

**UNIVERSITY OF GHANA
COLLEGE OF HUMANITIES**



**EFFECTS OF MOBILE MONEY SERVICES ON FINANCIAL DEVELOPMENT IN
GHANA.**

BY

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN
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DECLARATION

I, KASAPA MANFRED hereby declare that this thesis is the original research undertaken by myself under the guidance of my supervisors towards the award of the Master of Philosophy Degree in Economics in the Department of Economics University of Ghana.

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ABSTRACT

Ghana's financial sector has seen a transforming change with the introduction of mobile money services. The service over the years has transformed from being only a money transfer service to mix of other financial services such as payments and saving services. With mobile money service seeing increasing growth in terms of agents, customers, transactions and currently with four Mobile Network Operators in the mobile money industry, the study documents the effects mobile money services exert on the depth of Ghana's financial sector development and also the currency in circulation.

Using monthly data from 2010 to 2016, the study employs an Autoregressive Distributed lag (ARDL) approach by Pesaran et al (2001) to examine the effect of mobile money transactions on the depth of Ghana's financial development and the impact it has on the currency in circulation.

Two Models were estimated in the study. The first was constructed to examine the impact of mobile money transactions on the currency in circulation and the second captured the effect of mobile money transactions on financial development in Ghana. The Bound test to cointegration revealed that all variables in both models converged to a long run equilibrium once there were deviations in the short run. Both CUSUM and CUSUMSQ tests showed that the long run relationship of both models were stable.

In the short and long run, mobile money services were found to deepen Ghana's financial sector development. Also, mobile money services in Ghana were found to positively increase the amount currency in circulation.

The study recommends that the use of mobile money service in Ghana should be encouraged. Also regulators (Bank of Ghana and National Communication Authority) should put in place holistic

and sustainable mobile money/payment policy actions. These policy actions should be made to revise the “e-money issuer guidelines by Bank of Ghana” into a comprehensive mobile money/payment policy that further incorporates mobile money services into all financial operations and sectors within Ghana. Again, monetary policy measures by central bank should take into consideration the mobile money phenomenon as it could influence the currency in circulation which could affect the effectiveness of its policy.

DEDICATION

I dedicate this work to the Almighty God first and foremost as well as my mother and my four brothers for the inspiration and immense financial support.

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LIST OF ABBREVIATIONS

ACH	Automated Clearing House
ADF	Augmented Dickey Fuller
AIC	Akaike Information Criteria
ARDL	Autoregressive Distributed Lag
ATM	Automated Teller Machine
CCC	Cheque Codeline Clearing
DMB	Deposit Money Banks
EMI	Electronic-Money Issuer
ERP	Economic Recovery Programme
FINSAP	Financial Adjustment Programme
GACH	Ghana Automated Clearing House
GHIPSS	Ghana Interbank Payment and Settlement Systems
GIS	Ghana Interbank Settlement
GSM	Global System for Mobile Communication
GSMA	GSM Association
ICT	Information and Communication Technology
MNOs	Mobile Network Operators
NCA	National Communication Authority
NFC	Near Field Communication
P2P	Person To Person
POS	Point Of Sale

PP	Philip Perron
ROSCA	Rotating Saving and Credit Association
RTGS	Real Time Gross Settlement
SIM	Subscriber Identity Module
SMS	Short Message Service
UBBL	Universal Banking Business License
USSD	Unstructured Supplementary Service Data

CHAPTER ONE

INTRODUCTION

1.1 Background

Mobile telephony technology in recent times has seen a sharp rise in its adoption and usage in most emerging and developing economies (Donovan, 2012). Its adoption could also be realized within the financial sector where people enjoy financial services on mobile phones. In Saharan Africa alone, the number of adults with mobile money account increased from 24% in 2011 to 34% in 2014 (World Bank, 2015). Mobile money services have extended the reach of financial services in the past decade than the traditional banking service (GSMA, 2015). Financial and economic activities have taken a different turn with the introduction of mobile money services. In Ghana, the mobile money services have supported a variety of financial transactions which includes cash deposits, and withdrawal, cash transfers, bill payments and balances checks

Financial deepening or financial expansion usually defined in terms of the development of the financial sector can be explained by an increase in the provision of financial services in an economy (Quartey & Afful-Mensah 2014). This means an improvement in the efficiency of the financial system as a result of changes in the role and structures of financial institutions, methods by which financial services are provided and the introduction of new instruments. Mobile money serves as a financial instrument of electronic payment that facilitates trade and enhances the exchange of goods and services. The introduction of mobile money services has supported the expansion of financial sector services by providing financial services to the unbanked and making available a whole range of financial instruments such as mobile banking.

Mobile money services have become very instrumental in supporting and improving the rudimentary activities of the banking sector. Cash or fund transfer has relatively become faster and cheaper with the mobile money services. Within the mobile money ecosystem, there are mobile money agents who act as financial intermediaries for cash collection (cash deposits) and cash receipts (withdrawals). These agents are key stakeholders within the financial sector who partake in the financial intermediation process.

A well-developed financial sector is one that accounts for minimal cost and risk. The reduction of transaction cost does not stop with the introduction of money, however, it will continue as long as there is financial innovation (Estrada et al. 2010). Mobile money, credit cards and Automated Teller Machine (ATM) are but a few examples of financial innovation that reduce cost. Handling monies come with several risks, the introduction of mobile money has helped in reducing the incident of theft and robbery as monies are converted into electronic-money (e-money) on mobile money wallet. Through the mobile money service, savings have been made easier especially with the large majority outside the formal financial system. Customers of the mobile money service easily save on the electronic-wallet without patronizing informal means of saving such as the “Susu collectors” which usually comes with higher risk.

A look at the evolution of payment systems shows how money has changed its form from the inception of commodity money (gold, silver) to fiat money (paper currency), checks, electronic payment and electronic money (Mishkin, 2004). Mobile money which strongly performs the key functions of money as a medium of exchange and a store of value can be categorized as a form of electronic money (e-money). The depth of Ghana’s financial sector with mobile money services as a new payment and transfer system carries weight of influencing the flow of hard cash used within the financial sector.

According to ACP Observatory on Migration (2014), mobile money services comes in three form; mobile payment service, mobile transfer service and mobile banking (m-banking services). Under the mobile banking services, customers of financial institutions have access to their account and can make payments and transfer. This service is exclusive to only the account holder of the financial institutions. With the mobile payment service, the unbanked public can make payments or facilitate the exchange of goods and services with an electronic wallet (mobile wallet) without using cash. Mobile transfer services allow the unbanked to send or receive sums of money to or from other mobile phone users. According to Muisyo et al. (2014), performance of banks and other banking institutions has greatly been boosted with the introduction of mobile money services and its convenience and dependability have increased customer satisfaction with operations of these banks.

Ghana's financial sector has undergone changes in terms of the number of institutions and services rendered as a result of financial sector liberalisation programme pursued in the late 1980s (Quartey, 2008). The transformation within the financial (banking) sector has evolved from the "Brick and mortar" commercial banking where customers are served by tellers, account balance checks at the bank premises to automatic teller machines (ATMs), online banking, electronic banking (e-banking) and now mobile money services. These developments can be attributed to the simplicity, easy access, and the introduction of new financial products into the sector. Currently, there are four Mobile Network Operators (MNO) offering the mobile money services. They are MTN Ghana, Tigo Ghana, Airtel Ghana and Vodafone Ghana. Recently, several banks have incorporated mobile money services into their operations and have developed applications that synchronises mobile money accounts and bank accounts of customers. Out of 29 Deposit Money Banks (DMB), there are over 15 partner banks with the mobile money service in Ghana.

1.2 Statement of the Research Problem.

The introduction of mobile money services Ghana has brought about a successful union between mobile telephony services and the financial or banking service sector. Mobile network Operators (MNOs) and partner banks are extending and expanding banking services at relatively reduced time through mobile money services. High transaction costs, complex accounts opening and maintenance processes have contributed to low financial inclusion and deepening in most developing economies (Donovan, 2012).

Prior to the introduction of the mobile money services, traditional banking services had limited access to people especially in rural areas as bank branches were located mainly in highly populated areas. Financial services such as cash transfers and payments were sometimes worrisome, this was because banking services were limited to a stand-still type of operation either at the banking premise or at ATMs. Personal savings also became problematic for people outside the formal banking sector. The conduct of financial transactions through the banking sectors was not encouraging especially for most rural folks because they had to embark on long journeys for a financial transactions to be done due to limited bank branches available and what is seen as cumbersome bank processes.

According to Aker & Mbiti (2010), mobile money services have evolved from the usual money transfer service to a formalized and regulated payment and financial service. In Ghana, the widespread use of mobile money services has transformed the financial sector service delivery. Over the years, mobile money has metamorphosed from the traditional money transfers to a broad spectrum of services such as personal savings, utility bill and fee payments, mobile credit purchases, m-banking among others. To some extent, the service has reduced transaction costs, shortened transaction time, improved security and eased the process of exchange of good and

services. It has created a bright opportunity for the gap between the financially excluded and included in society to be bridged. These services rendered through the mobile money platform to some appreciable extent have implications on the depth of Ghana's financial sector which is a key indicator of financial development.

Arrau & De Gregorio (1991) also argued that financial innovation and technological development have brought about changes in how monies are held by individuals. The expansion and extension of financial services through mobile money services to the non-banked public could result in the rise of economic and cash transactions. Such a situation could become a difficult task for monetary authorities when controlling cash in the hands of non-bank public. Orazio et al. (2002) also posit that financial innovations which introduce new financial instruments and means of payments can change cost involved in cash management and also affect how monies are held. This means that financial innovation such as the mobile money services can alter the way cash is held by individuals and also the flow of the currency in circulation. With this situation in hand, what could be the possible effect of mobile money services on the currency in circulation?

As aforementioned, financial institutions and utility service providers are incorporating mobile money services into their operations and payment schemes making cash payments and transfers relatively faster and cheaper. However, it is imperative to note that the upsurge in the number of agents, subscribers and transactions volumes of the mobile services connotes an increase in financial services reaching the general public. With financial transactions increasing through mobile money services, what could be the causal impact of mobile money services on financial deepening or the depth of Ghana's financial sector development? With payment and transfer services such as mobile money also increasing, what could be the impact of the service on the currency in circulation?

There are several studies that exist on the socio-economic impact of mobile money, its use and impact on the savings and performance of the banking sector. Kisaka et al. (2015) found a positive link between mobile banking deepening and the performance of commercial banks. Mbiti & Weil (2014) provided evidence of a strong relationship between mobile money (M-pesa) adoption and the rate of money transfer. Their estimations showed an increased patronage of financial services through the mobile money service (M-pesa). Aker & Wilson (2013) recorded that mobile money services helped reduce transaction cost in cash transfers and boosted savings among households. Asongu (2012) recorded a positive impact of mobile banking on the informal intermediary sector since it was characterised by cash transactions outside the formal banking system. Seldom did these studies capture the effects mobile money services have on the macroeconomic variables and the depth of the financial sector. To fill this gap and add to existing literature, the study seeks to determine how mobile money services affect financial sector development in Ghana.

1.3 Research questions.

The study seeks to address the following questions:

1. What has been the impact of mobile money transactions on Ghana's financial development?
2. Has the increasing use of mobile money services had an impact on the currency in circulation in Ghana?

1.4 Objective of the study.

The objectives of the study are as follows:

1. To examine the effect of mobile money transactions on Ghana's financial development.
2. To examine the impact of mobile money transactions on the amount of currency in circulation.

1.5 Justification of the study.

The introduction of mobile money services in Ghana in the last quarter of 2009 has grown from a transfer system into an array of varied financial products and services. Although being a mobile based service, it strongly performs the core functions executed by most financial institutions in the country. Yet, little is known about how these services are affecting the financial development of the country.

The uttermost task of the central bank is to maintain stable prices. To achieve this, the central bank controls the amount of currency in circulation through the use of monetary policies such inflation targeting and monetary policy adjustments. Financial innovation such as mobile money could potentially influence payment and transfer systems, how monies are held and further affect the flow of currency in circulation. Failure to account for the impact of mobile money service on the flow of currency in circulation could hinder monetary policies. As part of Bank of Ghana's broader strategies to create an enabling regulatory environment for convenient, efficient and safe non-cash retail payment and funds transfer mechanisms, findings of the study will provide information that will be useful to policy makers and regulatory bodies in formulating monetary policies which will stir up economic growth and financial development.

1.6 Organisation of the Study.

This work will have six chapters of which the introduction is the first. The second chapter covers literature review. Chapter three will look at the overview of Ghana's Mobile Money services, the financial sector, and its developments. Chapter four elaborates the study's theoretical framework and methodology. Chapter five will contain the estimations and discussion of results. The last chapter presents the summary, conclusion, and recommendations from the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter examines the relevant literature on mobile money, its adoption and implications on financial development. The first section would review the theoretical aspects of mobile money, its role, and implication on the financial sector as well as some theories in financial development. The second section would cover a review of the empirical literature which considers the disparate methods that have been used to estimate the effect of mobile money services on financial development.

2.2 Theoretical Review

2.2.1 Definition, Characteristics and Role of Mobile Money Services.

The term “mobile money” comes with different names, descriptions, and definition across various literature. Mobile money is defined by Di Castri (2013) as

“monetary value that is made available to a user to conduct transactions through a mobile device which is accepted as a means of payment by parties other than the issuer, issued on receipt of funds in an amount equal to the available monetary value, electronically recorded, mirrored by the value stored in an accounts usually open in one or more banks and redeemable for cash.” (p.5).

Mobile money is a form of .e-money. In simple terms, mobile money describes electronic financial services performed through a mobile phone (ACP Observatory on Migration, 2014)

In a study on monetary theory and electronic money, Jack et al. (2010) explained M-pesa¹ as a Short Message Service (SMS)-based monetary service tailored for deposits and transfers from a virtual account on a mobile phone usually separate from the banking system. Savings, payments and bank account transactions are made available to individuals who tend to use this service. Cash deposits made into mobile phone-based account (mobile money account) reflect the possessions by the account holder of a product referred to as e-money. They argued that as long as value is retained when e-money is transferred over the mobile phone, mobile money could be used as a means of exchange and a way of transferring purchasing power.

Kendall et al. (2011) described mobile money as a network tool that stores and moves money for the exchange of cash, payments and electronic value between key stakeholders such as financial institutions, businesses and clients. Mobile money services allow customers to make cash exchange for e-money on mobile devices, transfer e-money and convert e-money back into hard cash (Mbiti & Weil, 2014).

Mobile money comes under three major services according to ACP Observatory on Migration (2014); Mobile transfers, Mobile payments and Mobile banking (M-banking). Customers make cash deposits onto electronic accounts also known as mobile wallet at mobile money agents. Mobile wallets or account are credited or debited when a transaction takes place. These agents act as financial intermediaries in accepting deposits and giving out cash. Mobile transfer services are made available without the need of a bank account. A cash transfer transaction can be made by a mobile money customer (sender) through an agent to another customer (receiver) who can redeem his cash from a different agent. Lyons (2010) narrated that mobile transfer service could be a

¹ M-pesa is a mobile money service in Kenya

Person to person (P2P) transaction effected from a subscriber's mobile money account to another mobile money account without the involvement of an agent. This is typically an electronic transfer via mobile. M-commerce also known as mobile payments are services that enable people to exchange good and services and also make payments at shops or remotely without the use of cash.

Mobile banking is a mobile service that enables banking institutions to delivery financial services to the banked and unbanked public (Darrat, 1999; Kithaka, 2014). Kithaka (2014) classifies mobile banking into two, first, the transformational m-banking which is the provision of banking services through the mobile phone to cover the unbanked. Second is the additive m-banking service where the mobile phone is used as an additive channel to improve the bank services of those already in the formal banking system. Mobile money and mobile banking show open doors for financial institutions to extend banking services to new clients, in this way expanding their market (Lee et al., 2007; Kithaka, 2014).

Mobile money services carry the ability to make the financial system more comprehensive, steady, efficient and also to improve the safety of the financial consumers (Castri, 2013). According to Jenkins (2008), mobile money's ability to induce financial sector inclusion triggers monumental potential for development impact. Savings made through mobile money enable one to invest in generations and make wealth. Mobile money services provide a more secured and convenient option to the semi/informal financial services and monetary based portfolios. It does not only lessen the reliance on physical cash by enabling digital payment through the mobile phone but provides a platform for a much more extensive scope or range of financial services. The complex infrastructure (mobile connectivity, cash in and cash out networks and mobile money account) tailored for transactions and storing monies electronically are used by financial organisations to

offer services and products. This stirs up competition and improves efficiency within the financial sector.

According to GPMI (2012), an inclusive financial sector has a more diversified and stable retail and deposit base. In terms of systematic risk, they posited that mobile money poses less overall risk than the banking and other payment systems. Financial instability occurs when financial intermediation between savings and investments break down due to shocks in the financial system (Hannig & Jansen, 2010). According to Hannig & Jansen (2010), large numbers of small transactions executed every now and again put considerable strain on supervisory resources, however, it poses constrained systematic risk since they reflect a small share of the overall financial asset. Mobile money services are characterised by frequent transactions involving small sums which pose relatively small systemic risk to the financial sectors. Per a 2016 payment statistics report of the Bank of Ghana, mobile money services recorded the highest volumes of transactions when compared with other payment systems over the past 4 years in Ghana.

Mobile money service does not only appreciate the role cash plays in terms of its function as money in an economy which generally are: store of value, medium of exchange, unit of account and as a standard of deferred payment but further reduces the cost and risk associated with cash. It serves as an alternative to money in the form of electronic cash.

2.2.2 Diffusion of Innovation theory

Rogers (1983) explained that innovation synonymous to technology or a technological change and defined diffusion as

“the process by which an innovation is communicated through certain channels over time among the members of a social system” (p. 5).

Consequently, diffusion is a process that spreads out innovation or novelty out from the point of creation to the user and one that occurs in the society as a group process (Rogers, 2003). He argued that there are four element involved in the process of innovation or technology diffusion: a) the innovation; b) the communication channel; c) the social system d) the time factor

- *Innovation*: This is the idea, tool, object or the platform perceived as new by the potential adopter and should be considered as attractive to adjust to. According to Rogers, the level and speed of adoption of an innovation by a person or a group is determined by the perceived relative advantage of the innovation. It could be financial or non-financial and could be measured in economic terms (Dibra, 2015). Mobile money services could be tagged as an innovation adopted and used by people in (the banked) and outside (unbanked) the formal financial sector.
- *Communication channel*: Rogers (2003) explained that is the means through which an innovation is introduced or made available to persons or actors involved in the social system. With mobile money services, the mobile phones and the availability of mobile communication services act as a channel for persons enjoy financial services. Banks extend financial services to people through telecommunication means and its serves as a platform for payments and transfers.
- *Social system*: Rogers (2003) defined it as

“A social system is defined as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems” (Rogers, 1983, pp.24)

An innovation is diffused within the boundaries of the social systems. In relation to the mobile money service, this social system entails the forces of Mobile network operators

(MNOs), the banks, mobile money agents and mobile money customer and the whole financial sector.

- *Time*: According to Rogers, there is a time dimension required in an innovation's rate of adoption in a system sometimes measured as the number of members of the system that adopts the innovation in a time range.

The four elements with the Diffusion of Innovation theory by Rogers form a basis for the adoption of mobile technology within the financial sector. The level and speed of adoption of mobile money services is associated with the relative advantage or benefit, complexity and reliability the service provides in terms of the ease in making of payments and transfers, time and cost reduction compared with the crude banking services. Mobile money services are innovative ways of delivering financial services and the diffusion of innovations theory provide cognitive insights on how the adoption and deployment of mobile money services impacts the financial development. Also, the theory provides insights on how Mobile Network Operators (MNO's), banks and key stakeholders can improve speedier adoption of mobile money services to deepen the financial sector.

2.2.3 The transaction cost innovation theory

There are several theories that have been outlined by various researchers to define and explain financial innovation. Relevant to this study is the Transaction cost innovation theory which was designed by Hicks & Niehans (1983). They believed that the leading factor of financial innovation was to reduce transaction cost. It was put forward that financial innovation is the response of technological advancement that helps in reducing transaction cost. Reduction in transaction cost influenced by financial innovation leads to improvement in financial services.

2.2.4 McKinnon and Shaw Hypothesis Theory for Financial development.

Most developing countries have resorted to financial “repression” policies to generate revenue to finance government expenditure. These repressive policies carried non-explicit taxes on a country’s domestic financial activities which supported government to supplement its budgetary constraint (Kohli & Kletzer, 2001; Fry, 1988; Fry, 1997a). These included interest rate ceilings exchange rate control and high reserve requirements for commercial banks.

McKinnon (1973) and Shaw (1973) argued that developing countries which have adopted repressed financial policies such as low interest rate ceilings impeded the development of their financial sectors and therefore retarded economic growth. Interest rate ceilings prevented the flow of loanable funds hence restricted the quantity and quality of investments rather than a liberalized financial system that accounted for higher interest rate. Higher interest rate would attract savings by households which would increase loanable funds. This leads to a higher investments and fasten economic growth. McKinnon and Shaw raised the concern that developing countries had inefficient informal financial markets outside the mainstream banking sector and were not able to efficiently intermediate savings by household to productive investment. They explained that liberalizing the financial system or the banking system and raising interest rates would pool funds from unproductive cash holdings and inflation hedges to the financial system which in turn will be channelled to a more efficient and effective productive sectors. In Shaw’s analysis, financial intermediation processes were restricted when interest rates were set below equilibrium point. This would make investors seek opportunities from informal credit markets. Shaw maintained that financial liberalisation helped in integrating both the formal and informal credit sector markets and efficiently channel funds between savers and investors. McKinnon emphasized on the significance

of deposits in promoting investment. High deposit rates attracted the inflow of bank deposits which would promote external financial investment.

2.2.5 Neo-Structuralists' view of Financial Development.

Van Wijnbergen (1983) and Taylor (1983) raised a different view contrary to the notion made by McKinnon- Shaw. They argued that the mainstream banking system was less efficient than the informal financial and credit markets in the intermediation process for financial resources. They believed that the informal credit sector provided a complete intermediation process compared with the banks which absorbed funds for reserve requirements. The informal financial sector was viewed as “competitive and agile” by Taylor (1983), while reserves requirement of banks deflected the intermediation process making these bank less efficient in credit intermediation. According to their analysis, higher interest rates in developing countries incited portfolio shifts from assets with the informal financial markets to bank deposits. Van Wijnbergen (1983) concluded that high interest rates or financial liberalisation polices would reduce total amount of credit and credit supply. This phenomenon would slow down economic growth and the pace of financial development.

2.2.6 Determinants of Financial Development.

Demirgüç-Kunt & Levine (2008) explained that financial development occurs when

“Financial instruments, markets, and intermediaries ameliorate – though do not necessarily eliminate – the effects of information, enforcement, and transactions costs and therefore do a correspondingly better job at providing the five financial functions. Thus, financial development involves improvements in the (i) production of ex ante information about possible investments, (ii) monitoring of investments and implementation of corporate governance, (iii) trading, diversification, and management of risk, (iv) mobilization and pooling of savings, and (v) exchange of goods and services” (p.5).

The main determinants that account for these instances outlined include institutional factors, policy factors, macroeconomic factors, geographic factors among others (Yongfu, 2010).

- *Institutional Factors*

Yongfu (2010) narrated that the legal and administrative framework covering property right protection, prudent book-keeping practices, and contract implementation were key for financial development. Mayer & Sussman (2001) made emphasis on the fact that regulation governing information confidentiality, admissible banking and accounting benchmarks and deposit insurance seemed to have a substantive effect on financial development. According to La Porta *et al.* (1997), financial development is influenced when legal laws and enactments were able to guide and shape the right of external investors. Beck *et al.* (2003) proved that the adaptability and flexibility of legal systems promote financial development by doing a good job at meeting the changing financial needs of the economy. In Beck *et al.* (2003) 's application of Acemoglu *et al.* (2001)'s settler mortality hypothesis to financial development, they found out that colonizers (extractive colonizers) aimed at putting up institutions that focused more on small elite groups than private investors in unfavourable environments, while colonizers (settler colonizers) established systems geared towards the support of private property right and balanced the state's power in conducive environment hence promoting financial development. Institutions may have a profound effect on the supply leading side of financial development and the degree of institutional advancement could have substantive impact on the financial systems (Yongfu, 2010).

- *Policy view*

This view is concerned with the relevance of macroeconomic policies, the openness of market financial liberalization policies in deepening the financial sector. Yongfu (2010) postulates that policy effects on financial development could be supply leading or demand leading. Huybens &

Smith (1999) theoretically analysed the impact of inflation on financial development. They came out with the conclusion that the greater the level of inflation the smaller and less efficient the financial sector. Recent literature also reveals that trade openness' policies boosted financial sector development (Do & Levchenko, 2007; Law, 2004). Financial liberalisation policies to some extent have recorded some positive impact on financial sector development and economic growth according to evidence recorded in recent literature following McKinnon and Shaw Hypothesis.

Other key factors that are deemed key determinants of financial sector are income level, economic growth, savings, and technology.

2.2.7 Mobile money and implications for money demand and money supply

In theory, the growth of financial innovation could improve the efficiency in the financial sector by reducing costs. However, it could also complicate the process in which the monetary policies are conducted in instance of an unstable money demand. The central bank targets these monetary aggregates which require a stable demand function to achieve its ultimate goal which is inflation targeting or price stability. According to Sriram (2000), the stability of demand for money played a crucial role in the conduct of monetary policy especially in terms of the right policy plan and action. Several factors account for the instability of money demand such as changes in regulations, financial reforms and financial development (Anderson 1985). He iterated that money demand instability could arise from changes in income velocity as a result of swings in interest rates and several income unrelated factors. Also, money stocks that may not correspond to money balances desired in the short run could lead to unexpected changes in velocity.

According to Gurley & Shaw (1960), financial innovation can increase interest rate elasticity of demand and therefore variation in velocity of money. Misati et al. (2010) also posits that financial

innovation could weaken interest rate channel and thus affect monetary policy. Melnik & Yashiv (1994) also argued that financial innovation affects macroeconomic variable through bank asset side of the balance sheet and in addition, could impact on money demand. He explained that financial innovation allows consumers to change their portfolio allocation which has implications for bank's ability to lend and thus affects interest rate. Lippi & Secchi (2009) found out that financial innovation leads to lower interest rate elasticity. It is clear that financial innovation such mobile money could account for an unstable demand for money which could affect the amount of currency in circulation in an economy. Such instances could have severe implications for policy decisions.

According to Mbiti & Weil (2014), the speed at which mobile money and other forms of electronic money (e-money) were penetrating the financial system called for attention on its implication on the monetary aggregates. They posited that mobile money and various forms of electronic money could have implications for the measurement of monetary aggregates and the relationships between money supply, price levels, and real variables. Again, they postulated that e-float associated mobile money to a large extent acted as a form of money and failure to measure it in monetary aggregates would result in loose monetary policies. An example cited in their analysis considered the fact that monetary policy could be weaker than the central bank thought if the e-float should grow faster than the conventional form of money which is cash. A remedy to this situation would be to add stocks of e-money into measures of money, M1, but this could be tricky. This is because, in the case of mobile money, e-money is totally backed by cash deposits or transaction accounts held at commercial banks. And when these deposits are subtracted from M1 and mobile money e-float are added the resulting effect is zero. Also, Mbiti & Weil (2014) posited that transaction velocity of e-money or mobile money could be higher than transaction velocity of

monetary aggregates such as cash. It was added that frequent circulation of a small amount of mobile money transaction gave the same transaction made with larger quantities of cash.

2.2.8 E-money, Mobile Money, and Payment systems

Considerable attention has been drawn to the fact that, the introduction of electronic payment systems were changing ways in which routine financial and banking services were conducted (Kirchner, 1996). Electronic money (E-money) and mobile money increasingly look set to replace cash as the preferred medium of exchange. It allows the purchase and sale of goods and services through the mobile telephony infrastructure quickly and cheaply, resulting in significant costs reduction across an economy. “This in itself is a significant development, given the important role of transaction cost in determining the nature and extent of an economy’s production possibilities” (Kirchner, 1996). Hankel et al. (1999) noted that the demand for high powered money as a percentage of GDP continued to decline over the years in most advanced countries because of advancements in payment technology and systems that have reduced the liquidity needs for daily transactions. Analytically, demand for reserve or high powered money arises from several factors including reserve requirement by banks, demand for liquidity by the non-bank public, especially in the form of currency for low value transactions. In most developing countries, mobile money services as a payment system tend to make the financial sector more inclusive, leading the majority of non-bank public to enjoy financial services which would result in higher liquidity demands. In many instance, where mobile money services have become phenomenal they compete directly with central bank money and since mobile money (electronic money) and currency are imperfect substitutes there would be a positive demand for both.

According to Klein & Mayer (2011), M-pesa clearly establishes the fact that a payment system can operate entirely independently of a banking system. With the speed, convenience, and transparency of payments made on cell phones, it is very likely for other technology to replace bank clearing systems. With mobile money services fully offering liquidity and security outside of the banking system, the traditional role of banks in making liquidity and maturity transformation becomes less critical for the financial sector as a whole. Individuals can save outside of the formal banking system and channel it in less liquid and longer assets. In other words, the public good aspect of banking, namely the payments and safe custody functions are removed from banking and operated by other service providers that have little or no risk associated with them.

2.2.9 Mobile money as a network infrastructure & platform for financial services

Jonathan & Camilo (2008) stressed on the fact that, most mobile money transactions in most developing countries make available opportunities for users to store monetary value in virtual accounts (mobile account or electronic account) through mobile phones. Savings formally requires a bank account, mobile money as a network infrastructure enables users (without a bank account) to obtain a quasi-bank account managed by both Mobile Network Operators (MNO) and commercial bank (Asongu, 2013). Mobile money users can cash in and cash out balances from these account. The system enables one to transfer stored funds between several linked accounts. With mobile money, mobile phone and in particular Subscriber Identity Module (SIM) cards can serve as smart cards just like Automated Teller Machine (ATM) cards. The service allows mobile phone to act as Point of Sale (POS) devices. This could be used to transact and communicate with financial institution to complete transaction authorization. According to Asongu (2013), if cash and access to savings were considered as goods and services that users could buy, then mobile money enables mobile phone to serve as POS devices for cash collection and distribution.

According to Kendall et al. (2011), the system of mobile money gives clients a wide array of transaction outlets close to work places and homes reducing the cost of accessing financial services.

2.3 Empirical Review on Mobile money services and Financial Development

Several empirical studies have been undertaken to determine the impact or effect of financial innovation, technology and mobile money on financial development.

The empirical review below considers disparity methods used in different literatures to analyse the impact and effect of mobile money services, ICT and financial innovation on financial development.

Nandhi (2012) investigated the effects of mobile banking on the saving practices of low income earners in India. The study was based on field survey that captured 160 mobile banking customers from three districts. The survey revealed that the capacity of low income earners to save had increased through mobile banking services. Ninety (90) percent of customers stated that the mobile banking service had increased their ability to save. This was because it was much safer and effective to save on the mobile money wallet. Also, the mobile banking service was considered as a good alternative for the informal and traditional forms of savings for the customers. It was also realized that mobile banking users had decreased their dependence on other saving alternatives which were costly and risky.

Jack & Suri (2011) gathered and analysed data from a two-round survey on households in a study that captured the economic use on mobile money service among Kenyans. The initial round of survey captured 3,000 households across Kenya while the following round of survey captured 2,016 of the initial 3,000. It was realised that the mobile money service (M-pesa) had become a

saving instrument. There was an increase in the percentage of M-pesa users who used the mobile money service as a saving instrument from 75 percent in the initial survey round to about 85 percent in the second round of survey. The proportion of users who saved on M-pesa increased between the two rounds among the banked and the unbanked. Also, results analysed from both rounds of survey revealed that mobile money users were likely to send and receive remittances than non-users. In the follow up survey, remittances sent via the mobile money platform had increased to about 75 percent from 50 percent in the initial round.

Plyler et al. (2010) explored the community level economic effects of M-pesa within 3 districts in Kenya. The study gathered and analysed both qualitative and quantitative data from agents, financial service providers and market surveys. They found out that M-pesa had increased the volume of cash inflows and outflows and the rate of cash flows within communities raising the amount of cash in circulation. The M-pesa service had caused businesses to expand and increased job opportunities. This was because these business ventures were able to meet increasing demand of goods and services because of increased cash in circulation driven by M-pesa transactions.

Kamukama & Tumwine (2012) examined the effect of mobile money services on the liquidity position of commercial banks in Uganda. Using an Ordinary Least Square (OLS) cross sectional and quantitative research design on 345 respondents from 23 commercial banks, they found out that, increased use of mobile money services was associated with lowered bank deposits by clients which negatively affected commercial bank's liquidity position. It was explained that the liquidity position of commercial banks was falling and mobile money services accounted for 36.7 percent of variance in the liquidity of commercial banks.

Wanyonyi & Bwisa (2013) employed a chi-square test on a survey of 36 micro enterprises to examine the influence of Mobile money transfer Services on the performance of Micro enterprises.

They found out in the study that the use of mobile money transfer services for a) business to business transfers when making payments to suppliers and b) customer to business transfers intended to make purchases from businesses and redeem debt from credit sales improved the performance of micro enterprises.

Aker & Wilson (2013) gathered data from 97 participants on a research to analyse whether mobile money could be used to promote saving in Ghana. Using a baseline survey as well as a follow-up survey on the same participants on mobile money usage and saving patterns. It was realised in the initial stages that mobile money was mainly used for sending and receiving remittance. The follow up survey revealed that 26 percent of participants were using mobile money for both savings and remittances. They suggested that mobile money would reduce transaction cost incurred in cash transfers and boost households to save which is key for rural folks to smooth consumption in time of shocks.

Merrouche & Nier (2012) assessed the impact of payment system on the amount of credit offered by the banking system using payment system reforms in 10 Eastern European countries over 1995-2005 period. They found out that payment system reforms were associated with increasing trends in credits. It was also evident in their findings that Payment system reforms resulted in decreases in the amount of cash used for transaction purposes in the economy relative to the use of bank deposits. Since deposits were well intermediated within the financial system, they posited that it could improve the creation of credit. They concluded that an effective payment system was a vital prerequisite for credit acceleration.

Manizheh et al. (2013) studied on financial development and Information communication Technology (ICT) amongst 9 countries from the Middle East and North African (MENA) region. Using panel co-integration and Dynamic Ordinary least squares method (DOLS) analysis, they

revealed that information communication technology has a positive impact of financial development. It was recorded in their results that a 10 percent increase in mobile phone subscribers per 100 people increased market capitalization by 1.2 percent. They concluded that information communication technology has a stronger impact on stock market activities of the MENA countries.

Using Generalized Method of Moment (GMM) on a sample of sixty-one countries from 1990 – 2002, Shamim (2007) conducted a cross sectional analysis on ICT environment, financial sector, and economic growth. She found out statistically that in a connected society with an increased number of mobile phone subscribers and internet users, the financial sector deepened. It was realised that there was a positive relationship between e-finance and connectivity and this would enhance economic growth in countries where e-finance has attained an appreciable level.

Kisaka et al. (2015) examined the relationship between mobile banking deepening and financial performance of commercial bank in Kenya. The study applied a descriptive research design which covered 6 telecommunication service providers and 43 commercial banks in operating in Kenya as at June 2014. There was a direct positive link between total number of mobile banking customers and value of mobile banking transactions but the study revealed a weak insignificant positive relationship between mobile banking deepening and the financial performance of commercial banks. They concluded that the financial performance of the commercial banks in Kenya could have been affected by other indicators which were not considered in the study.

Mbiti & Weil (2014) analysed data from national household survey (FinAccess) tailored to measure financial access in relation with the impact of mobile banking services in Kenya. Estimates from a random fixed effect model analysis portrayed a strong positive association between the adoption of M-pesa services and the rate of sending and receiving money transfers.

There was a huge negative relationship between m-pesa usage and informal means of savings such as Rotating Saving and Credit Association (ROSCA). Velocity of M-pesa which was measured as total value of person to person transfer over outstanding balance of e-float stood between 11 and 14.5. Their estimation showed that increased use of M-pesa would increase patronage of financial service. With this, they realised M-pesa adoption would decrease the unbanked populace by 28 percentage points. Mbiti & Weil (2014) concluded that increased usage of the mobile money service lowered the tendency to keep savings with informal saving machinery such as ROSCA.

Mago & Chitokwindo (2014) examined the effect of mobile banking services on financial Inclusion in Zimbabwe. A qualitative research and a survey design was employed to estimate the impact of the two variables in the Masvingo district on 270 respondents. It was found out that low income people were willing to adopt mobile banking for several reasons. A convincing majority were eager to adopt the mobile banking services because it was easy to use, easily accessible, cheaper in terms of cost, convenient and more secure. The low income earners left in the informal sector could now enjoy similar formal financial services through mobile banking.

Asongu (2012) investigated on the new indicators for Mobile Banking Nexus. In his study, the financial deepening indicators were designed into 3 categories to capture formal, semi-formal and informal sector analysed how mobile banking services influenced each sector. Using monetary supply components, Asongu (2012) noted the informal sector is characterised mainly with cash dealings where most cash holders are not in the formal banking system hence constructed its financial depth indicator as $(\text{Money Supply} - \text{bank deposits}) / \text{GDP}$. For the semi-formal sector, its financial depth indicator was constructed as $(\text{financial deposit} - \text{Bank deposits}) / \text{GDP}$ while the formal sector was $(\text{bank deposits}) / \text{GDP}$. Financial deposit consisted of demand, time and savings deposits at Deposit Money Banks (DMBs) and other Financial

Institutions. Bank deposit consisted of time, savings demand deposit with DMBs. After using both endogeneity-robust and heteroscedasticity-autocorrelation consistent (HAC) estimation analysis on a panel data gathered from 52 African countries, it was realised that mobile banking had a significant impact on the informal financial sector. Mobile banking services had a positive impact on the informal intermediary/financial sector. The depth of the semi-formal and the formal financial sector was negatively affected by mobile banking incidence. He concluded that disentangling different components of financial deepening indicators into segments such as formal and semi-formal and formal could improve the understanding of mobile-finance nexus.

A study on financial innovation and money demand in Kenya by Kasekende (2016) re-estimated the relationship demand for money and mobile money using ARDL approach to cointegration. Using quarterly data from 2000 to 2014, the results showed demand for money was stable and that the inclusion of mobile money had a positive relationship with money demand. They concluded that this positive relationship could be due to the fact that mobile money is backed up in the commercial banks as deposits. Since mobile money (e-money) is an alternate form of cash, increases in the use of mobile money service would increase demand for money since the unbanked population would engage in transaction using this alternative form of cash.

Ajide (2016) in his study on Financial Innovation and Sustainable Development in Selected Countries in West Africa investigated on the effect of financial innovation augmented with bank competition on sustainable development in eight West African Countries. Using panel data estimation he established two proxies for both bank concentration (market concentration and Boone Indicator) and financial innovation (growth of credit to private sector as a percent of GDP and the ratio of M3 to M1). In his analysis, there was a positive relationship of bank concentration and financial innovation on economic development, however, it factualised that the development

effect of financial innovation was sensitive to the choice of proxy used. While one of the proxies showed a positive effect, the other showed a negative effect. He concluded that results signalled differential impacts of financial innovation adopted in the financial sector. He explained further that, financial innovations could discourage economic growth through the reduction of demand for money. He meant individuals could shift to less liquid assets which would discourage consumption. Contrary to this, he also found out that financial innovations could lead to an increase in demand for money when payment systems improve. Individuals would demand for more of liquid cash. This would boost consumption, production would increase, leading to an increase in growth and development.

Mannah-Blankson & Belnye (2004) examined the impact of financial innovation on money demand with a cointegration and error correction model on the study financial innovation and the demand for money in Ghana. Using the volume of card transactions as a proxy for financial innovation over a quarterly period between 1992 and 2000. They realised that financial innovation reduced the pressure on over-the-counter services to bank customers and improved the banking system's operational efficiency. It was found out the increases in financial innovation resulted in an increase in the demand for M1 and a decrease in the demand for M2.

2.4 Conclusion

The theoretical literature provides a vital understanding of the various definitions and characteristics of mobile money services. The operational definitions of mobile money and its role in the financial sector as a network infrastructure and platform for financial services provide insights into how the mobile money service works and relates directly or indirectly to financial development. It also highlights on the implications of mobile money as a form of money and as a payment system on the supply and demand of money or cash balances. The literature also

highlighted on different theories of money and various schools of thoughts on financial developments.

Most of the empirical literature reviewed discussed how mobile money services had impacted savings, remittance and transfers on a micro or community level. Nandhi (2012); Jack & Suri (2011); Aker & Wilson (2013); Mbiti & Weil (2014) all found out that mobile money services promoted savings and had positively impacted on the saving levels of individuals especially low income earners. Mbiti & Weil (2014) pointed out that mobile money services had increased the patronage of financial service but had also decreased the tendency to resort to informal saving machinery such as the ROSCA.

Plyler et al. (2010); Kamukama & Tumwine (2012); Merrouche & Nier (2012) also considered the impact of mobile money and payment systems on amount of cash in circulation, the liquidity position of banks and creation of credit. Merrouche & Nier (2012) found out that improved payment system was associated with improved credit creation for the banking system. Plyler et al (2010) a contrary view recorded that mobile moneys services had accounted for an increased circulation of cash within communities as a result of increased volumes of cash inflows and outflow. This contrary view was further buttressed by Kamukama & Tumwine (2012) who recorded that mobile money services negatively impacted on the liquidity position banks as a result lower bank deposits through mobile money activities. Mannah-Blankson & Belnye (2004) in another view documented that financial innovation had increased the demand for M1 even though it had improved the efficiency of banking operation.

Mago & Chitokwindo (2014); Asongu (2012) both documented that mobile money/ banking service had improved financial inclusion and intermediation bringing most low income earners in the informal sector into the formal financial sector.

In relation to these reviews, this study seeks to improve on literature pertaining to the Ghana economy and on a macro level, where existing studies were mainly restricted to impact of mobile services on savings, transfers, financial inclusion, liquidity of bank and credit creation of banks primarily using descriptive research methods on micro level. This study seeks to contribute to existing literature by examining the macro-economic impact of mobile money services on the depth of Ghana's financial sector development and its currency in circulation.

CHAPTER THREE

OVERVIEW OF MOBILE MONEY SERVICES AND DEVELOPMENT OF THE FINANCIAL SECTOR IN GHANA.

3.1 Introduction

This chapter looks at the development of mobile money services in Ghana as well as the stakeholders involved. It will also look at an overview of Ghana's financial sector and its development.

3.2 Mobile money ecosystem in Ghana

For the purpose of this study, we need to understand certain key terms and stakeholders that make up the mobile money ecosystem. The mobile money ecosystem is a complex mix of mobile telecommunication infrastructure and financial services that make it functional.

3.2.1 Telecommunication Networks (Telco's)/ Mobile Network Operator (MNOs)

The backbone of mobile money services depends immensely on the operations of mobile network services. These telecommunication networks or Mobile Network Operators are institutions that provide GSM² services for mobile communication that link people from different spatial locations through a Subscriber Identity Module (SIM) card. Voice transmission, Short Message Service (SMS) and internet data services form the core operations of these telecoms. These Mobile Network Operators (MNOs) provide and manage the technical infrastructure and network tools needed to make mobile money services interoperable. A mobile money service cannot be operated if there is no network service available on a subscriber's phone. The input of these Mobile Network

² GSM - Global System for Mobile communication

Operators is core to the mobile money ecosystem. They provide the “bearer channel” through which instructions are communicated between a user’s handheld device and the mobile money application platform. Commonly used bearer channels are Unstructured Supplementary Service Data (USSD) platform or the SMS means. In Ghana, there are 6 mobile network operators; MTN, Vodafone, Tigo, Airtel Ghana, Expresso, Globalcom.

3.2.2 Aggregator

The role of the aggregator in the mobile money ecosystem is more or less a coordinating role between mobile money agents and the mobile network operators. They are usually subsidiaries and often owned by the Telecommunication operators. It is the mandate of the aggregator to recruit new mobile money agents. According Mbiti & Weil, (2014), the aggregator is the head office or the “super agent” of mobile money service who directs the flow of operation from the Telecommunication network service to the mobile money agent but can also transact business directly with the customers. They facilitate the conversion of fiat money to e-money and e-money to fiat money.

3.2.3 Mobile Money Agent

Mobile money agents are also key players within the mobile money ecosystem. Sometimes referred to as merchants or retailers, they could be persons or businesses institutions contracted to facilitate financial transaction for users. Their role is to convert fiat money into e-money and e-money into cash to enable the transfer of e-money from a consumer or customer to another. They act as mini banks where monies are deposited and converted into e-money and also e-money is redeemed and converted into cash. They execute cash-in and cash-out functions and normally operate under small shelves and shops with cash vault to enable them run their businesses. Agents

sometimes register new users and earn commission for each transaction they execute. Cash deposits with agents in exchange for the purchase or sales of e-money is kept in the agents account held with the Deposit money Banks (DMBs). An agent can execute a transaction, that is, facilitate the sale or purchase of e-money up to the tune of the e-float (the balance of e-money or physical money held in the bank account of the agent with the Deposit Money Banks (DMBs)). The agent or the aggregator is limited to the balance of e-money (e-float) it issues to the amount of cash deposits made with these banks.

3.2.4 Deposit Money Banks/ Commercial Banks

The mobile money service will break down without the presence of commercial banks or deposit money bank. This is because the e-money will cease to act as a form of money if it is not backed by physical cash or deposits with banks. Deposit money banks or the commercial banks hold floats or accounts of mobile money customers. This enables the transfer of funds between several mobile money accounts.

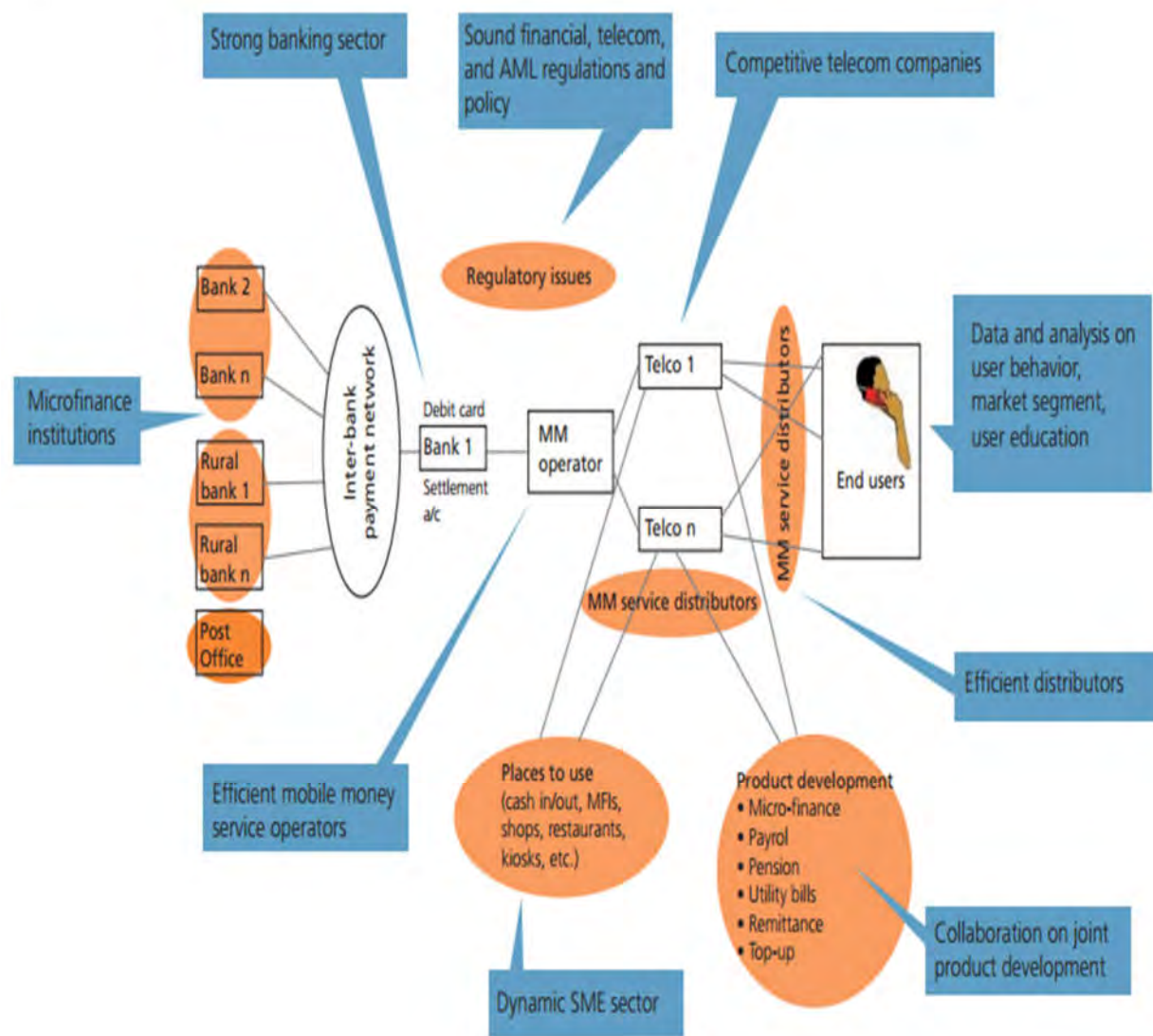
3.2.5 Mobile money customer.

The mobile money customer is the end user or final consumers of mobile money service. Consumers enjoy financial services such as fund transfers, savings, remittances and cash payments on their hand set. Registration for a mobile money service comes with less cumbersome documentation. An existing mobile number requires a valid Identity card to subscribe for the mobile money service. A unique Personal Identification Number (PIN) is assigned to the registered customers to make secured transactions. The concept works like the ATM system, thus the mobile SIM card with its unique PIN would work perfectly in any mobile handset.

3.2.6 Regulator

The regulator is the authority that imposes regulations, monitors, enforces compliance and plays supervisory role over the entire ecosystem. This regulator is usually the central bank. In Ghana, the Bank of Ghana is the regulator that gives out guidelines with regards to the issuance of E-money. The National communication Authority (NCA) play a critical role in the regulatory and supervision of the operations of Mobile Network Operators

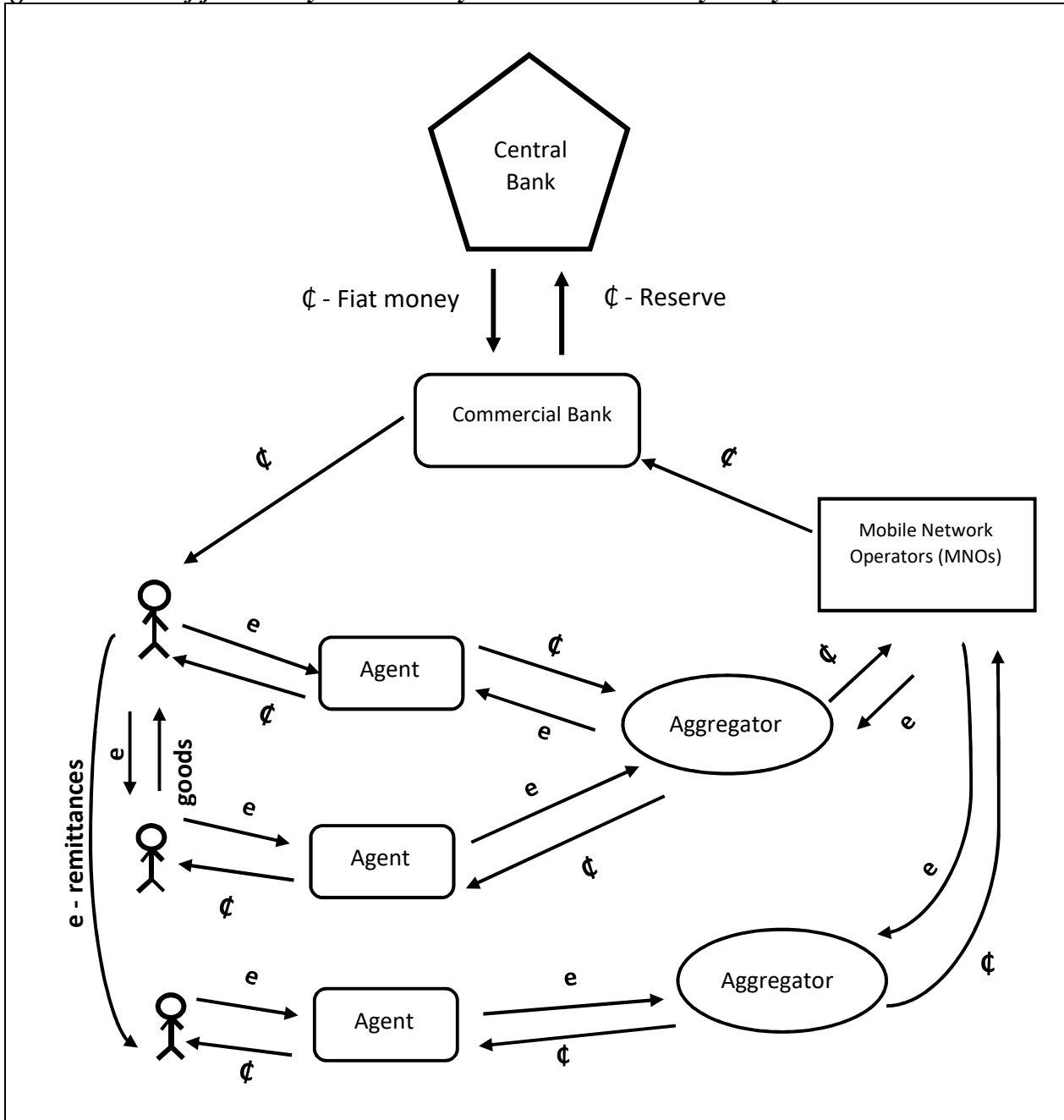
Figure 3.1 Sample of Mobile money ecosystem



Source: Jenkins, (2008).

Figure 3.1 illustrates how stakeholders (end users, banks, MNOs or Telcos) within the mobile money ecosystem relate with each other in executing and delivering financial transactions through the mobile money platform.

Figure 3.2 Flow of fiat money and e-money under Mobile Money Ecosystem

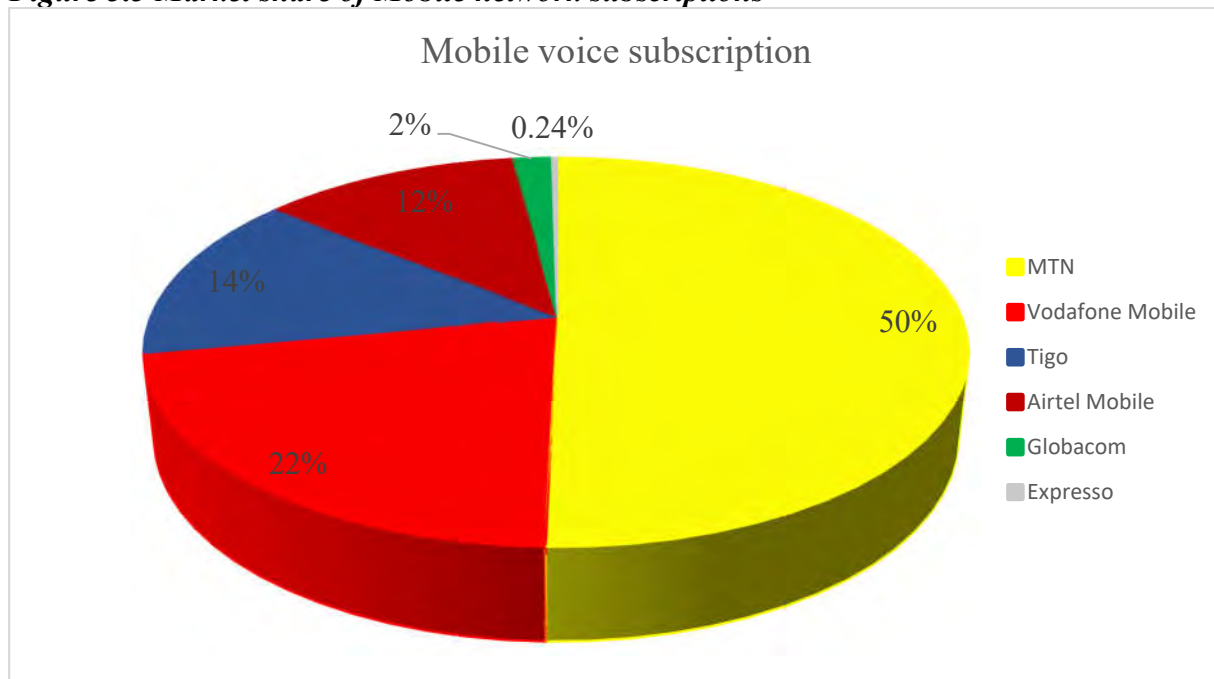


Source: Jack et al. (2010)

Figure 3.2 also portrays the exchange of goods and money and the movement of e-money and fiat money between agents and banks (commercial banks and central bank) facilitated by aggregators and Mobile Network Operators (MNOs).

3.3 Mobile Telecommunication Evolution in Ghana.

The inception of mobile telecommunication since 1992 has significantly evolved over the years. With just one operator Mobitel (Tigo Ghana) then in operation and under 900 mobile phone subscribers, the mobile telecommunication industry gradually saw new operators move into the industry. SpaceFon, Spacefon- Areeba now MTN launched its operation in 1996 expanding the mobile subscriber base to over 14,000. Ghana Telecom (now Vodafone Ghana) introduced OneTouch GSM in the year 2000, this shot up the mobile network operators to 3 increasing mobile phone subscription to 90,000. Between 2003 and 2011, three additional mobile network operators joined the industry. These are “Zain” now Airtel, “Expresso” formerly “Kasapa” and Globacom. Presently in Ghana, there are six mobile telecommunication networks in operation with 38,305,078 mobile voice subscriptions as at the end of December 2016 (National Communications Authority, 2017). Mobile Telecommunication Network (MTN) captures the largest share of mobile voice subscribers with 19,296,157 representing 50.37%. Vodafone (previously OneTouch) follows with 8,289,913 subscribers which is 21.64% of the telecom market holding. Tigo’s mobile subscriptions stood at 5,339,052 representing 13.94%. For Airtel, its mobile subscription stood at 4,591,051 which was 11.99%. Total subscriptions for Globacom and Expresso were 695,306 and 93,599 with a total market share of 1.82% and 0.24% respectively.

Figure 3.3 Market share of Mobile network subscriptions

Source: National communication Authority, (2017)

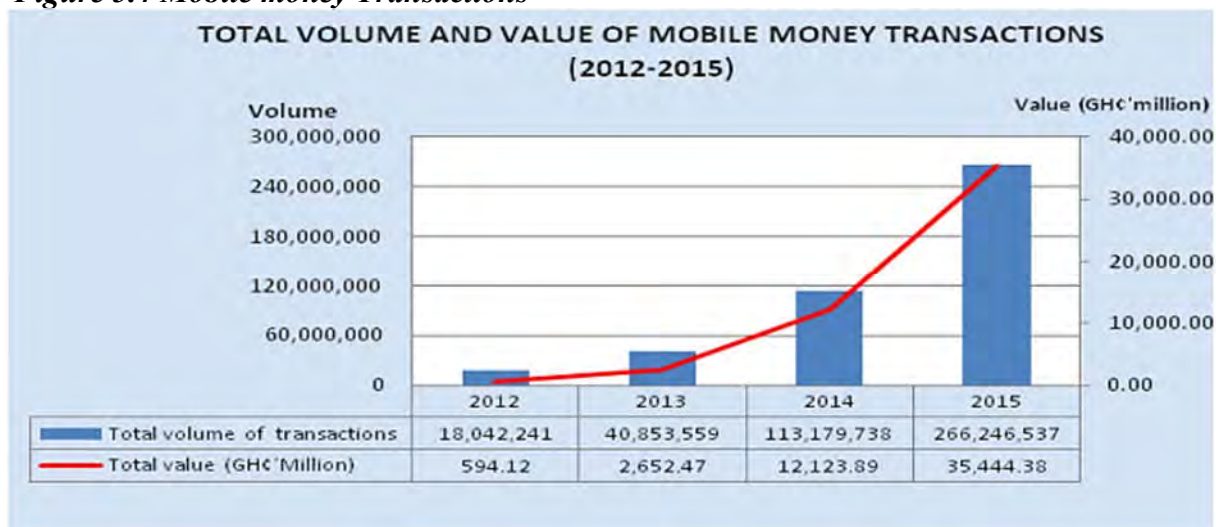
3.4 Mobile money in Ghana

Out of the total six mobile network operators in Ghana, Four of them provide mobile money services to their customers or subscribers and the Ghanaian population on a large scale. The first to emerge in the market was MTN in 2009. Airtel mobile joined the mobile money ecosystem to provide mobile money services in 2010. Tigo launched their mobile money services in 2011. In 2015, Vodafone Ghana became the fourth network to enter the ecosystem. These four mobile network operators hold 97.94% of market share of the mobile telecom subscribers. The pace of adoption for mobile money services recorded a low trend in its initial stages of introduction in the country but has seen relatively high adoption and usage in the past couple of years. This is due to the relative ease and convenience for subscribers in holding a mobile money account. Registration for a mobile money service with all four Mobile network Operator in Ghana come with absolute simplicity. With just a national ID card, one can register for a mobile money account. Active

mobile money customers have continued to rise significantly from 26,000 in 2010 to 8,313,283 in 2016 per a 2016 Payment system statistics released by the Bank of Ghana.

Mobile money services in Ghana has evolved from the regular money transfer to a whole range of financial services such savings, Point of Sale (POS) payments, Utility payments services, Treasury Bill (T-bill) purchases. Mobile money agents also have increased year on year from 2010 to 2016. Active agents totalling 8,660 in 2012 moved to 107,415 as at December 2016. Most of these agents in Ghana usually operate in mini-shops and under umbrella stands. Majority of banks in Ghana also run mobile money services in their banking premises.

Figure 3.4 Mobile money Transactions

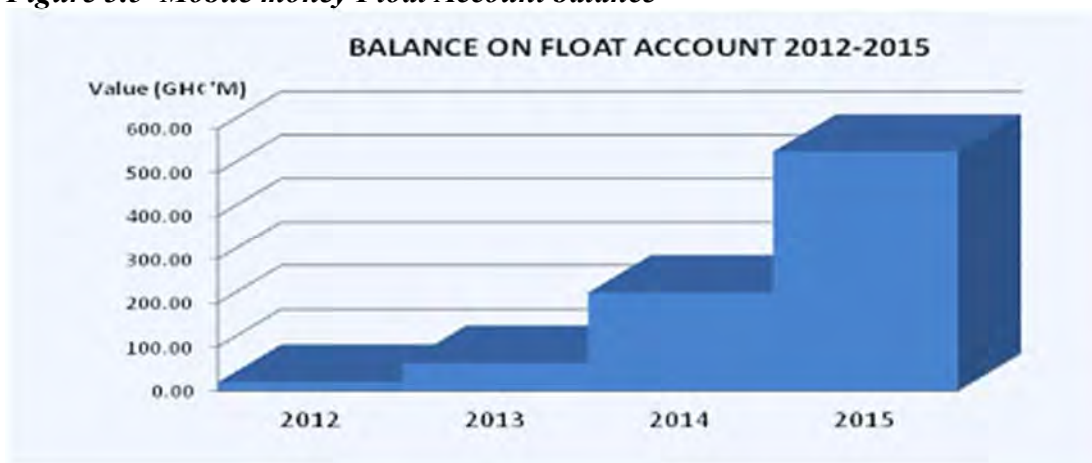


Source: Bank of Ghana, (2015)

The penetration of mobile money services in Ghana has astronomically risen in recent years. The value of mobile money transaction reaching GH¢26.82 million in 2010 rose to GH¢594.12 million in 2012 and broke into GH¢2.65billion in 2013. In 2015, the value of transactions hit GH¢35.4billion, an increment of more than 216 percent over the previous year which was just GH¢5.85billion shy of total deposit liabilities of 29 banks as the end of the year (Bank of Ghana, 2015).

The total year on year growth in mobile money services caused the e-float balance of the service to increase from GH¢19.59 million in 2012 to GH¢547.96 million to 2015. In 2014, the annual growth in the balance of mobile money e-float was recorded at 255.51% while in 2015 it was approximately 145.36%. Whereas in most countries, mobile money accounts do not earn interest on e-float, the Bank of Ghana after realizing the quantum of total float in the system was approaching USD100 million, it instructed banks to pay interest on these e-float accounts. It was decided that not less than 80% of interest be paid to their end customers by E-money Issuers in the new Electronic-money Issuer (EMI) guideline. In September 2016 a total of GH¢15.2 million representing 80% of total interest earned on float was shared among mobile money customers.

Figure 3.5 Mobile money Float Account balance



Source: Bank of Ghana (2015)

From table 3.1 below, there has been a continuous increase in mobile money agents, registered mobile money customers and the total volumes and value of mobile money transactions in Ghana. Volumes of mobile money transactions recorded about 94% of total volume of non- cash retail payments in 2015 according to Bank of Ghana (2015). Registered mobile money customers as at 2015 were 13,120,367 while active customers who are considered to have transacted at least once in 90 days shot up from 345,434, in 2012 to 4,868,569 in 2015. At the end of 2016, the number of

active customers was 8,313,283 representing an annual growth of 70.75% in 2016. The total values of transactions under mobile money services recorded an annual growth of 357.08 and 192.35 in 2014 and 2015 respectively. It increased from GH¢35.4billion in 2015 to GH¢78.5billion in 2016 representing an annual growth rate of 121.5%

Table 3.1 Mobile money payment Statistics

Indicators	2012	2013	2014	2015	2016	Annual Growth 2014(%)	Annual Growth 2015(%)
Active Mobile Money Customers	345,434	991,780	2,526,588	4,868,569	8,313,283	154.75	92.69
Registered Agent(Cumulative)	8,660	17,492	26,889	79,747	136,769	53.72	196.58
Active Agent	5,900	10,404	20,722	56,270	107,415	99.17	171.55
Total Volume of Mobile Money Transactions.	18,042,241	40,853,559	113,179,738	266,246,537	550,218,427	177.04	135.24
Total Value of Mobile Transactions (GH¢ Million).	594.12	2,652.47	12,123.89	35,444.38	78,508.90	357.08	192.35

Source: Bank of Ghana (2015)

3.4.1 MTN Mobile Money

MTN Ghana pioneered mobile money services in Ghana in August 2009 and christened it MTN mobile money in partnership with nine Banks. Its mobile money services concentrated mainly on financial transfers or cash transfer in its initial stage of roll-out. Being the largest market share holder of mobile voice subscriptions of 50.2%, MTN has grown its mobile money subscriber base to approximately 2.5 million registered customers with over 10,000 mobile money agents performing over 50 million transactions monthly across Ghana (Ghana News Agency, 2010). Its mobile money services has transformed from a transfer base system to a more integrated financial

service. It includes bill payments (such as DSTV, ECG post-paid, school fees), purchase and payment of insurance, payment for goods and services (airline tickets, shopping etc.), card-less ATM withdrawal and link Bank Account services (so customer can move money from bank account to their mobile money wallet and vice versa). New innovative products like savings and loans have been added to the MTN mobile money service. This saving product allows mobile money subscribers to save on their mobile money at a rate 12% per annum. Currently, the service is in partnership with sixteen banks running through the nation. MTN mobile money also allow customer to purchase Government of Ghana Treasury Bills with as low as GH¢5.

3.4.2 Airtel Money

Airtel money was the second money mobile service that was launched in the Ghana. The service was introduced in 2010 as Zap mobile money services which was operated by Zain Ghana before it was taken over by Airtel in November 2010. The service initially focused primarily on fund transfer. Being the fourth largest voices subscription market holder with 11.99%, Airtel Money continues to bring innovative mobile payment platform system within the mobile money ecosystem such Tap2tap service the uses NFC (Near Field communication) system for the payment of goods and services. The service also allows the payment of utility bills. A saving product “Airtel money Jara” allows a customer to earn 12% interest on savings on mobile money wallet. Airtel Money Bosesa is a Nano loan credit service in conjunction with partner banks that allows one to access a loan and cash it out and pay back all through the mobile money service. It come with an initial interest charge of 20%. Airtel money operates an ATM cardless transaction with 6 banks in Ghana. This enable one to withdraw cash from a mobile money wallet through an ATM without the involvement of agent.

3.4.3 Tigo Cash

The third mobile money services launched in Ghana was Tigo Cash in 2011 by Tigo operated by Millicom Ghana Limited. Currently, its voice subscriber base is 13.49% of total market share. Tigo's mobile money service is no different the others. The service includes cash remittances, bulk mobile payments which allow small and medium scale enterprises (SMEs) Non-governmental Organisations (NGO) and corporate entities to pay clients, employees, and vendors. Even though Tigo cash allows the payment of services like DSTV bills its basic product is P2P transaction. Tigo cash had an active agent base of 949 as at the end of 2013. The company, however, went through several phases to arrive at this number of agents. In 2012, it had over 3000 agent network across Ghana, but most of those agents were inactive. After re-evaluation and rationalization of its agents, their numbers shrank to about 949 by the end of 2013. This process eliminated all inactive agents from their systems.

3.4.4 Vodafone Cash

With 8,289,913 voice subscribers representing 22% of the market share Vodafone Ghana formerly Ghana Telecom launched its mobile money services on the Ghanaian market in December 2015. Vodafone mobile money services provides similar services to the already existing mobile money service providers in the country. The service helps send and receive e-money, withdraw cash, electronically pay Vodafone related bills and also perform ATM cardless transactions.

3.5 Developments in the monetary and financial sector

3.5.1 Banking and financial sector Reforms, Laws and Regulations

Ghana's banking sector seems more vibrant compared with other countries in the sub-region (Quartey & Afful-Mensah, 2014). The financial sector witnessed massive state and government intervention in between the 1960's and 1980's, this led to consequential losses suffered by the banks. The period from 1983 -1988 was an era of crisis in Ghana's financial sector. High defaults rates had rendered most banks assets non-performing, high level of inflation crowded out the capital base of most operating banks. This weakened the confidence within the financial sector adversely affecting the bank deposit. A wave of economic and structural reforms were instituted as an integral part of measures for the financial sector reconstruction and transformation in the late 1980's. Financial adjustment programme (FINSAP 1) introduced in the 1988 was part of a comprehensive macroeconomic reform program by the World Bank and IMF to revamp Ghana's financial sector. Its main objectives were: (1) to review the legal and regulatory environment and amend the existing Banking and laws (2) restructure the banking sector to make the banks more viable and efficient and (3) revitalize the financial system by creating new institution. The program sought to clean up non-performing assets and to restructure distress banks in order to restore profitability and viability in the banking system (Adu, et al. 2013). It included policy tools such as right price setting, the abolishment of direct controlled regimes, the development of capital and security markets that led to the establishment of Ghana Stock Exchange and the shifts from unorthodox financial practices such as low interest rate to indirect policy measures that was more market oriented. The second part of the programme (FINSAP 2) continued with the enactment of Non-Bank financial Intermediary Law in 1993. In line with this, the bank of Ghana restricted the minimum reserve requirements for banks, brought in new financial instrument and open market

operations for liquidity management. Its major objective was to privatise public sector banks and develop the non-bank financial institutions (NBFIs) to bridge the loop holes in the financial system which was not served by the banks (Gockel & Brownbridge, 1996). Among several measures made by the central bank to improve regulatory and supervisory framework and as part of the liberalisation process in the financial system, a couple of new laws were enacted to strengthen and further deepen the financial system. The Financial Sector Strategic Plan (FINSSP) was implemented in the early 2000's and this led to the passage of the Bank of Ghana ACT (2002) and subsequently Banking Bill and payment systems bill in 2003. The banking bill focused on enhancing an effective supervisory role by the central bank on the banking industry while the payment system bill was geared towards overhauling and improving the potency of Ghana's payment system (Quartey & Afful-Mensah, 2014).

The Payment system Act 2003 was a legislative instrument that authorized that Bank of Ghana to oversee, regulate and manage payment systems in the country. Specifically, the Act gives authority to the bank to i) establish, operate, promote and supervise payment, funds transfer, clearing and settlement system subject to such rules, ii) designate any other payment, fund transfer, clearing and settlement system operating in the country.

Universal Banking system was introduced by the Bank of Ghana in February 2003. Universal Banking Business License (UBBL) was expected to bring competition in the banking industry. The License allowed banks to undertake commercial, development, investment and merchant banking without having an individually separate license. The passage of the universal banking law allowed different types of banking services to be operated under a single corporate banking system (Owusu-Dankwa et al, 2014; Hinson, 2004).

3.6 Trend of financial deepening in Ghana

Financial deepening basically describes the extent of development of a country's financial sector. Primarily it refers to the scope and range of how financial services are delivered in an economy. It also measures how financial intermediaries are able to serve and meet societal needs through its intermediation processes. The degree of financial depth of a country is pivotal to its development growth according to supply-led theorist.

According to Gockel & Brownbridge (1996), financial repression was the prime factor that led to severe financial shallowing before the post Economic Recovery programme (ERP) in Ghana. Financial deepening indicators such as broad money over GDP ratio stood steady at 0.2 from 1964 to 1974, gradually increased to a maximum of 0.29 in 1975 and then fell to 0.125 in 1983. Currency over M2 ratio moved from 0.35 in 1970 to 0.5 in 1983. This revealed that the intermediation process by the banking system had been poor making bank deposit relatively less attractive to cash holdings. Bank deposit to GDP ratio fell from 0.195 in 1977 to 0.074 in 1984. Aryeetey & Gockel (1990) explained that street banking was on the rise compared to the formal sector intermediary

Several major factors accounted for the decline in the financial depth in the post ERP era. They include negative deposit rate, currency appropriation that took place in 1979 and 1982 and the freezing of bank accounts. A decree authorising the government to look into bank accounts details of customers eroded the level of confidence among the Ghanaian citizenry in using the formal bank system. They resorted to informal and semi-formal financial intermediaries and held savings in different forms such as assets and buildings acquisition. Credit to private sector as a ratio of GDP recorded a low value of 0.036 in 1983. It had fallen from 0.098 in 1977 as a result of high

government credit requirement which reduced funds loanable to the non-governmental agencies. 87% of net domestic credit was captured by government in 1983 (Gockel & Brownbridge, 1996).

The M2+ to GDP ratio gradually rose showing an increasing trend from 1997 to 2012. M2+ to GDP ratio recorded over 300% increase between 1997 and 2012 with M2+/GDP rising from 0.18 in 1997 to 0.75 in 2012. The financial sector of Ghana comprised of 33 non-banking financial intermediaries and 17 banks in 1997. These numbers have currently increased to 53 and 29 respectively. According to Quartey & Afful-Mensah (2014), these development within financial sector has positive influenced the financial depth of the country.

3.7 Payment systems in Ghana

Ghana's payment system is an array of institutional infrastructure arrangement and processes for the initiation and transfer of monetary claims in the form of financial institutional and central bank claims. The payment system has considerably improved over the years since the era of micro ink character recognition (MICR) cheques in 1997. These significant improvements and development in Ghana's payment system could be linked primarily to the fast growing ICT industry in the country and global evolution of payment systems. Improvements have been made feasible due to the several reforms in the financial sectors to adapt to global structural changes. Other forms of payment instruments in Ghana are progressively gaining grounds in an economy which highly relies on cash as a payment instrument. Cheques recorded 71.7% of non-cash retail payment making it the leading non cash payment instrument in the country in 2015 (Bank of Ghana, 2015). Mobile Money which has become prominent in the economy recorded 150.16% and 205.77% growth in volume and value of transactions in 2015.

The payment and settlement landscape in Ghana is made up of the following channels:

- The Real Time Gross Settlement (Ghana Interbank Settlement) for wholesale payment and settlements
- National switch – gh-link
- The Cheque Codeline Clearing System (CCC) and Automated Clearing House (ACH)
- Small value transactions systems such as the credit cards, ATM/POS cards, debit cards, ezwich smartcards, stored valued facilities
- Internet banking and mobile phone banking

3.7.1 The Real Time Gross Settlement (RTGS)/ (Ghana Interbank Settlement) system

With high volumes and values of transactions increasing and its associated high transaction and opportunity cost, it was necessary for policy makers to transform the economy geared toward a cash-light system that provided a relatively more efficient payment and settlement system. The Bank of Ghana introduced *The Real Time Gross Settlement (RTGS)/ Ghana Interbank Settlement (GIS)* system in 2002 with the objective of enforcing electronic processing and settlement of interbank transactions on gross basis in real time. The transfer system is a highly secured one which uses SWIFT secure for domestic inter-bank funds transfer. These settlements are effected on real time grossly and payment made are final and irrevocable under the GIS system. Its introduction for high-value interbank payment helped alleviate risks within payment and settlement systems. Before the introduction of the GIS system, settlements between Bank of Ghana and Deposit Money Banks took a few days to complete. The launch of Ghana interbank settlement system was in accordance with policy measures of the central bank to create “an enabling environment for safe, sound, secure and timely payments” (Bank of Ghana, 2007).

3.7.2 The Ghana Interbank Payment and Settlement Systems Limited (GhIPSS) /National switch

The Ghana Interbank Payment and Settlement Systems Limited (GhIPSS) is a wholly owned subsidiary of the Bank of Ghana. With its incorporation in May 2007, GhIPSS was charged with the implementation and management of payment structure interoperability of financial institutions in the country. In accordance with its mandate, GhIPSS implemented and currently manages National Biometric Smart Card Banking and Payment System (E-zwich), Cheque Codeline Clearing (CCC) System, Ghana Automated Clearing House (GACH) System, National Switching and Processing System (gh-link). GhIPSS payment infrastructure is currently used by all banking

institutions in Ghana including the ARB Apex Bank and its affiliates (The Apex body for 150 Rural and Community banks), 11 Savings and Loans Companies and 4 third party payment providers.

In 2008, National Biometric Smart Card Banking and Payment System (E-ZWICH) was introduced. It offered a suite of electronic payment and banking services accessible from Point of Sale (POS) Terminal and the ATM. The E-ZWICH is a cashless payment system that gives merchant an alternative to the use of cash. The E-ZWICH retail application manages the flow of funds between customer, merchants and selected financial institution. It offers a convenient and cost effective system for the payment of third party bills electronically. The system supports the transfer of funds from a card bearer to another through a traditional bank to an E-ZWICH Point of Sale (POS) Terminal or ATM. Funds are transferable from a traditional bank account to an E-ZWICH smart card and vice versa under the E-ZWICH system via ATM or POS terminal. The system made the payments, pensions, wages and salaries distribution easy. Currently, monthly allowances of approximately 60,000 National Service persons are paid through the E-ZWICH system.

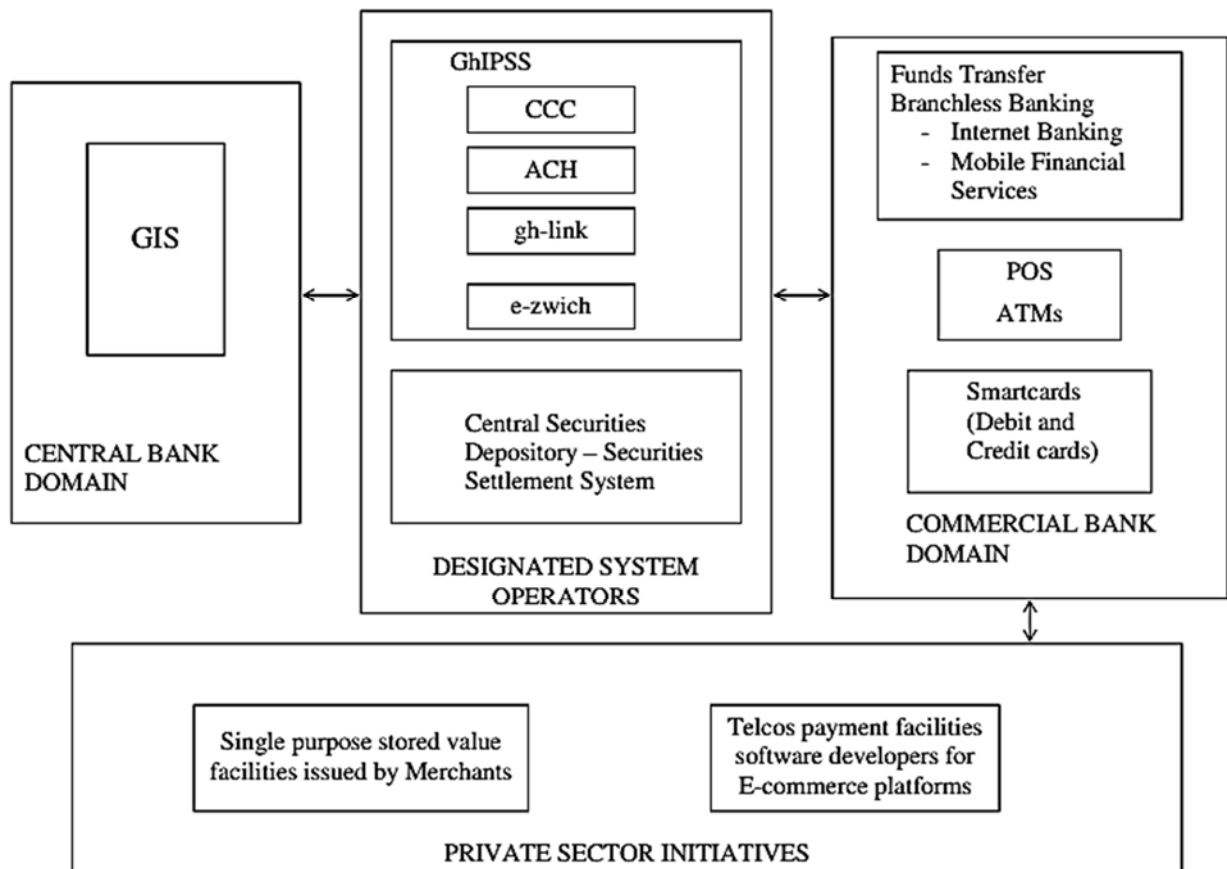
The Ghana Interbank Payment and Settlement Systems Limited (GhIPSS) provides a platform for interbank switching and processing system which interconnects switches of financial institutions and systems of third party institutions. Under the GhIPSS, gh-link was introduced in Ghana 2012 to ensured interbank service and product switching such as interbank ATM and POS switching. This service allows interoperability within the ATM network of all banks in Ghana making it possible for cards issued by different banks to use a particular ATM by another bank.

3.7.3 The Cheque Codeline Clearing System

The bank of Ghana through GhIPSS introduced the Cheque Codeline Clearing (CCC) System in 2009 to fasten the process within the cheque clearing system. The Cheque Codeline Clearing with cheque truncation is an electronic system that process cheques with its image and its codeline data. This process system has made the clearing of cheque faster and less cumbersome reducing the cycle of the clearing cheque to two days from the an initial 3 to 8 days.

3.7.4 Ghana Automated Clearing House (GACH)

With the introduction of the Automated Clearing House, payments are received, processed and cleared in the form of direct credit and direct debits electronically on behalf of the banks. This system took off in 2011 aiming to improve payments to customers and also move from a predominantly cash based economy with its associated high risk and cost to a more efficient payment scheme like cheques and electronic cash. Direct credit payments could range from single or bulk credit payment which include wages and salaries, pension payment, interest payment, insurance settlement and p2p payment. GACH Direct Credit payments services are rendered within 24 hours regular service but could be delivered within 4 hours for an express service. GACH Direct Credit payments services comprises of loan and Rent Payments, Utility and insurance settlement on behalf of a consumers authorizing his or her bank to make payments on their behalf to a service provider.

Figure 3.6 Payment System Landscape in Ghana

Source: Bank of Ghana (2014)

The diagram above, figure 3.6 shows the institutional arrangement of infrastructures, processes and stakeholders involved in the payments systems in Ghana.

3.8 Guidelines for E-money Issuers in Ghana

Structures and mechanisms must be put in place in an economy where market players compete actively among themselves in order to create an equal ground for doing business fairly. These structures and mechanisms come in the form of rules and regulations, controls, standards and guidelines to promote healthy competition, prevent and mitigate the existing and unforeseen challenges that come along. In line with this and with the promotion and supervision of electronic

and other payments, fund transfer, clearing and settlement systems, the Bank of Ghana issued out guidelines for financial institutions and Dedicated E-money Issuers (DEMI) and the general public in July 2015. This guideline also covers the players of the entire mobile money ecosystem in Ghana. The guideline replaces the previous guidelines for Branchless Banking in 2008. Here under this guidelines, non-banks institutions are given the privilege to set up, run and manage e-money business as a separate legal entity under the supervision of the Bank of Ghana. Its main objective was to promote financial inclusion in Ghana under a risk-free, safe and sound financial system. Also, to extend financial services beyond the traditional branch based banking to the domain of everyday transactions. It also ensures that e-money is issued out only by financial institutions regulated under the 2004 Banking Act or by licensed non-bank entities and dedicated e-money issuers (“Dedicated EMIs”).

Under the guideline, all e-money account and transaction must be denominated only in Ghana and issued at par on the receipt funds by the issuer. The guideline ensured that E-money issuers passed on not less than 80% of interest accrued on the pooled e-float less of charges to the holder of the pooled e-money accounts. As a result of this, mobile money customers in Ghana started enjoying interest on their mobile money wallet receiving a total of GH¢15.2 million (Aryee & Pius, 2016). In compliance with Anti-Money Laundering Act 2008 to prohibit criminal activities and money laundering, transaction limits on side of e-money merchants or agents and e-money customers were spelt out under the guideline (Bank of Ghana, 2015). An aggregate monthly transaction limit of GH¢100,000 and daily transaction limit of GH¢10,000 are placed on the account of an agent.

Insights drawn from Kenya show that mobile money services took off with an impressive start. It was launched in July 2007 with daily registration of about 5000 accounts (Morawczynski, 2011). Two years after its launch the total number of accounts or users rose to 7.7million representing

about 38% of Kenya's adult population (Morawczynski, 2011). This growth represents over 2600 percentage increase with over 90% of these mobile money accounts declared active. The value of mobile money services in Kenya was approximately 0.2% of commercial bank deposit in July 2007 but increased to 4.4% in 2009. According to Morawczynski (2011), the volumes of mobile money transactions and mobile money customers increased by 4600% and 2600% in 2 years after its introduction.

Monthly statistics provided by Lyons (2010) on mobile money services showed that total registered mobile money customers in Kenya as at 2010 was estimated to 9.7million out of which about 60 percent are active. Total mobile money agents were estimated to be about 18000 with monthly average peer to peer transactions valued at USD 328 million. According to Lyons (2010), Safaricom's mobile money users in Kenya made a monthly average total of USD 650 million withdrawal/deposits transactions at mobile money agents.

According to Jack et al (2010), the success of mobile money services in Kenya could be ascribed to the wide spread and network of 16000 mobile money agents who provide financial services to customers.

3.9 Conclusion

Mobile money services in Ghana started on a slow pace compared with that of Kenya. With only one Mobile Network Operator and limited number of agents in its initial year of operation, the industry is steadily growing over the years. Currently, there are four Mobile Networks Operating the mobile money service in Ghana with over 18 million register out of 42% are active. With volumes and values of mobile money transactions increasing over the years, its adoption and use

for Financial services is gradually gaining grounds among Ghanaians because it is relatively easier and faster to use in conducting financial transactions.

CHAPTER FOUR

THEORETICAL FRAMEWORK AND METHODOLOGY

4.1 Introduction

This chapter looks at the theoretical framework and methodology for the study which covers the impact of mobile money services on the financial sector. Also, unit root test for stationarity and the source of data that would be used are included.

As the central bank aims at promoting and maintaining a stable price level and an effective and efficient operation of the banking system that would lead to economic growth, it is very critical to have a look at the effect of mobile money services on the financial sector development and analyse how it influences the amount of currency in circulation in order to create a safe enabling environment for convenient and efficient non-cash payment and transfer system. For these reasons, we consider the role of monetary theory in explaining and understanding innovative products such as mobile money services. The chapter aims to highlight the key features of the model which offers a broader understanding about the operational design of mobile money ecosystem and advise policy options facing financial regulators and authorities.

4.2 Theoretical Framework

4.2.1 Townsend Model of Financial Deepening and Growth

This study draws on the Townsend Model of Financial Deepening and Growth (Townsend, 1983) and the Quantity theory of money. The model assumes that each household of type j can produce only good j . Each household has a utility function over its own consumption of good j and a good it cannot produce ($j + I$) as well as leisure. When households are in autarky (without physical or

electronic contact, no trade is possible) so each household consumes all of good j only. In this case, there is no need for a means of payment. However, when travelling is made possible, household j will have the opportunity to only trade with either household $j + 1$ (who values good j) or with household $j - 1$ (who values good j). A system of autarky would rise when trade is decentralised in the absence of a valued fiat money.

Townsend and Wallace (1982) improved the model by incorporating a Walrasian, centralized trade system with electronic debits and credits where households could now hold intra-period debt for within-period purchases and also send and receive credits electronically at the same time. Originally, when a household (j) travels to market $m_{j,q}$ to purchase good q from household q , it is as if a household were using a credit card or phone linked electronically to a central account which will be paid at the end of the period. Another member of household j who travels to market $m_{j,p}$ and sells good j is paid with a credit card from household p . At the end of the period, these electronic debits and credits are cleared and accounts must be balanced. In the equilibrium of this electronic accounting system, fiat money plays no role and has a zero price. These prices of goods are in some arbitrary unit of account. Though households remain spatially separated and have no physical contact, it is as if they are transacting with one another in a centralized market that ignore spatial segmentation as far as prices and values are concerned. In summary, if the assumption that substitution effects overshadows income effects and focus is made on prices, the consumption cost of the non-produced good in terms of labour is infinite in autarky system and very high in the fiat money regime relative to the centralized Walrasian electronic clearing system. Moving from autarky to a decentralized money regime and then to the centralized Walrasian electronic system, the model predicts that the supply of labour increases, output of the produced

commodity also rises, consumption of non-produced good rises while consumption of produced good drops, trade volume increases, and welfare increases.

According Jack et al (2010), the focal point of the model considers the improvement in communication technology and links the degree of financial interconnectedness of agents with the level of economic development in cross section and also over time. The main notion from the model is that interconnectedness will increase as electronic and online payments and transfers connect agents who are physically and geographically separated. This would increase labour specialisation, consumption of goods and cause a market-shift skewed towards the use of electronic-money relative to fiat money. This shows how financial development and growth are inter-related and further explains how mobile money services facilitates trade and invariably impact on GDP overtime.

The conclusion that can be drawn on the basis of this model is that mobile money services will change the financial connectedness of individuals and agents in an economy which in the model above will trigger higher economic development. The central idea is that mobile money can be viewed as a technological innovation that lowers trade cost, expedites financial transfers (credit and debits) between spatially separated agents and integrate household who are financially excluded from the financial system.

As mobile money services changes the financial interconnectedness among agents and individuals and increases monetized exchange, the service works in such a way that, a transaction would not be possible without deposits made at the bank. Mobile money services are 100 percent backed by deposits. McKinnon laid emphasis on how deposits will deepen the financial sector and promote investment. The definition of M2 captures deposits hence will capture deposits transactions made through mobile money services. The financial interrelation ratio, M2 over GDP, is a way used to

measure the depth of the financial sector development. It is quite clear how this measure relates to the amount of transactions done through the mobile money services. On the basis of this analysis, we reformulate an extended model used which capture the effect of mobile money services in section 4.3.2.

Financial innovation such as mobile money can improve efficiency in the financial sector but can also complicate ways in which policy is conducted as a result of unstable demand for cash. To understand the implications of mobile money services on the amount of currency in circulation, it is imperative to first comprehend the theory of money demand and also the quantity theory of money.

From the quantity theory of money, the Classical economists posit that there is a direct relationship between quantity of money supply and price levels.

$$(MV = PY) \text{ --- (Equation 4.1)}$$

Where M is money supply, V is Velocity of money, P is price level, Y is output

From Equation 4.1

$$M = \frac{1}{v}PY \text{ --- (Equation 4.2)}$$

Let $k = \frac{1}{v}$, from Equation 4.2

$$M = kPY \text{ --- (Equation 4.3)}$$

From Equation 4.3, money supply is a function of (k), (p) price level and (Y) output. In the money market equilibrium, (M) money supply equals money demand M^d . Hence demand for money is also function of (k), (p) price level and (Y) output. According to the Keynesians, k in *equation 4.3* represents velocity of money, can be influenced by technological changes and institutional

structure such as payment systems unlike the classical economist who argued that velocity of money is fairly constant. Financial innovation such as mobile money services can affect interest rate elasticity of demand and could therefore cause variations in velocity of money. These variations in the velocity of money could affect the money demand function (Equation 4.3) which could have an influence on the amount of currency in circulation.

Mobile money services as a payment system and as institutional structure can influence the velocity of money hence affect how cash is held and consequently the amount of currency in circulation. Income levels also influences the how cash is held and the level of currency in circulation. From literature and Keynesian point of view about liquidity preference, interest rates affect how cash balances are held, hence it could influence the amount of cash or currency circulating in an economy. In the light of these analysis, an estimating framework which captures the quantity theory of money and money demand is used in section 4.3.1.

4.3 Model Specification and Estimation Method

4.3.1 Model (1) for estimating the impact of mobile money services on the currency in circulation

On the basis of the quantity theory of money, which is a non- linear (multiplicative) function, a trans-log (ln) operation is carried out to express the relationship between the dependent and independent variables as a linear function.

$$M = kPY \text{ --- --- --- --- --- } \textit{Equation 4.4}$$

$$\ln(M) = \ln(kPY) \text{ --- --- --- --- --- } \textit{Equation 4.5}$$

$$\ln(M) = \ln(k) + \ln(Y) + \ln(P) \text{ --- --- --- --- --- } \textit{Equation 4.6}$$

From the trans-log function developed above, the model further employs an augmented form of Hamori (2008) traditional money demand specification.

The model is given as

$$CIC_t = f(GDP_t, MMT_t, FEX_t, MPR_t) \text{ --- Equation 4.7}$$

$$\ln(CIC_t) = \alpha_0 + \alpha_1 \ln(MMT_t) + \alpha_2 \ln(GDP_t) + \alpha_3 \ln(FEX_t) + \alpha_4 MPR_t + \varepsilon_t$$

From Equation 4.7,

CIC_t = Currency in circulation at period t,

GDP_t = Gross Domestic Product (Income) at period t,

MMT_t = Volume of total mobile money transactions at period t,

FEX_t = Foreign exchange rate at time t,

MPR_t = monetary policy rate at period t.

The co-efficient α_1 which represents the effect of mobile money transactions on the level of currency in circulation is expected to be negative (Duune & Kaskende (2016); Lippi & Secchi (2009)) although in some literature it could carry a positive sign (Hye, 2009; Mannah-Blankson & Belyne, 2004). GDP is expected to have a positive sign this is because theory predicts a direct positive relationship between income and money demand. Monetary policy rate (MPR) is expected to have negative sign as the theory for money demand suggests it captures the effects of opportunity cost of holding real money balances. Exchange Rate (FEX) could take a positive or negative sign depending whether the wealth or substitution effect is greater. Under wealth effect, foreign exchange rate could carry a positive sign. Dobson et al. (2001) posits that depreciation of exchange rate would cause foreign assets owned by domestic residents or the local citizens to increase. That is wealth would increase, currency in circulation would increase because of an increased demand for money. However, when exchange rate is negative, the currency in circulation

could decrease because money demand would decrease as the domestic currency would be substituted for foreign currency that would yield higher returns.

4.3.2 Model (2) for estimating the effect of mobile money on financial development.

In this model, a model used by Nzotta & Okereke (2009) is reformulated. It is then extended to include financial innovations such as mobile money services

$$FD = f(MMV_t, MPR_t, INF_t, RR_t, PSDEPGDP_t) \text{ --- Equation 4.8}$$

$$FD_t = \beta_0 + \beta_1 MMV_t + \beta_2 MPR_t + \beta_3 INF_t + \beta_4 FEX_t + \beta_5 RR_t + \beta_6 PSDEPGDP_t + \mu_t$$

From Equation 4.8,

FD_t = Financial development indicator which captures the ratio of Money supply (M2) to GDP at period t,

$MMV_t = (\frac{MM}{GDP})$, value of mobile money transaction to GDP ratio at period t,

FEX_t = Foreign exchange rate at time t,

INF_t = Rate of inflation at period t

MPR_t = Monetary policy rate (interest rate) at period t

RR_t = Reserve Requirement ratio

$PSDEPGDP_t$ = Private sector total deposit by the bank to Gross domestic product ratio.

The value of mobile money transaction to GDP ratio (MMV_t) is expected to have a positive sign on financial development as recorded in literature Asongu (2012) that great chunk of monetary based (M0) is now captured in less developed countries by mobile money services. INF_t is

expected to be negative in relation to financial development. Theoretically, studies by Moore (1986), Choi & et al (1996) explained high levels of inflation reduces the returns on savings therefore discouraging savings. Credit becomes scarce because of high informational frictions as a result of discouraged savings. MPR_t is also expected to be have a negative sign even though in theory, Shaw (1973) indicates it could have a positive sign. $PSDEPGDP$ is expected to carry a positive sign which suggests that currency in the hands of the individuals other than the banking system become part of the intermediation process. RR is expected to negative. Giorgio (1999) theoretically observed that high levels of reserve requirement is negative linked with the level of development in the financial sector.

4.4 Model Estimation

An Autoregressive Distributed lag (ARDL) approach by Pesaran et al. (2001) will be employed in estimating Equations 4.7 and 4.8. For small samples, the ARDL technique is expected to have a better small-sample properties and it is robust to different lags of integration (Pesaran et al., 2001).

4.4.1 ARDL Bounds Test for Co-integration

Equations 4.7 and 4.8 are generalised to be of the form:

$$Y_t = \gamma_0 + \gamma_1 X_{1t} + \gamma_2 X_{2t} + \gamma_3 X_{3t} + \gamma_4 X_{4t} \text{ --- (Equation 4.9)}$$

According Pesaran et al. (2001), an ARDL Bounds Test is employed to estimate the existence of a long run relationship between dependent variable Y_t and its casual variables (X_1, X_2, X_3, X_4) in Equation 4.6. To proceed, Equation 4.6 is remodelled as a conditional ARDL model of the form:

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 X_{1t-1} + \beta_3 X_{2t-1} + \beta_4 X_{3t-1} + \beta_5 X_{4t-1} + \sum_{i=1}^p \phi_{1i} \Delta Y_{t-i} + \sum_{i=1}^p \phi_{2i} \Delta X_{1t-i} + \sum_{i=1}^p \phi_{3i} \Delta X_{2t-i} + \sum_{i=1}^p \phi_{4i} \Delta X_{3t-i} + \sum_{i=1}^p \phi_{5i} \Delta X_{4t-i} + \varepsilon_t \text{ --- ---}$$

—(Equation 4.10)

A null hypothesis ($H_0 : \beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5$) of no long run relationship among variables tested against an Alternative hypothesis ($H_1 : \beta_0 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5$) of long run relationship among variables.

4.4.2 Short-run and Long-run estimate

When cointegration among variables is confirmed, coefficient for the long run is obtained through the estimation of ARDL (p, q_1, q_2, q_3, q_4) found in Equation 4.8.

$$Y_t = \beta_0 + \sum_{i=1}^p \beta_1 Y_{t-i} + \sum_{i=0}^{q_1} \beta_2 X_{1t-i} + \sum_{i=0}^{q_2} \beta_3 X_{2t-i} + \sum_{i=0}^{q_3} \beta_4 X_{3t-i} + \sum_{i=0}^{q_4} \beta_5 X_{4t-i} + v_t \text{ --- (Equation 4.11)}$$

The short run coefficient is also obtain by estimating the error correction version of ARDL. Once established, the speed of Adjustment to long run equilibrium is determined. ECT_{t-1} is the first lag of the error correction term, the residual of the cointegration equation.

$$Y_t = \beta_0 + \sum_{i=1}^p \phi_{1i} \Delta Y_{t-i} + \sum_{i=1}^{q_1} \phi_{2i} \Delta X_{1t-i} + \sum_{i=1}^{q_2} \phi_{3i} \Delta X_{2t-i} + \sum_{i=1}^{q_3} \phi_{4i} \Delta X_{3t-i} + \sum_{i=1}^{q_4} \phi_{5i} \Delta X_{4t-i} + \delta ECT_{t-1} + v_t \text{ --- --- (Equation 4.12)}$$

4.4.3 Unit Root Test for Stationarity

The stationarity or non-stationarity of a data set can impact its behavioural properties of a regression model. The presence of a unit root in a time series data would make it non-stationary. This situation is regarded as a statistical challenge which is undesirable in empirical analysis. In order for the result of a regression analysis to be reliable, variables must be stationary. Variables of the equation in both models could be non-stationary at levels, in this case, a test is performed at first difference. If the variables still persist to be non-stationary, a test on the second difference is performed. The order of integration of a variable is determined by the level a variable is differenced.

Stationarity of a variable is checked by employing a unit root test. A regression based method proposed by Dickey and Fuller (1979) is used to investigate whether a variable has unit root. A null hypothesis that the series has unit root ($\phi = 1$) is tested against an alternate hypothesis that the series is stationary. The Dickey-fuller (DF) test equation takes the form

$$y_t = \phi y_{t-1} + e_t \text{ --- (Equation 4.13)}$$

But in practice, Equation 4.13 is employed in the regression.

$$\Delta y_t = \phi y_{t-1} + e_t \text{ --- (Equation 4.14)}$$

where ($\phi = 1$) is equivalent to the test of $\phi = 0$ that is ($\phi - 1 = 0$). Here, the Dickey- Fuller test is appropriate if μ_t is white noise. However, the presence of autocorrelation in the dependent variable Δy_t would make the test invalid. An augmented form of the test called Augmented Dickey Fuller test is used to correct the problem. Augmented Dickey-Fuller test equation takes the form

$$\Delta y_t = \alpha_0 + \varphi y_{t-1} + \sum_{i=0}^k \beta_i \Delta y_{t-i} + e_t \text{ --- (Equation 4.15)}$$

Where y_t is any variable in the model. k lags of the dependent variable Δy_t is incorporated into the model, that is (Δy_{t-1}) forms an augmentation in the model. The introduction of the i th number of lags of Δy_t ensures that the μ_t is white noise and autocorrelation is absorbed in the Δy_t (Dickey and Fuller, 1981)

A regression test is run on each variable against its lagged terms and lagged differenced term of the kind. To include the constant α_0 or the constant term and the linear trend t or none in the equation, a line graph of each variable is plotted to observe their characteristics. The appropriate test with respect to the data characteristics is applied as follows. If the calculated t-ratio of the coefficient φ with negative sign is less than its critical value, then is said to be stationary.

Philips and Perron (1988) developed an alternative method for testing for the presence of unit root. The difference between the Augmented Dickey-Fuller test and the Phillip-Perron test is how serial correlation is controlled for in each test. The Philip-Perron Test employs a nonparametric autoregression for the Dickey Fuller test equation in Equation 4.14 and modifies the t-ratio of the coefficient so that asymptotic distribution of the test statistic is not affected by serial correlation.

The two main test statistic employed in Phillip-Perron test are Z_t, Z_ρ . And are computed as follows

$$Z_\rho = n(\hat{\rho}_n - 1) - \frac{1}{2} \frac{n^2 \hat{\sigma}^2}{s_n^2} (\hat{\lambda}_n^2 - \hat{\gamma}_{0,n})$$

$$Z_t = \sqrt{\frac{\hat{\gamma}_{0,n}}{\hat{\lambda}_n^2}} \frac{\hat{\rho}_n - 1}{\hat{\sigma}} - \frac{1}{2} (\hat{\lambda}_n^2 - \hat{\gamma}_{0,n}) \frac{1}{\hat{\lambda}_n} \frac{n \hat{\sigma}}{s_n}$$

$$\hat{\gamma}_{j,n} = \frac{1}{n} \sum_{i=j+1}^n \hat{u}_i \hat{u}_{i-j}$$

$$\hat{\lambda}_n^2 = \hat{\gamma}_{o,n} + 2 \sum_{j=1}^q \left(1 - \frac{j}{q+1}\right) \hat{\gamma}_{j,n}$$

$$S_n^2 = \frac{1}{n-k} \sum_{i=1}^n \hat{u}_i^2$$

Where u_i is the OLS residual, k is the number of covariates in the regression, q is the number of Newey-West lags to be used in calculating $\hat{\lambda}_n^2$ and σ is the OLS error of $\hat{\rho}$. The critical values are linearly interpolated from the table of values that appear in Fuller (1996) and the Mackinnon p-values are the regression surface published in MacKinnon (1994).

4.4.4 Test for Heteroscedasticity

An assumption which is critical in the OLS estimation is the assumption of Homoscedasticity; that is the variance of the error term must be constant over time. When this assumption does not hold and the variances of the error term is non constant, it is said to be heteroscedastic. Even in the presence of heteroscedasticity, the OLS estimators will still give unbiased coefficient estimates but these estimates would not be the Best Linear Unbiased Estimator (BLUE). Hence any conclusion drawn on these estimates will be erroneous and misleading because the OLS standard errors will be large. The study would employ a Breusch-Pagan- Godfrey Test to check whether the variances of error terms are consistent over time.

4.4.5 Test for Autocorrelation

Also, it is assumed that the error term are uncorrelated with one another. The term “autocorrelation” is when values of error terms are correlated. With such a situation in hand, the coefficient estimates of the OLS would be inefficient with the standard errors relatively smaller

than the real standard errors. The study would employ Breusch–Godfrey LM test to check for the presence of Serial correlation.

4.5 Data Source

Data used for empirical analysis was obtained from statistical reports by Bank of Ghana, Ghana Statistical Services. Specifically, monthly time data on mobile money services, foreign real exchange rate, currency in circulation, Treasury bill rate, monetary policy rate and money supply were obtained from the Bank of Ghana. Quarterly data on Real Gross Domestic Product (GDP) was obtained from Ghana Statistical Service. However, monthly time series data for GDP was derived using partial Denton Interpolation procedure. According to Sax & Steiner (2013), the Denton’s method of interpolation interpolates low frequency time series data into high frequency series. The procedure is “relatively simple, robust, and well-suited for large-scale applications” (Bloem et al, 2010). Data employed for both models in this study ranges from 2010 month one (2010: January) to 2016 month twelve (2016: December). The study considered this time frame because mobile money services became fully functional in Ghana in the last quarter of 2009 and available data on mobile money services emerged from 2010.

CHAPTER FIVE

ESTIMATION AND DISCUSSION OF RESULTS

5.1 Introduction

In this chapter, the summary statistics, stationarity properties of variables and empirical outcome from econometric time series analysis using Autoregressive distributed lag approach on both models (1. the impact of mobile money services on the currency in circulation and 2. Effect of mobile money services on financial development) are presented. Results of several diagnostics test are also included in this chapter. The analyses were carried out using E-views 9 and Stata 13 econometrics software.

5.2 Summary Statistics

From Table 5.1 below, the total number of observations for all variables in model 1 and 2 is Eighty four (84). Over the time period considered for the study, the amount of currency in circulation was as at average of GH¢ 5.38 billion. Gross Domestic Product (GDP) was observed be at an average of GH¢ 8.24 billion over the study period. The maximum and minimum value for GDP for the study period was GH¢15.9 billion and GH¢2.05 billion respectively. Mobile money services observed an average of 11,899,431 transactions over the study period. The minimum and maximum volumes of mobile money transactions observed per month were 8,654 and 63,617,236 respectively.

With Foreign exchange rate (FEX), the Ghana Cedi depreciated against the US Dollar at an average rate of 2.4793 over the study period. It experienced its highest and lowest depreciation rate at 4.3274 and 1.4168 Ghana Cedi per US Dollar respectively. Monetary Policy Rate (MPR) was

averagely at 17.89% over the study period. Its highest rate and lowest rate were 26% and 12.5% respectively.

The Value of mobile money transaction to GDP ratio (MMV) recorded a maximum and minimum value of 0.6182 and 0.00031 respectively while 0.12302 is its average ratio over the study period.

The maximum and minimum ratio observed over the study period for Reserve Requirement (RR) were 13.5% and 8.2% respectively. On the average, the reserve requirement ratio was 10.4%.

Inflation rate (INF) over the study period was at an average of 12.89%. 19.2% and 8.39% were the highest and lowest rate for inflation over the study period respectively. The average, maximum and minimum values observed for Private sector deposits by DMB to GDP ratio (DEPGDP) are 2.47, 3.10 and 1.89 respectively. The financial development indicator, FD (M2 to GDP ratio) is observed to have an average of 2.45, a maximum value of 2.91 and a minimum value of 1.89 over the study period.

Table 5.1 Summary statistics

	Observations	Mean	Maximum	Minimum	Standard Deviation
CIC (GH¢ ‘Million)	84	5,384.418	11,374.72	2,055.9	2,261.039
GDP (GH¢‘Million)	84	8,240.536	15,899.40	2,983.773	3,519.512
MMT	84	11,899,431	63,617,236	8,654	16,334,231
FEX	84	2.4793	4.3274	1.4168	0.9975
MPR	84	17.8869	26	12.5	4.672
MMV	84	0.12302	0.6182	0.00031	0.1672
RR	84	10.4036	13.5	8.2	0.8703
INF	84	12.8894	19.2	8.39	3.6752
FD	84	2.4463	2.9101	1.8938	0.2345
DEPGDP	84	2.4710	3.1018	1.8895	0.2838

Source: Author’s estimations

5.3 Test for Unit Root

Stationarity test is relevant to this study because an Autoregressive distributed lag (ARDL) model will yield consistent long run estimates under variables that are integrated at levels or of order 1. The presence of $I(2)$ variables will yield wrong estimates. Hence stationarity test is carried out to see the order of integration of variables. A rejection of unit root in a variable signifies that a variable is stationary.

Line plots were necessary in testing the presence of unit roots among variables. This provides a basis for including the trend option in testing for stationarity or unit root among some variables. Unit Root results for the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) at levels and first difference of the variables are reported in table 5.2, 5.3, 5.4 and 5.5.

LCIC, LGDP, and LMMT represent the logged values of Currency in Circulation (CIC), Gross Domestic Product (GDP) and the volume of mobile money transactions (MMT) respectively.

ADF and PP tests show that the presence of unit root in the logged value of currency in circulation (LCIC) is rejected at 5% and 10% level of significances. That is (LCIC) is stationary at levels and of order $I(0)$.

Gross domestic product (LGDP) is stationary at levels under ADF test. The presence of unit root is rejected at 5% and 10% significance level when PP test is employed at levels. From both results, LGDP is integrated of order 0 that is $I(0)$.

The volume of mobile money transactions (LMMT) is not stationary at levels at 1% and 5% levels but after first difference, the presence of unit root is rejected at all levels when ADF test is employed. However, the presence of unit root LMMT is rejected at all significant levels under PP test meaning LMMT is stationary at levels.

Foreign exchange rate (FEX) is not stationary at levels at 1%, 5%, and 10% significance levels. However, the presence of unit root is rejected at all levels after first difference under ADF and PP test.

The value of mobile money transaction to GDP ratio (MMV), Monetary Policy Rate (MPR) and Inflation (INF) are also not stationary at levels under ADF and PP test at all significance level (1%, 5%, and 10%). However, stationarity is achieved for all three variables after first difference at 1%, 5%, and 10% under ADF and PP test.

Stationarity is also achieved at levels for Reserve Requirement ratio (RR) using ADF and PP at 1%, 5% and 10% level of significance. This means RR integrated of order 0 or I(0).

5.3.1 Augmented Dickey Fuller Test and Philip-Perron Test at Levels

Table 5.2 Augmented Dickey Fuller Test (levels)

Variable	Statistics	1%	5%	10%	P-value
LCIC	-4.0038	-4.0753	-3.4662	-3.1598	0.0123
LGDP	-6.0785	-4.0753	-3.4662	-3.1598	0.0000
LMMT	-3.2386	-4.0769	-3.467	-3.1602	0.0844
FEX	-1.9016	-4.0739	-3.4655	-3.1593	0.6447
MPR	0.6706	-3.5113	-2.8962	-2.5856	0.9908
MMV	2.3533	-4.0901	-3.4734	-3.164	1.000
RR	-4.2365	-3.5123	-2.8972	-2.5858	0.0005
INF	-0.5631	-3.5113	-2.8962	-2.5856	0.8721
FD	-6.796	-4.0724	-3.4648	-3.1589	0.0000
DepGDP	-5.957	-4.0753	-3.4662	-3.1597	0.0000

Source: Author's estimation

Table 5.3 Philip-Perron Test (levels)

Variable	Statistics	1%	5%	10%	P-value
LCIC	-3.879	-4.0724	-3.4649	-3.159	0.0172
LGDP	-3.5090	-4.0724	-3.4649	-3.159	0.0449
LMMT	-9.020	-4.0724	-3.4649	-3.159	0.0000
FEX	-2.2609	-4.0724	-3.4649	-3.159	0.4500
MPR	0.3224	-3.5112	-2.8967	-2.5856	0.9782
MMV	1.3264	-4.0724	-3.4649	-3.159	1.000
RR	-5.6945	-3.5112	-2.8967	-2.5856	0.0000
INF	-0.9013	-3.5112	-2.8967	-2.5856	0.7833
FD	-4.0212	-4.0724	-3.4649	-3.1589	0.0116
DepGDP	-3.648	-4.0724	-3.4649	-3.1589	0.0317

Source: Author's estimation

5.3.2 Augmented Dickey Fuller Test and Philip-Perron Test at First Difference**Table 5.4 Augmented Dickey Fuller Test (First Difference)**

Variable	Statistics	1%	5%	10%	P-value
FEX	-14.9083	-4.0739	-3.4655	-3.1593	0.0000
LMMT	-4.8883	-4.0767	-3.467	-3.1602	0.0008
FEX	-14.9083	-4.0739	-3.4655	3.1594	0.0000
MPR	-9.3883	-3.5123	-2.8972	-2.5859	0.0000
MMV	-9.5312	-4.0739	-3.4655	3.1594	0.0000
INF	-6.8366	-3.5123	-2.8972	-2.585	0.0000

Source: Author's estimation

Table 5.5 Philip-Perron Test (First Difference)

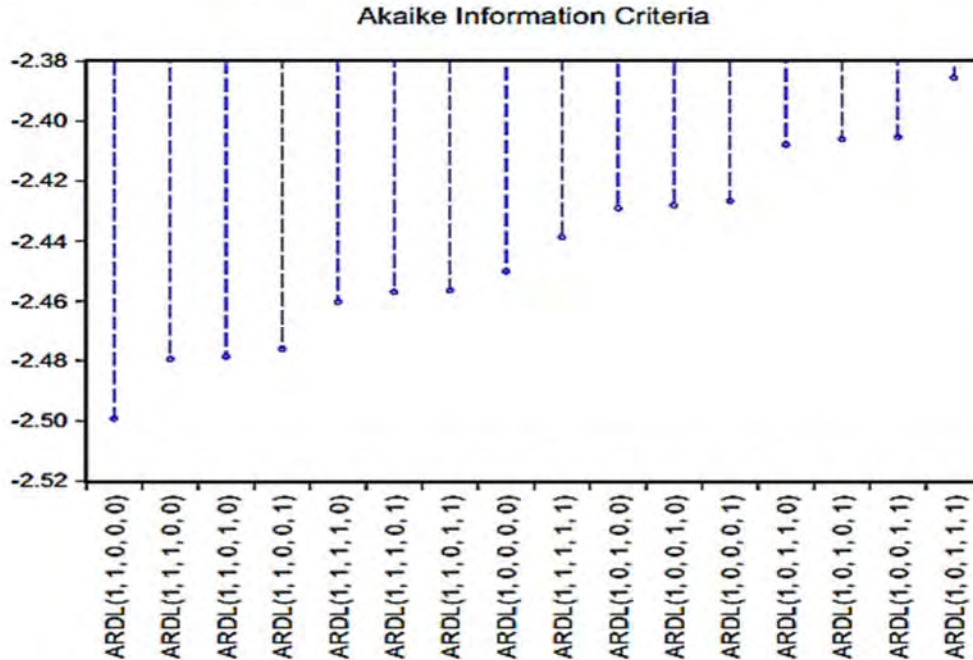
Variable	Statistics	1%	5%	10%	P-value
FEX	-13.9713	-4.0724	-3.4649	-3.159	0.0000
FEX	-13.9713	-4.0739	-3.4655	-3.1594	0.0000
MPR	-9.3223	-3.5123	-2.8972	-2.5859	0.0000
MMV	-9.5339	-4.0739	-3.4655	-3.1594	0.0000
INF	-6.8366	-3.5123	-2.8972	-2.5859	0.0000

Source: Author's estimation

5.4 Lag Selection Structure (Model 1)

After the Augmented Dickey Fuller test and Philip Perron Test are employed to verify the absence of $I(2)$, the ARDL Bounds test for co-integration is carried out. The optimal lag selection structure of the ARDL model is based on Akaike information criterion. From Figure 5.1, the Akaike Information Criterion (AIC) estimated for ARDL (1,1,0,0,0) is -2.5082 which is the least among Top 20 Models considered. Hence ARDL (1,1,0,0,0) is considered to be the most fitting lag structure for Model 1.

Figure 5.1 Akaike Information criteria lag selection structure (Model 1)



5.5 ARDL Bounds Test for cointegration (Model 1)

From Table 5.6, the F-statistics (7.5297) from the bounds test is greater than the upper bound critical value $I(1)$ at 1%, 5% and 10% level of significance, hence the null hypothesis of no co-integration is rejected. This is an indication that there is some evidence of long run relationship or cointegration that exists between the amount of currency in circulation (LCIC) and the variables (LGDP, LMMT, FEX, MPR).

Table 5.6 ARDL Bounds Test for long run co-integration for Model 1

	Level of significance						
	F-statistics	1%		5%		10%	
		Lower bound I(0)	Upper bound I(1)	Lower bound I(0)	Upper bound I(1)	Lower Bound I(0)	Upper bound I(1)
F(LCIC LGDP LMMT,FEX,MPR)	7.5297	3.74	5.06	2.86	4.01	2.45	3.52

Cointegration exist if null hypothesis is rejected. That is if F-statistic larger than the upper bound I(1) critical value. We do not reject the null hypothesis is F-statistics is lesser than the lower bound I(0) critical value. Estimated Results, The impact of mobile money services on the currency in circulation (Model 1)

From Table 5.7 below, GDP, LMMT, and FEX have a positive relationship on the amount of currency in circulation while MPR has a negative relationship. Gross Domestic Product or Income (LGDP) is insignificant in the short run but significant at 1% in the long run, it depicts a positive sign as quantity theory of money predicted. This result is line with some empirical studies in Ghana (Havi et al., 2014; Nchor & Adamec, 2016). A 1 percent increase in income (GDP) will cause the amount of currency in circulation to increase by 0.6580% in the long run.

The volume of Mobile money transactions (LMMT) is also significant at 5% in the long run and 10% in the short run. It carries a positive relationship with currency in circulation in the long run and in the short run. As mobile money services increases by 1%, the amount of currency in circulation increases by 0.0803% in the long run and 0.0404% in the short run. The possible reason for this is that mobile money which is a form of money (electronic money) is 100% backed up by deposits at Deposit Money Banks (DMBs) and the service is mainly characterised with cash transfers. Even though there is an expected shift away from more liquid money (cash) as the use of financial innovation increases, this is not so with mobile money services in Ghana. Mobile money service as a cash transfer system outweighs its role as a payment system. People engage more in cash transactions as it is easier and faster to transfer money via the mobile money services.

This result is empirically in line with findings of Mannah-Blankson & Belnye (2004) who found a positive influence of financial innovation on M1 using the volume of card transactions as a proxy.

Foreign exchange rate (FEX) has an insignificant positive relationship with currency in circulation both in the long run and short run. An increase (depreciation) of nominal exchange rate by 1% leads to a 1.26% and 0.6% increase in currency in circulation in long run and short run respectively.

Havi et al. (2014) also found nominal exchange rate to be positively inelastic to demand of real money aggregates.

The long run aspect of the Model 1 is determined by the lagged error term $ECM(-1)$. The result from Table 5.8 shows that Error Correction Term, $ECM(-1)$ of the short run error correction model is correctly signed and significant at 1% level. This means that the variables $D(LGDP)$, $D(LMMT)$, $D(FEX)$ and $D(MPR)$, are truly casually related with the dependent variable $D(LCIC)$. The significance of the $ECM(-1)$ means if all other influences are held constant, changes in $D(LGDP)$, $D(LMMT)$, $D(FEX)$ and $D(MPR)$ will help restore $D(LCIC)$ to its long run equilibrium value, should $D(LCIC)$ deviate from the value consistent with its long term equilibrium. The Value of the $ECM(-1)$ which is -0.5036 means the speed $D(LCIC)$ takes to adjust from its short run deviation to the long run equilibrium by changes in $D(LGDP)$, $D(LMMT)$, $D(FEX)$ and $D(MPR)$ is about 50.36%.

Table 5.7 Estimates of Long-Run Coefficients ARDL (1,1,0,0,0)

Variable	Coefficient	Standard errors	p-values
LGDP	0.6580***	0.1746	0.0003
LMMT	0.0803**	0.0362	0.0293
FEX	0.0126	0.0661	0.8494
MPR	-0.0038	0.0116	0.7388
Constant	1.4942	1.0481	0.1552

, **, * mean p-value <10%, 5% and 1% respectively*

Table 5.8 Short-Run Coefficients with Error correction Term

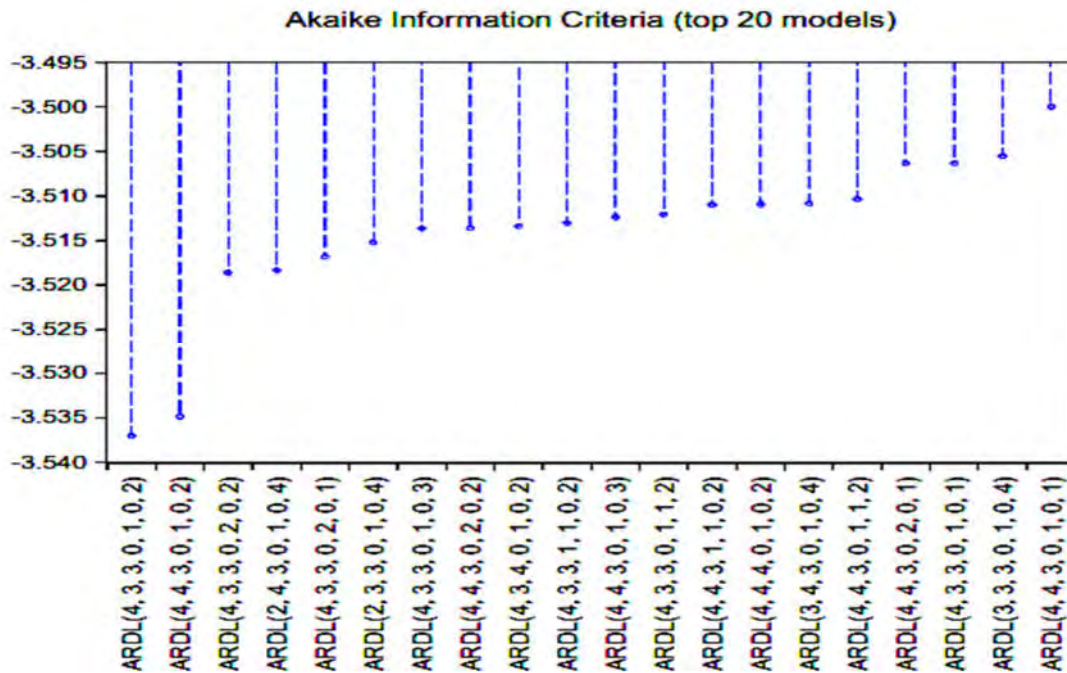
Variable	Coefficient	Standard errors	p-values
D(LGDP)	-0.0360	0.1507	0.8118
D(LMMT)	0.0404*	0.2013	0.0618
D(FEX)	0.0063	0.0333	0.8495
D(MPR)	-0.002	0.0058	0.7376
ECM(-1)	-0.5036***	0.0885	0.0000

, **, * mean p-value <10%, 5% and 1% respectively*

5.6 Lag Selection Structure (Model 2)

The optimal lag selection structure of the ARDL model is based on Akaike information criterion (AIC). Estimates of the AIC for the top 20 lag structure models show that ARDL(4,3,3,0,1,0,2) has the least value of -3.5371, hence is considered to be the most fitting lag structure for Model 2.

Figure 5.2 Akaike Information criteria lag selection structure (Model 2)



5.7 ARDL Bounds Test for cointegration (Model 2)

From Table 5.9 below, the null hypothesis of no cointegration is rejected, this is because the F-statistics (8.0295) from the bounds test is greater than the upper bound critical value I(1) at 5% and 10% level of significance. This is also an indication that there is some evidence of long run relationship that exists between the financial development indicator (FD) and the causal variables (MMV, MPR, INF, FEX, RR, DEPGDP).

Table 5.9 ARDL Bounds Test for long run co-integration for Model Two

	Level of significance				
	F-statistics	5%		10%	
		Lower bound I(0)	Upper bound I(1)	Lower Bound I(0)	Upper bound I(1)
F(FD MM,MPR,INF, FEX,RR,DEPGDP)	8.0295	2.45	3.61	2.12	3.23

Cointegration exist if null hypothesis is not accepted. That is if F-statistic larger than the upper bound I(1) critical value. We do not reject the null hypothesis if F-statistics is lesser than the lower bound I(0) critical value

5.8 Estimated Results, The effect of mobile money on financial development (Model 2).

From Table 5.10 and 5.11 below, all lags of the mobile money transaction value to GDP ratio (MMV) in the short run carry a positive coefficient. The second lag of MMV was significant at 5% level in the short run but was not statistically significant in the long run. The estimated coefficient of MMV has its a priori expected sign. This means an increase in mobile money services by 1 has the potential deepening the financial sector development by 0.2456 in the long run and 0.8840 in the short run. The positive relationship is partly because mobile money service in Ghana has raised the efficiency of financial intermediation through increased variety of financial products and services, resulting in an improved payment and transfer system. Also, it lends support to the argument by Jonathan & Camilo (2008) who stressed on the fact the mobile money services in developing countries make available opportunities for users to store monetary value in virtual mobile account. The result also falls in line with the empirical findings of Asongu (2012) who found out the mobile banking positively influenced the informal financial intermediary sector by 0.227%.

Monetary Policy Rate (MPR) records a negative significant coefficient in the short run at 5% level but a positive significant result at 10% significance level in the long run. The coefficient of two significant lags in the short run gave conflicting outcomes. A summation of these two significant

outcomes yielded a negative result of $(-0.0282 + 0.0253 = -0.0029)$ in the short run. Here monetary policy rate has an adverse effect on financial development in the short run over the study period. This result confirms theoretically that, higher interest rates restricts lending by banks as a tool for financial development. It is also argued that higher prime rates or monetary policy rate could potentially create a wider interest rate spread with Deposit Money Banks (DMBs) and this could discourage savings because of lower returns on deposit. Empirically, it is in accordance with findings of Takyi & Obeng (2013) who found out that, interest rate negatively affected financial development. However, in the long run, monetary policy rate carries a positive impact on financial development. Theoretically, liberalising the financial system would discourage restrictions within financial intermediation process. The result in the long run is similar to findings of Adusei & Frimpong (2014) who found a positive long run relationship between prime lending rate and financial development in Ghana.

Inflation (INF) is insignificant both in the long run and short run error correction model. Results from Tables 5.10 and 5.11 show that inflation has a negative relationship with financial development. Inflation creates macroeconomic instability which negatively affects the financial sector development. Theoretically, higher levels of inflation leads to poor financial intermediation as it worsens the problem of information asymmetry. This is in line with the findings of Akosah (2013) who found inflation had both long run and short run adverse effect on financial development.

The short run and long run coefficient of nominal Foreign Exchange rate (FEX) have a significant negative relationship with financial development. An increase (depreciation) in the nominal exchange rate by 1 will worsen the development of financial sector by 0.1247 and 0.2198 in the long run and short run respectively. Unstable Fluctuations in the exchange rate over the study

period did not have a positive impact on financial development in Ghana. Empirically, these results fall in line with Ubesie (2016) who found out that unstable variations in the foreign exchange rate had an adverse effect on the financial depth in Nigeria.

Reserve requirement ratio (RR) has an insignificant positive relationship with financial development indicator both in the long and short run estimates. This result suggests that the financial policies have some level of positive impact on financial development. Empirically, it also falls in line with findings of Tovar et al. (2012) who argued from a practical policy perspective that reserve requirements help address the pro-cyclicality of the credit cycle and build in hedges against times of scarce liquidity in some Latin American countries. He further explained that reserve requirement improves the funding structure of banks, reducing the risk of exposure hence stimulating financial development

Private sector deposit to GDP (DEPGDP) which is highly significant both in the long run and short run error correction model is positively related to the financial development indicator.

The result from Table 5.11 shows that Error Correction Term, $ECM(-1)$ of the short run error correction model is correctly signed and also significant at 1% level. The significance of the $ECM(-1)$ means that if all other influences are held constant, changes in $D(MMV)$, $D(MPR)$, $D(INF)$, $D(FEX)$, $D(RR)$ and $D(DEPGDP)$ will help restore $D(FD)$ to its long run equilibrium value should the $D(FD)$ deviate from the value consistent with its long term equilibrium. The Value of the $ECM(-1)$ is -0.8386. This means the speed $D(FD)$ takes to adjust from its short run deviation to the long run equilibrium by changes in $D(MMV)$, $D(MPR)$, $D(INF)$, $D(FEX)$, $D(RR)$ and $D(DEPGDP)$ is about 83.86%.

Table 5.10 Long Run estimates

Variable	Coefficient	Standard errors	p-values
MMV	0.2456	0.158683	0.1269
MPR	0.0122*	0.007115	0.0905
INF	-0.0022	0.005843	0.7071
FEX	-0.1247***	0.031828	0.0002
RR	0.0102	0.007157	0.1577
DEPGDP	0.6708***	0.042915	0.0000
C	0.7591***	0.152358	0.0000

*, **, *** mean p-value <10%, 5% and 1% respectively

Table 5.11 Short Run error correction Representation or Cointegration Form

Variable	Coefficient	Standard errors	p-values
D(FD(-1))	0.3489***	0.087673	0.0002
D(FD(-2))	0.0954*	0.043613	0.0327
D(FD(-3))	0.0861*	0.041634	0.0428
D(MMV)	0.2646	0.293524	0.3709
D(MMV(-1))	0.1262	0.369145	0.7337
D(MMV(-2))	0.8440**	0.308634	0.0082
D(MPR)	0.0017	0.010084	0.8679
D(MPR(-1))	-0.0282**	0.012182	0.0243
D(MPR(-2))	0.0253**	0.009733	0.0118
D(INF)	-0.0018	0.004907	0.7076
D(FEX)	-0.2198*	0.037392	0.0000
D(RR)	0.00868	0.006089	0.1636
D(DEPGDP)	0.8921***	0.039898	0.0000
D(DEPGDP(-1))	-0.1541*	0.083091	0.0685
ECM(-1)	-0.8386***	0.125924	0.0000

*, **, *** mean p-value <10%, 5% and 1% respectively

5.9 Diagnosis Test

5.9.1 Test for Heteroskedasticity

A Breusch-Pagan- Godfrey test for Heteroskedasticity was employed on Models 1 and 2. The null hypothesis of Homoskedasticity is not rejected. It was concluded that the variables of Models 1 and 2 do not suffer for the problem of Heteroskedasticity.

5.9.2 Test for Serial Correlation

A Breusch-Godfrey Serial Correlation Lm Test is also employed to check the presence of serial correlation in both models. From table 5.12, the null hypothesis of no serial correlation based on the LM test statistics is not rejected. Model 1 and 2 are therefore concluded to be free of serial correlation.

Table 5.12 DIAGNOSIS TEST

DIAGNOSIS TEST				
Test	Model	F-statistics	Probability value	
Breusch-Pagan- Godfrey test (Heteroskedasticity)	Model 1	1.0731	0.3861	
	Model 2	0.7236	0.7803	
Breusch- Godfrey LM Test (Serial correlation)	Model 1	1.4564	0.2397	
	Model 2	0.1467	0.8638	
Ramsey's Reset Test	Model 1	0.0012	0.9729	
	Model 2	0.0097	0.9215	
Stability Test	Model 1		Stable	
	Model 2		Stable	

Source: Author's estimations

5.9.3 Stability Test

A Cusum and Cusum of square test is employed to verify the whether the ARDL model is stable. From Figure 5.3 and 5.4 below, the red dotted lines indicate the critical bounds. Figure 5.3 shows the residuals for long run equilibrium for Model 1 function is relatively stable. The results imply that the null hypothesis of no stability for Model 1 is rejected at 5% significance level.

Also, Figure 5.4a shows that residuals for long run equilibrium for Model 2 function is relatively stable. Figure 5.4b shows that the sum of squares of recursive residual for Model 2 function is also stable and entirely remains within the critical bound through the study period. The results imply that the null hypothesis of no stability for Model 2 is rejected at 5% significance level. Hence both Model 1 and 2 are stable.

Figure 5.3 Plot of Cummulative Sum of Residuals (CUSUM) Model 1

Figure 5.1

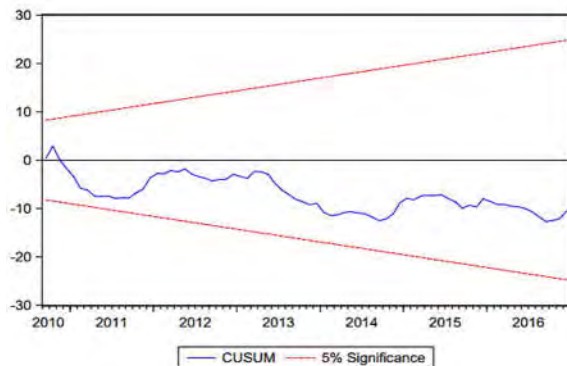


Figure 5.4 Plot of Cumulative Sum and Cumulative Sum of Squares of Residuals (CUSUM & CUSUMSQ) Model 2

Figure 5.4 A

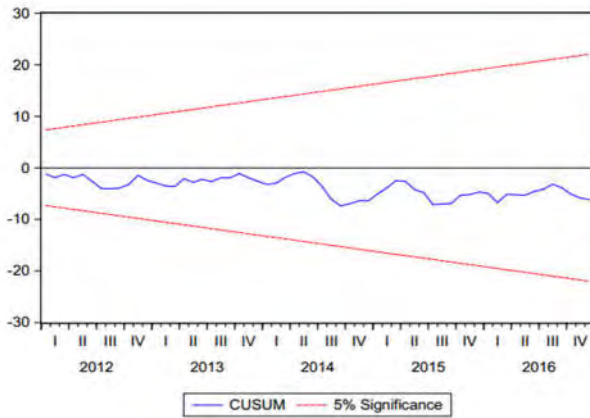
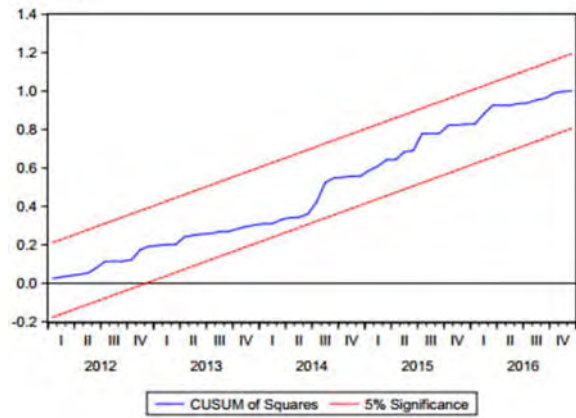


Figure 5.4 B



5.9.4 Conclusion

The introduction of mobile money services in Ghana is found to have a positive impact on the financial development both in the long and short run co-integration model signifying that mobile money services have come to deepen the financial sector development in Ghana.

Additionally, mobile money services have positive relationship with the amount of currency in circulation both in the long and short run. That is, as mobile money services increases there is an increase in the demand for cash hence increasing the currency in circulation.

CHAPTER SIX

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

6.1 Introduction

The growth in financial services offered through the mobile money platform necessitated the main purpose of this study which is to empirically investigate the effects of mobile money services on Ghana's financial development and also its impact on currency in circulation. The objectives of the study were to i) investigate the effect of mobile money services on financial development in Ghana and ii) examine the impact of mobile money transactions on the currency in circulation. In this chapter, summaries, conclusions, and recommendations are presented. Limitations of the study are also discussed.

6.2 Summary

To some extent, the emergence of mobile money services have made "off-counter" financial services easier and more convenient. These services rendered, have had some impact on the financial development of the country. Also, mobile money services as a payment system have some implications on how cash is held and used in economic transactions.

The study focused on reviewing various theoretical and empirical literature on mobile money, financial development, payment systems and money demand and supply. The theoretical review emphasized on the role of mobile money services within the financial section, its implications on money demand and money supply as well as various definitions of the mobile money. The empirical literature reviewed some studies that were conducted on mobile money, its impact on the financial sector and also demand for liquid cash. It pointed out various estimation techniques carried out in these studies.

The study presented an overview of the mobile money services, the payment and financial sector landscape and developments in Ghana. The trend of Ghana's financial sector development was also discussed in the study.

The methodology used in this study was rooted in Townsend's model of financial deepening and growth and Quantity theory of money. It employed an Autoregressive distributed lag (ARDL) estimation approach on a monthly time series data over the study period from 2010 to 2016. This time period was considered because mobile money services started in the last quarter of 2009 and the data obtained for the study started from 2010. Unit root tests were carried out to check the order of integration or the level at which the variables were stationary. The variables employed were either stationary at levels $I(0)$ or at first difference $I(1)$. Two models were designed under the study, the first was to estimate the impact of mobile money transactions on the currency in circulation while the second model investigated the effect of mobile money services on financial development. ARDL Bound's Test procedure for cointegration analysis was used to examine the long run relationship among variables in both models. The results revealed that there is a long run relationship among variables in both models.

Empirical analysis and results presented in the previous chapter showed that there is a positive relationship between mobile money transactions and the currency in circulation both in the long and short run. This result is consistent with empirical findings by Mannah-Blankson & Belnye (2004) who found a positive impact of financial innovation on M1 using volume of card transactions as a proxy for financial innovation.

Also, there is a positive relationship between mobile money services and financial development in Ghana in both the long and short run. An increase in mobile money service exerts a positive effect

on financial development by 0.884% in the short run and 0.2456% in the long run. This also falls in line with empirical findings of Asongu (2012).

6.3 Conclusion

In the light of the findings, it can be inferred that mobile money services have positively impacted Ghana's financial development. The convenience, relative ease and the speed at which monetary transactions are conducted through the mobile money service have greatly influenced the delivery of financial services in Ghana. Mobile money services have proven to be of great support to the financial sector and economic lives of Ghanaians.

Also, the infusion of mobile network services and financial services through the mobile phone has positively influenced the way cash is held and used in business transactions. This has led to increases in the currency in circulation over the study period in Ghana.

6.4 Recommendations

The empirical results have significant implications for Ghana's financial sector. On the basis of the above conclusions, the study recommends that the use of mobile money service should be encouraged. The regulators (the central bank and National Communication Authority) should put in place holistic and sustainable mobile money/payment policy actions. These policy actions should be made to revise the "e-money issuer guidelines by Bank of Ghana" into a comprehensive mobile money/payment policy that further incorporates mobile money services into all financial operations and sectors within Ghana. This policy would ensure and further promote the use of mobile money services in the country so as to deepen the financial sector.

Also, we recommend that proliferation of active mobile money agents within Ghana since their operations will further help intermediate financial activities such as cash deposit/receipts and

payments. This will boost the mobile money services by providing services to the unbanked and further deepen the financial sector development in Ghana. The study also recommends financial institutions to embrace and adapt the mobile money service into their routine operations.

Strict regulations and laws should be put in place to ensure the efficiency and effectiveness of mobile money services are always guaranteed to users at all times. Monetary policy measures should take into consideration the mobile money phenomenon as it could influence the currency in circulation which could affect the effectiveness of its policy. The central bank should ensure that mobile money transactions are monitored to prevent large sums of cash balances outside the banking system which has liquidity threats on the economy.

6.5 Limitations of the Study

It was quite a challenge obtaining data on mobile money. Data on mobile money services was unavailable for years before 2010, this is because the service started in that later quarter of 2009. This compelled us to use monthly data obtained from 2010 to 2016. This necessitated the interpolation of quarterly data on Gross Domestic Product into monthly series using Denton's partial interpolation procedure. Mobile Network Operators were reluctant to give out much detailed data such as mobile money deposit/savings, this also limited the scope of analysis.

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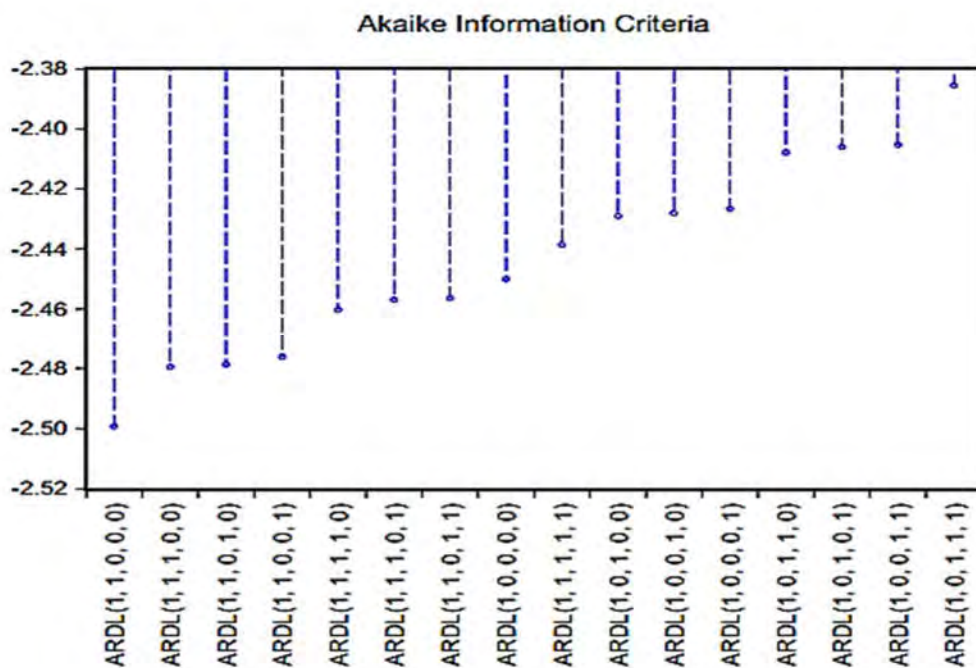
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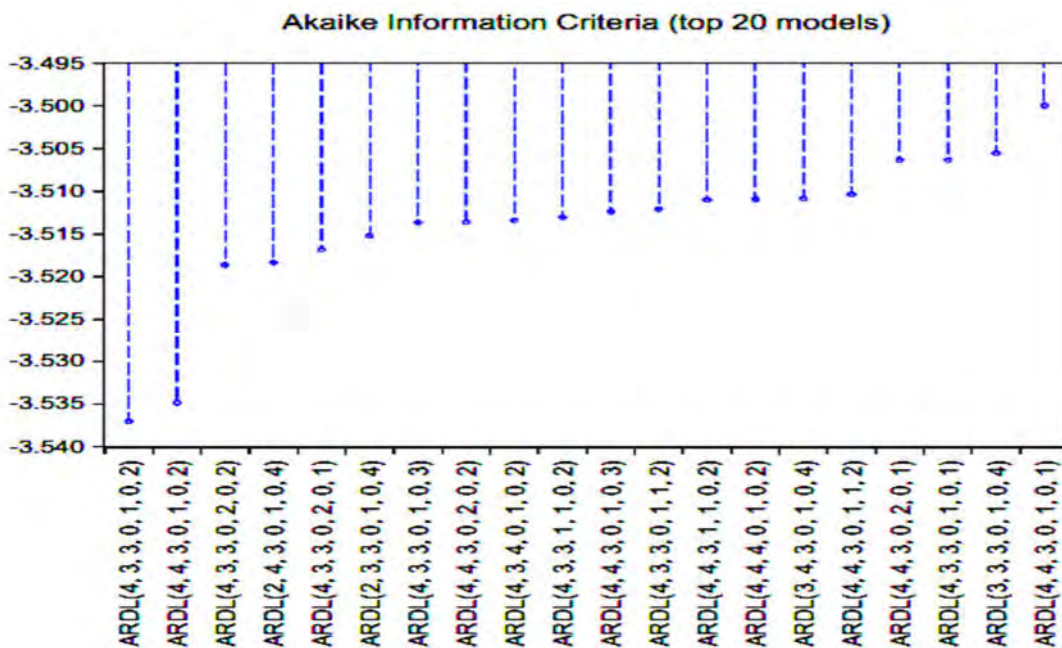
APPENDIX

Akaike criteria lag selection structure

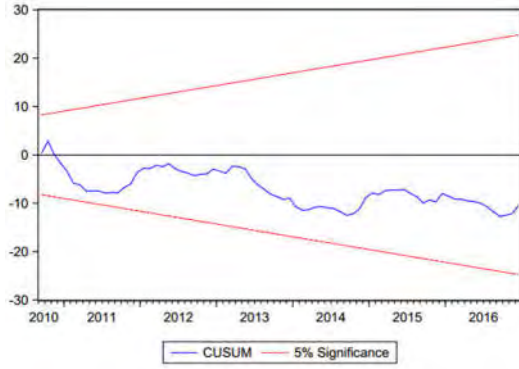
Model 1



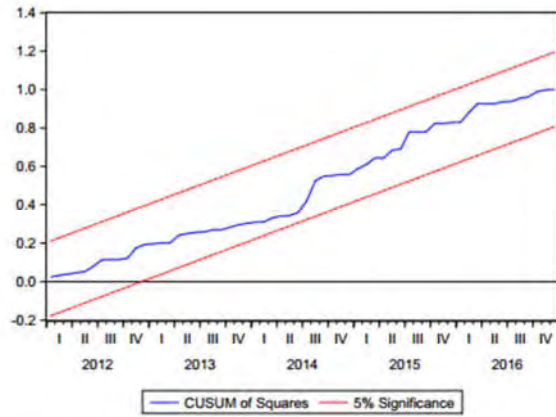
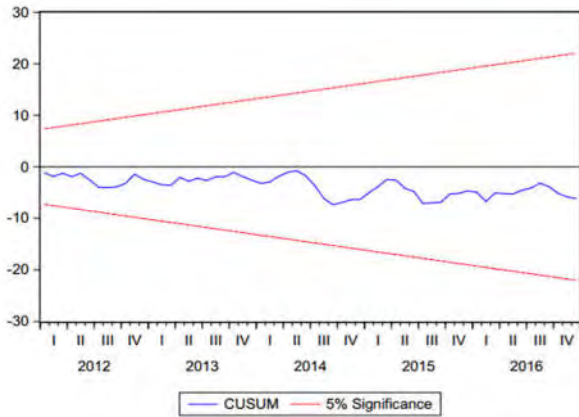
Model 2



Plot of Cummulative Sum and Cummulative Sum of Squares of Residuals (CUSUM &CUSUMSQ) Model 1



Plot of Cummulative Sum and Cummulative Sum of Squares of Residuals (CUSUM &CUSUMSQ) Model 2



ARDL Bounds Test for cointegration

The impact of mobile money services on the currency in circulation (Model 1)

ARDL Bounds Test		
Date: 07/20/17 Time: 08:18		
Sample: 2010M02 2016M12		
Included observations: 83		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	k
F-statistic	7.529655	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Effect of mobile money services on financial development (Model 2)

ARDL Bounds Test		
Date: 07/20/17 Time: 07:53		
Sample: 2010M05 2016M12		
Included observations: 80		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	k
F-statistic	8.029481	6
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

Long run and Short Run error correction Estimates

The impact of mobile money services on the currency in circulation (Model 1)

ARDL Cointegrating And Long Run Form				
Dependent Variable: LCIC				
Selected Model: ARDL(1, 1, 0, 0, 0)				
Date: 07/20/17 Time: 08:19				
Sample: 2010M01 2016M12				
Included observations: 83				
Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP)	-0.036005	0.150708	-0.238909	0.8118
D(LMMT)	0.040458	0.021342	1.895702	0.0618
D(FEX)	0.006345	0.033331	0.190369	0.8495
D(MPR)	-0.001952	0.005805	-0.336200	0.7376
CointEq(-1)	-0.503612	0.088527	-5.688804	0.0000
Cointeq = LCIC - (0.6581*LGDP + 0.0803*LMMT + 0.0126*FEX -0.0039 *MPR + 1.4942)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP	0.658057	0.174585	3.769266	0.0003
LMMT	0.080336	0.036166	2.221279	0.0293
FEX	0.012599	0.066105	0.190593	0.8494
MPR	-0.003875	0.011580	-0.334632	0.7388
C	1.494248	1.040810	1.435659	0.1552

. Effect of mobile money services on financial development (Model 2)

ARDL Cointegrating And Long Run Form				
Dependent Variable: FD				
Selected Model: ARDL(4, 3, 3, 0, 1, 0, 2)				
Date: 07/10/18 Time: 11:21				
Sample: 2010M01 2016M12				
Included observations: 80				
Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FD(-1))	0.348918	0.067673	3.979745	0.0002
D(FD(-2))	0.095380	0.043613	2.186970	0.0327
D(FD(-3))	0.086147	0.041634	2.069158	0.0428
D(MMV)	0.264611	0.293524	0.901499	0.3709
D(MMV(-1))	0.126177	0.369145	0.341808	0.7337
D(MMV(-2))	0.844031	0.308634	2.734732	0.0082
D(MPR)	0.001684	0.010084	0.167045	0.8679
D(MPR(-1))	-0.028150	0.012182	-2.310849	0.0243
D(MPR(-2))	0.025265	0.009733	2.595783	0.0118
D(INF)	-0.001849	0.004907	-0.376933	0.7076
D(FEX)	-0.219820	0.037392	-5.878799	0.0000
D(RR)	0.008587	0.006089	1.410318	0.1636
D(DEPGDP)	0.892189	0.039898	22.362004	0.0000
D(DEPGDP(-1))	-0.154144	0.083091	-1.855128	0.0685
CointEq(-1)	-0.838572	0.125924	-6.659351	0.0000
Cointeq = FD - (0.2456*MMV + 0.0122*MPR - 0.0022*INF - 0.1247*FEX + 0.0102*RR + 0.6708*DEPGDP + 0.7591)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MMV	0.245597	0.158683	1.547722	0.1269
MPR	0.012242	0.007115	1.720542	0.0905
INF	-0.002205	0.005843	-0.377481	0.7071
FEX	-0.124701	0.031828	-3.917922	0.0002
RR	0.010241	0.007157	1.430831	0.1577
DEPGDP	0.670823	0.042915	15.631268	0.0000
C	0.759081	0.152358	4.982230	0.0000

Line Plots

