). *Exchange rate regimes and financial dollarization: Does flexibility reduce bank currency mismatches?* Working Paper: No. Co2- 123, Berkeley, California: University of California, Department of Economics, Centre for International and Development Economics Research.

Atta-Mensah, J., & Bawumia, M. (2003). *A Simple Vector-Error-Correction Forecasting Model for Ghana*. Working Paper, WP/BOG-2003/01, Accra: Bank of Ghana.

Baharumshah, A. Z., Chan, T.-H., & Fountas, S. (2008). Re-examining purchasing power parity for East-Asian currencies: 1976–2002. *Applied Financial Economics,* 18(1), 75-85.

Baharumshah, A. Z., Mohd, S. H., & Masih, A. M. (2009). The Stability of Money Demand in China: Evidence from the ARDL Model. *Economic Systems,* 33(3), 231-244.

Bahmani-Oskooee, M. (2001). How stable is M2 money demand function in Japan? *Japan and the World Economy,* 13(4), 455-461.

Bahmani-Oskooee, M., & Chomsisengphet, S. (2002). Stability of M2 money demand function in industrial countries. *Applied Economics,* 34(16), 2075-2083.

Bahmani-Oskooee, M., & Domac, I. (2003). On the link between dollarization and inflation: Evidence from Turkey. *Comparative Economic Studies,* 45(3), 306-328.

Bahmani-Oskooee, M., & Gelan, A. (2009). How stable is the demand for money in African countries? *Journal of Economic Studies,* 36(3), 216-235.

Bahmani-Oskooee, M., & Ng, R. C. W. (2002). Long-run demand for money in Hong Kong: an application of the ARDL model. *International journal of business and economics,* 1(2), 147-155.

Bahmani-Oskooee, M., & Rhee, H.-J. (1994). Long-run elasticities of the demand for money in Korea: evidence from cointegration analysis. *International Economic Journal,* 8(2), 83-93.

Bahmani-Oskooee, M., & Techaratanachai, A. (2001). Currency substitution in Thailand. *Journal of Policy Modelling,* 23(2), 141-145.

Bailey, S. A. (2007). Investigating the link between financial dollarization and inflation: evidence from Jamaica. *Business, Finance & Economics In Emerging Economies,* 2(1), 67-95.

Balicilar, M., Ozdemir, Z. A., & Cakan, E. (2011). On the nonlinear causality between inflation and inflation uncertainty in the G3 countries. *Journal of Applied Economics*, XIV(2), 269-296.

Balino, T., Bennett, A., & Borensztein, E. (1999). *Monetary policy in dollarized economie*s (IMF Occasional Paper: No. 171). Washington, D.C.: International Monetary Fund.

Ball, L. & Sheridan, N. (2004). Does Inflation Targeting matter? National Bureau of Economic Research Working Paper W9577. Cambridge, Massachusetts: National Bureau of Economic Research.

Ball, L. (1992). Why High Inflation Raise Inflation Uncertainty. *Journal of Monetary Economics*, 29, 371-388.

Banerjee, A., Dolado, J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of time series Analysis,* 19(3), 267-283.

Bank of Ghana (2014a). Inflation Outlook and Analysis. Bank of Ghana Monetary Policy Report, 4, No. 2/2014.

Bank of Ghana (2014b). *Monetary Time Series Data*, Accra: Bank of Ghana.

Barimah, A. (2014). Exponential GARCH Modelling of the Inflation-Inflation Uncertainty Relationship for Ghana. *Modern Economy*, 5, 506-519.

Barimah, A., & Amuakwa-Mensah, F. (2012). Does inflation uncertainty decrease with inflation? A GARCH model of inflation and inflation uncertainty for Ghana. *West African Journal of Monetary & Economic Integration*, 12, 32-61.

Barrell, R., Davis, E. P., & Pomerantz, O. (2009). The impact of EMU on real exchange rate volatility of EU countries. *National Institute Economic Review 208*, 101-108.

Bartram, S. M., & Karolyi, G. A. (2006). The impact of the introduction of the Euro on foreign exchange rate risk exposures. *Journal of Empirical Finance, 13(4-5),* 519–549.

Basso, H. S., Calvo –Gonzalez, O., & Jurgilas, M. (2007). *Financial dollarization: The role of banks and interest rates.* ECB Working Paper Series No 748. European Central Bank.

Basso, H. S., Calvo-Gonzales, O., & Jurgilas, M. (2011). Financial Dollarization: The Role of Foreign-Owned Banks and Interest Rates. *Journal of Banking & Finance*, 35(4): 794-806.

Batini, N. & Yates, A. (2003). Hybrid Inflation and Price-Level Targeting. *Journal of Money, Credit and Banking*, 35 (June), 283 – 300.

Batini, N. (2004). Achieving and Maintaining Price Stability in Nigeria. IMF Working Paper 04/97. Washington, D.C.: International Monetary Fund.

Batini, N., Levine, P., & Pearlman, J. (2008). *Optimal Exchange Rate Stabilization in a Dollarized Economy with Inflation Targets*. Working Paper 2008-004, Peru: Central Reserve Bank.

Bawumia, M. (2014). *Restoring the value of the Cedi*. Speech delivered at Central University College, Accra on 25 March 2014.

Bawumia, M., & Abradu-Otoo, P. (2003). *Monetary Growth, Exchange Rates and Inflation in Ghana: An Error Correction Analysis*. Working Paper WP/BOG-2003/05, Accra: Bank of Ghana.

Becklelmans, L. (2005). Credit and Monetary Policy: An Australian SVAR. Reserve Bank of Australia Research Discussion Paper 2005-06.

Bednarik, R. (2007). *Loan dollarization in V4 Countries*. Published in International Conference on Increasing Competitiveness or Regional, National and International Markets, Munich.

Berg, A., & Borensztein, E. (2000a). The choice of exchange rate regime and monetary target in highly dollarized economies. *Journal of Applied Economics,* 3(2), 285-324.

Berg, A., & Borensztein, E. R. (2000b). *The Pros and Cons of Full Dollarization*. IMF Working Paper WP/00/50, Washington D.C.: International Monetary Fund.

Berg, A., Borensztein, E., & Mauro, P. (2003). Monetary regime options for Latin America. *Finance and Development,* 24-26.

Bernanke B. S., & Blinder, A. (1988). Credit, money, and aggregate demand. *American Economic Review, 78*(2), 435-439.

Bernanke, B. & Mishkin, F. (1997). Inflation Targeting: A New Framework for Monetary Policy? *Journal of Economic Perspectives*, 11(2), 97 – 116.

Bernanke, B. S. (1986). Alternative Explanations of the Money-Income Correlation. NBER Working Paper Number 1842, Cambridge, Massachusetts: National Bureau of Economic Research.

Bernanke, B. S., & Blinder, A. S. (1992). The Federal Funds Rate and the channels of monetary transmission. *The American Economic Review*, 82(4), 901-921.

Bernanke, B. S., & Gertler, M. (1995). Inside the Black Box: The Credit Channel of Monetary Policy Transmission. *Journal of Economic Perspectives*, 9(4), 27–48.

Bernanke, B. S., & Mihov, I. (1995). Measuring monetary policy. NBER Working Paper, Cambridge, Massachusetts: National Bureau of Economic Research.

Bernanke, B. S., & Mihov, I. (1998). Measuring Monetary Policy. *The Quarterly Journal of Economics*, 113(3), 869–902.

Bernanke, B. S., & Woodford, M. (1997). Inflation Forecasts and Monetary Policy. NBER Working Paper No. W6157, Cambridge, Massachusetts: National Bureau of Economic Research.

Bernanke, B. S., Boivin, J., & Eliasz, P. (2005). Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach. *The Quarterly Journal of Economics*, 120(1), 387-422.

Bernanke, B. S., Laubach, T. Mishkin, F. S., & Posen, A. S. (1999). *Inflation Targeting: Lessons from the International Experience*. New Jersey: Princeton University Press.

Billmeier, A., & Bonato, L. (2002). *Exchange rate pass-through and monetary policy in Croatia.* IMF Working Paper WP/02/109, Washington, D.C.: International Monetary Fund.

Billmeier, A., & Bonato, L. (2004). Exchange rate pass-through and monetary policy in Croatia. *Journal of Comparative Economics, 32*(3), 426-444.

Black, F. (1976). Studies of Stock Price Volatility Changes. Proceedings from the American Statistical Association, Business and Economic Statistics Section, 177-181.

Blanchard, O. J. (1989). A Traditional Interpretation of Macroeconomic Fluctuations, *American Economic Review*, 79, 1146-1164.

Bleakley, H., & Cowan, K. (2002). Corporate dollar debt and depreciations: Much ado about nothing? Working Paper No. 532, Inter-American Development Bank.

Bofinger, P. (1991), The transition to convertibility in Eastern Europe: A monetary view, In J. Willianson (Ed.), *Currency convertibility in Eastern Europe*. Washington, D.C.: Institute for International Economics.

Bogetic, Z. (2000). Official dollarization: Current experiences and issues. *Cato Journal. 20*(2), 179-213.

Boivin, J., Kiley, M. T., & Mishkin, F. S. (2010). How Has the Monetary Transmission Mechanism Evolved Over Time? *In Handbook of Monetary Economics*, 1st ed., Vol. 3, ed. B. M. Friedman & M. Woodford, pp. 369–422. North Holland: Elsevier.

Bollerslev, T. (1986). Generalised Autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31, 307-327. North-Holland: Elsevier.

Bollerslev, T. (1990). Modeling the coherence in short–run nominal exchange rate: A multivariate generalized ARCH model. *Review of Economics and Statistics*, 72, 498–505.

Bollerslev, T., Engle, R. F. & Wooldridge, J. M. (1988). A capital asset pricing model with time–varying covariances. *Journal of Political Economy*, 96, 116–131.

Bordo, M. D., & Choudhri, E. U. (1982). Currency substitution and the demand for money: some evidence for Canada. *Journal of Money, Credit and Banking*, 14(1), 48-57.

Branson, W.H., & Henderson, D. (1984). The specification and influence of asset markets. NBER Working Papers, Cambridge, Massachusetts: National Bureau of Economic Research.

Breitung, J., Bruggemann, R., & Lutkepohl, H. (2004). Structural vector autoregressive modeling and impulse responses, in H. Lutkepohl and M. Kratzig (eds), *Applied Time Series Econometrics*, Cambridge University Press, Cambridge, pp. 159–196.

Broda, C., & Levy-Yeyati, E. (2006). Endogenous deposit dollarization. *Journal of Money, Credit, and Banking*, 38(4), 963–88.

Brook, A, Karagedikli, O. & Scrimgeour, D. (2002). An Optimal Inflation Target for New Zealand: Lessons from the Literature. *Reserve Bank of New Zealand Bulletin*, 65(3), 5 – 16.

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society. Series B (Methodological)* 149-192.

Buch, C. M. (2001). Money demand in Hungary and Poland. *Applied Economics,* 33(8), 989-999.

Buigut, S. (2009). Monetary policy transmission mechanism: Implications for the proposed East African Community (EAC) Monetary Union. Paper presented at the CSAE Conference 2009 Retrieved from http://www.csae.ox.ac.uk/conferences/2009-EDiA/papers/300-Buigut.pdf.

Burdekin, R.C.K. & Siklos, P.L. (2004). Deflation: Current and Historical Perspectives. Cambridge: Cambridge University Press.

Calvo, G. (1999). Capital Markets and the Exchange Rate, mimeo, University of Maryland.

Calvo, G. A. (2002). On dollarization. *Economics of Transition, 10*(2), 393-403.

Calvo, G. A., & Carlos, V. (1996). From currency substitution to dollarization: Analytical and policy issues, In Calvo, G. A. (Ed.), *Money, exchange rates and output* (pp. 153-75). Cambridge, Massachusetts: MIT Press.

Calvo, G. A., & Vegh, C. A. (1992). Currency substitution in developing countries: an introduction. IMF Working Paper WP/92/40): International Monetary Fund.

Calvo, G. A., Izquierdo, A., & Mejia, L.-F. (2004). On the empirics of sudden stops: The relevance of balance-sheet effects. NBER Working Papers 10520, Cambridge, Massachusetts: National Bureau of Economic Research.

Campbell, J. Y., & Kyle, A. S. (1993). Smart money, noise trading and stock price behaviour, *Review of Economic Studies*, 60, 1–34.

Canto, V. A. (1985). Monetary policy, dollarization, and parallel market exchange rates: The case of the Dominican Republic. *Journal of International Money and Finance*, 4, 507-521.

Carranza, L., Galdon-Sanchez, J. E., & Gomez-Biscarri, J. (2009). Exchange rate and inflation dynamics in dollarized economies. *Journal of Development Economics, 89*(1), 98-108.

Centre for Economic Policy Analysis (2009). *The current state of the macroeconomy of Ghana 2000-2009*. Greenhill, Accra.

Chang, R. (2000). Dollarization: A scorecard. *Federal Reserve Bank of Atlanta Economic Review,* Third Quarter, 85(3), 1-11.

Cheng, K. C. (2006). *A VAR analysis of Kenya's monetary policy transmission mechanism: How does the Central Bank's REPO rate affect the economy*? IMF Working Paper WP/06/300, Washington, D.C.: International Monetary Fund.

Chhibber, A., & Shaffik, N. (1990). The Inflationary Consequence of Devaluation and Parallel Market: The Case of Ghana. In Chhibber, A. and S. Fisher (eds.) Economic Reform in Sub-Saharan Africa. Washington, D.C.: World Bank.

Chowdhury, A. (2014). Inflation and inflation-uncertainty in India: the policy implications of the relationship, *Journal of Economic Studies*, 41(1), 71–86.

Chowdhury, A. R. (1993). Does Exchange Rate Volatility Depress Trade Flows? Evidence from Error-Correction Models. *The Review of Economics and Statistics*, 75, 700-706.

Chowdhury, K. (2011). Modelling the Balassa-Samuelson Effect in Australia. *Australasian Accounting, Business and Finance Journal,* 5(1), 77-91.

Christensen, B. V. (2011). *How monetary transmission mechanisms in Africa changed?* (BIS Paper: No. 56. 37-61). Basel, Switzerland: Bank for International Settlements.

Christiano, L. J., Eichenbaum, M., & Evans, C. (1996). The effects of monetary policy shocks: Evidence from the flow of funds. *Review of Economics and Statistics, 78*(1), 16-34.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1998). Monetary Policy Shocks: What Have We Learned and to What End? NBER Working Paper No. 6400, Cambridge, Massachusetts: National Bureau of Economic Research.

Clarida, R., Gali, J., and Gertler, M. (1999). The Science of Monetary Policy: A New Keynesian Perspective. *Journal of Economic Literature*, XXXVII, 1661–1707.

Clark, P., Tamirisa, N., Wei, S.-J., Sadikov, A., & Zeng, L. (2004). Exchange rate volatility and trade flows - some new evidence. IMF Research Paper, Washington, D.C.: International Monetary Fund.

Clements, B., & Schwartz, G. (1993). Currency substitution: The recent experience of Bolivia. *World Development*, 21(11), 1883-1893.

Clements, B., Kontolemis, Z., & Levy, J. (2001). Monetary policy under EMU: Differences in the transmission mechanism? IMF Working Paper WP/01/102, Washington, D.C.: International Monetary Fund.

Coleman, S. (2012). Where Does the Axe Fall? Inflation Dynamics and Poverty Rates: Regional and Sectoral Evidence for Ghana. *World Development*, 40(12), 2454–2467.

Corrado, G. (2007). An open economy model with currency substitution and real dollarization. *Journal of Economic Studies*, 35(1), 69-93.

Cuddington, J. T. (1983). Currency substitution, capital mobility, and money demand. *Journal of International Money and Finance,* 2(2), 111-133.

Cukierman, A., & Meltzer, A. (1986). A theory of ambiguity, credibility, and inflation under discretion and asymmetric information. *Econometrica*, 54, 1099-1128.

Cushman, D. O., & Zha, T. (1997). Identifying monetary policy in a small open economy under flexible exchange rates. *Journal of Monetary Economics, 39*(3), 433-448.

Dabla-Norris, E., & Floerkemeier, H. (2006). *Transmission mechanisms of monetary policy in Armenia: Evidence from VAR analysis*. IMF Working Paper: WP/06/248, Washington, D.C.: International Monetary Fund.

Dagher, J., & Kovanen, A. (2011). On the stability of money demand in Ghana: A bounds testing approach. *IMF Working Papers* 11/273, Washington, D.C.: International Monetary Fund.

De Nicolo, G., Honohan, P., & Ize, A. (2003). Dollarization of the Banking System: Good or Bad? *Journal of Banking and Finance,* 29(7), 1697-1727.

De Nicoló, G., Honohan, P., & Ize, A. (2005). Dollarization of bank deposits: Causes and consequences. *Journal of Banking & Finance,* 29(7), 1697-1727.

Debelle, G. (1997). Inflation Targeting in Practice. IMF Working Paper 97/35, 1–34. Washington, D.C.: International Monetary Fund.

Dell'Ariccia, G. (1999). Exchange rate fluctuation and trade flows: evidence from the European Union. *IMF Staff Papers*, 46, 315-334.

Devereux, M. B., & Yetman, J. (2010). Price Adjustment and Exchange Rate Pass-through. *Journal of International Money and Finance*, 29, 181-200.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74 (366), 427–431.

Ding, Z., Granger, C. W. J., & Engle, R. F. (1993). A Long Memory Property of Stock Market Returns and a New Model. *Journal of Empirical Finance*, 1, 83–106.

Domac, I., & Peria, M. S. M. (2003). Banking crises and exchange rate regimes: is there a link? *Journal of International Economics, 61*(1), 41-72.

Domowitz, I., & Elbadawi, I. (1987). An error-correction approach to money demand: the case of Sudan. *Journal of Development Economic,* 26(2), 257-275.

Donyina-Ameyaw, S. (2004). *A small macroeconomic model of trade and inflation in Ghana.* Warwick Economic Research Papers No.696, Coventry: University of Warwick, Department of Economics.

Dordunoo, C. K. (1994a). The Structure and Policy Implications of a Macroeconomic Model of Ghana. *World Development*, 22(8), 1243-1251.

Dordunoo, C. K. (1994b). The foreign exchange market and the Dutch auction system in Ghana, Research Paper 24. Nairobi: African Economic Research Consortium.

Dornbusch, R. (1976). Expectations and Exchange Rate Dynamics. *Journal of Political Economy*, 84(6), 1161–76.

Dornbusch, R. (2001). Fewer Monies, Better Monies. *American Economic Review*, 91(2), 238-42.

Drakos, A. A. Kouretas, G. P., & Zarangas, L. P. (2010). Forecasting financial volatility of the Athens stock exchange daily returns: An application of the asymmetric normal mixture GARCH model. *International Journal of Finance and Economics*, 15, 331-350.

Dungey, M., & Pagan, A. (2000). A Structural VAR Model of the Australian Economy. *Economic Record*, 76, 321–342.

Duttagupta, R., Fernandez, G., & Karacadag, C. (2004). From Fixed to Float: Operational Aspects of Moving toward Exchange Rate Flexibility, IMF Working Paper No. 126, Washington, D.C.: International Monetary Fund.

Easterly, W. R., Mauro, P., & Schmidt-Hebbel, K. (1995). Money demand and seigniorage-maximizing inflation. *Journal of Money, Credit and Banking,* 27(2), 583-603.

Edwards, S., & Magendzo, I. (2003). *A Currency of one's own? an empirical investigation on dollarization and independent currency unions*. NBER Working Paper: 9514. Cambridge, Massachusetts: National Bureau of Economic Research.

Edwards, S., & Magendzo, I. I. (2001). *Dollarization, inflation and growth,* NBER Working Paper: No. 8671. Cambridge, Massachusetts: National Bureau of Economic Research.

Egert, B., & MacDonald, R. (2009). Monetary Transmission Mechanism in Central and Eastern Europe: Surveying the Surveyable. *Journal of Economic Surveys*, 23, 277–327.

Eichengreen, B., & Hausmann, R. (1999). *Exchange rates and financial fragility*. NBER Working Paper No. 7418. Cambridge, Massachusetts: National Bureau of Economic Research.

Elbadawi, I., & Majd, N. (1996). Adjustment and economic performance under a fixed exchange rate: A comparative analysis of the CFA zone. *World Development,* 24(5), 939-951.

El-Erian, M. (1988). Currency substitution in Egypt and the Yemen Arab Republic: A comparative quantitative analysis. *Staff Papers-International Monetary Fund*, 35(1), 85-103.

Elkhafif, M. A. T. (2003). Exchange rate policy and currency substitution: The case of Africa's emerging economies. *African Development Review*, 15(1), 1-11.

Elliot, G., Rothenberg, T. J., & Stock, J. H. (1996). Efficient tests for an autoregressive unit root, *Econometrica*, 64, 813-836.

Engle, R. F. (1982). Autoregressive conditional heteroskedasticity with estimates of the variance of U.K. inflation. *Econometrica*, 50, 987-1008.

Engle, R. F. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroscedasticity models, *Journal of Business and Economic Statistics*, 20, 339–350.

Engle, R. F., & Bollerslev, T. (1986). Modelling the Persistence of Conditional Variances. *Econometric Reviews,* 5, 1–50.

Engle, R. F., & Ng, V. K. (1993). Measuring and Testing the Impact of News on Volatility, *Journal of Finance*, 48, 1749-1778.

Engle, R. F., Lilien, D. M., & Robins, R. P. (1987). Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model. *Econometrica,* 55, 391–407.

Engle. R., & Sheppard, K. (2001). Theoretical and empirical properties of dynamic conditional correlation multivariate GARCH. NBER Working Paper 8554, Cambridge, Massachusetts: National Bureau of Economic Research.

Erasmus, L., Leichter, J. & Menkulasi, J. (2009). *Dedollarization in Liberia: Lessons from Cross-Country Experience.* IMF Working Paper No. 09/37, Washington, D.C: International Monetary Fund.

Erceg, C. & Levin, A. (2003). Imperfect credibility and inflation persistence. *Journal of Monetary Economics*, 50(4), 915-944.

Ericsson, N. (1997). Distributed lags. IMF Working Paper WP/01/102, Washington, D.C.: International Monetary Fund.

Ewusi, K. (1977). The Determinants of Price Fluctuations in Ghana, ISSER Discussion Paper, University of Ghana, Legon.

Feige, E. (2003). Dynamics of Currency Substitution, Asset Substitution and De Facto Dollarization and Euroization in Transition Countries. *Comparative Economic Studies*, 45(3), 358-383.

Ferrer, C. E. (2003). The ABC of Dollarization, published by Kurt Schuler in Currency Boards and Dollarization.

Fielding, D. (1994). Money demand in four African countries. *Journal of Economic Studies,* 21(2), 3 - 37.

Fielding, D. (1999). Interest, credit, and liquid assets in Cote d'Ivoire. *Journal of African Economies,* 8(3), 448-478.

Fielding, D., & Shields, K. (2003). *Economic integration in West Africa: Does the CFA make a difference?* Retrieved from http://www.le.ac.uk/economics/research/RePEc/lec/leecon/dp03-8.pdf.

Fountas, S. (2001). The relationship between inflation and inflation-uncertainty in the UK: 1885-1998, *Economics Letters*, 74, 77-83.

Friedman, B. M., & Kuttner, K. N. (1992). Money, income, prices, and interest rates, *The American Economic Review*, 82(3), 472-492.

Friedman, M. (1956). The Quantity Theory of Money—A Restatement, in M. Friedman, ed., *Studies in the Quantity Theory of Money*. Chicago: University of Chicago Press.

Friedman, M. (1963). Inflation: Causes and Consequences. New York: Asia Publishing House.

Friedman, M. (1977). Nobel Lecture: Inflation and Unemployment, *Journal of Political Economy*, 85, 451-472.

Frimpong, S., & Adam, A. M. (2010). Exchange rate pass-through in Ghana, *International Business Research*, 3(2), 186–192.

Fuentes, M. (2009). Dollarization of debt contracts: evidence from Chilean firms. *The Developing Economies,* 47(4), 458-487.

Galindo, A. and Leiderman, L. (2005). Living with Dollarization and the Route to Dedollarization, Inter-American Development Bank, Working Paper No 526.

Galindo, A., Izquierdo, A., & Montero, J. (2005). *Real exchange rates, dollarization, and industrial employment in Latin America.* Banco de España Working Paper No 0601.

Gallant, A. R., Rossi, P. E., & Tauchen, G. (1992). Stock Prices and Volume, *Review of Financial Studies*, 5, 199-242.

Gallant, A. R., Rossi, P. E., & Tauchen, G. (1993). Nonlinear Dynamic Structures, *Econometrica*, 61, 871-907.

Geweke, J., & Porter-Hudak, S. (1983). The estimation and application of long memory time series models. *Journal of Time Series Analysis*, 4, 221–238.

Ghalayini, L. (2011). The impact of dollarization on the efficiency of monetary in Lebanon: Interaction between dollarization and inflation. *Middle Eastern Finance and Economics,* 14, 128-139.

Ghana Statistical Service (2015). Consumer Price Index Press Releases, Accra: GSS.

Ghana Statistical Service (2015). *Inflation Rate for December 2014 is 17.0%, Newsletter Consumer Price Index (CPI) December 2014 New series*, Accra: Ghana Statistical Service <http://www.statsghana.gov.gh>

Ghartey, E. E. (1998a). Monetary dynamics in Ghana: evidence from cointegration, error correction modelling, and exogeneity. *Journal of Development Economics,* 57(2), 473-486.

Ghartey, E. E. (1998b). Money demand in Jamaica: Evidence from cointegration, error correction modelling, and exogeneity. *The North American Journal of Economics and Finance, 9*(1), 33-43.

Giovannini, A. (1988). Exchange Rates and Traded Goods Prices, *Journal of International Economics*, 24, 45-68.

Giovannini, A., & Turtelboom, B. (1994). *The Handbook of International Macroeconomics. Currency Substitution*. Malden, MA: Blackwell.

Girton, L., & Roper, D. (1981). Theory and implications of currency substitution. *Journal of Money, Credit and Banking,* 13(1), 12-30.

Glosten, L. R., Jaganathan, R., & Runkle, D. (1993). On the Relation between the Expected Value and the Volatility of the Normal Excess Return on Stocks. *Journal of Finance*, 48, 1779–1801.

Goldstein, M. & Turner, P. (2004). *Controlling Currency Mismatches in Emerging Markets*. Institute for International Economics, Washington, D.C.

Goujon, M. (2006). Fighting inflation in a dollarized economy: The case of Vietnam. *Journal of Comparative Economics,* 34(3), 564-581.

Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, 37, 424–438.

Greenspan, A. (1996). Opening Remarks, in *Achieving Price Stability*, Federal Reserve Bank of Kansas City, Kansas, 1–5.

Grier, K., & Perry, M. (2000). The effects of real and nominal uncertainty on inflation and output growth: some GARCH-M evidence *Journal of Applied Econometrics*, 15, 45–58.

Grilli, V., & Roubini, N. (1994). Liquidity and exchange rates: puzzling evidence from the G-7 countries. Mimeo Yale University.

Gruben, W. C., & McLeod, D. (2004). Currency competition and inflation convergence. Working Paper No. 0204, Federal Reserve Bank of Dallas: Centre for Latin America.

Guidotti, P. E., & Rodriguez, C. (1992). Dollarization in Latin America: Gresham's Law in Reverse? IMF Staff Papers, 39(3), 518-544.

Gyima-Brempong, K. (1992). Exchange Control and Black Market Exchange Rate in Ghana: A Simultaneous Equation Approach, *East African Economic Review,* 8**,** 41-53.

Hamilton, J. D. (1994). *Time series analysis*. New Jersey: Princeton University Press.

Hammond, G. (2012). *State of the art of inflation targeting*. Bank of England, Centre for Banking Studies. United Kingdom.

Haque, N. U., & Montiel, P. (1991). Capital mobility in developing countries: Some empirical tests. *World Development*, 19(10), 1391-1398.

Hausmann, R., & Panizza, U. (2003). On the determinants of original Sin: An empirical investigation. *Journal of International Money and Finance,* 22(7), 957-990.

Hausmann, R., Panizza, U., & Stein, E. (2001). Original Sin, Pass-through, and Fear of Floating, Mimeo, Harvard University.

Hausmann, R.; Gavin, M., Pages-Serra, C., & Stein, E. (1999). Financial Turmoil and the Choice of the Exchange Rate Regime, Working Paper No. 400, Washington, D.C.: Inter-American Development Bank. Retrieved from <http://www18.iadb.org/WMSFiles/products/research/files/pubS-133.pdf>

Hendry, D. F. (2001). Modelling UK inflation, 1875–1991. *Journal of Applied Econometrics*, 16, 255–275.

Hendry, D. F., & Ericsson, N. R. (1991). An econometric analysis of UK money demand in monetary trends in the United States and the United Kingdom by Milton Friedman and Anna J. Schwartz. *The American Economic Review,* 81(1), 8-38.

Henstridge, N. M. (1999). De-monetisation, inflation and coffee: the demand for money in Uganda. *Journal of African Economies,* 8(3), 345-385.

Herrera, L. O., & Valdés, R. (2003). *Dedollarization, Indexation and Nominalization: The Chilean Experience.* United States: Inter-American Development Bank Discussion Paper. Available at http://www.bcentral.cl/estudios/documentos-trabajo/pdf/dtbc261.pdf.

Honig, A. (2009). Dollarization, exchange rate regimes, and government quality. *Journal of International Money and Finance, 28*(2), 198-214.

Honoham, P. (2007). Dollarization and exchange rate fluctuations. Policy Research Working Papers. Washington, D.C.: The World Bank.

Honohan, P., & Shi, A. (2002). *Deposit dollarization and the financial sector in emerging economies.* Development Research Group, Washington, D.C.: The World Bank.

Horvath, B., & Maino, R. (2006). *Monetary transmission mechanisms in Belarus.* IMF Working Paper WP/06/246. Washington, D.C.: International Monetary Fund.

Hsing, Y. (2012). Test of the trilemma for five selected Asian countries and policy implications. *Applied Economics Letters,* 19(17), 1735-1739.

http://www.bankofengland.co.uk/education/Documents/ccbs/handbooks/pdf/cc bshb29.pdf.

Hudson, J., & Mosley, P. (2008). Aid Volatility, Policy and Development, *World Development*, 36(10), 2082–2102.

Humpage, O. (2002). An Incentive-Compatible Suggestion for Seigniorage Sharing with Dollarizing Countries, Discussion Paper No. 4, Retrieved from <https://fraser.stlouisfed.org/docs/historical/frbclev/pdp/frbclv_pdp_200206_004.pdf>

Imrohoroglu, S. (1994). GMM estimates of currency substitution between the Canadian dollar and the US dollar. *Journal of Money, Credit and Banking*, 26(4), 792-807.

International Monetary Fund (2005). Does inflation targeting work in emerging markets? In World Economic Outlook, Washington, D.C.: International Monetary Fund.

International Monetary Fund (2015). International Financial Statistics. Washington, D.C.: International Monetary Fund.

Irfan, C. (2003). Money demand, financial liberalization and currency substitution in Turkey. *Journal of Economic Studies*, 30(5).

Ize, A., & Levy-Yeyati, E. (2003). Financial Dollarization, *Journal of International Economics*, 59(2), 323–347.

Ize, A., & Levy-Yeyati, E. (2005). *Financial de-dollarization: Is it for real?* (IMF Working Paper: WP/05/187). Washington, D.C.: International Monetary Fund. Retrieved from <http://www.imf.org/external/pubs/ft/wp/2005/wp05187.pdf>

Ize, A., & Parrado, E. (2002). *Dollarization, Monetary Policy, and the Pass-Through*. IMF Working Paper No. WP/02/118, Washington, D.C.: International Monetary Fund.

Jebuni, C. D., Sowa, N. K., & Tutu, K. S. (1991). Exchange Rate Policy and Macroeconomic Performance in Ghana. AERC Research Report No. 6, Nairobi: African Economic Research Consortium.

Jiranyakul, K., & Opiela, T. P. (2010) Inflation and inflation uncertainty in the ASEAN-5 economies. *Journal of Asian Economics*, 21, 105–112.

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models, *Econometrica*, 59, 1551–1580.

Johansen, S. (1995). *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*, Oxford: Oxford University Press.

Kallon, K. M. (1992). An econometric analysis of money demand in Ghana. *The Journal of Developing Areas*, 26(4), 475-488.

Karacal, M. (2005). *Does dollarization really matter? An empirical investigation of the Turkish Economy.* PhD thesis, The University of Wisconsin-Milwaukee.

Karahan, O. (2012). The Relationship between Inflation and Inflation Uncertainty: Evidence from the Turkish Economy, *Procedia Economics and Finance*, 1, 219–228.

Karanasos, M., Karanassou, M., & Fountas, S. (2004). Analyzing US inflation by a GARCH model with simultaneous feedback. *WSEAS Transactions on Information Science and Applications*, 1, 767–72.

Kesriyeli, M., Ozmen, E., & Yigit, S. (2011). Corporate sector liability dollarization and exchange rate balance sheet effect in Turkey. *Applied Economics, 43*(28-30), 4741-4747.

Kessy, P. (2011). *Dollarization in Tanzania: Empirical Evidence and Cross-Country Experience.* IGC Working Paper 11/0251, London: International Growth Centre.

Kim, C.-J., Nelson, C. R., & Piger, J. (2004). The less-volatile U.S. economy: A Bayesian investigation of timing, breadth, and potential explanations. *Journal of Business and Economic Statistics, 22*(1), 80(14).

Kim, S., & Roubini, N. (2000). Exchange anomalies in the industrial countries: a solution with a structural VAR approach, *Journal of Monetary Economics*, 45, 561-586.

King, M. (2005). Monetary Policy: Practice Ahead of Theory. Mais Lecture 2005, Cass Business School, City University, London, May 17.

Kohn, D. (2007). Success and Failure of Monetary Policy since the 1950s. Speech at Monetary Policy over Fifty Years, Deutsche Bundesbank, Frankfurt, Germany.

Kokenyne, A., Ley, J., & Veyrune, R. (2010). *Dedollarization*, IMF Working Paper WP/10/188, Washington, D.C.: International Monetary Fund.

Komarek, L., & Melecky, M. (2001). *Currency substitution in the transition economy: A case of the Czech Republic 1993-2001.* Warwick Economic Research Paper No.613, University of Warwick, Retrieved from http://wrap.warwick.ac.uk/1573/1/WRAP_Komarek_twerp613.pdf

Kovanen, A. (2011). Does Money Matter for Inflation in Ghana? IMF Working Paper 11/274, Washington, D.C.: International Monetary Fund.

Kremers, J. J., Ericsson, N. R., & Dolado, J. J. (1992). The power of cointegration tests. *Oxford Bulletin of Economics and statistics,* 54(3), 325-348.

Kumar, S., Webber, D. J., & Fargher, S. (2013). Money demand stability: A case study of Nigeria. *Journal of Policy Modelling,* 35(6), 978-991.

Kurasawa, K., & Marty, A. L. (2007). Optimal inflation under dollarization. *Journal of International Money and Finance,* 26(2), *251-264*.

Kwakye, J. K. (1981). *An Econometric Analysis of Price Behaviour in Ghana*, Accra: University of Ghana.

Kwiatkowski, D., Phillips, P. C., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of econometrics,* 54(1), 159-178.

Kyereboah-Coleman, A. (2012), Inflation targeting and inflation management in Ghana, *Journal of Financial Economic Policy*, 4(1), 25–40.

Lange, C., & Sauer, C. (2005). Dollarization in Latin America: Seigniorage costs and policy implications. *The Quarterly Review of Economics and Finance*, *45*, 662-679.

Lawson, R. M. (1966). Inflation in the consumer market in Ghana. *Economic Bulletin of Ghana*, X(1).

Lay, S. H., Kakinaka, M., & Kotani, K. (2012). Exchange rate movements in a dollarized economy: The case of Cambodia. ASEAN Economic Bulletin, 29(1), 65-78. Retrieved from <http://muse.jhu.edu/journals/asean_economic_bulletin/>

Leeper, E. M., Sims, C. A., & Zha, T. (1996). What does monetary policy do? *Brookings Papers on Economic Activity*, *2*, 1-78.

Leiderman, L. & Svensson, L.E.O. (eds). (1995), Inflation Targets, Centre for Economic Policy Research, London.

Leiderman, L., Manio, R., & Parrado, E. (2006). Inflation targeting in dollarized economies. IMF Working Paper WP/06/157. Washington, D.C.: International Monetary Fund.

Levich, R. M. (1986). Empirical Studies of Exchange Rates: Price Behaviour, Rate Determination, and Market Efficiency. NBER Working Papers, Cambridge, Massachusetts: National Bureau of Economic Research.

Levin, A., Natalucci, F. M. & Piger, J. M. (2004). The Macroeconomic Effects of Inflation Targeting. *Federal Reserve Bank of St. Louis Review*, 51–80.

Levy-Yeyati, E. (2006). Financial dollarization: evaluating the consequences. *Economic Policy*, 21(45), 61–118.

Lizondo, J. S., & Montiel, P. J. (1989). Contractionary Devaluation in Developing Countries: An Analytical Overview, *International Monetary Fund Staff Papers*, 36(1), 182–227.

Longmore, R., & Robinson, W. (2004). Modelling and Forecasting Exchange Rate Dynamics: An Application of Asymmetric Volatility Models. Working Paper WP2004/03, Bank of Jamaica.

Luca, A., & Petrova, I. (2008). What drives credit dollarization in transition economies? *Journal of Banking and Finance, 32*(5), 858-869.

Lütkepohl, H. (1991). *Introduction to Multiple Time Series Analysis*. New York: Springer-Verlag.

Lütkepohl, H., & Reimers, H.-E. (1992). Impulse response analysis of cointegrated systems. *Journal of Economic Dynamics and Control,* 16(1), 53-78.

Mackinnon, J. G. (1991). Critical values for cointegration tests. In R. F. Engle and C. W. J. Granger (eds), *Long-run Economic Relationships: Readings in Cointegration* (pp. 267–76), Oxford: Oxford University Press.

Mackinnon, J. G. (1996). Numerical Distribution Functions for Unit Root and Cointegration Tests, *Journal of Applied Econometrics,* 11, 601-618.

Mackinnon, J. G., Haug, A. A., & Michelis, L. (1999), Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration, *Journal of Applied Econometrics*, 14, 563-577.

Mankiw, N. G., Reis, R. & Wolfers, J. (2003). Disagreement about inflation expectations, NBER Working Papers No. 9796, Cambridge, Massachusetts: National Bureau of Economic Research.

Mannah-Blankson, T., & Belnye, F. (2004). Financial innovation and the demand for money in Ghana: Bank of Ghana Working Paper 2004/08, Accra: Bank of Ghana.

Marbuah, G. (2011). On the Inflation-Growth Nexus: Testing for Optimal Inflation for Ghana, *The West African Journal of Monetary and Economic Integration*, 11(2), 54–82.

Marquez, J. (1987). Money demand in open economies: a currency substitution model for Venezuela. *Journal of International Money and Finance,* 6(2), 167-178.

McKenzie, M. D. (1999). The Impact of Exchange Rate Volatility on International Trade Flows, *Journal of Economic Surveys*, 13(1), 71-106.

McKenzie, M. D., & Brooks, R. (1997). The Impact of Exchange Rate Volatility on German - US Trade Flows. *Journal of International Financial Markets, Institutions, and Money*, 7, 73-87.

McKinnon, R. I. (1982). Currency substitution and instability in the World dollar standard, *American Economic Review*, *72*, 320–333.

McKinnon, R. I. (1985). Two concepts of international dollarization, In M. Connolly & J. McDermott (Eds.), *The economics of the Caribbean Basin* (pp. 101–118). New York: Praeger.

McKinnon, R. I. (1993). The rules of the game: International money in historical perspective, *Journal of Economic Literature*, *31*, 1–44.

McKinnon, R. I. (1996). Direct and indirect concepts of international dollarization. In P. Mizen and E. J. Pentecost (Eds.), *The macroeconomics of international currencies: Theory, policy and evidence* (pp. 44–59). U.K.: Edward Elgar Publishing Ltd.

Mecagni, M., Corrales, J. S., Dridi, J., Garcia-Verdu, R., Imam, P., Matz, J.,… & Yehoue, E. (2015). Dollarization in Sub-Saharan Africa: experience and lessons, Washington, D.C.: International Monetary Fund.

Meller, B., & Nautz, D. (2009). The impact of the European monetary union on inflation persistence in the Euro area. Discussion Paper: No. SFB649DP2009-037.

Melvin, M. (1988). The dollarization of Latin America as a market-enforced monetary reform: Evidence and implications. *Economic Development and Cultural Change*, 36(3), 543-558.

Melvin, M., & Afcha, G. P. (1989). Dollar currency in Latin America: a Bolivian application. *Economics Letters,* 31(4), 393-397.

Mengesha , L. G., & Holmes, M. J. (2015). Does dollarization reduce or produce inflation? *Journal of Economic Studies*, 42(3), 358-376.

Mengesha, L. G. (2013), An Investigation of the Macroeconomic and Monetary Effects of Dollarization in Eritrea, A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Economics at The University of Waikato, New Zealand.

Mengesha, L. G., & Holmes, M. J. (2011). Dollarization of less developed countries: a note on the computation of a hard currency index, *International Journal of Economics and Research*, 2(2), 61-66.

Mengesha, L. G., & Holmes, M. J. (2013). Does Dollarization Alleviate or Aggravate Exchange Rate Volatility? *Journal of Economic Development*, 38(2), 99–118.

Mercedes, G.-E. (2010). *Peru: Drivers of De-dollarization*. IMF Working Paper WP/10/169, Washington, D.C.: International Monetary Fund.

Miles, M. A. (1978). Currency substitution, flexible exchange rates, and monetary independence. *The American Economic Review*, 68(3), 428-436.

Mishkin, F. S. & Schmidt-Hebbel, K. (2002). One Decade of Inflation Targeting in the World: What Do We Know and What Do We Need to Know? in N. Loayza and R. Soto, eds., *Inflation Targeting: Design, Performance, Challenges* (Central Bank of Chile: Santiago, 171 – 219.

Mishkin, F. S. (1995). Symposium on the monetary transmission mechanism. *Journal of Economic Perspectives, 9*(4), 3-10.

Mishkin, F. S. (1996). The Channels of Monetary Transmission: Lessons for Monetary Policy. *Banque De France Bulletin Digest,* 27, 33 – 44.

Mishkin, F. S. (1999). International Experiences With Different Monetary Policy Regimes. *Journal of Monetary Economics*, 43, 579–606.

Mishkin, F. S. (2000). Inflation target in emerging countries, NBER Working Paper 7618, Cambridge, Massachusetts: National Bureau of Economic Research.

Mishkin, F. S. (2000). What Should Central Banks Do?" Federal Reserve Bank of St. Louis *Review*, 82(6), 1 – 13.

Mishkin, F. S. (2007). Inflation Dynamics. National Bureau of Economic Research Working Paper No. 13147, Cambridge, Massachusetts: National Bureau of Economic Research.

Mishkin, F. S., & Schmidt-Hebbel, K. (2002). One Decade of Inflation Targeting in the World: What Do We Know and What Do We Need to Know? In Inflation Targeting: Design, Performance, Challenges, edited by N. Loayza and R. Soto, 171–219. Santiago: Central Bank of Chile.

Mishra, P., & Montiel, P. J. (2012). How Effective Is Monetary Transmission in Low Income Countries? A Survey of the Empirical Evidence, IMF Working Papers WP/12/143, Washington, D.C.: International Monetary Fund.

Mizen, P. D., & Pentecost, E. J. (1996). Currency substitution in theory and practice. In P. MIZEN and J. PENTECOST (eds.*) The Macroeconomics of International Currencies: Theory, Policy and Evidence*. Edward Elgar Publishing Company. USA.

Montiel, P., & Serven, L. (2004). Macroeconomic Stability in Developing Countries: How Much Is Enough? Policy Research Working Paper 3456, Washington, D.C.: World Bank.

Mueller, J. (1994). Dollarization in Lebanon. IMF Working Paper No. 94/129, Washington, D.C.: International Monetary Fund.

Mugume, A. (2011). Monetary transmission mechanisms in Uganda. Bank of Uganda. Retrieved from <https://www.bou.or.ug/bou/bou-downloads/research>

Mumuni, Z., & Owusu-Afriyie, E. (2004). Determinants of the Cedi/Dollar Rate of Exchange in Ghana: A Monetary Approach, Bank of Ghana Working Paper WP/BOG-2004/06, Accra: Bank of Ghana.

Mundell, R. A. (1963). Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science/Revue canadienne de economiques et science politique,* 29(04), 475-485.

Narayan, P. K. (2004). Fiji's tourism demand: the ARDL approach to cointegration. *Tourism* Economics, 10(2), 193-206.

Neanidis, K. C., & Savva, C. S. (2009). Financial dollarization: Short-run determinants in transition economies. *Journal of Banking and Finance, 33*(10), 1860-1873.

Nell, K. S. (2003). The stability of M3 money demand and monetary growth targets: the case of South Africa. *Journal of Development Studies,* 39(3), 155-180.

Nelson, D. B. (1991), Conditional Heteroskedasticity in Asset Returns: A New Approach, *Econometrica*, 59, 347–370.

Ngalawa, H. P. E., & Viegi, N. (2011). Dynamic effects of monetary policy shocks in Malawi. *South African Journal of Economics,* 79(3), 224-250.

Nwafor, F., Nwakanma, H., Nkansah, P., & Thompson, F. (2007). The quantity theory of money in a developing economy: Empirical evidence from Nigeria. *African Economic and Business Review,* 5(1), 1-9.

Obstfeld, M., & Gertler, M. (1995). The Mirage of Fixed Exchange Rates. *Journal of Economic Perspectives* , 9(4), 73-96.

Obstfeld, M., Shambaugh, J. C., & Taylor, A. M. (2005). The trilemma in history: trade-offs among exchange rates, monetary policies, and capital mobility. *Review of Economics and Statistics,* 87(3), 423-438.

Ocran, M. K. (2007). *A Modelling of Ghana's Inflation Experience: 1960-2003*. AERC Research Paper No. 169, Nairobi: African Economic Research Consortium.

Oomes, N., & Ohnsorge, F. (2005). Money demand and inflation in dollarized economies: The case of Russia, *Journal of Comparative Economics,* 33(3), 462–483.

Orphanides, A. & Williams, J. C. (2003). Imperfect knowledge, inflation expectations, and monetary policy. National Bureau of Economic Research Working Paper No. 9884. Cambridge, Massachusetts: National Bureau of Economic Research.

Orphanides, A. & Williams, J. C. (2007). Inflation Targeting under Imperfect Knowledge. in Mishkin, F. and Schmidt-Hebbel, K., (Eds) Monetary Policy under Inflation Targeting, Santiago: Central Bank of Chile.

Ortiz, G. (1983). *Dollarization in Mexico: Causes and Consequences*. NBER Working Paper, Cambridge, Massachusetts: National Bureau of Economic Research.

Payne, J. E. (2009). Official dollarization in El Salvador and the inflation-inflation uncertainty nexus. *Applied Economic Letters*, *16*(12), 1195-1199.

Pesaran, M. H., & Pesaran, B. (1997). *Working with Microfit 4.0*. Cambridge: Camfit Data Ltd.

Pesaran, M. H., & Shin, Y. (1995). *Long-Run Structural Modelling*. Department of Applied Economics, Cambridge: University of Cambridge.

Pesaran, M. H., & Shin, Y. (1999). *An autoregressive distributed lag modeling approach to cointegration analysis*. Department of Applied Economics, Cambridge: University of Cambridge.

Pesaran, M. H., & Smith, R. P. (1998). Structural analysis of cointegrating VARs. *Journal of Economic Surveys*, 12, 471-505.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics,* 16, 289–326.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association,* 94(446), 621-634.

Peseran, M. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economic Letters*, 58, 17-29.

Petursson, T. G. (2001). *The transmission mechanism of monetary policy: Analysing the financial market pass-through,* Working Paper No. 14, Central Bank of Iceland. Retrieved from Sedlabanki Islands. Retrieved from <http://www.sedlabanki.is/uploads/files/wp-14.pdf>

Phillips, P. C. B. (1999a). Discrete Fourier transforms of fractional processes. Unpublished working paper No. 1243, Cowles Foundation for Research in Economics, Yale University. <http://cowles.econ.yale.edu/P/cd/d12a/d1243.pdf>.

Phillips, P. C. B. (1999b). Unit root log periodogram regression. Unpublished working paper No. 1244, Cowles Foundation for Research in Economics, Yale University. <http://cowles.econ.yale.edu/P/cd/d12a/d1244.pdf>.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika,* 75(2), 335-346.

Pianalto, S. (2005). Expectations, Communications, and Monetary Policy. *Federal Reserve Bank of Cleveland, Economic Commentary,* 04.15.2005.

Piffanelli, S. (2001). The Instrument of Monetary Policy in Germany. A Structural VAR Approach. DESA Discussion Paper No. 19, United Nations Department of Economic and Social Affairs.

Pindyck, R. S. (1982). Adjustment Costs, Uncertainty, and the Behaviour of the Firm, *American Economic Review*, 72 (3), 415-27.

Plosser, C. I., Schwert, G. W., & White, H. (1982). Differencing as a test of specification. *International Economic Review*, 23(3), 535-552.

Poddar, T., Khachatryan, H., & Sab, R. (2006). *The monetary transmission mechanism in Jordan* (IMF Working Paper: WP/06/48). Washington, D.C.: International Monetary Fund. Retrieved from <http://www.imf.org/external/pubs/ft/wp/2006/wp0648.pdf>

Quispe-Agnoli, M., & Whisler, E. (2006). Official dollarization and the banking system in Ecuador and El Salvador. *Federal Reserve Bank of Atlanta Economic Review, 91*(3), 55-71.

Rajan, R. (2004). Dollar Shortages and Crises. NBER Working Paper No. 10845, Cambridge, Massachusetts: National Bureau of Economic Research.

Rajan, R. G., & Tokatlidis, I. (2005). Dollar Shortages and Crises. *International Journal of Central Banking*, 1(2), 177-220.

Ramaswamy, R., & Slok, T. (1998). The real effects of monetary policy in the European Union: What are the differences? IMF Staff Papers, *45*(2), 374-396.

Ramirez-Rojas, C. L (1985). *Currency Substitution in Argentina, Mexico and Uruguay*. IMF Staff Papers, 32, 629–667.

Randa, J. (1999). Economic Reform and the Stability of the Demand for Money in Tanzania. *Journal of African Economies,* 8(3), 307-344.

Reinhart, C. M., Rogoff, K. S., & Savastano, M. A. (2003). *Addicted to dollars*. NBER Working Paper 10015. Cambridge, Massachusetts: National Bureau of Economic Research.

Rennhack, R., & Nozaki, M. (2006). *Financial dollarization in Latin America*. IMF Working Paper: WP/06/7, Washington, D.C.: International Monetary Fund.

Rojas-Suarez, C. L. (1992). Currency substitution and inflation in Peru. *Revista de Analisis Economico*, 7, 153-176.

Rose, A. K. (2000). One Money, One Market: Estimating the Effect of Common Currencies on Trade. *Economic Policy*, 15(30), 7–46.

Rose, A. K., & van Wincoop, E. (2001). National Money as a Barrier to International Trade: The Case for Currency Union. *American Economic Review*, 91(2), 386–390.

Rosenberg, C. B., & Tirpak, M. (2008). Determinants of Foreign Currency Borrowing in the New Member States of the EU. IMF Working Paper WP/08/173, Washington, D.C.: International Monetary Fund.

Rotemberg, J., & Woodford, M. (1997). An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy. *NBER Macroeconomics Annual*, 12, 297–361. Cambridge, Massachusetts: National Bureau of Economic Research.

Sahay, R., & Vegh, C. A. (1995). Dollarization in transition economies: Evidence and policy implications. IMF Working Paper WP 95/96, Washington, D.C.: International Monetary Fund.

Sahay, R., & Vegh, C. A. (1996). Dollarization in transition economies: Evidence and policy implications. In: Mizen, P., Pentecost, E. J. (Eds.), *The Macroeconomics of International Currencies: Theory, Policy, and Evidence*, U.K.: Cheltenham, pp. 193- 224.

Saikkonen, P., & Lütkepohl, H. (2000a). Testing for the cointegrating rank of a VAR process with an intercept. *Econometric Theory,* 16(03), 373-406.

Saikkonen, P., & Lütkepohl, H. (2000b). Testing for the cointegrating rank of a VAR process with structural shifts. *Journal of Business and Economic Statistics,* 18(4), 451-464.

Saikkonen, P., & Lütkepohl, H. (2000c). Trend adjustment prior to testing for the cointegrating rank of a vector autoregressive process. *Journal of time series Analysis,* 21(4), 435-456.

Samkharadze, B. (2008). *Monetary transmission mechanism in Georgia: Analyzing pass-through of different channels* (NBG Working Paper: No. 02/2008). Retrieved from <http://www.nbg.gov.ge/index.php?m=451>

Sanusi, A. R. (2010a). Lessons from the Foreign Exchange Market Reforms in Ghana: 1983-2006. *Journal of Economics and Allied Fields*, IV (2).

Sanusi, A.R. (2010b). Exchange rate pass-through to consumer prices in Ghana: Evidence from structural vector auto-regression. *The West African Journal of Monetary and Economic Integration*, 10(1), 25-54.

Savastano, M. M. A. (1996). Dollarization in Latin America-Recent Evidence and Some Policy Issues. IMF Working Paper 96/4, Washington. D.C.: International Monetary Fund.

Savvides, A. (1996). CFA Franc Zone membership and exchange rate variability. *Journal of African Economies, 5*(1), 52-68.

Saxegaard, M. (2006). *Excess liquidity and the effectiveness of monetary policy: Evidence from Sub-Saharan Africa,* IMF Working Paper WP/06/115, Washington, D.C.: International Monetary Fund.

Schnabl, G. (2007). *Exchange rate volatility and growth in small open economies at the EMU periphery,* Working Paper No 773, European Central Bank. Retrieved from <http://www.ecb.int/pub/pdf/scpwps/ecbwp773.pdf>

Schoenmaker, D. (2011). The financial trilemma. *Economics Letters,* 111(1), 57-59.

Setzer, R. (2006). *The Politics of Exchange Rates in Developing Countries: Political Cycles and Domestic Institutions*, New York: Physica-Verlag Heidelberg.

Simmons, R. (1992). An error-correction approach to demand for money in five African developing countries. *Journal of Economic Studies,* 19(1), 29-47.

Sims, C. A. (1972). Money, Income, and Causality. *American Economic Review*, 62(4), 540-552.

Sims, C. A. (1986). Are Forecasting Models Usable for Policy Analysis? Federal Reserve Bank of Minneapolis, *Quarterly Review*, Winter, 2-16.

Sims, C. A. (1992). Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy, *European Economic Review*, 36, 975–1000.

Sims, C. A., & Zha, T. A. (2006). Does monetary policy generate recessions? *Macroeconomic Dynamics*, 10, 231-272.

Sims, C. A., Stock, J. H., & Watson, M. W. (1990). Inference in linear time series models with some unit roots. *Econometrica*, 58, 113–144.

Soto, R. (2008). Dollarization, economic growth, and employment. *Economics Letters*, *105*(1), 42-45.

Sowa, N. K. (1994). Fiscal deficit, output growth, and inflation targets in Ghana. *World Development*, 22(8), 1105-1117.

Sowa, N. K. (1996). Policy consistency and inflation in Ghana. AERC Research Paper No. 43, Nairobi: African Economic Research Consortium.

Sowa, N. K., & Acquaye, I. K. (1998). Financial and Foreign Exchange Liberalisation in Ghana, Centre for Policy Analysis Research Papers. No.10 Accra: CEPA.

Sowa, N. K., & Kwakye, J. K. (1993). Inflationary Trends and Control in Ghana. AERC Research Paper 22, Nairobi: African Economic Research Consortium.

Steel, F. (1979). Hyperinflation in Ghana. *Legon Observer*, 308-312.

Stock, J. H., & Watson, M. W. (2001). Vector Autoregressions. *Journal of Economic Perspectives*, 15(4), 101-115.

Svensson, L.E.O. (1998). Inflation Targeting as a Monetary Policy Rule. IIES Seminar paper no. 646, presented at the Sveriges Riksbank-IIES Conference on Monetary Policy Rules, Stockholm.

Swanson, E. (2006). Would an Inflation Target Help Anchor U.S. Inflation Expectation? *FRBSF Economic Letter 2006-20*.

Taylor, J. (1995). The Monetary Transmission Mechanism: An Empirical Framework, *Journal of Economic Perspective*, 4, 11-26.

Taylor, S. (1986). *Modelling Financial Time Series*, New York: John Wiley & Sons.

Terkper, S. (2014). *The Budget Statement and Economic Policy of the Government of Ghana for the 2015 Financial Year*. Presented to Parliament on 19th November 2014. Accra: Ministry of Finance. Retrieved from <http://www.parliament.gh/assets/file/Budget/Budget-Statement-2015_0.pdf>

Tille, C. (2003). The Impact of Exchange Rate Movements on U.S. Foreign Debt. *Current Issues In Economics and Finance,* 9 (1), Federal Reserve Bank of New York.

Tobin, J. (1969). A General Equilibrium Approach to Monetary Theory. *Journal of Money, Credit, and Banking*, 1(1), 15-29.

Towbin, P., & Weber, S. (2011). Limits of Floating Exchange Rates: the Role of Foreign Currency Debt and Import Structure, IMF Working Paper WP/11/42, Washington, D.C.: International Monetary Fund

Tsangarides, C.G. (2010). *Monetary policy transmission in Mauritius using a VAR analysis,* IMF Working Paper WP/10/36, Washington, D.C.: International Monetary Fund.

Tse, Y. K. & Tsui, A. K. (2002). A multivariate generalized autoregressive conditional heteroscedasticity model with time–varying correlations. *Journal of Business and Economic Statistics*, 20, 351–362.

Valdovinos, C.G.F., & Gerling. K. (2011). Inflation Uncertainty and Relative Price Variability in WAEMU Countries. IMF Working Paper WP/11/59, Washington, D.C.: International Monetary Fund.

Viseth, K. R. (2001). *Currency substitution and financial sector developments in Cambodia*, Working Paper No. IDEC01-4, International and Development Economics.

Walsh, C. (2008). Inflation targeting: what have we learned? The John Kuszczak Memorial Lecture, prepared for the conference on International experience with the conduct of monetary policy under inflation targeting, Bank of Canada, 22–23 July.

Willett, T. D., & Banaian, K. (1996). Currency substitution, seigniorage, and the choice of currency policies. In P. Mizen & J. Pentecost (Eds.). *The macroeconomics of international currencies: Theory, policy and evidence* (pp. 77–95). U.S.A: Edward Elgar Publishing Ltd.

Yinusa, D. O. (2008). Between dollarization and exchange rate volatility: Nigeria's portfolio diversification option. *Journal of Policy Modelling*, 30(5), 811-826.

Yinusa, D. O., & Akinlo, A. E. (2008). Exchange rate volatility and the extent of currency substitution in Nigeria. *Indian Economic Review*, 43(2), 161-181.

Zakoian, J. M. (1994). Threshold Heteroskedastic Models, *Journal of Economic Dynamics and Control*, 18, 931-944.

Zamaroczy, M., & Sa, S. (2003). *Economic policy in a highly dollarized economy: The case of Cambodia*. IMF Occasional Paper No.219. Washington, D.C.: International Monetary Fund.

Zivot, E., & Andrews, D. W. K. (2002). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business and Economic Statistics*, 20(1), 25-44.