UNIVERSITY OF CAPE COAST

EFFECT OF FINANCIAL INNOVATION ON THE DEMAND FOR MONEY IN GHANA

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Name: Benjamin Adjei Adjetey

Signature:……. Date:…….

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Name: Dr. Camara K. Obeng

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ABSTRACT

The study examined the effect of financial innovation on the demand for money in Ghana. Specifically this study examined the long run and short run relationships between financial innovation, real income, interest rate, price level, real effective exchange rate and demand for money; tested for the stability of the demand for money function and established the direction of causality between innovation (and other regressors) and the demand for money in Ghana.

The study employed quarterly time series data from 1983(1) to 2012(4) for Ghana and used the Autoregressive Distributed Lag (ARDL) approach to cointegration. The study also employed the Principal Component Analysis to construct an index of financial innovation.

The regression results showed that in the long, financial innovation, real income, and price level had positive effect on narrow and broad money demand whiles interest rate and real effective exchange rate had negative effect on narrow and broad money demand in Ghana. The short run results also revealed that real income (both current and previous values), and price level, and financial innovation had positive effect on narrow and broad money demand whiles interest rate (both current and previous values) and real effective exchange rate had negative effect on narrow and broad money demand in Ghana. The narrow and broad money demand functions are also to be stable over the study period. It is therefore, recommended that government provides incentives to facilitate the improvement of financial innovation and constantly reassess the stability of the demand for money in line with financial innovation.

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DEDICATION

To my parents, Mr. Daniel Adjetey Anaanu and Madam Emelia Okailey Odai, and to the entire members of my extended family.

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LIST OF ACRONYMS

ADF	Augmented Dickey-Fuller
AERC	African Economic Research Consortium
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
ATM	Automated Teller Machine
BoG	Bank of Ghana
CMAP	Collaborative Masters Programme
CUSUM	Cumulative Sum of Recursive Residuals
CUSUMSQ	Cumulative Sum of Squares of Recursive Residuals
DW	Durbin Watson
ECM	Error Correction Model
ECT	Error Correction Term
ERP	Economic Recovery Programme
FINSAP	Financial Sector Adjustment Programme
GDP	Gross Domestic Product
GSS	Ghana Statistical Service
IMF	International Monetary Fund
JFE	Joint Facility for Electives
M1	Narrow Demand for Money
M2	Broad Demand for Money
OECD	Organisation for Economic Corporation and

	Development
PCA	Principal Component Analysis
PP	Phillips-Perron
SAP	Structural Adjustment Programme
SBC	Schwarz Bayesian Criterion
SIC	Schwarz Information Criterion
VAR	Vector Autoregressive
WDI	World Development Indicators
WER	World Economic Report

CHAPTER ONE

INTRODUCTION

Background to the Study

The concept of money demand has over the years attracted the interest of economists and the estimation of the demand for money function has been a leading subject in applied economics in many countries. This stems from the fact that it provides the monetary authority with a comprehensible view of the reaction of different macroeconomic aggregates to a change in money supply (Harb, 2004). It is important to emphasize that unlike the demand for goods which is restricted to the goods or commodity market, the demand for money involves other markets such as money market, capitalmarket, commodity market and foreign exchange market. Therefore, it has a direct bearing on monetary policyand so relevant to the study of macro-economics (Essien, Onwioduokit & Osho, 1996).

Demand for money serves as a conduit in the transmission mechanism for both monetary and fiscal policy. As well as being at the heart of the issue of monetary policy effectiveness, the demand for money is important in assessing the welfare implications of policy changes and for determining the role of signorage in the economy. Monetary policy seeks to influence money credit and prices through the liquidity position of banks and other related financial institutions. Since the demand for money function helps to ascertain the liquidity needs of the economy, knowledge of the factors that determine this function and the existence of a stable long run relationship between these factors and the

money stock constitute legitimate enquiries by the monetary authorities and researchers. This role of the demand for money in the monetary process has thus, generated quite a substantial body of empirical work.

According to Laidler (1995), the relationship between the demand for money balances and its determinants is a fundamental building block in most theories of macroeconomic models. The demand for money is also a critical component in the formulation of monetary policy and a stable demand for money has long been perceived as a pre-requisite for the use of monetary aggregate in the conduct of policy. Laidler (1995) noted that the significance of the demand for money stems from the fact that variables that seem to determine it are important in their own right. Real income, interest rate, and rate of inflation, as well as other relevant factors have a vital bearing on the economic well-being of any community.

Furthermore, Essien, Onwioduokit and Osho (1996) also asserted that stability of the demand for money is crucial in understanding the behaviour of critical macro-economic variables. A stable money demand has been stressed by policy-makers when it comes to a proper conduct of monetary policy whereby central banks can change their monetary aggregates to generate predictable impacts on output, interest rates and prices. The existence of a stable demand for money in the long run is very important in the implementation of monetary policy even in this new era of inflation targeting (Hayo, 1999). The stability of the money demand function is critical if monetary and fiscal policy are to have predictable effect overtime on real output and the price level. As noted by Opolot

(2006), the study of the demand for money function is a central issue in monetary economics because a stable demand for money function is essential for the conduct of effective monetary policy. The underlying rationale for having a stable money demand function is that it enables money growth rates to be sound predictors of future inflation and output trends.

The implementation of financial reforms in many countries has raised doubts about the use of monetary aggregates to stabilize inflation rates. Since the 1980s and following countless deregulation and liberalization policies, central banks in many advanced economies switched between instruments of monetary policy by moving away from policies that influence the money supply towards those which influence the bank rate. A large number of developed country case studies show that the demand for money has become unstable due to financial reforms and hence support the targeting of the rate of interest by central banks (McPhail, 1991; Haug, 1999; Caporale & Gil-Alana, 2005; Maki & Kitasaka, 2006; Haug, 2006).

It is also important to underscore that the function of the money demand is justifiably considered to be among the central behavioral relationships in macroeconomic theory. Nevertheless, Solans (2003) argued that the reliability of monetary aggregates measures responds to changes in the structure of the financial sector due to the presence of financial innovation. As seen with the global credit crunch sparked in 2008, which was triggered at least in part by innovative financial products, there will always be a need for careful scrutiny of

innovative financial products and their risks. Financial innovations are necessary and useful element in forecasting of the short-run money demand.

Notably, in the world, especially during the last decade, the issue of financial innovations has been profoundly investigated (Kogar, 1995; Frame & White, 2002). The pace of change in financial markets is rapid and this affects the demand for money balances in order to finance purchases. In recent years the demand for cash balances has declined relative to the demand for interest-bearing deposit accounts. Most people can finance their purchases using debit cards and credit cards rather than carrying around large amounts of cash. Financial innovation has reduced the demand for cash balances at each rate of interest - represented by an inward shift in the money demand curve.

The rising importance of the financial sector in the economic development of developing countries, as well as the rapid rate of innovation in that sector have generated a growing research interest in financial innovation. After Friedman's (1956) work on the demand for money, many researchers and policy makers have agreed that a stable money demand function is very important for the central bank’s monetary policy to reach its preferable objectives. In other words, money supply will have a predicable effect on real variables only when demand for money is stable.

However, in the 1980s, financial innovations in major financial centers represented the main reason behind the instability of narrow money demand. Therefore, Duca (2000) argued that monetary policy does not work only through the interest rate channel, but the money demand function does also provide useful

information about portfolio allocations. Theoretical research and empirical analysis using primary data on developing countries have shown that the money demand function can become unstable as a result of financial innovations and financial sector reforms (Lewis & Mizen, 2000). Partly, because of the instability in the money demand functions, most central banks in recent years have switched from money supply targeting which focused on monetary aggregates as the intermediate target to inflation targeting which seeks to stabilize prices by adjusting interest rates based on inflation forecasts.

What is financial innovation and why should we be concerned about it? This question has become increasingly important in the wake of the recent financial crisis, yet the nature of financial innovation remains poorly understood. The role that these products played in the financial crisis has generated a vigorous debate about the value of financial innovation and the proper regulatory response to the development of novel financial products. The battle lines in this debate are already forming. There are those who believe that financial innovation is largely useless. Others, by comparison, take a more moderate position, arguing that some financial innovation is good and some is bad. Lost in this debate, however, is a more fundamental question about the nature of financial innovation itself and its effect on modern financial markets. This question is both timely and important (Gubler, 2011).

Financial innovation should be understood first and foremost as a process of change, a change in the type and variety of available financial products to be sure, but also a change in financial intermediaries (such as banks) and in markets,

themselves (Gubler, 2011).Financial innovation is also defined as the introduction of new financial products and processes and expanded use of computer and communication technology in the financial system. It includes increased number and diversity of financial institutions that in sum produce a revolution in the delivery of financial services. In this regard, financial innovation is generally marked by the introduction of a new product or a new process in the financial system. Financial innovation may also involve modifying an existing idea, as either a product or a process (Manley, 2002; Ansong, Marfo-Yiadom, & Asmah, 2011).

Another way to think about financial innovation is in terms of its function. Economists say that the overall function of financial innovation is to reduce financial market imperfections (World Economic Forum Report, 2012). Merton (1992) noted that financial innovation performs six main functions: to provide ways of clearing and settling payments to facilitate trade (e.g. credit and debit cards, stock exchanges); to provide mechanisms for the pooling of resources and for the subdividing of shares in various enterprises (e.g. mutual funds, securitization); to provide ways to transfer economic resources through time, across borders and among industries (e.g. savings accounts, loans); to provide ways of managing risk (e.g. insurance); to provide price information to help coordinate decentralized decision-making in various sectors of the economy (e.g. contracting by venture capital firms); and to provide ways of dealing with the incentive problem created when one party to a transaction has information that the

other party does not or when one party acts as agent for another (e.g. price signals).

Statement of the Problem

It is critical to underscore that monetary authorities constantly analyse the stability of the demand for money due to its effect on the behaviour of critical macroeconomic variables. This is because changes in the structure of the financial sector can objectively change the reliability of monetary aggregates measures, and thus the efficiency of the monetary policy. The explicit reason for this is that the presence of financial innovation introduces an additional element of uncertainty to the economic environment in which a central bank operates (Solans, 2003).

The World Economic Forum Report, (2012) stressed that financial innovation has been carefully examined over the past years because certain financial innovations went badly wrong in the run up to the recent crisis in the world. Moreover, Lewis and Mizen (2000) stressed that the instability in the demand for money function is generally attributed to financial innovation because money supply has become less endogenous or more exogenous

There have been some studies in both developed and developing countries that looked at the extent to which financial innovation has impacted on the demand for money relationships. More specifically, lots of studies have been conducted to evaluate the stability of the demand for money in Ghana amidst financial sector reforms. These include the work of Dagher and Kovanen (2011), Ghartey (1998), and Akoena (1996) etc. These studies have immensely

contributed to the understanding of money demand behaviour in Ghana. However, these studies failed to incorporate the element of financial innovations in evaluating the money demand function. Furthermore, there have been studies that examined the effect of financial innovation on financial savings in Ghana. A classic example is the work of Ansong, Marfo-Yiadom and Asmah (2011).

It is important to underscore that measuring financial innovation is very difficult. The appropriateness of the measurement of financial innovation depends on the country involved. Moreover, most microeconomic studies on financial innovations constructed an index to measure financial innovation. These include the work of Bylik (2006) and Ansong, Marfo-Yiadom and Asmah (2011). However, most of the macroeconomic studies on financial innovation in LDCs, Latin America and Asia employed the traditional measurement of financial innovation: Ratio of broad money (M2) to narrow money (M1) (Nagayasu, 2012; Ansong, 2011; and Mannah-Blankson &Belnye, 2004). The use of this measurement was rationalized on the grounds that a greater array of money substitutes will be reflected in broad money (M2) than in narrow money (M1).

There is no consensus on the effect of financial innovation on the demand for money. Some studies found a positive effect (Mannah-Blankson &Belnye, 2004), negative effect (Nagasu, 2012) and no effect (Odularu & Okunrinboye, 2010). However, little empirical evidence exists on the relationship between financial innovation and money demand particularly in Ghana. Moreover, money supply and financial innovation have been increasing over the years in Ghana.

One could wonder whether this trend is just a coincidence or one is influencing the movement of the other. This trend is shown in Figure 1 below.

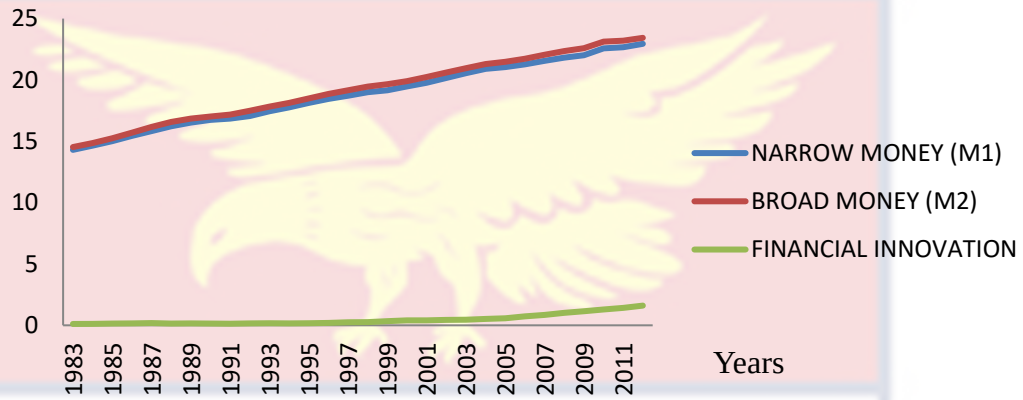


Figure 1: Trends of Money Supply and Financial Innovation in Ghana

Source: Generated by author using Microsoft Excel 2010

Figure 1 above shows the trend of money supply (narrow and broad) and financial innovation. The above figure clearly shows an increasing trend for all the variables though money supply rises faster than financial innovation.

This paper addresses this gap by empirically examining the effect of financial innovation on the demand for money in Ghana by constructing an index for financial innovation. This is crucial because in the recent past, Ghana's financial system has experienced remarkable financial innovation with possible implications on monetary transmission mechanisms and hence on the conduct of monetary policy.

Objectives of the Study

General

The main objective of the study was to examine the effect of financial innovation on the demand for money (narrow money demand [M1] and broad money demand [M2]) in Ghana.

Specific

Specifically, this study seeks to:

1. examine the long run relationship between the real demand for money (real narrow money demand [M1] and real broad money demand [M2]) and financial innovation, real income, interest rate, price level and real effective exchange rate in Ghana;
2. examine the short run relationship between the real demand for money (real narrow money demand [M1] and real broad money demand [M2]) and financial innovation, real income, interest rate, price level and real effective exchange rate in Ghana;
3. test for the stability of the real demand for money (real narrow money demand [M1] and real broad money demand [M2]) function in Ghana; and
4. establish the direction of causality between the real demand for money (real narrow money demand [M1] and real broad money demand [M2]) and financial innovation, real income, interest rate, price level and real effective exchange rate in Ghana.

Statement of Hypotheses

From the objectives stated above, the following hypotheses were tested:

1. H_O: Financial innovation does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

   H_1: Financial innovation positively or negatively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

2. H_O: Financial innovation does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

   H_1: Financial innovation positively or negatively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

3. H_O: Real income does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

   H_1: Real income positively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

4. H_O: Real income does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

   H_1: Real income positively affects narrow money demand (M1) and broad money demand (M2) in Ghana in the short run.

5. H_O: Interest rate does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

H_1: Interest rate negatively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

6. H_O: Interest rate does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

   H_1: Interest rate negatively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

7. H_O: Price level does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

   H_1: Price level positively or negatively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

8. H_O: Price level does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

   H_1: Price level positively or negatively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

9. H_O: Real effective exchange rate does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

   H_1: Real effective exchange negatively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the long run.

10. H_O: Real effective exchange rate does not affect real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

H_1: Real effective exchange rate negatively affects real narrow money demand (M1) and real broad money demand (M2) in Ghana in the short run.

11. H_O: The real narrow money demand (M1) and real broad money demand (M2) in Ghana are not stable.

    H_1: The real narrow money demand (M1) and real broad money demand (M2) in Ghana are stable.

12. H_O: There is no direction of causality between real narrow money demand (M1) and real broad money demand (M2) and financial innovation, income, interest rate, price level and real effective exchange rate in Ghana.

    H_1: There is uni- or bi- direction of causality between real demand for money and financial innovation, income, interest rate, price level and real effective exchange rate in Ghana.

Significance of the Study

The growing significance of the financial sector in the economy of Ghana cannot be downplayed due to the role that financial institutions play in terms of mobilisation and allocation of saving (capital) to productive investment.The Ghanaian financial sector has experienced some notable changes after the financial sector liberalization such as influx of private banks into the market and the expanded use of branches by existing and new banks, development of new technologies to deliver financial services, such as Automated Teller Machines (ATMs), Electronic Funds Transfer at Point of Sale (EFTPOS) and other stored

value cards (Mannah-Blankson &Belnye 2004). Although these changes could affect the nature and stability of the money demand function in Ghana, empirical work is limited on the subject matter.

This is an important concern because Lewis and Mizen (2000) noted that there is a widespread perception that financial innovation is behind the instability in the demand for money function. This is because money supply has become less endogenous or more exogenous (i.e. due to a regime change) and therefore, the standard function may not have been able to cope with this regime change and the different associated dynamic change.

Therefore, this study seeks to examine the effect of financial innovation on the money demand in Ghana. It is hoped that the conclusions and policy recommendations from this study will help policy makers better understand the relationships between demand for money and financial innovation in Ghana. The study will also contribute to the stock of literature and policy issues relating to demand for money substantially in Ghana.

Scope of the Study

The focus of the study was to examine the effect of financial innovation on the money demand in Ghana. This is very important due to the notable changes in the financial system of Ghana following the financial liberalization.

Data was collected on monetary aggregates (M1and M2), real income (proxy by real GDP), interest rate (proxy by 3-months Treasury bill rate), inflation rate, exchange rate and financial innovation (proxy by ratio of monetary

aggregate, ratio of bank credit to the private sector to GDP, and ratio of M3 to GDP) spanning from 1983(1) to 2012(4).

The study employed the Autoregressive Distributed Lag (ARDL) bound test for cointegration developed by Pesaran and Shin (1995, 1999), Pesaran et al. (1996) and Pesaran (1997).

Organization of the Study

The study is divided into six chapters as follows: Chapter one covers the background of the study followed by statement of the problem, objective of the study, statement of hypothesis, significance of the study, scope of the study and organization of the study (which gives an insight into how the study has been organized).

Chapter two deals with the overview of the Ghanaian economy which is sub-divided into overview of financial system in Ghana and trend of variables used for the study.

Chapter three deals with the review of related literature for the study. The literature review comprises theoretical literature and empirical literature review.

Chapter four is concerned with the research methodology used in the study. It deals with the specification of the model for the study, research design, population and sampling techniques, research instrument, data source and method of data collection, definition and measurement of variables, and estimation techniques.

Chapter five is devoted to the presentation, analysis and discussion of the results. It also deals with the testing of the hypotheses formulated in the first chapter.

Chapter six, being the last chapter, contains the summary, conclusions, policy implications, limitations of the research and areas for future study.

CHAPTER TWO

OVERVIEW OF THE GHANAIAN ECONOMY

Introduction

This chapter presents the overview of financial system in Ghana followed by trend of variables.

Overview of Financial System in Ghana

The financial system of Ghana has undergone remarkably metamorphosis which can conveniently be classified as the colonial era, centrally planned and closed economy period, economic recovery and structural adjustment period.

The Colonial Era (up to 1960)

During the colonial era, the financial system was mainly characterized by minimalist conditions. This is due to the colonial government's concentration on provision of a basic currency infrastructure and banking services forthe foreign trading enterprises within the colonial system (Mensah, 1997). Ghana also had an open economy with the private sector as the main engine of economic growth and the public sector was concerned basically with public administration.

The colonial government also limiteditself to monetary stability and therefore,linked monetarygrowth to export performance. According to Newlyn and Rowan (1954) and Mensah(1997), banking was established with the aim of providing bankingservices for the British trading enterprises and the British Colonial Administration. The first branch of abank, called Bank of British West Africa Limited (BBWA), was set up for business in 1896 with the purpose

ofimporting silver coins from the Royal Mint and also providing banking andcurrency services to expatriate companies and the colonial administration (Mensah, 1997).

The period following the Second World Warsaw the commencements of a financial system which goes beyond a monetary system. The Bank of the Gold Coast was established in 1953 by the then Government and Alfred Engleston, formerly of the Bank of England. Fortunately, by 1957, three banks were established: The Colonial bank (nowBarclays Bank), the British Bank of West Africa and the Bank of Gold Coast. The formation of Bank of Gold Coast was in response to agitation from indigenous Africans for an indigenous bank thatwould be more serious to their borrowing needs(Newlyn & Rowan, 1954; Aryeetey, 1994;Mensah, 1997). The three banking institutions offered traditionalbanking services which included documentary credit (letters of credit); discounting bills of exchange; collection; and remittances (Mensah, 1997).

Furthermore, this period also witnessed the commencements of securitized finance. For instance on the initiative of theBank of the Gold Coast, the first Treasury bill issued was madewith the bank acting as agents for theflotationin July 1954. The bank also guaranteed to buy the bill at all times. This was the first attempt to create asecurities market(Aryeetey, 1994;Mensah, 1997). The Treasury bill issue was for a total of £500,000 of three-month Treasury Bills issued at 3/8 of 1%(Mensah, 1997).

According to Newlyn and Rowan (1954), displeasure with the foreign banks focused on their conservative lending policies, modelled on those employed

in the UK, and in particular their demands for the types of securitywhich were uncommon in Ghana. Therefore, at independence, the Bank of the Gold Coast was split into the Bank of Ghana (operating as a bank of issue to be developed into a complete central bank) and the Ghana Commercial Bank (to be developed into the largest commercial bank with a monopoly on the accounts of public corporation).

The Centrally Planned and Closed Economy Period (1960-83)

Bawumia (2010) described the periods (1957-1983) as the direct controls regime.In the immediate post-independence era, the government of Kwame Nkrumah espoused a socialistdevelopment strategy under which the state was to be principal in all aspects of economic policy making and implementation (Mensah, 1997). This period was characterized by import licensing;exchange controls; quantitative restrictions on interest rates; and forced lending programs including requirements for banks to lend to sectors of theeconomy which were considered priority sectors by the government(Mensah, 1997).

During this period, there were perceived gaps by the commercial banks which therefore, necessitated the establishment of development finance institutions (DFIs): the National InvestmentBank (NIB), in 1963, to provide long term finance for industry; the Agricultural DevelopmentBank (ADB) in 1965; to provide finance for agricultural purposes; the Bank for Housing and Construction (BHC), in 1974, toprovide loans for housing, industrial construction and companies producing buildingmaterials; and the Merchant Bank, in 1972, to offer

one-stop corporate banking services(Adjetey, 1978; Mensah, 1997).The DFIs mobilised funds from deposits as well as from government and foreign loans and undertook commercial banking activities as well as development banking.Also the Bank of Ghana provided credit guarantees to the banks to cover loans andadvances to industrial and agricultural enterprises.

The Structural Adjustment and Transition Period (1983-present)

Prior to this period, it was clear that the country was experiencing economic challenges therefore, by 1983 an attempt was made to reverse the situation. The Government, with the assistance and guidance of the International Monetary Fund (IMF), introduced the Economic Recovery Programme (ERP). This signaled the end of Socialism in Ghana and provided a useful tool for economic development (Aryeetey, Harrigan& Nissanke, 2000;Bawumia, 2010). The components of the economic recovery programme included devaluation of the currency; control of bank credit; dismantling of various forms of price and distribution controls; elimination of many subsidies; broadening of the tax base; restoration of macroeconomic balance; and public sector restructuring and downsizing (Aryeetey, Harrigan & Nissanke, 2000).

During the 1980s it was generally agreed that the success of the economic recovery programme is dependent onreforms and restructuring of the financial system. Therefore, with the technical and financial assistance from the International Development Agency (IDA), the government embarked upon a FinancialSector Reform Programme in 1988 (Mensah, 1997; Aryeetey, Harrigan

& Nissanke, 2000). The objectives of the programme were: to undertake the restructuring of financially distressed banks; to enhance the soundness of the banking system through an improved regulatory and supervisory framework; to improve the mobilization and allocation of financial resources – including the development ofmoney and capital markets. These objectives were supported by the IDA through a Financial Sector Adjustment Credit of US$100million (Mensah, 1997).

The financial sector adjustment programme can be grouped into two phase namely FINSAP I (1988-2000) and FINSAP II (2001-2008).Bawumia (2010) provided detailed information on what transpired in these two phases.

Table 1: Financial Sector Reform in Ghana

Financial Sector Adjustment Programme (FINSAP I) 1988 – 2000	**Financial Sector Adjustment Programme (FINSAP II) 2001 – 2008**

• Liberalization of interest rates and abolition of directed credit
• Restructuring of financially distressed banks
• Strengthening of the regulatory and supervisory framework
• Promotion of non-bank financial institutions:
  ○ discount houses
  ○ finance houses
  ○ acceptance houses
  ○ leasing companies
• Liberalization of the foreign exchange market
• Establishment of forex bureau
• Establishment of the Ghana Stock Exchange
	• Bank of Ghana Act 2002
	• Monetary Policy Committee (MPC) process – Transparency
	• Universal Banking
	• Abolishing Secondary Reserve Requirements
	• Banking Act 2004
	• Banking Amendment Act 2007 – Offshore Banking
	• Long Term Savings Act 2004
	• Venture Capital Trust Fund Act 2004
	• Payment System Act, 2003
	• Foreign Exchange Act 2006
	• Anti-Money Laundering Act 2008
	• Credit Reporting Act 2008
	• Licensing of first Credit Reference Bureau

Table 1 continued

Financial Sector Adjustment Programme (FINSAP I) 1988 – 2000	Financial Sector Adjustment Programme (FINSAP II) 2001 – 2008
• Banking Act 1989 • Bank of Ghana Law 1992, PNDCL 291 • Securities Industry Law 1993, PNDCL 333 • NBFI Law 1999, PNDCL 328 • Insurance Act 1989, PNDCL 227 Social Security Act 1991, PNDCL 247	• Establishment of a Collateral Registry • Borrowers and Lenders Act 2008 • Insolvency Act, 2003 • Home Finance Act 2008 • Non-Bank Financial Institutions Act 2008 • Central Securities Depository Act 2007 • National Pensions Act 2008 • Rural Banking Reforms: o ARB Apex Regulations 2006 (L.I. 1825) o Governance Reforms o Millennium Challenge Account – networking computerization, etc. • Payment and Settlement System Reforms: o Real Time Gross Settlement System (RTGS) o Automated Clearing House (ACH) o Cheque Codeline Clearing (CCC) o Ghana Interbank Payments and Settlement System (GHIPSS) • Strengthening of the regulatory and supervisory framework o Risk Based Supervision o Stress Testing • ISO 27001 Certification for the Bank of Ghana • Redenomination of the Currency

Source: Bawumia (2010)

Table 1 above shows the various phases of the financial sector reform in Ghana. It can be seen from Table 1 above that FINSAP I spanned for a period of 13 years which brought about the liberalization of interest rates and foreign exchange market, abolition of directed credit, restructuring of financially distressed banks, strengthening of the regulatory and supervisory framework and promotion of non-bank financial institutions. However, FINSAP II spanned for a period of 8 years which brought to fore several Acts such asBank of Ghana Act 2002, Insolvency Act, 2003, Banking Act 2004,Foreign Exchange Act 2006, Banking Amendment Act 2007, Central Securities Depository Act 2007, Anti-Money Laundering Act 2008, Credit Reporting Act 2008, Borrowers and Lenders Act 2008, Home Finance Act 2008, and Non-Bank Financial Institutions Act 2008. This period also led to the formation of the Monetary Policy Committee (MPC) as well as the redenomination of the currency.

Trends in Variables

There have been some changes in real income, interest rate, price level, real effective exchange rate and financial innovation in Ghana over the years. The trends in these variables are discussed below.

Trends in Real Narrow and Broad Demand for Money (RM1 and RM2)

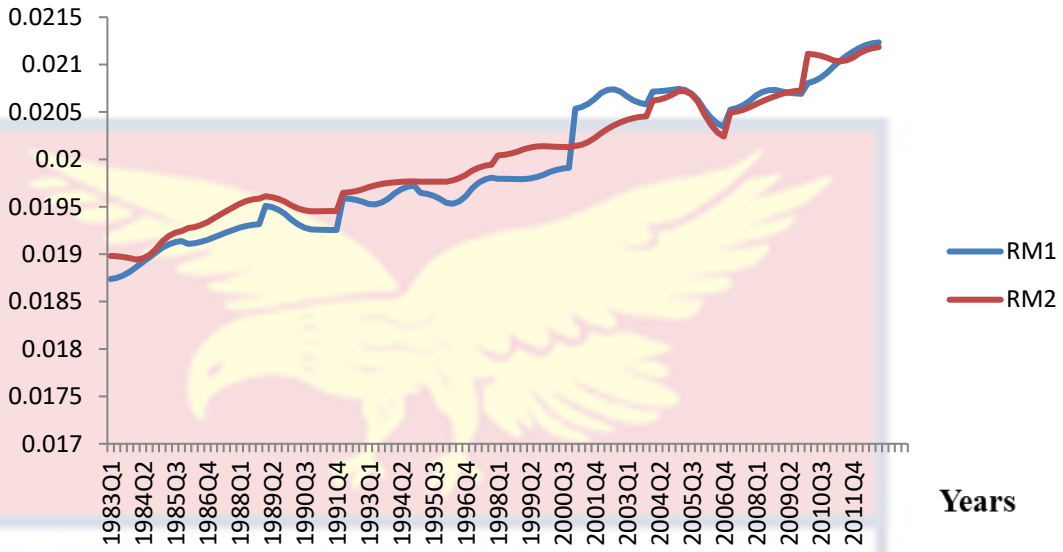


Fig 2: Trends in Real Narrow and Real Broad Demand for Money

Source: Generated by author using Microsoft excel 2010

Figure 2 above depicts the trend in real narrow demand for money (RM1) and real broad demand for money (RM1) using quarterly data for Ghana from 1983 to 2012. It can be seen that both real narrow and broad demand for money fluctuates (increases and decreases) over the study period. Both real narrow and broad demand for money recorded a lowest value in 1983Q1 and a highest value in 2011Q3 However, both real demand for money and real broad demand for money showed an increasing trend generally over the study period.

Trends in Real Income

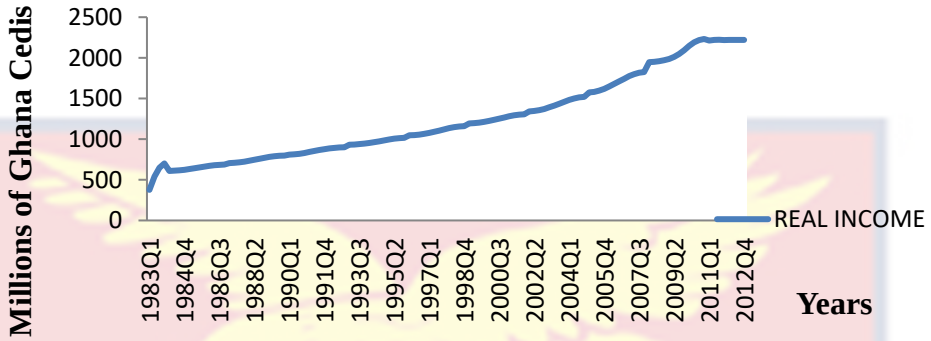


Fig. 3: Trends in Real Income

Source: Generated by author using Microsoft excel 2010

Figure 3 above shows the trend in real income using quarterly data for Ghana from 1983 to 2012. It is clear from the figure 3 above that real GDP generally showed an increasing trend over the study period. Furthermore, real GDP recorded a lowest value in 1983Q1 and a highest value in 2010Q1.

Trends in Interest Rate

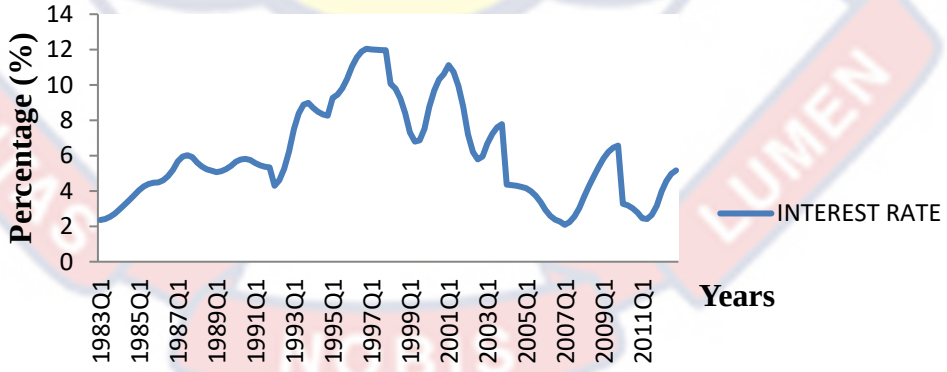


Fig 4: Trends in Interest Rate

Source: Generated by author using Microsoft excel 2010

Figure 4 above illustrates the trend in interest rate using quarterly data for Ghana from 1983 to 2012. It can be seen that interest rate fluctuates (increases and decreases) over the study period. For instance interest rate recorded a lowest value of 2 percent in 2007Q1 and a highest value of 12.1 percent in 1997Q1.

Trends in Price Level

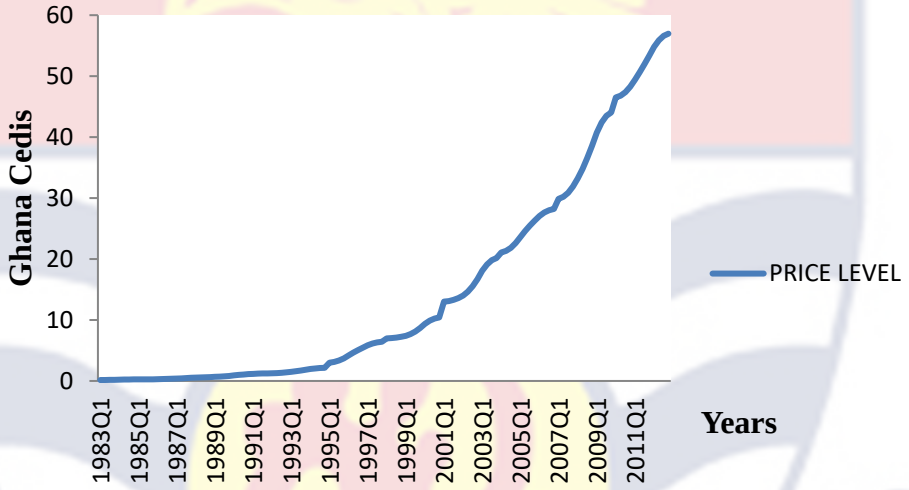


Fig. 5: Trends in Price Level

Source: Generated by author using Microsoft excel 2010

Figure 5 above shows the trend in price level using quarterly data for Ghana from 1983 to 2012. It is obvious from the figure 4 above that price level generally showed an increasing trend over the study period. However, the price level increases slowly from 1983Q1 to 1995Q1before shooting up spontaneously from 1995Q1 to 2011Q1.

Trends in Exchange Rate

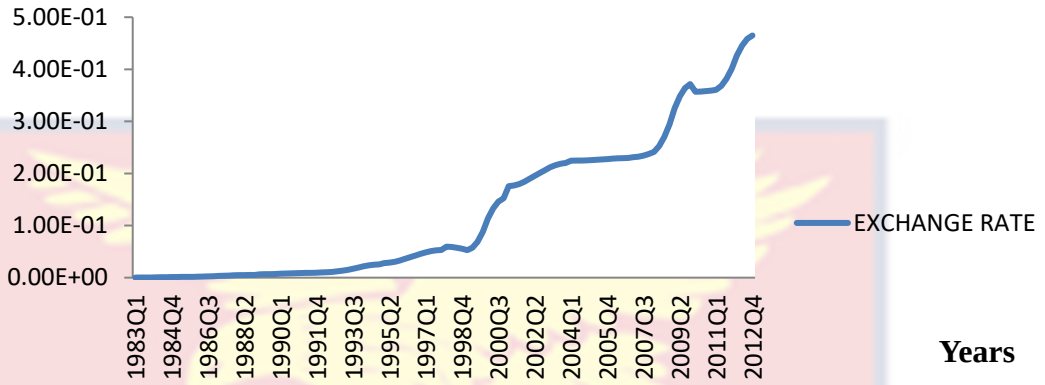


Fig. 6: Trends in Exchange Rate

Source: Generated by author using Microsoft excel 2010

Figure 6 above describes the trend in real effective exchange rate using quarterly data for Ghana from 1983 to 2012. It is evident from the figure 6 above that the exchange rate increases (depreciates) over the study period. However, there was a marginal appreciation of the real effective exchange rate from 1998Q1 to 1999Q1 and 2010Q1 to 2011Q1. Furthermore, the exchange rate increases (depreciates) slowly from 1983Q1 to 1998Q4 before shooting up spontaneously from 1998Q4 to 2012Q4.

Trends in Financial Innovation

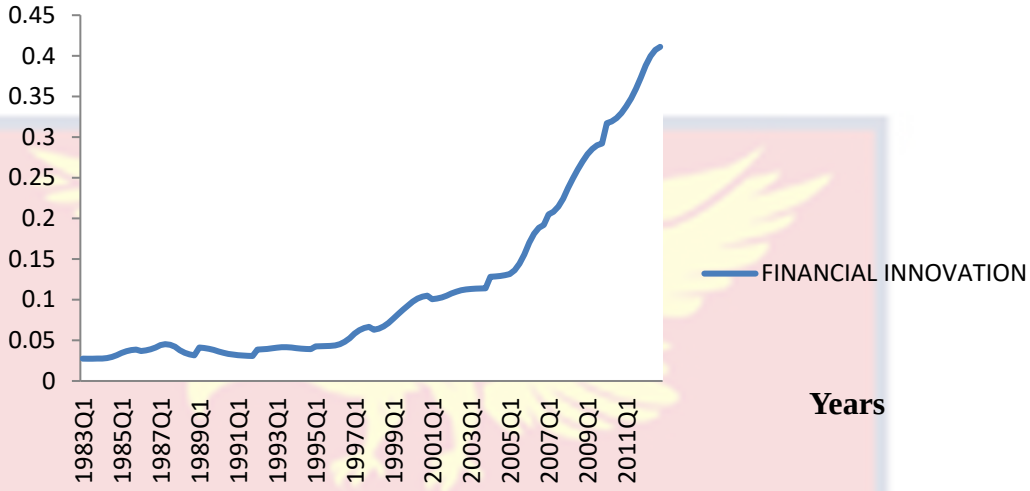


Fig. 7: Trends in Financial Innovation

Source: Generated by author using Microsoft excel 2010

Figure 7 above describes the trend in financial innovation using quarterly data for Ghana from 1983 to 2012. It can be seen that financial innovation generally increased over the study period. However, prior to financial sector reform in Ghana in 1988, financial innovation increases steadily as shown above, whilst it increases significantly after the financial sector reform.

CHAPTER THREE

REVIEW OF RELATED LITERATURE

Introduction

This chapter painstakingly presents the various theoretical and empirical studies on money demand. The first part of the chapter deals with the theoretical literature and the second reviews the various empirical researches on money demand, both in developed and developing countries, including Ghana.

Theoretical Literature Review

There is a diverse gamut of money demand theories. The theoretical underpinnings of the demand for money have been well established in the economic literature with widespread agreement that the demand for money is primarily determined by real cash balances. This theoretical development is based on the evolution of the definition and functions of money.

Money is defined by its functions: anything is money which is used as money. Money is what money does (Hicks, 1967;Ganda, 2000; Lewis & Mizen, 2000). Money is defined as the medium of exchange and the standard unit in which prices and debts are expressed (Ritter, Silber & Udell, 1997). It serves basically four functions: medium of exchange, store of value, unit of account and source of deferred payment (Laidler, 1995, Wesche, 1996; Lewis & Mizen, 2000). What then is the demand for money? Demand for money is the demand for real money balances; it is the amount of real cash balances that economic entities are willing to hold at any specific time. The demand for money can be defined as the

desire to hold money in liquid form rather than other forms of wealth such as stocks, bonds, etc. It often stems from three main motives, which are; transactionary, precautionary and speculative which are influenced by several factors; levels of income and wealth, rates of interest, expectations of economic agents and institutional features of an economy (Bannock & Davis, 1998). Put differently, it is the desire to hold cash or liquid assets rather than the equivalent in demand deposits. It is also known as liquidity preference.

The theoretical development on money demand, from the classical to the post-Keynesian economists, used the four major functions of money to formulate their theories of money (Teigen, 1971). Some of the theories of demand for money are Classical theory (Quantity Theory of Money), Keynesian, Monetarist (Friedman), Baumol and Tobin Model (Post-Keynesian), McKinnon and Shaw Model.

Classical theory (Quantity Theory of Money)

The literature on money demand comprises different theories. At the outset, the classical economists such as Schumpeter (1954) considers money merely as a veil to enable economic activities to occur since it is used as a numeraire to price products with no real effect on economic variables. Thus the classical economists limited their view of money to its function as a medium of exchange and propose that the most obvious reasons that households and businesses demand money is for facilitating transactions. Therefore, money is neutral in the sense that changes in money supply affects only the price level and

not real output. Money removes the problem of barter system, which was buffeted by a lack of double coincidence of wants. Then, the quantity theory of money took birth and which had two versions, separately developed by Fisher (1911) and Pigou (1917). This view was clearly expressed by the quantity theory of money. The first theory was Fisher's equation of exchange. This is written as:

$$MV = PT \qquad (1)$$

Where M is the money supply in circulation, Velocity of money (i.e. the number of times money is changing hands), Price level and T is the volume of transactions. This equation presents the difficulty that the associated data are not available for all transactions. With the development of national income and product accounts, emphasis shifted to national-income or final-product transactions, rather than gross transactions. Therefore, equation 1 was modified as:

$$MV = PQ \qquad (2)$$

Where M, V, and P are already defined but Q is output level. It is assumed thatV is constant and Y (long-run) is constant, therefore, a change in the nominal money supply (M) must lead to a proportionate change in the absolute price level (P).

The Cambridge Cash Balance Approach is another version of the quantity theory. This approach is more concerned with what determines the amount of money an individual agent would wish to hold given the desire to conduct transaction. The Cambridge School assumed that money was only held to

expedite transactions and had no further purpose. Thus, the Cambridge school were in effect attempting to set out a theory of the demand for money. When formalising their model the Cambridge economists particularly Pigou chose to simplify it by assuming that for an individual the level of wealth and the level of income over short period at least move in stable proportion to one another. They then argued that other things being equal the demand for money in nominal term is proportional to the nominal level of income for each individual and hence for the aggregate economy as well. Thus, they wrote a demand equation for money as:

$$M^d = kPy \quad \ldots\ldots(3)$$

Where M^d is the demand for money in nominal terms, Py is the nominal level of income and k is the fraction of spending that people have and own in the form of money balances – which might depend on other variables depending on individual choice or taste such as interest rate (opportunity cost) and wealth.

At equilibrium in the money market, demand for money is equal to the supply of money ($\overline{M^S}$) i.e. $M^d = \overline{M^S} = M$. Thus

$$M = kPy \quad \ldots\ldots(4)$$

But since k is inversely related with V (i.e. **k=1/V**), we can have $MV = PQ$ that is an equivalent expression to quantity theory formulation.

Keynesian Demand for Money

Keynes (1936) criticized the Cambridge equation precisely because it neglects the role of interest rates in determining the demand for money. He offered an alternative formulation of the demand for money which he calls 'liquidity preference' (Laidler, 1995). Thus he radically changed the money demand concept from "an all spending state" to "a hoarding state" since he views that there are three motives for holding money, in particular, the transactionary motive, the precautionary motive and the speculative motive (Laidler, 1995; Fry,1995).

The transactionary demand for money occurs on the back of non-synchronization of receipts and payments and its demand function is positively related to the level of income. According to Keynes, the transaction motive described the necessity of holding cash to bridge the gap between receipts and planned regular payments (Laidler, 1995; Fry,1995).

In a parallel manner, the precautionary demand for money is also positively related to the level of income but it is based on the need for holding money to cater for any unforeseen contingencies as and when required. He suggested that people also find it prudent to hold some cash in case they are not able to realise other assets quickly enough to be of use to them for those classes of payments that cannot be considered regular and planned such as paying unexpected bills. This he called the precautionary motives of holding money and suggested that both transaction and precautionary motives depends on the level of income (Laidler, 1995; Fry,1995).

Finally, people may hold speculative balances if they expect the market value of alternative assets to fall. The most appealing part of Keynes theory is the speculative demand for money, which is based on interest rate level and with an inverse relationship. Thus the speculative motive for holding money arises from the desire to maximize wealth (Laidler, 1995; Fry,1995).

The simplest form of the total Keynesian demand for money function is given by:

$$M_d = kY + l(r) \quad \text{.....(5)}$$

Where M_d is demand for money, kY is the transactions and precautionary which depend on the level of income (Y), and l(r) is the speculative balances depend on the current rate of interest, **k>0** and l < **0**.

Milton Friedman's View/Theory on Demand for Money

Friedman's view on demand for money draws attention away on why people hold money. His view considered factors that determine how much money people would love to hold under various circumstances. These factors are expected percentage rate of change of price level, and, the interest rate earned on holding other assets rather than money. Friedman view money just like any other assets, and money yields a flow of services just like any other assets, however his view did not show any analysis on how this flow of services are satisfied (Laidler, 1995).

Friedman's only analysis on the demand for money emphasized that, the more money held the lesser the valuable services are held (and vice-versa). He also talked about the diminishing marginal rate of substitution between goods and

consumption. Friedman accentuated the inclusion of wealth in the demand for money function and by wealth he means human capital and non-human capital. He recognized the problem of lack of market in human wealth, therefore according to him, the ratio of human to non-human wealth should be considered as a subsidiary variable in the demand for money. The opportunity cost of holding money is the income earned from holding bonds, equity and human wealth and the market forces determined the amount of holding bonds, and equity via interest rate (Laidler, 1995).

Friedman demand-for-money function is expressed as:

$$M_d = f(W, r - \frac{1}{r}\frac{dr}{dt}, \frac{1}{P}\frac{dP}{dt}, h)P \quad \text{.....(6)}$$

Where; M_d is demand for money, W is wealth, r is the rate of interest, h is the ratio of human to non-human wealth, P is the price level, and all the time derivatives denote expected rates of change. Other things being equal, the higher the expected rate of return to holding money, the more of it will be held and vice versa. However, the stability in the demand for money function by Friedman is not verified through empirical evidence, therefore, one cannot really say much about whether the variables used are significant without empirical evidence.

Another contribution of Friedman (1956) was his modification of the quantity theory. He argued that "the quantity theory is in the first instance a theory of the demand for money. It is not a theory of output, or, of money income, or of the price level".Therefore, his version of the quantity theory is expressed as follows:

$$M^{d} = kPy \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

According to Friedman, equation (7) can be interpreted as the demand for money function, with k (=1/v) behaviourally determined. It is not a theory about nominal income, Y = Py, because a supply of money function and a redefinition of equilibrium is needed to get to the determination of income. Furthermore, it is not a theory about P or y separately unless we know what determines the other (Lewis and Mizen, 2000).

Portfolio Approach to the Transaction Demand for Money (Post - Keynesian)

The theoretical work on the transaction demand for money by both Baumol (1952) and Tobin (1956) seeks to draw more precisely implication about the variables that determine the segment of the demand for money than Keynes' analysis did. They assumed that the individual agent receives an income payment once per time period (say, one month) and that the entire receipts of the agent are expended at a constant rate over the period. Then, the agent will hold some assets at every time period, except the final time period when last expenditure is made. The agent incur a brokerage fee every time wealth is switched between assets (money and bond only) and that the aim of the individual is to determine that level of bond holdings which will jointly maximize the returns from interest income and minimize brokerage cost (Laidler, 1995; Lewis & Mizen, 2000).

The total cost of making transactions (TC) is written as:

$$TC = c(\frac{T}{K}) + r(\frac{K}{2}) \quad \text{.....(8)}$$

Where T is the real value of the agent's income (or the real value of the volume of transaction carried out), K is the real value of bond turned into cash every time such transfer takes place, c is the brokerage fee, r is the rate of interest per period, $c(T/K)$ is the outlay in brokerage fee and $r(K/2)$ is the opportunity cost of holding money.

However, money holdings over the period have an average value of $K/2$ and so the demand for money equation will be:

$$\frac{M_d}{P} = \frac{K}{2} = \frac{1}{2}\sqrt{\frac{2cT}{r}} \quad \text{.....(9)}$$

Thus the demand for transaction balances measured in real terms is proportional to the square root of the volume of transactions and inversely proportional to the square root of the rate of interest. This can also be expressed as:

$$M_d = \frac{1}{2}\sqrt{\frac{2cT}{r}} * P$$

$$M_d = \frac{1}{2} c^{0.5} T^{0.5} r^{-0.5} P \quad \text{.....(10)}$$

Therefore, the amount of money for transaction purposes is a function of the real value of the agent's income (T), brokerage fee (c), interest rate (r) and price level (P).

One major contribution of Baumol and Tobin to the demand for money is that is that there are economies of scale in holding money.

McKinnon and Shaw Model

In 1973, McKinnon and Shaw challenged the dominant theoretical positions of Keynes, Keynesians and the structuralist economists on the ground that the crucial assumptions in these paradigms are erroneous in the context of developing countries. They therefore, advocate financial liberalization and development as growth-enhancing economic policies. This is because the financial repression such as interest rate ceiling, high reserve requirement, directed credit polices and discriminatory taxation of financial intermediaries has harmful effect on economic growth.

At this point, it is important to introduce McKinnon's 'complementarity hypothesis' and Shaw's 'debt-intermediation view'. McKinnon's complementarity hypothesis is the proposition that savings and investment are complement and that savings act a conduit for investment. Therefore, an increase in the rate of interest will increase savings which will increase investment and therefore, improve the rate of economic growth. McKinnon's formal analysis of how real deposit rate of interest rate affects savings, investment and economic growth in based on an outside money model and it is assumed that all economic units are confined to self-finance; and indivisibilities in investment are of considerable importance. Following Keynes' finance motive, McKinnon argued

that potential investors must accumulate money balances prior to their investment. The lower the opportunity cost of accumulating real money balances or the higher the real deposit rate of interest, the greater is the incentive to save. The McKinnon's complementarity hypothesis is reflected in the demand for money function below:

$$\frac{M}{P} = f(Y, \frac{I}{Y}, d - \pi^e) \quad \text{.....(11)}$$

Where M is the money stock, Y is real GNP, P is the price level, (I/Y) is the ratio of gross investment to GNP, and ($d - \pi^e$) is the real deposit rate of interest. But

$$\frac{I}{Y} = f(\bar{r}, d - \pi^e) \quad \text{.....(12)}$$

Where $\bar{r}$ is the average return on physical capital (McKinnon, 1973 in Fry, 1995). Thus the complementarity is expressed in $\frac{\partial(M/P)}{\partial(I/Y)} > 0$ and $\frac{\partial(I/Y)}{\partial(d-\pi^e)} > 0$.

However, Shaw discards Keynes' finance motive and the neoclassical monetary growth model in favour of the debt-intermediation view. This stems from the fact that there are significant differences in the financial systems in developed and developing countries. For instance the developed countries possess sophisticated and elaborate systems of financial institutions which facilitate intermediation between savers and investors, contrary to developing countries. Therefore, Shaw constructed a monetary model in which money is backed by productive investment loans to the private sector and that the amount of money stock, in relation to the level of economic activity, is positively related to the extent of financial intermediation between savers and investors through the

banking system. He thus proposed that improved financial intermediation through financial liberalization and financial development, increases the incentive to save and invest, thereby raising the average efficiency of investment. It emphasized that Shaw's debt-intermediation view is based on an inside money model which produces a demand or money function expressed as:

$$\frac{M}{P} = f(Y, v, d - \pi^e) \quad \text{.....(13)}$$

Where v is a vector of opportunity costs in real terms of holding money and the real yields on all forms of wealth, including money, is expected to have a positive effect on the saving ratio (Shaw, 1973 in Fry, 1995).

It is pointed out that in these first generation financial repression models (McKinnon and Shaw), the money demand is a function of the real deposit rate of interest ($d - \pi^e$). With d fixed, a rise in the expected inflation (π^e) reduces demand for money in real terms (M/P). Therefore, as the liabilities of the banking system contracts in real terms, its assets and hence its supply of credit for investment finance shrinks.

Empirical Literature Review

There have been a lot of empirical literatures on the issue of demand for money. The study looks at some studies in Ghana and then proceeds with some empirical literature on financial innovations and money demand in the other part of the world.

Empirical Literature Review for Ghana

Some of the empirical literature on financial innovations and money demand in Ghana are as follows:

To begin with, Dagher and Kovanen (2011) adopted the bounds testing procedure developed by Pesaran et al. (2001) to test the stability of the long-run money demand for Ghana. The results provide strong evidence for the presence of a stable, well-identified long-run money demand during a period of substantial changes in the financial markets. The empirical evidence points to complex dynamics between money demand and its determinants while suggesting that deviations from the equilibrium are rather short-lived.

Employing cointegration and error correction modelling, Mannah-Blankson and Belnye (2004) examined the impact of financial innovation resulting from the Financial Sector Adjustment Program (FINSAP) in Ghana launched in September 1987 on money demand. The findings from the study showed the long run demand for real money balances in Ghana to be driven by income, inflation, exchange rate and financial innovation with financial innovation exerting a positive influence on the money demand in the long-run. Short-run results showed changes in income, inflation and financial innovation as having a significant impact on money demand. Increases in innovations lead to an increase and a decrease in the demand for M1 and M2 respectively. Stability test results conducted indicate that both M1 and M2 are stable despite the growth in financial innovation in Ghana. However, the study failed to indicate how the

impact analysis was done and also ignored the transmission mechanism from financial innovation to demand for money.

In addition, Kallon (1992) examined whether the Ghanaian demand for real money balances was stable during the 1966:1 to 1986:4 period. The results failed to reject the null hypothesis of structural stability. The paper also finds evidence of the nominal adjustment specification as the appropriate short-run adjustment mechanism for the demand for real M1 balances. Furthermore, suggestion of foreign interest rates not having any significant effect on the demand for money in Ghana was evidenced.

Also, Ghartey (1998) examined the demand for money in Ghana employing the Engle-Granger (1987) as well as Johansen's (1988) co-integration and error-correction modeling techniques. Application of the CUSUM and CUSUMSQ tests reveal that, in Ghana the demand for money is stable but that the adjustment is rather slow.

Empirical Literature Review for the Rest of the World

Some of the empirical literature on financial innovations and money demand in for other parts of the world are as follows:

Firstly, Iyoboyi and Pedro (2013)estimated a narrow money demand function of Nigeria from 1970 to 2010 using autoregressive distributed lag bounds test approach to cointegration. The empirical results found cointegration relations among narrow money demand, real income, short term interest rate, real expected exchange rate, expected inflation rate, and foreign real interest rate in the period

under investigation. Real income and interest rate are significant variables explaining the demand for narrow money in Nigeria, although real income is a more significant factor in both the short and long term.

Secondly, Nagayasu (2012) analysed the effect of financial innovation on money demand using the panel cointegration method. Using Japanese regional data and the money demand specification, the results first provided evidence of instability in the simple money-output relationship. However, when this relationship was extended to include a proxy for a comprehensive measure of financial innovation, the model was found to be stable. Furthermore, consistent with economic theory, evidence is obtained of financial innovation leading to decreased demand for liquid financial assets. However, the study failed to indicate the transmission mechanism from financial innovation to money demand.

Using the Error Correction Model approach, Ramlall (2012) investigated the long run and short-run components of the broad money demand function in Mauritius for the period spanning from 2000 to 2009. The results from the study showed that M2 is positively elastic with respect to GDP, with the elasticity coefficient revolving around 2.80%. The low adjustment coefficient for VECM further substantiates the fact that there is indeed a lack of alternative assets to M2 and above all fully justifies the transition from monetary targeting to interest rate targeting. Evidence was found in favour of foreign asset substitution but only through the exchange rate channel. Findings further showed that the local stock market does not act as a substitute to local money holdings. Overall, the study points out a rather stable demand for money function in Mauritius so that the

monetary authority can contemplate using it as a complementary tool but chiefly for long-run policy assessments.

In addition, Lungu, Simwaka, Chiumia, Palamuleni, and Jombo (2012) analyzed the money demand function for Malawi during the period of 1985-2010 using monthly data. Cointegration test results indicate a long-run relationship amongst real money balances, prices, income, exchange rate, Treasury bill rate and financial innovation. However, the study failed to indicate how financial innovation was measured and the transmission mechanism from financial innovation and money demand.

Furthermore, Herve and Shen (2011) employed Juselius and Johansen cointegration test with time series data covering the period of 1980-2007 to demonstrate that there is a long run equilibrium relationship between money supply and its main determinants, real income (GDP) and interest rate in Cote d'Ivoire. The results showed that there is long-term relationship among these variables as well as the linkage between them. And that only real money balance has significant long –run economic impact of variations in monetary policy in Cote d'Ivoire. However, the study also revealed that the effect of aggregate is not so stable linking with it determinants. However, the study failed to show the linkages between the variables.

Using a comparative analysis of the effectiveness of the determinants of the demand for money, Yamden (2011a) examined the determinants of the demand for money in developing and the developed countries. It was found out that income related factors or the scale variables are more effective in the

developing countries while factors that work through the financial system are more effective in the developed economies and that stock market variables should not be ignored in modeling demand for money even in emerging economies since they constitute an alternative to holding cash.

Again, Yamden (2011b) examined the demand for money in Nigeria. The study used annual time series spanning 26 years on both narrow and broad money, income, interest rate, exchange rate and the stock market. The study found out that money demand function is stable in Nigeria for the sample period and that income is the most significant determinant of the demand for money.

Moreover, Misati, Lucas, Anne and Shem (2010) empirically examined the effect of financial innovation on monetary policy transmission focusing on the interest rate channel through which the Central Bank implements monetary policy. The study used Two Stage Least Squares (2SLS) and monthly data covering the period, 1996-2007 and established that financial innovation dampens the interest rate channel of monetary transmission mechanism.

In addition, Odularu andOkunrinboye (2009) analysed whether financial innovations that occurred in Nigeria after the Structural Adjustment Programme of 1986 has affected the demand for money in Nigeria using the Engle and Granger Two-Step Cointegration technique. Though the study revealed that demand for money conforms to the theory that income is positively related to the demand for cash balances and interest rate has an inverse relationship with the demand for real cash balances, it was also discovered that the financial innovations introduced into the financial system have not significantly affected

the demand for money in Nigeria. However, this study used dummy to represent financial innovation which might not necessarily be true.

Sumner (2009) estimated the long-run demand for money function using an unrestricted error-correction model which incorporates short-run dynamics for Thailand from 1953 to 2002. The results revealed that the demand for real money balances is a stable function of a scale variable and a coherent measure of opportunity cost, with all the properties predicted by economic theory.

Also, Nair, Samudram, and Vaithilingam (2008) examined the long-run and short-run behaviour of the demand for money (M1, M2, and M2+) in Malaysia using unrestricted error correction model (UECM) and the Bounds test (Pesaran, Shin, & Smith, 2001) to determine if the demand for money is cointegrated with real income, interest rate, and the price level. The Bounds test revealed that the demand for M1, M2, and M2+ are cointegrated with its determinants at the 1% level of significance. Thus, the long-run demand for money was found to be stable. However, this study is critiqued for using only three independent variables for the estimation

Also, Baharumshah (2004) investigated the money demand function for Malaysia in the 1971–1996 period using the multivariate cointegration and error correction model methodology. The results suggest that a stable long-run relationship exist between real M2, the interest rate differential, income and stock prices. Stock prices have a significant negative substitute effect on long-run as well as short-run broad-money demand (M2). The analysis from the vector error correction model (VECM) and causality tests found that money is endogenous

and that there is at least a unidirectional relationship between stock prices and real M2.

Using quarterly Mexican data for the period 1978:1 to 2000:4, RodrGuez and Turner (2003) estimated the demand functions for broad money and foreign currency deposits. The results from the Johansen cointegration tests revealed significant evidence for currency substitution in the broad money equation. While the demand function for foreign currency deposits is harder to interpret, significant evidence of substitution between domestic money balances and US$ deposits is found.

Moreover, Valadkhani (2002) examined the long-run determinants of the demand for M2+ in New Zealand employing the Johansen cointegration technique and quarterly data for the period 1988:1-2002:2- the results showed that the demand for money is cointegrated with real income, the spread between interest on money and on non-money assets, the expected rate of inflation, and the real effective, (trade weighted index) exchange rate. However, the study failed to indicate how the expected rate of inflation was captured.

Additionally, Buch (2001) analysed the determinants and the stability of money demand functions in Hungary and Poland using monthly data for the years 1991 through mid-1998, using an error-correction framework. The results suggested that long-run parameters are in line with economic theory and therefore, money demand functions can serve as a useful reference for monetary authorities.

Using autoregressive distributed lag approach to cointegration analyses, Siddiki (2000) estimated the demand for real broad (M2) money in Bangladesh from 1975 to 1995 using the most recently developed autoregressive distributed lag approach to cointegration analyses. The empirical results show that there is a unique cointegrated and stable long-run relationship among real per capita broad money demand, real per capita income, domestic interest rates and unofficial exchange rate (UM) premiums which act as a surrogate for foreign interest rates. With money as the dependent variable, the results showed that the income and interest elasticities are positive while the UM premium elasticity is negative. However, the study is critiqued on the basis of using unofficial exchange rate instead of real effective exchange rate.

Pedro (1998) analysed the effect of financial innovation on the demand for narrow money in Portugal between 1970 and 1996 using an error-correction model. The results show no signs of model instability. Also the shifts observed in the velocity of circulation seem to be unrelated to the development of financial innovation.

Furthermore, Hamori and Hamori (1999) empirically analysed the stability of the money demand function in Germany using both quarterly (1969:1 to 1989:4; 1969:1 to 1994:1) and monthly data (January 1969 to December 1989) using Johansen's (1988) co-integration and the error correction model (ECM). The results revealed a stable relationship between money supply and real economic activity, and the money demand function was stable prior to German re-unification. The stability of money demand tends to be rejected, however, when

the sample period was extended to cover German re-unification, and that the structural change occurred around 1990.

Finally, Thornton (1998) examined the demand for money function in Italy over the period 1861-1980 using Johansen procedure of cointegration. The results from the Johansen procedure of cointegration indicate a unique, long-run demand function for currency and the broad money supply and that the real income and interest rate elasticities accord reasonably well with expectations from monetary theory in terms of size and sign. It was also disclosed that both currency and the money supply broadly defined are suitable aggregates with which to consider the long-run economic impacts of changes in monetary policy in Italy.

Conclusion

This chapter dealt with the review of related literature, both theoretical and empirical. However, it first provided a brief background of the financial sector in Ghana including the various Financial Sector Adjustment Programmes from 1988 to 2000 and from 2001 to 2008 as well as financial innovation developments in Ghana. Furthermore, this chapter reviewed some theories of demand for money such as Classical theory (Quantity Theory of Money), Keynesian, Monetarist (Friedman), Baumol and Tobin Model (Post-Keynesian), McKinnon and Shaw Model. Finally, this chapter provided some empirical literature on financial innovation and demand for money and noted that financial innovation affected the demand for money negatively.

CHAPTER FOUR

METHODOLOGY

Introduction

This chapter deals with the methodology employed in the study. The chapter is divided into the following headings; specification of the model including theoretical, empirical and econometric. Finally the chapter looked at the definition and measurement of variables of the model and a priori expected signs, estimation techniques, sources of data in the study, and conclusion.

Theoretical and Empirical Model Specification

Keynes (1936) suggested three motives for holding money; transactionary, precautionary and speculative motive. The transactionray and precautionary motives are a function of income. However, for the speculative motive, Keynes extended another function of money i.e. the store of value, which is dependent on the rate of return (interest rate). Therefore, this is specified as:

$$M^d = f(\overset{+}{y}, \overset{-}{r}) \quad \text{.....(14)}$$

Where M^d is the demand for money, y is income level (transactionary and precautionary motive) and r is the interest rate (speculative motive). There exist a positive relationship exist between the demand for money and income while an inverse relationship exist between the demand for money and interest rate.

However, Friedman (1956), Baumol (1952) and Tobin (1956) made a case for the inclusion of a variable that represents price level in modeling the demand for money. Therefore, model (14) was modified as:

$$M^d = f(\overset{+}{y}, \overset{-}{r}, \overset{\pm}{P}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

Where P is the price level, which is either positively or negatively related to the demand for money.

Furthermore, in an open economy, the external sector should not be ignored. In the light of this, Essien, Onwioduokit and Osho (1996)suggested that attempts should be made to capture the influence of exchange rate movement. Domowitz and Elbadawi (1987) suggested that the influence of the rate of change of parallel market exchange rate or its premium on the holdings of domestic currency vis-à-vis holdings of foreign exchange or other forms of durable assets could be strong enough to validate the use of the parallel market rate as the true opportunity cost variable. The introduction of the exchange rate into the demand for money function yields the following;

$$M^d = f(\overset{+}{y}, \overset{-}{r}, \overset{\pm}{P}, \overset{-}{exr}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

Where exr is the exchange rate between domestic currency and foreign currency, which has an inverse relationship with the demand for money.

Finally, the effect of financial innovation on the demand for money has received keen interest in both developed and developing countries. Hence, model (16) was modified as:

$$M^d = f(\overset{+}{y}, \overset{-}{r}, \overset{\pm}{P}, \overset{-}{exr}, \overset{\pm}{finnov}).....(17)$$

Where $finnov$ is the financial innovation index, which is either positively or negatively related to the demand for money.

Econometric Model Specification

There are 3 basic issues involved in specifying the demand for money function: the definition of money; the variables to be used; and the stability of the money demand relationships. However, it must be noted that specific features pertaining to developing countries and to developed countries tend to affect these issues differently. From the theoretical literature, a money demand specification should include a monetary aggregate, a scale variable and opportunity cost variables.The econometric models are specified as:

$$(RM1)_t = \alpha + \beta_1 y_t + \beta_2 r_t + \beta_3 P_t + \beta_4 exr_t + \beta_5 finnov_t + \varepsilon_t .....(18)$$

$$(RM2)_t = \alpha + \beta_1 y_t + \beta_2 r_t + \beta_3 P_t + \beta_4 exr_t + \beta_5 finnov_t + \varepsilon_t .....(19)$$

Where

$(RM1)_t$ = Real demand for narrow money at time t;

$(RM2)_t$ = Real demand for broad money at time t;

y_t = Real income level at time t (proxy by real GDP);

r_t = Domestic rate of interest at time t (proxy by 91-Day TB rate);

P_t = Price level at time t (proxy by the consumer price index);

exr_t = Exchange rate at time t (proxy by real effective exchange rate);

$finnov_t$ = Financial innovation index at time t;

ε_t = Stochastic disturbance term;

$\alpha, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are parameters to be estimated and the a priori expected signs are given as $\alpha > 0, \beta_1 > 0, \beta_2 < 0, \beta_3 >< 0, \beta_4 < 0, \beta_5 >< 0$.

Laidler (1995) and Lewis and Mizen (2000) stressed that irrespective of sample and frequency chosen, data must always be converted into natural logarithm in order to smoothen out the variation in the data, and for easier interpretation of the parameter estimates in terms of elasticities. The choice of the variables included in the above model was based on the literature, economic theory, available data, and their significance to the model chosen for the study. However, there is no need to take the natural logarithm of interest rate in the model (18) and model (19) since it has its values in percentages with the exception of real demand for money, real income, exchange rate and financial innovation. Furthermore, financial innovation is an index and there is no need to take the natural logarithm because there is very little variation in the values.

Therefore, model (18) and model (19) were modified as:

$$\ln(RM1)_t = \alpha + \beta_1 \ln y_t + \beta_2 r_t + \beta_3 \ln P_t + \beta_4 \ln exr_t + \beta_5 \ln finnov_t + \varepsilon_t \ldots (20)$$

$$\ln(RM2)_t = \alpha + \beta_1 \ln y_t + \beta_2 r_t + \beta_3 \ln P_t + \beta_4 \ln exr_t + \beta_5 \ln finnov_t + \varepsilon_t \ldots (21)$$

Definition, Measurement and Justification of Variables

Monetary Aggregates (M1and M2)

Demand for money is the demand for real money balances; it is the amount of real cash balances that economic entities are willing to hold at any specific time (Lewis and Mizen, 2000).The nature of the financial system varies from one country to another which also influences the choice of the monetary aggregates. Empirical studies in developing countries employed narrow money (M1) and broad money (M2) as appropriate monetary aggregate. However, for the purpose of this study, real M1 and real M2 were used separately as the measure of real demand for money. This is because M2 is an improvement in M1 and shows that Ghana is doing well in terms of savings deposits and time deposits.Moreover, it is possible that the explanatory variables will have different effects on both M1 and M2.M1 is the sum of M0 and demand deposits (where M0 consists of total reserves held by banking systems plus currency held in the hands of the public). M2 is the sum of M1, savings deposits, and time deposits. M2+ is the sum of M2 and foreign currency deposits.

Real Income (y)

The choice of scale variable has generated controversy among economists. Generally, current income, permanent income, wealth, industrial production and consumption expenditure have all been used as a scale variable (Sriram. 1999). However, most of the studies in developing countries employed current income, proxy by GDP. Therefore, for the purpose of this study, it is considered germane

to use real GDP as a proxy for real income. The rationale for the choice of real GDP is motivated by the fact that there is readily available data for the GDP whilst data on wealth is non-existent. Therefore, the study employs real GDP as an indicator for economic activities in Ghana. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. The real GDP is expected to have a positive relationship with the demand for money.

Domestic Interest Rate (r)

It must be underscored that an important issue in the specification of the demand for money function is the choice of opportunity cost variable. The interest rate is therefore, the opportunity cost of holding money. Generally, 3-month Treasury bill, deposit rate, lending rate, and interest rate spread have all been used as a scale variable. However, following Frimpong (2011), the domestic 3-month Treasury bill was used as a proxy for domestic interest rate for this study. This is because the TB is guaranteed by government, hence risk free asset. The domestic rate of interest is expected to have a negative relationship with the demand for money.

Price Level (P)

Friedman (1956), Baumol (1952) and Tobin (1956) made a case for the inclusion of a variable that represents price level in modeling the demand for money. For the purpose of this study, the consumer price index (CPI) was used as

a proxy for inflation. The World Bank defines consumer price index as the annual percentage change in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The price level is a reflection of macroeconomic instability. The price level is expected to have either a positive or negative relationship with the demand for money.

Exchange Rate (exr)

Exchange rate between two currencies is the price of one currency in terms of another. In other words the exchange rate is the price of the domestic country's goods and services relative to the prices of goods and services of other countries. This is chosen because changes in the exchange rate affect the country's demand for money leading to currency substitution. Depreciation or appreciation of the exchange rate results in portfolio shift between domestic and foreign currency. Some studies employed the nominal exchange rate especially the GH¢ per US$ as the exchange rate (Obeng, 2000; and Awuye, 2012). This is because since 1983, the exchange rate in Ghana has been depreciating against the major currencies of the world, particularly the US dollar. This has necessitated the acceptance of major foreign currencies by businessmen and traders as means of exchange and as superior store of value.

However, this study employed the real effective exchange rate to account for the overall performance of the domestic currency against the major trading countries. The real effective exchange rate is obtained by the product of the

nominal effective exchange rate and effective relative price indexes or nominal exchange rate i.e. an index of tracking a country's "average" exchange rate divided by a price deflator.

Financial Innovation (finnov)

Financial innovation involves a change in the type and variety of available financial and a change in financial intermediaries (such as banks) and in markets, themselves (Gubler, 2011). There are many indicators of financial innovation in the literature with their measurements strengths and weaknesses.

Mannah-Blankson and Belnye (2004) used the volume of cash card transactions in the Ghanaian economy and the ratio of broad money to narrow money, (M2/M1) as proxies to measure financial innovation. This is because the use of cash card represents ATMs, credit cards, money transfer cards, point of sale devices, debit cards, which have become common in the payment system.

Similarly, Carbó Valverde, López Del Paso, and Rodríguez Fernández (2007) applied the ratio of mutual fund business to GDP as proxy for product innovation, while ATM/branches were also used for technical change for regional distribution channels. Nagayasu (2012) employed bank concentration and per capita ATM as proxies for financial innovation.

Michalopoulos, Laeven and Levine (2009) proxy financial innovations by the growth of the ratio of bank credit to the private sector to GDP. This measurement is directly associated with the banking sector's ability to ensure allocation efficiency through credit allocation.

However, this study constructed an index of financial innovation using the principal component analysis (PCA). The variables used were the ratio of domestic credit to the private sector to GDP, the ratio of domestic credit provided by banking sector to GDP, and M3 to GDP.

Domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government. The banking sector includes monetary authorities and deposit money banks, as well as other banking institutions where data are available (including institutions that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other banking institutions are savings and mortgage loan institutions and building and loan associations (World Bank, 2013).

Domestic credit to private sector refers to financial resources provided to the private sector, such as loans, purchases of nonequity securities, and trade credits and other accounts receivable that establish a claim for repayment. For some countries these claims include credit to public enterprises (World Bank, 2013).

The ratio of domestic credit to the private sector to GDP and the ratio of domestic credit provided by banking sector to GDP indicate the level of financial services issued on merit and also the promotion of innovation and research and development in an economy.Michalopoulos, Laeven and Levine (2009) also argued that these ratios are directly associated with the banking sector's ability to ensure allocation efficiency through credit allocation. The higher the values of

these ratios,the low transaction and information costs and the higher level of financial intermediation and financial innovation (or development)(Beck&Leevine, 2000).

The ratio of M3 to GDP is the size of the financial intermediaries or depth as it captures the overall size of the financial sector as a percentage of GDP. This ratio is an indicator of the liquidity provision in the economy.It is also important to underscore that M3 is an improvement in M2 due to the inclusion of foreign currency deposits, whiles M2 is an improvement inM1 due the inclusion ofsavings deposits and time deposits.The financial system of Ghana has, thus, improved in terms of new products (deposits) as clarified above. Therefore, increases in the ratio of M3 to GDP can be linked to an improvement in financial innovation.

Construction of Financial Innovation

Principal Components Factor Analysis (PCA)

Factor analysis is a statistical technique which explains a set of observed variables in terms of a smaller number of latent variables called factors. These latent factors are assumed to account for the correlations among observed variables. The study employed factor analyses using the principal components approach to explore the relationships among the different financial innovation indicators variables and to identify which individual variables of financial innovation belong together.

The factor analysis investigated whether the ratio of domestic credit to the private sector to GDP, the ratio of domestic credit provided by banking sector to GDP, and ratio of M3 to GDP were distinct from one another. Appendix A shows the results of the factor analysis. The Kaiser-Guttman criterion (only the eigenvalues that are greater than one) that only one factor be kept as shown Table 2A in Appendix A. Therefore, for the purposes of the analysis, the study created one index. This prevents contaminating the included variables with noise with those variables that do not load strongly on a factor (DeVellis, 2003).

Test for Determining Appropriateness of Factor Analysis

It must be accentuated that in order to verify the statistical assumptions of linearity, normality and homoscedasticity for factor, a number of tests need to be carried out. According to Hair, Black, Babin, Anderson, and Tatham (2006), there are several approaches to determine whether the correlation in the data set is sufficient for factor analysis. One of such factors is examination of the correlation matrix. It is a simple way to determine the appropriateness of a matrix for factoring. From the perspective of homogeneity, by using factor analysis, low correlation coefficients throughout the matrix may indicate that factoring is inappropriate (Stewart, 1981). According to Hair et al., (2006), factor analysis is only appropriate if visual inspection of the correlation matrix reveals a substantial number of correlations greater than 0.30. Table 1A in Appendix A shows that satisfied this condition since the correlation among the variables are greater than 0.30.

Kaiser-Meryer-Olkin measure of sampling adequacy (MSA) approach tries to quantify the degree of interrelations among the variables and the appropriateness of factor analysis (Hair et al., 2006). The index ranges from 0 to 1, reaching 1 when each variable is perfectly predicted without error by the other variables (Hair et al., 2006). Kaiser and Rice (1974) summarised different levels of MSA: 0.90+ (marvelous); 0.80+ (meritorious); 0.70+ (middling); 0.60+ (mediocre); 0.50+ (miserable); and below 0.50 (unacceptable). Table 4A in Appendix A shows an overall kmo value of 0.5664which is greater than 0.50, therefore, Kaiser-Meryer-Olkin measure of sampling adequacy is satisfied.

Factor Extraction in principal Components Factor Analysis

Hair et al., (2006) recommends that if there are a lager set of variables, factor extraction procedures should be started by extracting the combinations of variables that explain the greatest amount of variance. The extraction then proceeds to the combinations that account for the smaller amount of variance and so onwards. There are two common criteria used to determine the number of factors to extract. These include: (1) latent root criterion; (2) screen plot.

The latent root criterion is the most commonly used technique to represent the amount of variance in the original variables that is associated with a factor (Aaker, Kumar, Day & Lawley, 2005). Each variable contributes a value of 1 to the total eigenvalue (Hair et al., 2006). If the factors have latent roots or eigenvalues greater than 1, they are considered significant. Any other factors with lower eigenvalues should be disregarded (Hair et al., 2006; Stewart, 1981).

Steps Involved in Principal Component Analysis (PCA)

The steps involved in constructing an index using the PCA are as follows:

Step 1: Subtracting the mean from each data dimension

For PCA to work properly, the mean must be subtracted from each of the data dimensions. The mean subtracted is the average across each dimension. Thus all the x_i values have $\bar{x}_i$ (the mean of the x_i values of all the data points) subtracted, and all the y_i values have $\bar{y}_i$ subtracted from them. This produces a data set whose mean is zero. Luckily, this is automatically computed by stata.

Step 2: Calculating the covariance matrix

The next step is to compute the covariance matrix. The definition for the covariance matrix for a set of data with n dimensions is given by:

$$C^{n\times n} = (c_{i,j}, c_{i,j} = \text{cov}(Dim_i, Dim_j)) \quad \text{.....(22)}$$

Where $C^{n\times n}$ is a matrix with n rows and n columns, Dim_i and Dim_j are the *ith* and *jth* dimensions respectively. Here again stata will automatically compute the covariance matrix.

Step 3: Calculating the eigenvectors and eigenvalues of the covariance

The next step is to take the eigenvectors of the covariance matrix in order to extract lines that characterise the data. These eigenvectors and eigenvalues are generated by stata automatically.

Step 4: Choosing components and forming a feature vector

In general, once eigenvectors are found from the covariance matrix, the next step is to order them by eigenvalue, highest to lowest. This gives you the components in order of significance. A matrix of vectors called feature vector must be formed. This is constructed by taking the eigenvectors that you want to keep from the list of eigenvectors, and forming a matrix with these eigenvectors in the columns. This is given by:

$$\text{Feature vector} = (eig_1 eig_2 eig_3 ... eig_n) \quad \text{.....(23)}$$

Where eig_n is the nth eigenvector.

Step 5: Deriving the new data set

This is the final step in PCA, and is also the easiest. Once the components (eigenvectors) that are appropriate to keep in the data have been chosen and formed a feature vector, then this vector needs to be transposed and multiply it on the left of the original data set, transposed. Thus:

$$\text{Final Data} = \text{Row Feature Vector} * \text{Row Data Adjust} \quad \text{.....(24)}$$

Where row feature vector is the matrix with the eigenvectors in the columns transposed so that the eigenvectors are now in the rows, with the most significant eigenvector at the top, and row data adjust is the mean-adjusted data transposed, i.e. the data items are in each column, with each row holding a separate dimension. In general, this is given by:

$$\text{Final data} = \sum_{i=1}^{k} (FV)_i * (DA)_i \quad \text{.....(25)}$$

Where $(FV)_i$ is the row feature vector, which is shown in Table 3A in Appendix A, $(DA)_i$ is the row data adjust, and k is the particular variable used.

Sources of Data

The study employed secondary quarterly time series data spanning from 1983(1) to 2012(4) on macroeconomic variables such as money supply, GDP, 91-Day Treasury bill rate, consumer price index, real effective exchange rate, ratio domestic credit provided by the banking sector to GDP, ratio of domestic credit to private sector to GDP. Data were sourced mainly from Bank of Ghana (BoG) and World Development Indicators (WDI). Variables such as money supply (M1, M2, and M3), and 91-Day Treasury bill rate were sourced from BoG whiles the remaining variables were sourced from WDI. It is important to underscore that a measure for financial innovation was constructed using indicators such as the ratio of domestic credit to the private sector to GDP, ratio of M3 to GDP, and the ratio of domestic credit provided by banking sector to GDP.

Estimation Techniques

As with all time series analysis, this study first of all, investigates the time series properties of the data by using the Augmented Dickey-Fuller (ADF) and the

Philip-Perron (PP) tests. The study will conduct unit root tests check the stationarity properties of the time series data. The study then proceeded to test for the long-run and short-run relationships among the variables using the Autoregressive Distributed Lag (ARDL) approach.

Unit Root Tests

The importance of the stationarity phenomenon arises from the fact that almost all the entire body of statistical estimation theory is based on asymptotic convergence theorems i.e., the weak law of large numbers, which assume that all data series are stationary. Nevertheless, in reality, non-stationarity is extremely common in macroeconomic time-series data. Thus treating nonstationary series as if they were stationary will bias the Ordinary Least Squares (OLS) and thus result in misleading economic analysis. Thus, the model will systematically fail to predict outcomes and can also lead to the problem of spurious (nonsensical/misleading) regressions where R-squared is approximating unity, *t* and *F*-statistics look significant and valid. In essence, the problem lies with the presence of nonsensical regression that arises where the regression of non-stationary series, which are known to be unrelated, indicates that the series are correlated. Hence, there is often a problem of incorrectly concluding that a relationship exists between two unrelated non-stationary series. This problem generally increases with the sample size, and is not normally solved by including a deterministic time trend as one of the explanatory variables in order to induce stationarity.

By definition a series is said to be stationary if it has a constant mean and a constant finite variance. On the contrary, a non-stationary series contains a clear time trend and has a variance that is not constant overtime. If a series is non-stationary, it will display a high degree of persistence i.e. shocks do not die out. A series Xt is said to be integrated of order *d*, denoted as I(*d*), if it must be differenced *d* times for it to become stationary. For example, a variable is said to be integrated of order one, or I(1), if it is stationary after differencing once, or of order two, I(2) if differenced twice. If the variable is stationary without differencing, then it is integrated of order zero, I(0).

Therefore, stationarity tests are a prerequisite before conducting most econometric works. Thus in time series analysis it is always a prerequisite to assess the stationarity status of all the variables before one can go on to undertake co-integration tests, in order to avoid spurious regression results. This is necessary due to the presence of deterministic trend or unit root in the data generating process (Hamilton, 1994;Lütkepohl & Krätzig, 2004) and to determine the order of integration of the variables (Lütkepohl & Krätzig, 2004). Even though, Nelson and Plosser (1982) argued that most of economic data have the presence of unit root rather than deterministic trend, one cannot emphatically conclude that with a given time series data set unless required test is done.

There are various methods of testing the presence of a unit root in a time series data. However, most studies use the ADF test and Dickey and Fuller (1979). The Augmented Dickey Fuller (ADF) test is used to determine the order of integration of the data. It is however well established in literature that the ADF

test has very low power in the presence of structural breaks as under such circumstances, it is biased towards nonrejection of a unit root. This test is, therefore, augmented by the Phillip Perron (PP) unit root test. While the former uses augmentation to whiten residuals, the latter uses non-parametric correction. However, they remain the most widely used in literature.

In general terms, we specify economic models based on the assumption that the variables are stationary. After the model has been specified, the variables are then tested for unit root (stationarity) using the Augmented Dickey-Fuller (ADF) tests. The simplest form of the unit root test or stationarity follows a simple random walk. We estimate an *AR (p)* which is given below:

$$X_t = \alpha X_{t-1} + \varepsilon_t \text{...} (26)$$

$\varepsilon_t \sim iid(0, \sigma_\varepsilon^2)$

From the stated equation, the assumption is that the underlining data generating process is $AR(1)$. Thus, it is assumed that the variable X is influence by the past observation and an innovation (shock) and ε_t is a white noise process. The variable is pure random walk, with $\alpha = 1$. Since the X_t is a random walk, it follows that, the variable is not integrated at the level hence there is the need to difference it to induce stationarity and find the order of integration (Koop, Poirier, & Tobias, 2007). Differencing X_t gives:

$$\Delta X_t = (1-\alpha)\Delta X_{t-1} + \varepsilon_t \text{...............................} (27)$$

It must be noted that the above regression is an example of what is sometimes called an unbalanced regression since, under the null hypothesis, the

regressand is I(0) and the sole regressor is I(1). Under the alternative hypothesis, both variables are I(0), and the regression becomes balanced again (Davison & Mackinnon, 1999). To test for stationarity among variables, the test follows an Ordinary Least Squares approach by estimating the above equation (Greene, 2012). The Dickey-Fuller equation following the above equation can be given as:

$$\Delta X_t = \rho \Delta X_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (28)$$

It follows that $\rho = (1-\alpha)$, hence if $\rho = 0$ then $\alpha = 1$ and if $\rho < 0$ then, $\alpha < 1$. Therefore, the Dickey-Fuller test the hypothesis for stationary / unit root on the behaviour of the ρ. It must be said that the DF test is a negative tail test (Enders, 2005; Hamilton, 1993). The hypothesis for the unit root test is given as:

$H_o : \rho = 0$ (There is unit root-non-stationarity) against the alternative

$H_a : \rho < 0$ (There is no unit root-stationary)

The DF test uses three basic underlining equations in testing for the presence of unit root of any time series data. The first formulation is the basic AR (1) with no constant (drift) term or deterministic trend. The second formulation includes a drift and the third formulation includes a drift and a deterministic trend terms in the model. These variants are expressed in the following equations.

$$\Delta X_t = \rho X_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (29)$$
$$\Delta X_t = c + \rho X_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (30)$$
$$\Delta X_t = c + \delta t + \rho \Delta X_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (31)$$

The variables c and t are constant and trend terms respectively. Equation 23 is however, very restrictive in the underlining assumptions.

The augmented Dickey–Fuller (ADF) unit root test is used to determine whether the variables are of stationary status. The ADF test controls for higher-order correlation by adding lagged difference terms of the dependent variable to the right-hand side of the regression. The Augmented Dickey-Fuller test (Dickey & Fuller, 1979) involves running a regression on first difference of the series, on the series itself, lagged once, or with more lagged difference terms, a constant and a time trend.

$$\Delta X_t = c_1 + c_2 t + c_3 X_{t-1} + \ldots + c_p \Delta X_{t-p} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (32)$$

Where X denotes the variable in question, Δ is the first difference operator, and $c_1, c_2, c_3, \ldots, c_p$ are parameters to be estimated, and ε_t is the stochastic random disturbance term.

It would seem natural to assess the significance of the ADF statistic using the normal table. However, under H_0, X_t is non-stationary, so conventional normal asymptotic are invalid. An alternative asymptotic framework has been developed to deal with non-stationary data.

The ADF calculated (tau statistic) is compared with the critical value. If the tau value is more negative than the critical values, the null hypothesis is failed to be rejected. The conclusion drawn in such case is the series are stationary. Conversely, if the tau statistic is less negative than the critical values, we fail to reject the null hypothesis and conclude that the series is non-stationary. This is because, the alternative hypothesis is one-sided, the ADF test rejects H_0 in favour of H_1 when ADF $< \varsigma$, where ς is the critical value from the ADF table. If the test does not reject H_0, a common conclusion is that the data suggests that Xt is non-

stationary. This is not really a correct conclusion, however it could be said that there is insufficient evidence to conclude whether the data are stationary or not. Yet, in the implied sense, we can say that the variables are not stationary.

If the variables are not stationary, linear regression techniques could result in highly correlated result among the variables. In such series, the value of any given data would be determined largely by the value of the preceding data point in the series. This autocorrelation must be controlled before inferences may be made about the correlation with other variables. If not controlled, this would lead to spurious results (Yule cited in Gujarati, 2000).

Cointegration Tests

The concept of cointegration has been widely used to test long-run relationships. Thus cointegration is an econometric concept which mimics the existence of a long-run equilibrium among economic time series. If two or more series are themselves nonstationary, but a linear combination of them is stationary, then they are said to be cointegrated (Wei, 2007). For instance supposing real money balances, real income and interest rate are non-stationary variables with a unit root and a linear combination of these non-stationary variables is stationary, then any deviation from the relation is temporary and the relation holds in the long run. If such a linear combination exists, the variables are said to be cointegrated.

The co-integration technique has been employed to test the linear relationship among the variables in our model (Engle &Granger, 1987; Johansen,

2002; Krichene, 1998). If a linear relationship of the variables yields a stationary error term, μ_t then it could be said that, the variables are said to be co-integrated. This implies an existence of a long run relationship between the variables. This means there is a general stochastic trend among these variables that makes it very unlikely for them to deviate from each other infinitely.

It is important to underscore that the widely used methods to test for cointegration include the two-step procedure of Engle and Granger (1987), the full information maximum likelihood-based approach of Johansen (1988), Johansen and Juselius (1990), Fully modified Ordinary Least Squares (FMOLS) by Philip and Hansen(1990) and the Connical Cointegration Regresion by Park (1992). These methods require that the variables under consideration must, as a matter of necessity, be integrated of order one. Hence, stationarity test must be done.

This pre-testing is argued to be problematic in the unit-root-cointegration literature where there is a very low power of the unit-root tests and in situations where there is a switch in the distribution function of the test statistics as one or more roots approach unity (Persaran, 1997). In light of this problem, a certain degree of uncertainty is introduced into the analysis. In addition, these tests suffer from low power and do not have good small sample properties (Cheung & Lai, 1993). Due to these limitations, this study makes use of a new approach to co-integration that has become much popular in recent years.

The methodology used here is based on the recently developed autoregressive distributed lag (ARDL) framework (Pesaran and Shin, 1995, 1999;

Pesaran *et al*,1997; Pesaran, 1997; Pesaran *et al*, 2001) which does not involve pre-testing of variables, thereby obviating uncertainty. In other words, it does not matter if the underlying regressors are purely *1(0),* purely *I*(1), or mutually cointegrated, the ARDL approach to testing for the existence of a relationship between variables in levels is applicable. The statistic underlying the procedure is the Wald or F-statisticin a generalised Dickey-Fuller regression, which is used to test the significance of lagged levels of the variables in a conditional unrestricted equilibrium correction model (ECM) (Pesaran *etal.*, 2001).

Again, the ARDL is very simple and the co-integration relationship to be estimated using OLS once the lag order of the model is identified unlike the multivariate Co-integration technique by Johansen and Juselius (1990). Moreover, the test is relatively more efficient in small or finite sample sizes. Estimates derived from Johansen-Juselius method of co-integration are not robust in small sample relative to the bounds test approach.

Another advantage of the ARDL is that it allows for inclusion of dummy variable in the co-integration test process. In addition, Tang, (2006) stated that, the ARDL approach is also applicable when the explanatory variables are endogenous and is sufficient to simultaneously correct for residual serial correlation. Also, where one is not sure about the unit root properties of the data, then applying the ARDL procedure is more appropriate model for empirical work. The above reasons, therefore, justify the adoption of the ARDL model for this study is reasonable.

Bound Testing Procedure

The study moves on to estimate the short run and long run coefficients by following the Unrestricted Error Correction Model (UECM) with unrestricted intercepts and no trends based on the assumption by Pesaran *etal* (2001). The conditional ADRL model is specified as:

$$\Delta \ln(RM1)_t = \alpha_0 + \beta_1 \ln(RM1)_{t\text{-}i} + \beta_2 \ln y_{t\text{-}i} + \beta_3 r_{t\text{-}i} + \beta_4 \ln P_{t\text{-}i} + \beta_5 \text{Inexr}_{t\text{-}i} + \beta_6 \ln finnov_{t-i} + \sum_{t=1}^{T} \lambda_1 \Delta \ln(RM1)_{t-i} + \sum_{t=1}^{T} \lambda_2 \Delta \ln y_{t-i} + \sum_{t=1}^{T} \lambda_3 \Delta r_{t-i} + \sum_{t=1}^{T} \lambda_4 \Delta \ln P_{t-i} + \sum_{t=1}^{T} \lambda_5 \Delta \ln exr_{t-i} + \sum_{t=1}^{T} \lambda_6 \Delta \ln finnov_{t-i} + \varepsilon_i \text{.....(33)}$$

$$\Delta \ln(RM2)_t = \alpha_0 + \beta_1 \ln(RM2)_{t\text{-}i} + \beta_2 \ln y_{t\text{-}i} + \beta_3 r_{t\text{-}i} + \beta_4 \ln P_{t\text{-}i} + \beta_5 \text{Inexr}_{t\text{-}i} + \beta_6 \ln finnov_{t-i} + \sum_{t=1}^{T} \lambda_1 \Delta \ln(RM2)_{t-i} + \sum_{t=1}^{T} \lambda_2 \Delta \ln y_{t-i} + \sum_{t=1}^{T} \lambda_3 \Delta r_{t-i} + \sum_{t=1}^{T} \lambda_4 \Delta \ln P_{t-i} + \sum_{t=1}^{T} \lambda_5 \Delta \ln exr_{t-i} + \sum_{t=1}^{T} \lambda_6 \Delta \ln finnov_{t-i} + \varepsilon_i \text{.....(34)}$$

Where $\Delta's$ are the first difference operators, $\beta's$ are the long run multipliers, $\lambda_1, \lambda_2, ..., \lambda_6$ are the short run coefficients to be estimated through the error correction framework in the ARDL models, $\alpha_0's$ are the constant terms (drift) and $\varepsilon_t's$ are the white noise error terms.

The first step in the ARDL approach is to estimate equations (33) and (34) by applying OLS. The second step is to test the null hypothesis of no long run relationship among the variables in equation (33) and (34) against the alternative hypothesis of the presence of a long run relationship among the variables using F-test denoted by $F_{RMi}(MD_i | y, r, P, exr, finnov)$ and it is given by:

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$$

$H_1 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 \neq 0$

Given that the asymptotic distribution of F-statistic is non-standard without considering the independent variables being I (0) or I (1), Peseran et al. (2001) generated and presented the appropriate critical values according to the number of independent variables in the models of presence or absence of constant term or time trend in the models. Therefore, the calculated F-statistic is compared with two sets of critical values developed on the basis that the independent variables are I (d), where $0 \leq d \leq 1$. Here, the lower critical bound assumes that all variables are I (0) whereas the upper critical bound assumes that the variables are I (1). If the calculated F-statistic exceeds upper critical value, then the null hypothesis of no co-integration is rejected irrespective of whether the variables are I (0) or I (1). This signifies that, there are long-run relationships among the variables.

On the other hand, if the F-statistic falls below the lower bound then the null hypothesis of no co-integration cannot be rejected. Additionally, if the F-statistic lies within the lower critical and upper critical bounds, then, the test is inconclusive (Peseran & Peseran, 1997). However, when all the variables are integrated of order zero (i.e. I (0)), then the null hypothesis of no co-integration is rejected implying that there exist long-run relationships among the variables, otherwise they are not co-integrated.

Long-Run and Short-Run Dynamics

Provided that co-integration is established from the ARDL, then the next step will be to estimate the following ARDL $(p, q_1, q_2, q_3, q_4, q_5)$ models in order to obtain the long run coefficients (estimates) in the equations above. These are given by:

$$\ln(RM1)_t = \pi_0 + \sum_{i=0}^{p} \lambda_1 \ln(RM1)_{t-i} + \sum_{i=0}^{q_1} \lambda_2 \ln y_{t-i} + \sum_{i=0}^{q_2} \lambda_3 r_{t-i} + \sum_{i=0}^{q_3} \lambda_4 \ln P_{t-i} + \sum_{i=0}^{q_4} \lambda_5 \ln exr_{t-i} + \sum_{i=0}^{q5} \lambda_6 \ln finnov_{t-i} + \mu_t \quad (35)$$

$$\ln(RM2)_t = \pi_0 + \sum_{i=0}^{p} \lambda_1 \ln(RM2)_{t-i} + \sum_{i=0}^{q_1} \lambda_2 \ln y_{t-i} + \sum_{i=0}^{q_2} \lambda_3 r_{t-i} + \sum_{i=0}^{q_3} \lambda_4 \ln P_{t-i} + \sum_{i=0}^{q_4} \lambda_5 \ln exr_{t-i} + \sum_{i=0}^{q5} \lambda_6 \ln finnov_{t-i} + \mu_t \quad (36)$$

Provided there exist long run relationships among the variables, then the unrestricted ARDL error correction representations (short run) are estimated as:

$$\Delta \ln(RM1)_t = \sigma_0 + \sum_{i=0}^{p} \alpha_1 \Delta \ln(RM1)_{t-i} + \sum_{i=0}^{q_1} \alpha_2 \Delta \ln y_{t-i} + \sum_{i=0}^{q_2} \alpha_3 \Delta r_{t-i} + \sum_{i=0}^{q_3} \alpha_4 \Delta \ln P_{t-i} + \sum_{i=0}^{q_4} \alpha_5 \Delta \ln exr_{t-i} + \sum_{i=0}^{q5} \alpha_6 \Delta \ln finnov_{t-i} + \phi ECT_{t-i} + \mu_t \quad (37)$$

$$\Delta \ln(RM2)_t = \sigma_0 + \sum_{i=0}^{p} \alpha_1 \Delta \ln(RM2)_{t-i} + \sum_{i=0}^{q_1} \alpha_2 \Delta \ln y_{t-i} + \sum_{i=0}^{q_2} \alpha_3 \Delta r_{t-i} + \sum_{i=0}^{q_3} \alpha_4 \Delta \ln P_{t-i} + \sum_{i=0}^{q_4} \alpha_5 \Delta \ln exr_{t-i} + \sum_{i=0}^{q5} \alpha_6 \Delta \ln finnov_{t-i} + \phi ECT_{t-i} + \mu_t \quad (38)$$

From equations (37) and (38) the $\alpha's$ are the coefficients relating to the short run dynamics of the convergence to equilibrium, ECT_{t-i} is the error

correction term resulting from the estimated long run equilibrium relationship, and ϕ is the coefficient denoting the speed of adjustment to long run equilibrium when there is a shock in the system. The coefficient of the lagged error correction term, ϕ,is expected to be negative and statistically significant to further confirm the existence of a cointegrating relationship among the variables in the model. Here, the residuals from the co-integration equation, lagged one (1) period is defined as:

$$ECT_{t1} = (RM1) - \sigma_0 + \sum_{i=1}^{p} \phi_{1i} \Delta \ln(RM1)_{t-i} - \sum_{i=0}^{q_1} \phi_{2i} \Delta y_{t-i} - \sum_{i=0}^{q_2} \phi_{3i} \Delta r_{t-i} - \sum_{i=0}^{q_3} \phi_{4i} \Delta \ln P_{t-i} - \sum_{i=0}^{q_4} \phi_{5i} \Delta \ln exr_{t-i} - \sum_{i=0}^{q5} \phi_{6i} \Delta \ln finnov \quad (39)$$

$$ECT_{t1} = (RM2) - \sigma_0 + \sum_{i=1}^{p} \phi_{1i} \Delta \ln(RM2)_{t-i} - \sum_{i=0}^{q_1} \phi_{2i} \Delta y_{t-i} - \sum_{i=0}^{q_2} \phi_{3i} \Delta r_{t-i} - \sum_{i=0}^{q_3} \phi_{4i} \Delta \ln P_{t-i} - \sum_{i=0}^{q_4} \phi_{5i} \Delta \ln exr_{t-i} - \sum_{i=0}^{q5} \phi_{6i} \Delta \ln finnov \quad (40)$$

Engle and Granger (1987) argue that when variables are co-integrated, their dynamic relationship can be specified by an error correction representation in which an error correction term (ECT) computed from the long-run equations must be incorporated in order to capture both the short-run and long-run relationships. It is worth mentioning that the error term indicates the speed of adjustment as stressed above to long-run equilibrium in the dynamic models. In other words, its magnitude shows how quick the variables converge to equilibrium when they are being disturbed. It is expected to be statistically significant with a negative sign. The negative sign indicates that any shock that

occurs in the short-run will be corrected in the long-run. Therefore, the larger the coefficients of the error correction term in absolute terms, the faster the convergence to equilibrium.

Diagnostics Tests

Post estimation tests were carried out to ensure the robustness and goodness of fit of the model used for the study. In order to very whether the estimates obtained from the model are efficient, the study will carry out a serial correlation test. The study employed the Lagrange Multiplier (LM) Test of Breusch (1978) and Godfrey (1978). The LM serial correlation test has some advantages over the Durbin-Watson test for serial correlation. Unlike the Durbin-Watson statistic, the LM test may be used to test for higher order ARMA errors, and is applicable whether or not there are lagged dependent variables. The LM tests the null hypothesis of no serial correlation up to the selected maximum lag length.

The study also employed the Regression Specification Error Test (RESET) proposed by Ramsey (1969) to ascertain whether the functional form of the model used in the study is correctly specified. The RESET is a general test for incorrect functional form, omitted variables as well as the correlation between regressors and the error term (Hall, Lilien, & Johnston, 1995). The RESET, test the null hypothesis that the correct specification of the model is linear against the alternative that the correct specification is non-linear. To examine the normality properties of the error term, the study will employ the Kurtosis test of normality.

Also to make sure the estimated coefficients are efficient heteroscedasticity test was conducted. For the test of stability, the structural stability test will be conducted by using the Cumulative Sum (CUSUM) of recursive residuals and the Cumulative Sum of Squares (CUSUMSQ) of recursive residuals as suggested by Pesaran and Pesaran (1997). This will be used to determine whether the coefficients of the estimated model are stable over the study period.

Granger Causality Tests

The study of causal relationships among economic variables has been one of the main objectives of empirical econometrics. According to Engle and Granger (1987), co-integrated variables must have an error correction representation. One of the implications of Granger representation theorem is that if non-stationary series are co-integrated, then one of the series must granger cause the other (Gujarati, 2001). Granger (1998) states in Granger representation theorem that if two variables are stationary of order one i.e. I(1) and cointegrated, then either the first variable causes the second variable or vice versa. To examine the direction of causality in the presence of co-integrating vectors, Granger causality test is conducted based on the following specifications:

$$\Delta Y_t = \delta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta Y_{t-i} + \sum_{i=0}^{p} \phi_{1i} \Delta X_{t-i} + \pi_{1i} ECT_{t-1} + \nu_t \quad \text{.....(41)}$$

$$\Delta X_t = \delta_0 + \sum_{i=1}^{p} \beta_{2i} \Delta X_{t-i} + \sum_{i=0}^{p} \phi_{2i} \Delta Y_{t-i} + \pi_{2i} ECT_{t-1} + u_t \quad \text{.....(42)}$$

Where ΔY and ΔX are our non-stationary dependent and independent variables, ECT is the error correction term, π_{1i} and π_{2i} are the speed of adjustments, p is the optimal lag order while the subscripts t and t-i denote the current and lagged values. If the series are not co-integrated, the error correction terms will not appear in equations 41 and 42. To find out whether the independent variable (X) granger-causes the dependent variable (Y) in equation 41, we examine the joint significance of the lagged dynamic terms by testing the null hypothesis:

$H_0 : \phi_{1i} = 0$, implying that the independent variable (X) does not granger-cause the dependent variable (Y), against the alterative hypothesis that

$H_1 : \phi_{1i} \neq 0$, implying that the independent variable (X) granger-causes the dependent variable (Y).

Similarly, to find out whether the independent variable (Y) granger-causes the dependent variable (X) in equation 42, we examine the joint significance of the lagged dynamic terms by testing the null hypothesis:

$H_0 : \phi_{2i} = 0$, implying that the independent variable (Y) does not granger-cause the dependent variable (X), against the alterative hypothesis that

$H_1 : \phi_{2i} \neq 0$, implying that the independent variable (Y) granger-causes the dependent variable (X).

Using the standard F-test or Wald statistic, four possibilities exist: First, rejection of the null hypothesis in equation 41 but failing to reject the null in equation 42 at the same time implies unidirectional causality running from X to

Y.Second, a rejection of the null hypothesis in equation 42 but at the same time failing to reject the null in equation 41 implies unidirectional causality running from *Y* to *X*. Third, simultaneous rejection of the two null hypotheses in equations 41 and 42 indicates bi-directional causality. Fourth, simultaneous failure to reject the two null hypotheses in both equations indicates independence or no causality between the variables of interest.

Tools for Data Analysis

The study employed both descriptive and quantitative analyses. Charts such as graphs and tables were employed to aid in the descriptive analysis. Unit roots tests were carried out on all variables using the Augmented Dickey-Fuller (ADF) and Philip-Perron tests to ascertain their order of integration in order to do away with spurious regression. Additionally, the study adopted the Autoregressive Distributed Lag (ARDL) econometric methodology test for co-integration of the variables introduced and popularised by Peseran and Peseran (1997), Peseran and Shin (1999), and Peseran et al. (2001) in order to obtain both the short and long-run estimates of the variables involved and also Granger causality test was conducted to determine the direction of causality between the dependent variable and the independent variables. All estimations were carried out using Econometric Microfit 4.1 and Eviews 5.0 software packages.

Conclusion

The chapter three presented the methodological framework that is suitable for the purpose of conducting the study. This study follows Keynes (1936); Friedman (1956); Baumol (1952); Tobin (1956); Teriba (1992); Essien, Onwioduokit and Osho (1996); Elbadawi (1992); and Mannah-Blankson and Belnye (2004) to specify the econometric model for demand for money using M1 andM2 that incorporate the element of financial innovation. It was emphasized that the study will employ annual time series data on real M1, real M2, real M3, real GDP, 91-Day Treasury bill rate, nominal and real effective exchange rate, and financial innovation index (constructed using indicators such as the ratio of domestic credit to the private sector to GDP, the ratio of domestic credit provided by banking sector to GDP, and the ratio of M3 to GDP) from 1983 to 2012. The time series data were sourced from BoG and WDI.

Furthermore, Augmented Dickey-Fuller and Philip-Perron (PP) were conducted to ascertain the stationarity status of the time series variables. The study employed the Autoregressive Distributed Lag (ARDL) econometric methodology to determine the long-run and short-run relationships among the variables. Finally, the study conducted the Granger causality test to establish the direction of causality between the real demand for money and financial innovation.

CHAPTER FIVE

RESULTS AND DISCUSSION

Introduction

This chapter presents and discusses thoroughly the estimation results. The results of the descriptive statistics of the relevant variables, both ADF and PP unit root tests to assess the stationarity status of the variables, Autoregressive Distributed Lag (ARDL) approach to cointegration and Granger-causality test results were presented and discussed. These results were discussed in relation to the hypotheses of the study.

Unit Root Tests

It was indicated in chapter four that one distinguishing feature of the bounds test (ARDL) approach to cointegration is that it does not necessitate the testing of the variables for unit roots because the variables may be either *I(0) or I(1)*. Nevertheless, it is also worthwhile to perform this test to verify that the variables are not integrated of an order higher than one. Thus the aim is to ascertain the absence or otherwise of *I*(2) variables so as to avoid problem of spurious regression. Thus, in order to ensure that some variables are not integrated at higher order, there is the need to complement the estimated process with unit root tests.

For this reason, before applying Autoregressive Distributed Lags approach to cointegration and Granger-causality test, unit root test was conducted in order to investigate the stationarity properties of the data. As a result, all the variables were examined by first inspecting their trends graphically. The Augmented

Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were applied to all variables in levels and in first difference in order to formally establish their order of integration. The optimal number of lags included in the test was based on automatic selection by Schwarz-Bayesian Criterion (SBC) and Akaike Information Criterion (AIC). The study used the P-values in the parenthesis to make the unit root decision, (that is, rejection or acceptance of the null hypothesis that the series contain unit root) which arrived at similar conclusion with the critical values. The unit root test results are presented below.

Table 2: Results of Unit Root Tests with Constant only: ADF Test

Levels			First Difference			
Variables	ADF-Statistic	Lag	Variables	ADF-Statistic	Lag	*I(O)*
lnRM1	-0.4597 [0.8939]	0	DlnRM1	-9.6302 [0.0000]***	0	*I*(1)
lnRM2	-0.1382 [0.9417]	0	DlnRM2	-9.2244 [0.0000]***	0	*I*(1)
Finnov	9.4289 [1.0000]	0	Dfinnov	-5.8939 [0.0000]***	0	*I*(1)
Lny	2.5227 [1.0000]	0	Dlny	-8.8354 [0.0000]***	0	*I*(1)
R	-1.6067[0.4760]	5	Dr	-8.4042[0.0007]***	0	*I*(1)
LnP	-3.3503[0.0148]**	0	DlnP	-9.1890[0.0000]***	0	*I*(0)
Lnreer	-5.7766[0.000]***	1	Dlnreer	-5.7673 [0.0000]***	0	*I*(0)

Note: *** indicate the rejection of the null hypothesis of non stationary at 1% level of significance, Δ denotes first difference, and *I(O)* is the order of integration. The values in parenthesis are the P-values.
Source: Computed by the author using Eviews 5.0 Package

The results of ADF test for unit root with intercept only in the model for all the variables are presented in Table 2 above. The null hypothesis is that the series is non-stationary, or contains a unit root. The rejection of the null

hypothesis for the test is based on the MacKinnon (1991) critical values as well as the probability values. It is clear from the unit root test results that with the exception of lnP and lnreer, the null hypothesis of the presence of unit root for all the other variables in their levels cannot be rejected since the P-values of the ADF statistic are not statistically significant at any of three conventional levels of significance. This means lnP and lnreer are stationary at their level with intercept so there is no need first differencing them. However, at first difference, all the other variables are stationary.

Table 3: Results of Unit Roots Test with Constant only: PP Test

Levels			First Difference			
Variables	PP-Statistic	BW	Variables	PP-Statistic	BW	*I(O)*
lnRM1	-0.5521 [0.8757]	3	DlnRM1	-9.6502[0.0000]***	2	*I*(1)
lnRM2	-0.1382 [0.9417]	0	DlnRM2	-9.2244 [0.0000]***	2	*I*(1)
Finnov	9.4288 [1.0000]	0	Dfinnov	-5.8939 [0.0000]***	6	*I*(1)
Lny	1.9293 [0.9998]	5	Dlny	-8.9825 [0.0000]***	6	*I*(1)
R	-1.5093 [0.5256]	1	Dr	-8.4361 [0.0000]***	2	*I*(1)
LnP	-2.8061 [0.0604]*	6	DlnP	-9.6302 [0.0000]***	5	*I*(0)
Lnreer	-8.1596 [0.0000]***	15	Dlnreer	-5.6646 [0.0000]***	8	*I*(0)

Note: *** indicate the rejection of the null hypothesis of non stationary at 1% level of significance, Δ denotes first difference, and *I(O)* is the order of integration. The values in parenthesis are the P-values.
Source: Computed by the author using Eviews 5.0 Package

The results of PP test for unit root with only intercept in the model for all the variables are also presented in Table 3 above. The PP unit root test results also confirmed the conclusion revealed by the ADF in Table 2 above. Thus all the

variables except lnP and lnreer are non-stationary at levels. This is because the P-values of the PP statistic are not statistically significant at any of the conventional levels of significance. This means there is no need to use the first difference of lnP and lnreer. However, at first difference, all the other variables are stationary since the null hypothesis of the presence of unit root (non-stationary) is rejected at 1 percent significant levels for all the series. This suggests that lnP and lnreer are integrated of order zero, *I(0),*whiles the rest of the variables are integrated of order one, I(1), when only intercept is in the model.

Table 4: Results of Unit Root Tests with Constant and Trend: ADF Test

Levels			First Difference			
Variables	ADF-Statistic	Lag	Variables	ADF-Statistic	Lag	*I(O)*
lnRM1	-2.2577[0.4532]	0	DlnRM1	-9.5895 [0.0000]***	0	*I*(1)
lnRM2	-2.4092[0.3730]	0	DlnRM2	-9.1691 [0.0000]***	0	*I*(1)
Finnov	3.1361 [1.0000]	0	Dfinnov	-7.9228 [0.0000]***	0	*I*(1)
Lny	1.2278 [1.0000]	0	Dlny	-8.8354 [0.0000]***	0	*I*(1)
R	-2.0654[0.5592]	5	Dr	-8.4851[0.0000]***	0	*I*(1)
LnP	0.3829 [0.9988]	0	DlnP	-10.0399 [0.000]***	0	*I*(1)
Lnreer	-5.68[0.000]***	1	Dlnreer	-6.2734 [0.0000]***	0	*I*(0)

Note: ***, **, and * indicate the rejection of the null hypothesis of non stationary at 1% , 5% and 10% level of significance respectively, denotes first difference, and *I(O)* is the order of integration. The values in parenthesis are the P-values.
Source: Computed by the author using Eviews 5.0 Package

The results obtained for ADF test for unit root with both intercept and trend in the model for all the variables are presented in Table 4 above. It can be

seen that with the exception of only lnreer (which is stationary at level), the rest of the variables are non-stationary at levels. This is because the P-values of the ADF statistic are not statistically significant. However, when these variables are differenced for the first time they become stationary. This is because the null hypothesis of the presence of unit root (non-stationary) is rejected at 1 percent significant levels.

Table 5: Results of Unit Root Test with constant and trend: PP Test

Levels			First Difference			
Variables	PP-Statistic	BW	Variables	PP-Statistic	BW	*I(O)*
lnRM1	-2.6873[0.2438]	4	DlnRM1	-9.6101[0.0000]***	2	*I*(1)
lnRM2	-2.8993[0.1666]	3	DlnRM2	-9.1897[0.0000]***	2	*I*(1)
Finnov	2.7969[1.0000]	1	Dfinnov	-7.9565[0.0000]***	2	*I*(1)
Lny	0.5929 [0.9994]	5	Dlny	-9.1036[0.0000]***	6	*I*(1)
R	-1.8919[0.6525]	1	Dr	-8.5435[0.0000]***	3	*I*(1)
LnP	0.0337[0.9963]	5	DlnP	-10.1982[0.0000]***	5	*I*(1)
Lnreer	-7.19[0.000]***	17	Dlnreer	-6.162054[0.0000]***	0	*I*(0)

Note: ***, **, and * indicate the rejection of the null hypothesis of non stationary at 1% , 5% and 10% level of significance respectively, denotes first difference, and *I(O)* is the order of integration. The values in parenthesis are the P-values.
Source: Computed by the author using Eviews 5.0 Package

Table 5 above presents the unit root test results obtained for the PP test with both intercept and trend in the model. It is clear that with the exception of lnreer, the null hypothesis of the presence of the unit root for the rest of the variables in their levels cannot be rejected since the P-values of the PP statistic are not statistically significant at the conventional levels of significance. However, at

first difference, these variables are stationary. This is because the null hypothesis of the presence of unit root (non-stationary) is rejected at 1 percent significant level for all the variables.

It is therefore clear from all the unit test results discussed above that the variables are integrated of either order zero, I(0) or order one, I(1). Since the test results have confirmed the absence of I(2) variables, ARDL methodology is now used for the estimation.

Bounds Tests for Cointegration

In the first step of the ARDL analysis, the presence of long-run relationships in model 1 and model 2 was tested. Given that the study employed quarterly data, the used a maximum lag length of 4 as suggested by Pesaran and Pesaran (1997).

Table 6: Results of Bounds Tests for the Existence of Cointegration

	90% Level		95% Level		99% Level	
Intercept with no trend	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
K=5	2.622	3.367	2.649	3.805	3.516	4.781
Dependent variable F_{lnRM1} (lnRM1|lny, r, lnP, lnreer, finnov)			F-stat 3.8914[.012]			
Intercept with no trend	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
K=5	2.622	3.367	2.649	3.805	3.516	4.781
Dependent variable F_{lnRM2} (lnRM2|lny, r, lnP, lnreer, finnov)			F-stat 3.8275[.024]			

Note: Critical values were obtained from Pesaran and Pesaran (1997), Appendix B, Case II & III. *K* is the number of regressors.

Source: Computed by the author using Microfit 4.1

The Table 6 above shows the results of bounds tests for the existence of cointegration. It can be seen that the joint null hypothesis of lagged level variables (that is, variable addition test) of the coefficients being zero (no cointegration) is rejected at 5 percent significance level for all the models used. This is because the calculated F-statistic value exceeds the upper bound critical value. For instance in model 1 with intercept and no trend where lnRM1 is the dependent variable, the calculated F-statistic value (3.8914) exceeds the upper bound critical value (3.805) at 5 percent significance level. Similarly for model 2 with intercept and no trend where lnRM2 is the dependent variable, the calculated F-statistic value (3.8275) exceeds the upper bound critical value (3.805) at 5 percent significance level. The implication of this outcome is that there exist a long run relationship between money demand and its determinants.

Results of Long Run Relationship for Model 1

Since the demand for money and its determinants are cointegrated, the long-run parameters of the ARDL model are estimated and the results are presented in the Table 7 below. The long-run ARDL model was estimated based on the Schwarz Bayesian Criterion (SBC).

Table 7: Estimated Long-Run Coefficients using the ARDL Approach for Model 1

ARDL(2, 2, 2, 2, 0, 0) selected based on SBC				
Dependent Variable: Narrow money demand				
Regressor	Coefficient	Standard Error	T-Ratio	P-values
Constant	3.5193	1.6136	2.1810	[0.081]*
Financial innovation	3.5978	2.1372	1.6834	[0.095]*
Real income	0.6961	1.2016	5.7932	[0.056]*
Interest rate	-0.1338	0.0458	-2.9178	[0.036]**
Price level	0.2024	0.0890	2.2740	[0.026]**
Real effective exchange rate	-0.2608	0.1553	-1.6793	[0.096]*

Note: ** and * denote significance level at 5% and 10% respectively
Source: Computed by the author using Microfit 4.1

As shown in Table 7 above, all the estimated coefficients have their a priori expected signs. From the results, the coefficient of financial innovation index is statistically significant at 10 percent significance level, indicating that if the country were to increase her financial innovation by 1 percent point, the demand for narrow money will increase by approximately 3.5978 percent point. This means that increases in financial innovation has the potential of stimulating the real narrow demand formoney (M1) in Ghana at the aggregate level over the study period. This positive effect of financial innovation lends support to the argument of Mannah-Blankson and Belnye (2004) who claim that greater innovation in the financial system in Ghana is associated with changes in structure of the financial system that increase the demand for narrow money. Furthermore,

this result contradicts that of Odularu and Okunrinboye (2009) who found that financial innovation has not significantly affected the demand for money in Nigeria.

The coefficient of real income is statistically significant at 10 percent significance level. This means that if the country were to increase her real income by 1 percent point, the real narrow demand for money will increase by approximately 0.6961 percent point. Thus an increase in a country's real income implies an increase in the level of economic activities which can only be matched by a rise in the demand for money. The positive relationship between current real income and the demand for money is in conformity with theory and empirical results (Yamden, 2011; Adam, Kessy, Nyella & O'Connell, 2010; Mannah-Blankson &Belnye 2004).

It is also clear from the estimated long run results that the domestic interest rate is statistically significant at 5 percent. For instance, if the country were to increase her domestic interest rate by 1 percent point, the real narrow demand for money will decrease by approximately 0.1338 percent point. This is because an increase in the domestic interest rate implies a decrease in the price of bond (inverse relationship between bond price and interest rate), therefore people will demand (buy) more bond and hold less money. This result confirms the findings of Iyoboyi and Pedro (2013), Lungu et al. (2012), Yamden (2011), Odularu andOkunrinboye (2009), and Sumner (2009) who found a significant negative relationship between interest rate and the demand for narrow money in the long run.

Furthermore, the coefficient of price level is statistically significant at 5 percent which indicates that if the country were to increase her price level by 1 percent point, the real narrow demand for money will increase by approximately 0.2024 percent point. This is because an increase in the price level reduces the purchasing power of money, therefore people needs more money to purchase goods and services. This view was clearly demonstrated by Baumol (1952) and Tobin (1956) in their portfolio approach to the transaction demand for money. However, Yamden (2011) found a negative relationship between the price level and the demand for money.

Finally, coefficient of real effective exchange rate indicates that that if the country's exchange rate increases by 1 percent point, the real narrow demand for money will decrease by approximately 0.2608 percent point. For instance in a period of currency depreciation, people engage in currency substitution and thus demand more foreign currency and less domestic currency (Bahmani-Oskooee et al., 1996; Arango et al., 1981).

The long-run results indicate that any disequilibrium in the system as a result of a shock can be corrected in the long-run by the error correction term. Hence, the error correction term that estimated the short-run adjustments to equilibrium is generated as follows.

ECM = (narrow demand for money) – 3.5978*(financial innovation) – 0.6961*(real income) + 0.1338*(interest rate) – 0.2024*(price level) + 0.2608*(real effective exchange rate) - 3.5193*Constant

Results of Short Run Relationship for Model 1

Once the long-run cointegrating model has been estimated, the next step is to model the short-run dynamic relationship among the variables within the ARDL framework. Thus, the lagged value of all level variables (a linear combination is denoted by the error-correction term, ECM_{t-1} is retained in the ARDL model.

Table 8 below presents the results of the estimated error-correction model of narrow demand for money for Ghana using the ARDL technique which is selected based on the SBC.

Table 8: Estimated Short-Run Error Correction Model using the ARDL Approach for Model 1

ARDL(2, 2, 2, 2, 0, 0) selected based on SBC

Dependent Variable: D(narrow money demand)

Regressor	Coefficient	Std Error	T-Ratio	P-values
DConstant	4.3230	2.9336	1.4736	[0.014]**
D(narrow money demand(-1))	0.7079	0.0714	9.9136	[0.000]***
D(financial innovation)	0.9406	0.1150	8.1795	[0.000]***
D(financial innovation(-1))	-0.8896	0.1178	-7.5519	[0.000]***
D(real income)	0.9955	0.4521	2.2019	[0.000]***
D(real income(-1))	1.5437	0.4403	3.5059	[0.000]***
D(interest rate)	-0.0162	0.0059	-2.7158	[0.000]***
D(interest rate(-1))	-0.0130	0.0059	-2.1802	[0.000]***
D(price level)	0.0249	0.0185	1.3460	[0.000]***
D(real effective exchange rate)	-0.0320	0.0184	-1.7438	[0.000]***
ECM(-1)	-0.1228	0.0294	-4.1718	[0.000]**

Table 8 continued

R-Squared	0.9899	R-Bar-	Squared	0.9892
S.E. of Regression	0.0703	F-stat.	F(15,100)	4.7511[.000]
Mean of Dep Variable	19.9946	S.D. of	Dep Var	0.6761
Residual Sum of Squares	.5292	Equa Log	- likelihood	148.0176
Akaike Info. Criterion	139.0176		SBC	126.6264
DW-statistic	2.1956			

Note: ***, ** and * denote significance level at1%, 5% and 10% respectively
Source: Computed by the author using Microfit 4.1

The results from the ARDL model as displayed in Table 8 suggest that the ultimate effect of previous period value of narrow demand for money on current values of narrow demand for money in the short-run is positive and statistically significant at 1 percent significant level. The implication is that current values of narrow demand for money are affected by previous quarters' values of real narrow demand for money in Ghana. This result is in line with finding in the empirical studies by Sumner (2009) and Baharumshah (2004).

The results also showed the expected negative sign of error correction term lagged one period (ECM_{t-1}) and it is highly significant at 1 percent significance level. This confirms the existence of the cointegration relationship among the variables (demand for narrow money and its determinants) in the model. It is important to underscore that the ECM stands for the rate of adjustment to restore equilibrium in the dynamic model following a disturbance. The coefficient of the error correction term (ECM) is around -0.1228. In other words, the significant error correction term suggests that a deviation from the

long-run equilibrium subsequent to a short-run shock is corrected by about 12.28 percent at the end of each quarter in a year. The rule of thumb is that, the larger the error correction coefficient (in absolute terms), the faster the variables equilibrate in the long-run when shocked (Acheampong, 2007). This then suggests that the rate of adjustment is very slow.

It also clear from the short run results that financial innovation has negative effect on the demand for narrow money in the previous period but a positive effect on the real narrow demand for money in the current period. The coefficient of financial innovation is statistically significant at 1 percent significance level in both the current and the previous period. For instance, a 1 percent point increase in financial innovation in the current period will induce the demand for narrow money to increase by approximately 0.9406percent point in the short-run. Similarly, a 1 percentage point increase in financial innovation in the previous period will induce the demand for narrow money to decrease by approximately 0.8896percent point in the short-run. This may be due to the fact people may be forming expectations about the future trend of financial innovation in the current period. For instance in the previous period they do not expect improved financial innovation in the immediate future period (now current period), therefore, there is no need for them to demand more of the domestic narrow money. However, in the current period, they expect an improved financial innovation in the future which necessitated the increased demand for money in the current period. This result is in conformity with the result of Mannah-Blankson &Belnye (2004) for a positive short relation between financial innovation and the

demand for money in the current period. Nevertheless, the result for the previous period does not concur.

Another important variable in the short run is the real income. It is evident from the short run results in Table 8 above that real income is statistically significant at 1 percent significance level and has positive effect on the real narrow demand for money both in the previous period and current period. For instance, a 1 percent point increase in real income in the current period and previous period will induce the real narrow demand for money to increase by approximately 0.9955 and 1.5437 percent points respectively in the short-run. The positive relationship between current real income and the real narrow demand for money is in conformity with theory and empirical results (Yamden, 2011; Adam, Kessy, Nyella & O'Connell, 2010; Mannah-Blankson &Belnye 2004).

Furthermore, consistent with the long-run results, the coefficient of domestic interest rate has the theorized negative effect on the demand for narrow money in the short-run both in the current period and previous period. The coefficient of domestic interest rate is statistically significant at 1 percent significant level in both the current and the previous period. From the results, a 1 percent point increase in domestic interest rate will induce the real narrow demand for money to decrease by approximately 0.0162 and 0.6130 percent points in the current period and previous period respectively.

Also, it is evident from the short run results in Table 8 above that the price level is statistically significant at 1 percent significance level and has positive effect on the real narrow demand for money and thus if the country were to

increase her price level by 1 percent point, the real narrow demand for money will increase by approximately 0.0249 percent point. Baumol (1952) and Tobin (1956) attributed this relationship to the declining effect of price level increases to the real income (or purchasing power).

Finally, real effective exchange rate has negative effect on the demand for narrow money and is statistically significant at 1 percent significance level in the short run.in the previous period but a positive effect on the real narrow demand for money in the current period. This means that in the short run people preferred to hold less of the domestic narrow money following a depreciation of domestic currency (Ghana cedis) against all the major currencies. This result confirms the assertion of Bahmani-Oskooee and Shabsigh (1996) and Arango and Nadiri (1981).

Diagnostics and Stability Tests for Model 1

In order to check for the estimated ARDL model, the significance of the variables and other diagnostic tests such as serial correlation, functional form, normality, heteroskedasticity and structural stability of the model were considered.

Table 9: Diagnostic Tests for Model 1

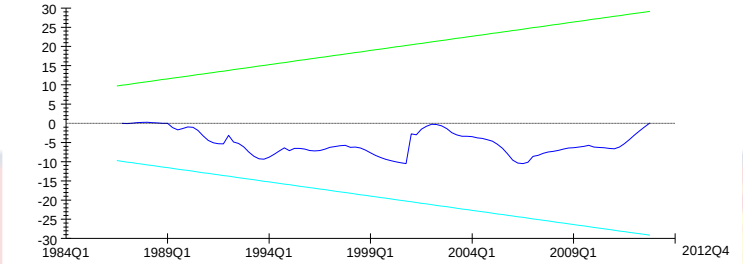
Diagnostics		**LM Version**	**F Version**
Serial Correlation	$X^2_{Auto}(4)$	2.3590[0.681]	F(4,96)= 0.3162[0.742]
Functional Form	$X^2_{Reset}(1)$	1.3565[0.364]	F(1, 99)= 0.7214[0.487]
Normality	$X^2_{Norm}(2)$	1.4757 [0.145]	Not applicable
Heteroscedasticity	$X^2_{White}(1)$	0.5195[0.231]	F(1, 114)= 0.2714[.351]

Note: X^2_{Auto}, X^2_{Reset},X^2_{Norm},*and* X^2_{White} are Lagrange multiplier statistics for test of serial correlation, functional form misspecification, non-normal errors and heteroskedasticity respectively.

Source: Computed by the author using Microfit 4.1

The test for serial correlation results in Table 9 above indicates an absence of serial correlation. It can also be seen that the errors are normally distributed and the model passes the Ramsey's RESET for correct specification of the model as well as the white hetroskedasticity test.

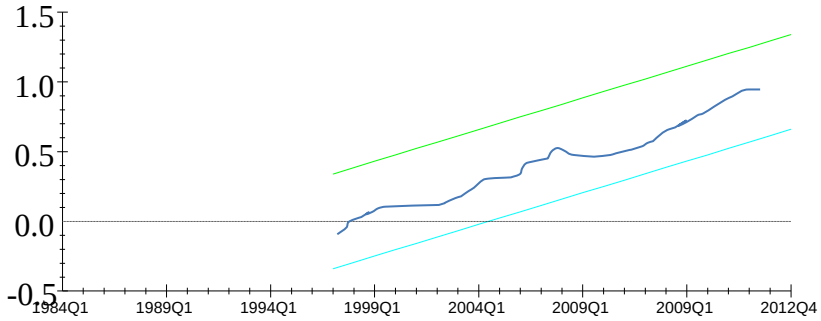
Finally, when analyzing the stability of the coefficients, the Cumulative Sum (*CUSUM*) and Cumulative Sum of Squares (*CUSUMQ*) are applied. Following Pesaran and Pesaran (as cited in Bahmani-Oskooee, 2004), the stability of the regression coefficients is evaluated by stability tests and they can show whether or not the parameter estimates are stable over time. This stability test is appropriate in time series data, especially when one is uncertain about when structural change might have taken place. The result for *CUSUM* and *CUSUMSQ* are shown in Figure 8 and Figure 9 below. The null hypothesis is that the coefficient vector is the same in every period and the alternative is that it is not (Bahmani-Oskooee, 2004). The *CUSUM* and *CUSUMQ* statistics are plotted against the critical bound of 5 percent significance level. According to Bahmani-Oskooee (2004), if the plot of these statistics remains within the critical bound of the 5 percent significance level, the null hypothesis that all coefficients are stable cannot be rejected.



The straight lines represent critical bounds at 5% significance level

Fig 8: Plot of Cumulative Sum of Recursive Residuals for Model 1

Source: Generated by the author using Microfit 4.1



The straight lines represent critical bounds at 5% significance level

Fig 9: Plot of Cumulative Sum of Square of Recursive Residuals for Model 1

Source: Generated by the author using Microfit 4.1

CUSUM and *CUSUMSQ* residuals are within the 5 percent critical bound (boundaries). That is to say that the stability of the parameters has remained within its critical bounds of parameter stability. It is clear from both graphs that both the *CUSUM* and *CUSUMQ* tests confirm the stability of coefficients of the demand for narrow money function in Ghana.

Granger Causality Tests for Model 1

After establishing cointegration among the variables, Granger causality test was then applied to measure the linear causation between the demand for narrow money and its determinants. The results of the Granger causality test are presented in Table 10 below.

Table 10: Results of Pair-wise Granger Causality Tests for Model 1

Null Hypothesis	Obs	F-Statistic	Probability	Remarks
Financial innovation does not Granger Cause real narrow demand for money	116	6.1425	[0.0002]**	Null is rejected
Real narrow demand for money does not Granger Cause Financial innovation	116	0.6436	[0.1001]	Cannot reject null
Real income does not Granger Cause real narrow demand for money	116	4.6459	[0.0017]**	Null is rejected
Real narrow demand for money does not Granger Cause real income	116	1.8419	[0.1261]	Cannot reject null
Interest rate does not Granger Cause real narrow demand for money	116	0.1125	[0.9779]	Cannot reject null
Real narrow demand for money does not Granger Cause interest rate	116	0.8654	[0.4873]	Cannot reject null
Price level does not Granger Cause real narrow demand for money	116	2.7621	[0.0419]**	Null is rejected

Table 10 continued

Real narrow demand for money does not Granger Cause price level	116	0.3232	[0.8619]	Cannot reject null
Real effective exchange rate does not Granger Cause real narrow demand for money	116	0.2639	[0.9006]	Cannot reject null
Real narrow demand for money does not Granger Cause real effective exchange rate	116	1.2807	[0.2822]	Cannot reject null

Note: **, and * denote significance level at 1%, 5% and 10% respectively
Source: Computed by the author using E-views 5.0

The Granger causality test results in Table 10 above suggests that the null hypothesis that financial innovation does not Granger cause real narrow demand for money is rejected at 5 percent significance level. This means that financial innovation Granger causedreal narrow demand for money. However, the null hypothesis that demand for narrow money does no granger cause financial innovation cannot be rejected at any significance level implying that real narrow demand for money does not granger cause financial innovation. There is therefore a unidirectional causality between real narrow demand for money and financial innovation.

Similarly, there exists a unidirectional causality between real income and real narrow demand for money at 5 percent significance level as well as the price level and the demand for narrow money at 5 percent significance level.

Finally, the rejection of both of the null hypothesis that the real narrow demand for money does not Granger cause domestic interest rate and real

effective exchange rate and vice versa implies that, there is no direction of causality between demand for narrow money and interest rate as well as demand for narrow money and real effective exchange.

Results of Long Run Relationship for Model 2

Since the demand for broad money and its determinants are cointegrated, the long-run parameters of the ARDL model are estimated and the results are presented in the Table 11 below. The long-run ARDL model was estimated based on the Schwarz Bayesian Criterion (SBC).

Table 11: Estimated Long-Run Coefficients using the ARDL Approach for Model 2

ARDL(2, 2, 2, 2, 0, 0) selected based on SBC

Dependent Variable: Broad money demand

Regressor	Coefficient	Standard Error	T-Ratio	P-values
Constant	1.0176	.5665	1.7964	[0.075]*
Financial innovation	0.6839	0.4404	1.5528	[0.012]**
Real income	3.7124	1.5303	2.4259	[0.015]**
Interest rate	-0.2372	0.1297	-1.8287	[0.021]**
Price level	0.6991	0.3503	1.9960	[0.048]**
Real effective exchange rate	-0.7021	0.3366	-2.0859	[0.039]**

Note: ** and * denote significance level at 5% and 10% respectively
Source: Computed by the author using Microfit 4.1

From the long run results for Model 2 above, the coefficient of financial innovation index is statistically significant at 5 percent significance level, indicating that if the country were to increase her financial innovation by 1 percent point, the real broad demand for money (M2) will increase by approximately 0.683percent point. This result is consistent with the result shown in Table5 above. Thus financial innovation is very critical in influencing the demand for money in the long run in Ghana. The positive effect of financial innovation lends support to the argument of Mannah-Blankson and Belnye (2004) who claim that greater innovation in the financial system in Ghana is associated with changes in structure of the financial system that increase the demand for narrow money.

It can also be seen that real income is statistically significant at 5 percent significance level, indicating that if the country were to increase her real income by 1 percent, the demand for broad money will increase by approximately 3.7124 percent point in the long run. This means that increases in real GDP has the potential of stimulating the demand for broad money (M2) in Ghana at the aggregate level over the study period. This positive effect of real GDP on the demand for broad money confirms the findings of Iyoboyi and Pedro (2013), Ramlall (2012), Lungu et al. (2012), Dritsaki and Dritsaki (2012), Yamden (2011), Odularu &Okunrinboye (2009), Sumner (2009), Baharumshah (2004) and Mannah-Blankson &Belnye (2004). However, the results from the study of Ramlall (2012) showed that M2 is positively elastic with respect to GDP, with the elasticity coefficient revolving around 2.80%. Nevertheless, Mannah-Blankson

&Belnye (2004) found that M2 is positively inelastic with respect to GDP, with the elasticity coefficient revolving around 0.2219 percentage point.

Furthermore, the estimated long run coefficient of domestic interest rate is statistically significant at 5 percent. For instance, if the country were to increase her domestic interest rate by 1 percent point, the demand for broad money will decrease by approximately 0.2372 percent point. The negative effective of interest rate on the demand for broad money is because an increase in the domestic interest rate implies a decrease in the price of bond which further compels people to demand (buy) more bond and hold less money. This result confirms the findings of Iyoboyi and Pedro (2013) and Lungu et al. (2012) who found a significant negative relationship between interest rate and the demand for narrow money in the long run.

In addition, the coefficient of price level indicates that that if the country were to increase her level by 1 percent, the demand for narrow money will decrease by approximately 0.6991 percent point. This result clearly confirms Baumol (1952) and Tobin (1956) view that an increase in the price level reduces the purchasing power of money, therefore people needs more money to purchase goods and services.

Finally, coefficient of real effective exchange rate indicates that that if the country's exchange rate increases (depreciates) by 1 percent point the demand for broad money will decrease by approximately 0.7021 percent point. For instance in a period of currency depreciation, people engage in currency substitution and thus demand more foreign currency and less domestic currency. This result confirms

the results of Mannah-Blankson et al. (2004), Bahmani-Oskooee et al. (1996) and Arango et. al (1981).

The long-run results indicate that any disequilibrium in the system as a result of a shock can be corrected in the long-run by the error correction term. Hence, the error correction term that estimated the short-run adjustments to equilibrium is generated as follows.

ECM = (broad demand for money) – 0.6839*(financial innovation) – 3.7124*(real income) + 0.2372*(interest rate) – 0.6991*(price level) + 0.7021*(real effective exchange rate) - 1.0176*Constant

Results of Short Run Relationship for Model 2

Once the long-run cointegrating model has been estimated, the next step is to model the short-run dynamic relationship among the variables within the ARDL framework. Thus, the lagged value of all level variables (a linear combination is denoted by the error-correction term, ECM_{t-1} is retained in the ARDL model.

Table 12 below presents the results of the estimated error-correction model of narrow demand for money for Ghana using the ARDL technique. The model is selected based on the SBC

Table 12: Estimated Short-Run Error Correction Model using the ARDL Approach for Model 2

ARDL(2, 2, 2, 2, 0, 0) selected based on SBC

Dependent Variable: D(narrow money demand)

Regressor	Coefficient	Std Error	T-Ratio	P-values
DConstant	1.2354	0.58427	2.1144	[0.037]**
D(broad money demand(-1))	0.1888	0.0875	2.1568	[0.000]***
D(financial innovation)	0.8303	0.4610	1.8011	[0.074]*
D(financial innovation(-1))	1.6974	0.6605	2.5699	[0.012]**
D(real income)	2.9044	0.8024	3.6198	[0.097]*
D(real income(-1))	2.1737	0.4342	5.0059	[0.000]***
D(interest rate)	-0.0441	0.0082	-5.3770	[0.000]***
D(interest rate(-1))	-0.0249	0.0071	-3.5240	[0.001]**
D(price level)	0.0849	0.0383	2.2180	[0.000]***
D(real effective exchange rate)	-0.0852	0.0367	-2.3254	[0.001]**
ECM(-1)	-0.1214	0.0399	-3.0381	[0.003]**

R-Squared	0.9974	R-Bar-	Squared	9.9959
S.E. of Regression	0.0456	F-stat.	F(15,100)	14.46[0.000]
Mean of Dep Variable	20.0600	S.D. of	Dep Var	0.5855
Residual Sum of Squares	0.1362	Equa Log	- likelihood	148.0176
Akaike Info. Criterion	224.5435		SBC	201.0921
DW-statistic	2.145			

Note: ***, ** and * denote significance level at1%, 5% and 10% respectively
Source: Computed by the author using Microfit 4.1

It is clear from the results above that the error correction term lagged one period (ECM_{t-1}) has the expected negative sign and it is significant at 5 percent significance level. Therefore, this verifies the existence of the cointegration relationship among the variables (demand for broad money and its determinants) in the model yet again. The coefficient of the error correction term (ECM) is approximately -0.1214 which suggests that a deviation from the long-run equilibrium following a short-run shock is corrected by about 12.14 percent at the end of each quarter in a year.

The results from the ARDL model suggest that the ultimate effect of previous period value of broad demand for money on current values of broad demand for money in the short-run is positive and statistically significant at 1 percent significance level. The implication is that current values of broad demand for money are affected by previous quarters' values of narrow demand for money in Ghana. This result is in line with finding in the empirical studies by Sumner (2009) and Baharumshah (2004).

The short run results above also show that financial innovation has positive effect on the real broad demand for moneyand is statistically significant at 10 percent and 5 percent in the current period and previous period respectively. Thus if Ghana increases her financial innovation by 1 percent point in current period and previous period, then real broad demand for moneywill increase by approximately 0.8303 percent point and 1.6974 percent point respectively. This result contradicts that of Mannah-Blankson andBelnye (2004) who had negative

short run relationship between financial innovation and the demand for broad money in the current period.

The most important variable in the short run is the real income. Just like the short run results obtained in the narrow money in Table 8 above, it is evident from the short run results in Table 12 above that real income has positive effect on the real broad demand for moneyin both the current period and the previous period. The coefficient of real income is statistically significant at 10 percent and 1 percent significance level in the current period and the previous period respectively. For instance, if Ghana increases her real income by 1 percent point in current period and previous period, then real broad demand for moneywill increase by approximately 2.9044 percent point and 2.1737 percent point respectively. The positive relationship between current real income and the real broad demand for moneyis in conformity with theory and empirical results (Yamden, 2011; Adam, Kessy, Nyella & O'Connell, 2010 and Mannah-Blankson &Belnye 2004).

Furthermore, the coefficient of domestic interest rate has the theorized negative effect on the real broad demand for moneyin the short-run in both the current and previous period. The coefficient of domestic interest rate is statistically significant at 1 percent significant level in but 5 percent in the previous period. From the results, a 1 percentage point increase in domestic interest rate will induce the real broad demand for moneyto decrease by approximately 0.0041percent point and 0.0249 percent point in the current and the previous period respectively.

Also, the coefficient of price level is statistically significant at 1 percent significance level and positively related to the real broad demand for moneyin the short-run. From the results, a 1 percent point increase in price level will induce the real broad demand for moneyto increase by approximately 0.0852percent point. The implication of this is that increases in the price level reduces the purchasing power of people and therefore may demand more money to meet their obligations.

Finally, consistent with previous short run results for narrow money demand in Table 8 above, Table 12 above shows that real effective exchange rate has negative effect on the demand for narrow money in the current period and is statistically significant at 5 percent significance level. This means that people preferred to hold less of the domestic narrow money following a depreciation of domestic currency (Ghana cedis) against all the major currencies in the current period. Furthermore, if the public expects the domestic currency to continue to depreciate against all the major currencies in the future, then the public would demand more foreign currency and less domestic currency, thus leading to a decrease in broad money demand. This result confirms the assertion of Bahmani-Oskooee and Shabsigh (1996) and Arango and Nadiri (1981).

Diagnostics and Stability Tests for Model 2

The study proceeded with the diagnostic tests of whether or not Model 2passes the tests of serial correlation, functional form, normality and heteroscedasticity as shown in Table 13 below.

Table 13: Diagnostic tests for Model 2

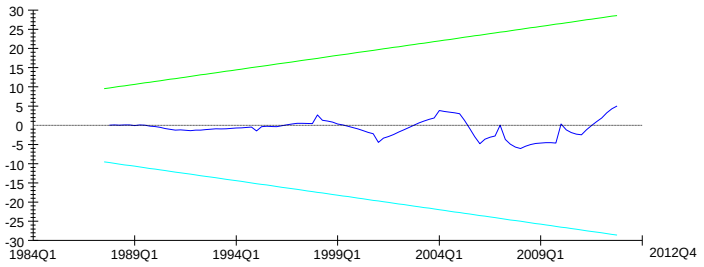
Diagnostics		LM Version	F Version
Serial Correlation	$X^2_{Auto}(4)$	1.3718[0.372]	F(4,96)= 0.545[0.189]
Functional Form	$X^2_{Reset}(1)$	0.1128[.5638]	F(1, 99)= 0.2317[0.569]
Normality	$X^2_{Norm}(2)$	0.8895 [0.2920]	Not applicable
Heteroscedasticity	$X^2_{White}(1)$	0.4618[0.3305]	F(1, 114)= 0.598[0.365]

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

Source: Computed by the author using Microfit 4.1

Table 13 above presents the diagnostic tests for Model 1. It can be seen that Model 2 passed all the diagnostic tests. Thus the test for serial correlation results in Table 13 above reveals an absence of serial correlation. Similarly, the errors are normally distributed and the model passes the Ramsey's RESET for correct specification of the model as well as the white hetroskedasticity test.

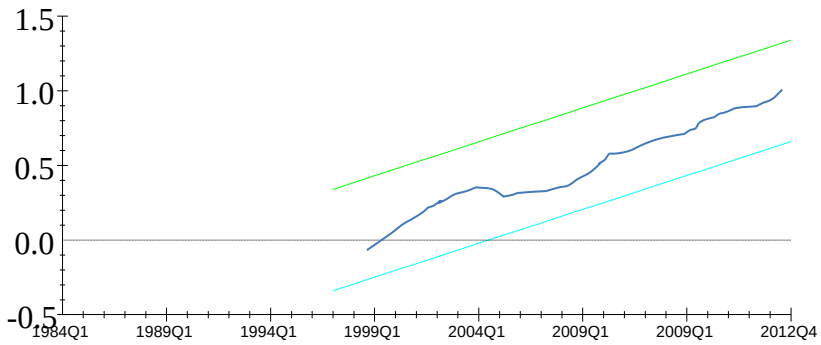
The results for *CUSUM* and *CUSUMQ* for model 2 are shown in Figure 10 and Figure 11 below.



The straight lines represent critical bounds at 5% significance level

Fig 10: Plot of Cumulative Sum of Recursive Residuals for Model 2

Source: Generated by the author using Microfit 4.1



The straight lines represent critical bounds at 5% significance level

Fig 11: Plot of Cumulative Sum of Square of Recursive Residuals for Model 2

Source: Generated by the author using Microfit 4.1

As shown in Figure 10 and Figure 11 above, the plot of both the *CUSUM* and *CUSUMSQ* residuals are within the 5 percent critical bound (boundaries). That is to say that the stability of the parameters has remained within its critical bounds of parameter stability. It is clear from both graphs that both the *CUSUM*

and *CUSUMQ* tests confirm the stability of coefficients of the demand for broad money function in Ghana.

Granger Causality Tests for Model 2

After establishing cointegration among the variables, Granger causality test was then applied to measure the linear causation between the demand for broad money and its determinants. The results of the Granger causality test are presented in Table 14 below.

Table 14: Results of Pair-wise Granger Causality Tests for Model 2

Null Hypothesis	Obs	F-Statistic	Probability	Remarks
Financial innovation does not Granger Cause real broad demand for money	116	4.8430	[0.0013]**	Null is rejected
Real broad demand for money does not Granger Cause Financial innovation	116	0.5035	[0.1009]	Cannot reject null
Real income does not Granger Cause real broad demand for money	116	5.5532	[0.0004]**	Null is rejected
Real broad demand for money does not Granger Cause real income	116	2.0886	[0.0873]*	Null is rejected
Interest rate does not Granger Cause real broad demand for money	116	0.0599	[0.9933]	Cannot reject null

Table 14 continued

Real broad demand for money does not Granger Cause interest rate	116	0.7122	[0.5854]	Cannot reject null
Price level does not Granger Cause real broad demand for money	116	2.1846	[0.0756]*	Cannot reject null
Real broad demand for money does not Granger Cause price level	116	0.5955	[0.6667]	Null is rejected
Real effective exchange rate does not Granger Cause real broad demand for money	116	0.3711	[0.8288]	Cannot reject null
Real broad demand for money does not Granger Cause real effective exchange rate	116	1.7037	[0.1545]	Cannot reject null

Note: **, and * denote significance level at 1%, 5% and 10% respectively
Source: Computed by the author using E-views 5.0

The Granger causality test results in Table 14 suggests that the null hypothesis that financial innovation does not Granger cause real broad demand for money is rejected at 5 percent significance level. This means that financial innovation Granger cause real broad demand for money. However, the null hypothesis that real broad demand for money does not granger cause financial innovation cannot be rejected at any significance level implying that real broad demand for money does not granger cause financial innovation. There is therefore, a unidirectional causality between demand for broad money and financial innovation.

Furthermore, there exists bidirectional causality between real income and real broad demand for money at 5 percent significance level.

Finally, the rejection of both of the null hypothesis that the real broad demand for money does not Granger cause domestic interest rate, price level and real effective exchange rate and vice versa implies that, there is no direction of causality between real broad demand for moneyand interest rate, price level as well as real broad demand for moneyand real effective exchange.

Findings versus the Literature Review

Keynes (1936) andMcKinnon (1982) postulated that the income level is positively related to the demand for money. Valadkhani (2002), Mannah-Blankson and Belnye (2004)andYamden (2011)empirically supported Keynes and McKinnonideas that income level is a very important scale variable in the demand for money function. It can be observed from the estimated results explained above that real income positively affected the real demand for money in both the long run and the short run. This result therefore, supported Keynes and McKinnon's prediction as well as empirical findings.

The interest rate is a measure of the opportunity cost of holding money. According toKeynes (1936), the interest rate represents the speculative demand for money with an inverse relationship. Odularu and Okunrinboye (2009), Yamden (2011) and Lungu et al. (2012) empirically confirmed Keynes' theory. The estimated results shown above also found a statistically significant negative relationship between interest rate and the demand for money in both the long run

and the short run and therefore, confirmed both theory and empirical literature findings.

The theoretical work on the transaction demand for money by both Baumol (1952) and Tobin (1956) found the price level to be positively related to the demand for money because an increase in the price level reduces the purchasing power of money which therefore, requires more money to purchase goods and services. Empirically, Mannah-Blankson and Belnye (2004) also found a statistically significant relationshipbetween the price level and the demand for money. The estimated long run and short run relationships from Table 7,8, 11 and 12 revealed that the price level positively affected the real demand for money and thus, confirmed both theory and other empirical findings.

Furthermore, Essien et al. (1996) empirically found a statistically significant negative effect of exchange rate on the demand for money.Thus, the exchange rate is an opportunity cost variable in the demand for function and as such increases in the exchange rate (depreciation) leads to currency substitution as people prefer to hold more of other foreign currencies at the expense of the domestically depreciated currency.It can also be seen from the estimated results explained above that real effective exchange rate negatively affected the demand for money in both the long run and the short run, hence supported other empirical findings.

Finally, there is a mix of empirical finding on the effect of financial innovation on the demand for money. For instance, Mannah-Blankson and Belnye (2004) found a statistically positive effect for Ghana, Nagayasu (2012) found an

inverse effect for Japan whiles Odularu and Okunrinboye (2009) found no effect for Nigeria. It can be seen from the estimated long and short run results that financial innovation positively affected the real demand for money and thus confirmed the findings of Mannah-Blankson and Belnye (2004). However, in the short run, only financial innovation in the previous period negatively and thus confirmed the findings of Nagayasu (2012).

Conclusion

In conclusion, this chapter examined the time series properties of the data used for estimation, presented and discussed the results. Unit root test employing both the ADF and the PP techniques essentially showed that some variables are stationary at levels whiles some of the series had to be differenced once to achieve stationarity. This implied that some of the series are integrated of order zero, $I(0)$ and others of order one, $I(1)$. The presence of non-stationary variables implied the possibility of the presence of a long-run relationship among the variables, which the study verified using ARDL bounds test.

The results show the presence of long-run and short-run relationship between money demand and its determinants. The results of the ARDL model selected based on SBC show that the error correction term (ECM_{t-1}) for financial development carried the expected negative sign. Also, the results imply that the variables play a significant role in determining financial innovation in Ghana.

The diagnostic and parameter stability tests revealed that the model passes the tests of serial correlation, functional form misspecification, non-normal errors

and heteroscedasticity at conventional levels of significance and the graphs of the CUSUM and CUSUMSQ indicate the absence of any instability of the coefficients because the plots of these graphs are confined within the 5 percent critical bounds of parameter stability suggesting that all the coefficients of the estimated ARDL model are stable over the study period.

The Granger causality test results revealed a unidirectional causality between financial innovation and demand for money.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The aim of this chapter is to elaborate on the findings of this study, draw conclusions and also to provide policy recommendations. The chapter begins with a summary, then concludes and makes policy recommendations. The chapter also presents the limitations and direction for future research.

Summary

The study sought to examine the effect of financial innovation on the demand for money in Ghana using quarterly dataset from 1983(1) to 2012(4). As such, the long run and short run relationships between the two variables were examined. The study also sought to examine the possibility of a causal relationship between financial innovation and demand for money and also to examine the direction of causality. In order to address the above objective, the Autoregressive Distributed Lagged Model (ARDL) approach to bounds testing of cointegration developed by Pesaran and Shin (1999) was used to examine the long run and short run dynamic parameters of the model.

The study began with the tests for unit roots to check for the stationarity properties of the variables employed in the study. Thus, the study employed the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for unit roots testing. These tests for the presence of unit roots were done in levels and first

difference with constant only and constant and trend. Both the ADF and PP tests for unit roots revealed that all the variables except real effective exchange rate, were stationary after first difference, that is, they were integrated of order one *I(1)*. This therefore, allowed the use of the ARDL Model which although ignores the stationarity problems in series, requires that variables are integrated of an order not higher than one.

The next step was to examine the possible long run and short run relationships among the variables in the study. The bounds test results for long run relationship revealed that financial innovation, real income and price level exerted a positive and statistically significant effect on both the narrow and broad demand for money whiles interest rate and real effective exchange rate exerted a negative and statistically significant effect on both the narrow and broad demand. The error correction model also revealed in the short run previous value of both narrow and broad demand for money, current and previous values of real income, current value of financial innovation and current value of price level exerted a positive and statistically significant effect on both the narrow and broad demand for money. However, current and previous values of interest rate and current value of real effective exchange rate exerted a negative and statistically significant effect on both the narrow and broad demand for money.

Furthermore, diagnostic tests revealed that both Model 1 and Model 2 passed the tests of serial correlations, functional form misspecification, non-normal errors, and heteroscedasticity. The cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares recursive residuals (CUSMSQ) also

revealed the existence of a stable demand for money function. The results of the Pairwise Granger causality test revealed a unidirectional causal relationship running from financial innovation to both narrow and broad demand for money.

Conclusions

The study sought out to examine the effect of financial innovation on the demand for money in Ghana. It was evident from the results discussed that the objective of the study was accomplished. The study tested the long run, short run, and causal relationship between financial innovation and demand for money in Ghana using quarterly dataset from 1983 to 2012.

It can be concluded from the study that both the long-run and short-run results found statistically significant positive effect of financial innovation, real income and price level on demand for narrow money. Nevertheless, interest rate and real effective exchange rate had statistically significant negative effect on demand for narrow money in both the long run and short run.

Furthermore, all the three models estimated provided evidence for stable system as depicted by the CUSUM and CUSUMSQ. Finally, the Granger causality test results revealed a uni-directional relationship running from financial innovation and price level to both narrow and broad demand for money. Also there is a uni-directional and bi-directional relationship running from real income to narrow demand for money and broad demand for money respectively.

Recommendations

Taking into consideration the findings from the study, the following recommendations were proposed.

Financial innovation is critical in influencing the demand for money in Ghana and to this end government and all policy makers need to provide incentives to financial institutions to facilitate the improvement of financial innovation.

Also for monetary policy purposes, it suggests that continued reliance on a stable demand for money function is valid given that the demand for money was stable for the period under review despite the increase in innovation in the financial sector. However, due to the fact that financial innovation is a continuous process, it is prudent for the stability of the demand for money to be constantly reassessed by the monetary authorities to ensure an effective control of the monetary aggregates.

Limitations of the Study

As with any research worldwide, there were fundamental problems which were inevitable in the study. The challenges encountered in this study primarily involved data quality and availability. Thus the limited availability of quarterly data on some key variables was a setback for this study. To produce highly reliable estimates especially with cointegration, variables that have their values already in quarters was needed. As a result, quarterly series were generated through interpolation for the purpose of the estimation. However, there is no gain

in the power of these tests by switching from low frequency to high frequency data and merely increasing the number of observations over a short time period. The use of interpolated quarterly series did not, however, pretense danger to the reliability of the results because other authors have employed similar approach and have arrived at reliable results.

Furthermore, some important variables such as bank concentration (number of banks per thousand of the population), ATMs, number of checks deposited and cleared were not available. This therefore, compelled the researcher to employ other variables to construct the financial innovation index.

Suggestions for Future Research

Based on the challenges that bedevilled the study, the following suggestions for future research were highlighted. The sample size should be increased in order to have findings that give more true representations of the demand for money and its determinants.

Furthermore, efforts must be made to incorporate variables such as bank concentration, ratio of number of cheques deposited and cleared by the financial institutions in measuring financial innovation. This was expected to give a broader measure of financial innovation.

Finally, future studies on demand for money should incorporate financial literacy, degree of political stability and apply different estimation techniques such as Johansen and Juselius' (1992) approach to cointegration based on Vector Autoregressive (VAR) etc.

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APPENDICES

APPENDIX A

PRINCIPAL COMPONENTS FACTOR ANALYSIS RESULTS

Description of Financial Innovation Variables

DCPS/GDP: The ratio of domestic credit to the private sector to GDP.

BC/GDP: and the ratio of domestic credit provided by banking sector to GDP

M3/GDP: The ratio of M3 to GDP

Table A1: Correlation matrix for principal component analysis

	DCPS/GDP	BC/GDP	M3/GDP
DCPS/GDP	1.0000		
BC/GDP	0.7240	1.0000	
M3/GDP	0.7600	0.3584	1.0000

Source: Computed by author using STATA 11.0

Table A2: Factor analysis

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp 1	2.2439	1.6017	0.7480	0.7480
Comp 2	0.6422	0.5283	0.2141	0.9620
Comp 3	0.1139	-	0.0380	1.0000

Source: Computed by author using STATA 11.0

Table A3: Principal components (eigenvectors)

Variable	Component 1 / Eigenvectors	Unexplained
DCPS/GDP	0.5476	0.3271
BC/GDP	0.6449	0.0668
M3/GDP	0.5331	0.3623

Source: Computed by author using STATA 11.0

Table A4: Kaiser-Meyer-Olkin measure of sampling adequacy

Variable	Kmo
M3/GDP	0.4728
DCPS/GDP	0.4875
BC/GDP	0.4696
Overall	0.5664

Source: Computed by author using STATA 11.0

APPENDIX B

SUMMARY STATISTICS OF THE VARIABLES

Table B5: Summary Statistics of the Variables

	lnRM1	lnRM2	Finnov	lny	r	lnP	Lreer
Mean	19.95376	20.02374	0.336533	21.88528	6.151083	1.525011	3.503232
Median	19.79193	19.99235	0.318087	21.85505	5.679739	1.901998	3.317915
Maximum	21.23398	21.18400	0.631897	22.75238	11.92000	4.042410	5.994351
Minimum	18.73756	18.94250	0.191829	21.15180	2.986111	-1.872060	2.911900
Std. Dev.	0.700365	0.608036	0.126224	0.427272	2.513712	1.834218	0.601785
Skewness	0.157612	0.154627	0.803457	0.247371	0.861994	-0.283866	2.465006
Kurtosis	1.684794	2.103525	2.625994	2.134113	2.870091	1.731398	9.310563
Jarque-Bera	9.145663	4.496525	13.61027	4.972646	14.94504	9.658356	320.6412
Probability	0.010329	0.105582	0.001108	0.183215	0.000568	0.007993	0.0150000
Sum	2394.451	2402.848	40.38399	2626.233	738.1300	183.0013	420.3879
Sum Sq. Dev.	58.37080	43.99527	1.895959	21.72479	751.9313	400.3582	43.09523
Observations	120	120	120	120	120	120	120

Note: Std. Dev. represents Standard Deviation while Sum Sq. Dev. represents Sum of Squared Deviation.
Source: Computed by the author using Eviews 5.0 Package

APPENDIX C

PLOT OF VARIABLES IN LEVELS

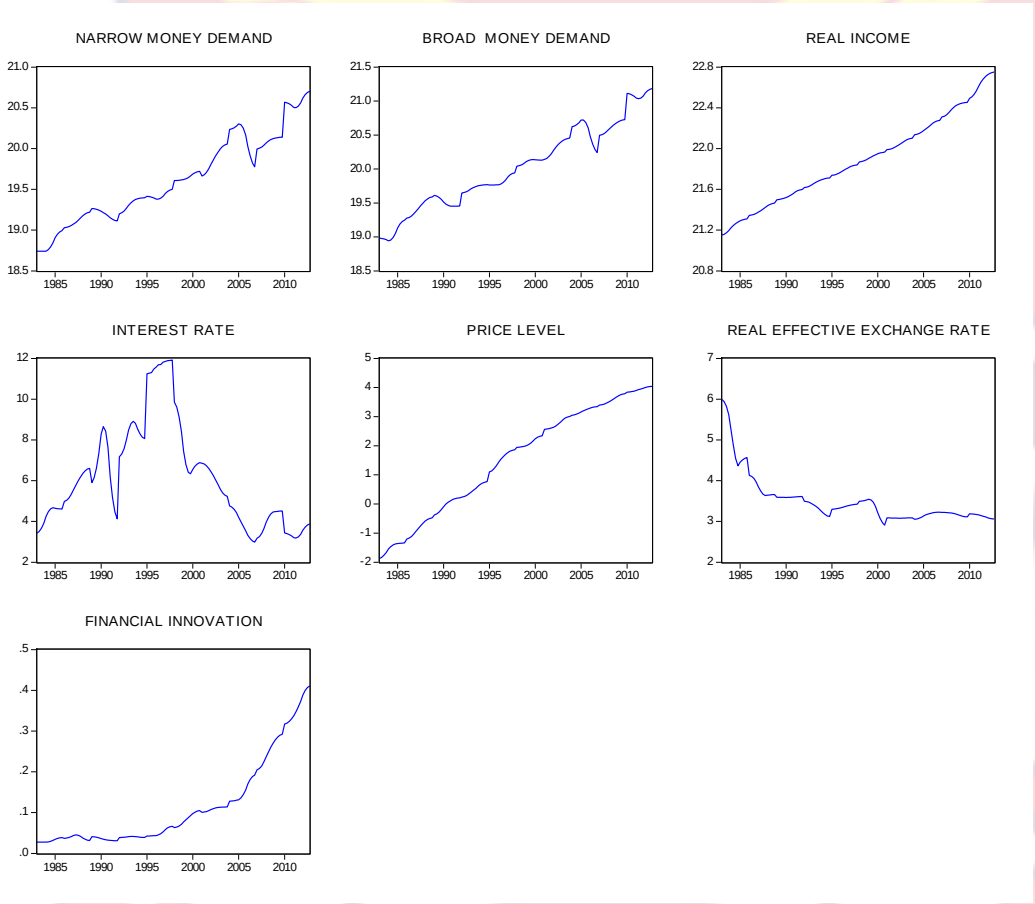

Figure C1: Plot of variables in levels

Source: Computed by the author using Eviews 5.0 Package

PLOTS OF VARIABLES IN FIRST DIFFERENCES

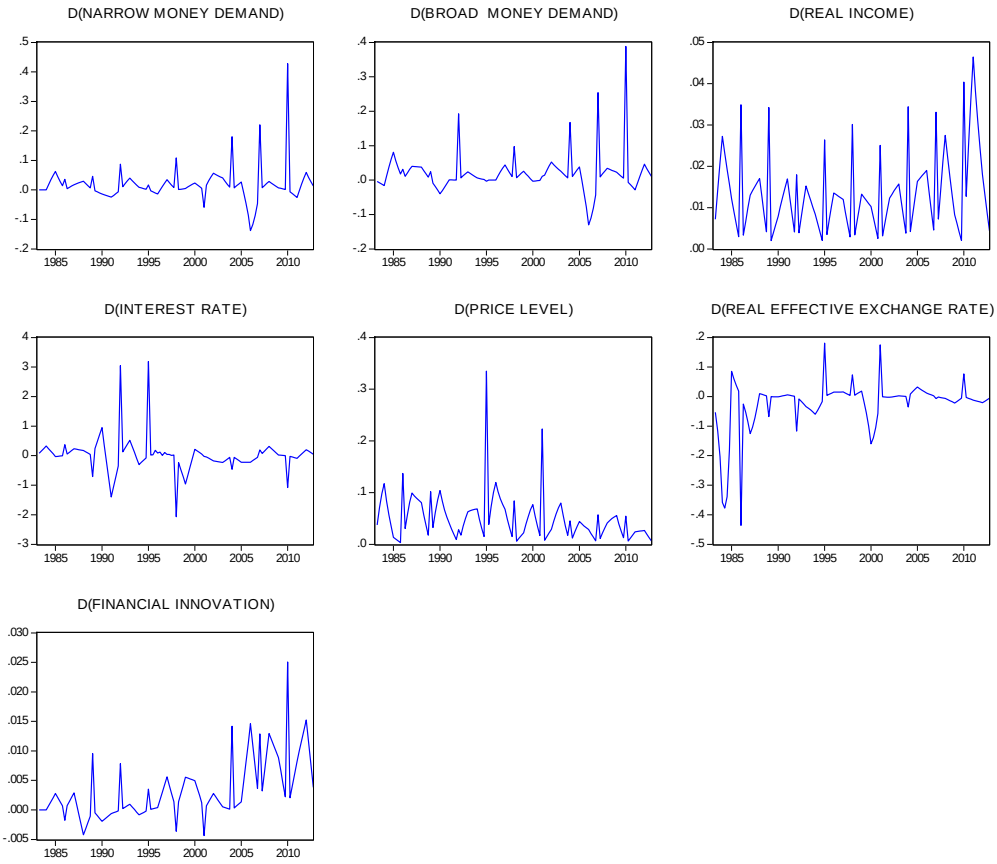

Figure C2: Plot of variables in first differences

Source: Computed by the author using Eviews 5.0 Package