EFFECT OF FINANCIAL INNOVATION ON MONEY DEMAND AND SUPPLY IN KENYA (2008-2016)

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A thesis submitted to the Graduate School in partial fulfilment for the Requirements of the Masters of Arts Degree in Economics of Egerton University.

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DECLARATION AND APPROVAL

DECLARATION

This thesis is my original work and to the best of my knowledge has not been presented for the award of a degree, diploma or certificate in this or any other university.

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APPROVAL

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DEDICATION

This study is dedicated to my mother, my late dad, brothers and sisters.

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ABSTRACT

The demand and supply of money is crucial in the determination of the effectiveness of monetary policy. Key financial innovations have taken place in Kenya due to the Structural Adjustment Programs and the technological advancements which have affected both the demand and supply of money. Previous Studies used the number of *M-pesa* and ATMs as a measure of financial innovation which did not give accurate results since not all registered *M-pesa* users carry out financial transactions and not all ATMs card holders use their cards in doing transactions. The studies also ignored the supply side of money in the financial sector. This study therefore aimed at overcoming these challenges by using the Volume of *M-pesa* transactions and volume of ATMs transactions since it would capture the actual effect of financial innovation in the economy by factoring in all the transactions carried out through *M-pesa* and ATMs. The general objective of the study was to establish the effect of financial innovation on money demand and Supply in Kenya. Specifically, the study sought to: investigate the effect of the volume of *M-pesa* transactions on money demand, determine the effect of the volume of ATMs transactions on the money demand, investigate the effect of the volume of *M-pesa* ransactions on money supply and determine the effect of the volume of ATMs transactions on the money supply. According to the World Bank, Kenya is leading in financial innovation in East Africa in terms of money transfer thus warranting this study. Study period was 2008-2016 based on data availability since data on volume of *M-pesa* transactions was available beginning the year 2008. This study was based on Keynesian Theory of Demand for Money and Friedman Quantity Theory of Money. This study used secondary data drawn from Kenya National Bureau of Statistics (KNBS), World Bank (WB) Central Bank of Kenya (CBK) and Safaricom. VECM model was employed in the analysis since some variables were found to be non-stationary after unit root test. Unit root test was conducted using the augmented Dickey Fuller test. Johansen Cointegration test was conducted and the results showed cointegration which was later addressed using Vector Error correction model. Autocorrelation was tested using Breausch-Godfrey LM test in which two lags were applied to correct its effect in the model. The study found positive correlation between financial innovation and money demand and supply which was statistically significant at 5% significant level. This study recommended that the government should regulate volume of transactions done through means such as mobile money such as *M-pesa* to control the amount of money demand and in the economy due to reduced *M-pesa* transactions. Government of Kenya should also regulate the amount of transactions done through the ATMs. This will reduce the demand and supply for money as a result of reduced transactions hence controlling money demand and supply in the economy. This will ensure a stable monetary system and a stable economy. Inclusion of other mobile money such as Airtel money, Orange money and equitel money in the study of financial innovation was recommended as the area of further research.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dickey Fuller
ATM	Automated Teller Machine
CBK	Central Bank of Kenya
CPI	Consumer Price Index
E-banking	Electronic Banking
ECM	Error Correction Model
FEVD	Forecast Error Variance Decomposition
GDP	Gross Domestic Product
IRF	Impulse Response Function
IRFs	Impulse Response Functions
KNBS	Kenya National Bureau of Statistics
MD	Money Demand
MS	Money Supply
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
WB	World Bank

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

According to Aspara, *et al* (2012), financial industry has been immensely transformed by changes in regulation, globalization and digitalization. These changes have highly increased the attention to customer experience and moved the financial industry from using technology only as facilitator of internal processes to being a crucial component in making transactions. Hence, in today's world where technological innovation can hardly be separated from other forms of innovation, including financial, it becomes even more important to understand how it impacts money demand and supply in Kenyan.

According to Shirakawa (2011), innovation in the financial industry has been an ongoing process with even more recent innovations such as bank teller replacement by ATM's and plastic cards, which are becoming increasingly more important than cash.

Financial innovation has been defined as "...the act of creating and then popularizing new financial instruments as well as new financial technologies, institutions and markets..." (Tufano, 2003,). According to Tufano (2003), product innovations are evidenced by new financial instruments while process innovations embody innovative means of distributing the financial products, executing or pricing the transactions. Financial innovations, therefore, entail new products, new services, new production processes and new organizational forms Frame & White, (2004). These financial innovations are seen as contributing to financial performance in Kenyan market.

The origin of economic thought which sees innovation as a determinant of economic performance is credited to Schumpeter (1934), whose study fronts innovation as its landmark initial contribution to economic literature. Nevertheless, there is compelling evidence that financial innovations generate returns to innovators and can positively affect the entire economy Lerner & Tufano, (2011). The benefits, according to the authors, are generated when households are able to have investment and consumption choices in addition to lowering the cost incurred in raising and deployment of funds. Consistent with Lerner and Tufano's (2011) findings, emerging financial innovations, especially in mobile money have propelled Kenya to the global limelight and aroused immense intellectual curiosity in the research community. In order to appreciate the context of this study these developments need

to be put into proper perspective the use of electronic card payments systems in Kenya has been there for decades. The most commonly used electronic card payments include credit cards, debit cards, prepaid cards, charge cards and Automated Teller Machine (ATM) cards. The electronic payment card market has been dominated by commercial banks and merchants for years. However, the introduction of mobile money in year 2007 in Kenya by the leading mobile phone service provider Safaricom has dramatically altered the electronic payment landscape in the country. Safaricom launched the world-acclaimed mobile money transfer service *M-pesa* (meaning mobile money; 'Pesa' means money in Kiswahili, one of Kenya's national language) which has won numerous awards for its role in improving financial access and financial inclusion in the country. The model has been adopted by the other mobile phone service providers in the country and commercial banks, leading to an unprecedented mobile money transaction growth in Kenya. The mobile money services sector in Kenya is one of the most advanced in the world (EIU, 2012). The financial innovation has significantly lowered the cost of money transfer in Kenya and increased the degree of financial deepening and financial inclusion. The country has robust mobile money agent network and adequate regulatory support from the Central Bank of Kenya. According to Demirgüç-Kunt and Klapper (2012), Kenya is Sub-Saharan Africa's regional leader in mobile money. The emergence of mobile phones is seen as central to the development of many electronic payment innovations Ingenico, (2012). Additionally, Al-Khouri, (2014) observed that advancements in internet technology as well as mobile phones subscriptions have significantly fueled the rise in electronic payments. The low penetration of formal financial services coupled with high rate of mobile subscription has led to rapid growth in mobile payments Capgemini & RBS, (2013). This development in mobile payments has resulted in a situation where the number of customers, number of transactions and the value of mobile payments have substantially dwarfed comparative figures for the combined usage of ATM cards, credit cards, charge cards, POS machines, prepaid cards and debit cards (CBK, 2015). Eight years down the line, mobile payments are the dominant cash transfer options in the country (CBK, 2015). Interestingly, although significant studies in the field of financial innovations are available, most of the studies have concentrated on financial products in developed countries (Lerner & Tufano, 2011). In effect, emerging financial innovations widely used in developing countries in general and Kenya in particular have been given a wide berth. On the other hand, where they have been studied, the emphasis has been on providing descriptive statistics (Jepkorir, 2010)

1.1.1 Financial Innovations in Kenya

Kenya has experienced phenomenal growth in financial innovations in the last ten years and some of these innovations have positioned the country as a global leader especially in mobile money innovations (Demirgüç-Kunt & Klapper, 2012). The country's Sub-Saharan Africa leadership in technological innovations has served to cement Kenya's leadership in the technologically driven and technology dependent financial innovations. The regulatory framework in the banking and telecommunications sectors strongly supports these innovations.

1.2 Statement of the Problem

It is important to understand the effect of financial innovation on money demand and supply in Kenya since its instability is a major cause of economic crises. This study aimed at investigating empirically the effect of financial innovation on money demand and supply in Kenya. Earlier studies used the number of *M-pesa* and the number of ATMs as a measure of financial innovation. This might lead to incorrect results since not all people with registered *M-pesa* accounts and ATM cards do the transactions using them. Some might obtain the ATM card but does not do any transaction using it. The same applies to some people with registered *M-pesa* accounts. In addition, most studies have been biased towards money demand ignoring money supply side yet it is also affected by the financial innovation through money multiplier and subsequently affecting money supply and monetary policies. A good economy is the one with Money demand and supply at equilibrium. Distortion of either money demand or money supply leads to negative effects such as inflation and ineffective monitory tools. It is therefore important to consider both money demand and money supply and how they are affected by financial innovation.

This study sought to overcome the above challenges by using the Volume of *M-pesa* transactions and volume of ATMs transactions to capture the real effect of financial innovation on money demand and supply in Kenya. The study also considered both money demand and supply on Kenyan economy.

1.3 Objectives of the Study

1.3.1 Overall Objective

The overall objective of this study was to determine the effect of financial innovation on Money demand and Supply in Kenya 2008-2016.

1.3.2 Specific Objectives

i. To investigate the effect of volume of *M-pesa* transactions on money demand in Kenya.
ii. To determine the effect of volume of ATMs transactions on the money demand in Kenya.
iii. To investigate the effect of volume of *M-pesa* transactions on money supply in Kenya.
iv. To determine the effect of volume of ATMs transactions on the money supply in Kenya.

1.4 Research Hypotheses

i. Volume of *M-pesa* transactions has no effect on money demand in Kenya.
ii. Volume of ATMs transactions has no effect on money demand in Kenya.
iii. Volume of *M-pesa* transactions has no effect on money supply in Kenya.
iv. Volume of ATMs transactions has no effect on money supply in Kenya.

1.5 Significance of the Study

Kenya is among the leading countries in Africa as far as financial innovation is concerned. The Kenyan financial system has undergone some remarkable changes as a result of the reforms and policies implemented by the monetary authorities since mid-80s. The effect of these reforms are evidenced in the rapid growth of financial variables such as saving, deposit, lending and borrowing, and money supply. Kenya is currently the most developed mobile phone market in East Africa (World Bank, 2009).

The main contribution of this study differentiating it from other studies in Kenya is that it used volume of *M-pesa* transactions and Volume of ATMs transactions as opposed to earlier studies which had used Number of *M-pesa* and number of ATMs to capture the effect of financial innovation. This study also considered effect of financial innovation on both money

demand and supply in Kenya as opposed to earlier studies which only considered money demand. This study aimed at filling the knowledge gap that is existing about the variations in money demand and supply due to the technological advancements in the financial sector in Kenya. The findings of this study will form a basis for informed monetary policy formulation in addressing issues of money demand and supply in the Kenyan economy. The knowledge gained from this study should serve as a point of reference for further studies.

1.6 Scope and Limitations of the Study

This study was carried out using time series covering period 2008 to 2016. The study focused on effect of financial innovation on money demand and supply in Kenya. Specifically, the study sought to determine the effect of volume of *M-pesa* and ATMs transactions on money demand and supply in Kenya.

1.7 Limitations of the Study

The limitation of the study is that it was difficult getting all the data about mobile money in Kenya. This limitation was overcomed by use of data from Safaricom mobile money. *M-pesa* money accounts for 75% of Mobile money in the Kenyan economy. It was also difficult getting a theory directly linking financial innovation and money supply. This limitation was addressed by the use of multiplier theory which shows how money supply is determined endogenously through behavior of financial institutions, currency ratio and reserve ratio.

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1.7 Definition of Terms

Automated teller machine (ATM) is an electronic telecommunications device that enables customers of financial institutions to perform financial transactions, such as cash withdrawals, deposits, transfer funds, or obtaining account information, at any time and without the need for direct interaction with bank staff.

Financial Innovation: The European Central Bank describes financial innovation as the technological advances which facilitate access to information, trading and means of payment, emergence of new financial instruments and services, new forms of organization, more developed and complete financial markets.

GDP: The total market value of all final goods and services produced in a country in a given year.

Inflation: The overall general upward price movement of goods and services in economy.

Monetary Policy: The process by which the monetary authority of a country controls the supply of money, through targeting a variety of instruments such as rate of interest for the purpose of promoting economic growth and stability

Money Supply: the quantity of money available within the economy to purchase goods, services and securities.

Money Demand: Demand for real money balances (quantity of money in real terms); desire of households and businesses to hold assets in a form that can be easily exchanged for goods and services.

M-pesa :(**M** for mobile, ***pesa*** is Swahili for money) is a mobile phone-based money transfer, financing and microfinancing service, launched in 2007
by Vodafone for Safaricom and Vodacom, the largest mobile network operators in Kenya and Tanzania.

M0 and M1: Refers to narrow money, normally include coins and notes in circulation and other money equivalents that are easily convertible into cash.

M2: Includes M1 plus short-term time deposits in banks and 24-hour money market funds.

M3: Includes M2 plus longer-term time deposits and money market funds with more than 24-hour maturity.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter covers theoretical literature, empirical literature, critique of the literature, theoretical framework and conceptual framework.

2.2 Theoretical Literature Review

2.2.1 Quantity Theory of Money

The classical economists view of monetary policy is based on the quantity theory of money. According to this theory, an increase in the quantity of money leads to a proportional increase in the price level and vice versa. All markets for goods continuously clear and relative prices adjust flexibly to ensure that equilibrium is reached. Therefore, the economy is assumed to be always at full employment level, except for temporary deviations caused by real disturbances (Pigou, 1927).

The role of money is simply to serve as the unit to express prices and values. Money facilitates the exchange of goods and services. Its use satisfies double coincidence of wants, that is, it acts as medium of exchange. Money is neutral; it does not influence the determination of relative goods prices, real interest rates and aggregate real income. The role of money as a store of value is regarded as limited under the classical assumption of perfect information and negligible transaction costs. The classical economists still recognized that some particular quantity of real money holdings would be needed by the economic entities under certain special circumstances. This consequently led to the formulation of the quantity theory of money (Pigou, 1928).

The quantity theory of money explains the role of money as a medium of exchange. In the classical work, it is stated that money affects nothing but the price level. The theory postulates a direct and proportional relationship between the quantity of money and the price level. The clearest exposition of the classical quantity theory approach is found in the work of Irving Fisher the book: The Purchasing Power of Money, published in 1911. He examined the relationship between the total quantity of money M (the money supply) and the total amount of spending on final goods and services produced in the economy $P \times Y$, where P is the price level and Y is aggregate income for the economy. Velocity (V) of money provides a link

between M and P×Y. It simply represents the average number of times per year that a unit currency is spent in buying the total amount of goods and services produced in the economy. The linkage is shown below.

$$MV = PY \quad (2.1)$$

In this expression, P denotes the price level, and Y denotes the level of current real GDP. Hence, PY represents current nominal output; M denotes the supply of money over which the Central Bank has some control; and V denotes the velocity of circulation, which is the average number of times a dollar is spent on final goods and services over the course of a year. The classical economists believe that the economy is always at or near the natural level of real output. As a result, classical economists assume that the equation of exchange is fixed, at least in the short-run. Furthermore, classical economists argue that the velocity of circulation of money tends to remain constant so that can be regarded as fixed. They believe that causation runs from money to price. Assuming that both Y and V are fixed, it follows that if the Central Bank was to engage in monetary policy, the effect of an increase in money supply can only increase the price level (Laidler, 2010).

An increase in M, only affects an increase in the price level P in direct proportion to the change in M and the opposite is true with a decrease in M. In other words, expansionary monetary policy can only lead to inflation. Contractionary monetary policy can only lead to the deflation of the price level. Thus, as far as the stabilization policy is concerned, fiscal policy has no role. It has no influence whatsoever on the price level. The only effect is felt on the interest rate and real magnitudes. The role of monetary policy is also limited. It has no influence on the real side of the economy but it exerts influence on the price and nominal magnitudes (Tsheole, 2006).

However, the quantity theory has a number of weaknesses. First, the quantity theory does not explain unemployment because it assumes away adjustment problems. It assumes that production is determined by resources, and since money is not a resource, changes in money should not change production. It is widely accepted that a well anticipated monetary changes has no effect on unemployment but only affect prices. While in actual fact the adjustment process of monetary disturbances also affects unemployment not just prices. Secondly, the

classical quantity theory assumes that there is a correlation between changes in the amount of money and changes in spending.

In this case, the changes in money supply are the cause of spending. Critics of the quantity theory have suggested that this correlation exists because changes in the amount of money in circulation are caused by, rather than the cause of, changes in business activity. In other words, the critics argue that changes in money are the effect, not the cause. Finally, the quantity theory assumes that changes in the amount of money in circulation do not alter velocity. The assumption was dismissed by the Keynesians, who instead, come out with an alternative assumption, that changes in money tend to be offset by changes in velocity (Tsheole, 2006).

According to Keynes, "The quantity theory of money is a truism." Fisher's equation of exchange is a simple truism because it states that the total quantity of money (MV+M'V') paid for goods and services must equal their value (PT). But it cannot be accepted today that a certain percentage change in the quantity of money leads to the same percentage change in the price level.

According to Crowther (1997), the quantity theory is weak in many respects. First, it cannot explain why there are fluctuations in the price level in the short run. Second, it gives undue importance to the price level as if changes in prices were the most critical and important phenomenon of the economic system. Third, it places a misleading emphasis on the quantity of money as the principal cause of changes in the price level during the trade cycle.

Prices may not rise despite increase in the quantity of money during depression; and they may not decline with reduction in the quantity of money during boom. Further, low prices during depression are not caused by shortage of quantity of money, and high prices during prosperity are not caused by abundance of quantity of money. Thus, the quantity theory is at best an imperfect guide to the causes of the trade cycle in the short period (Crowther, 1997).

2.2.2 The Baumol-Tobin Theory of Transaction Demand for Money

The theoretical work on the transaction demand for money by Baumol, (1958) seeks to draw more precise implications about the variables that determine the segment of the demand for money than Keynes' analysis did. They explained that individuals hold money or bonds at a

time due to uncertainty of interest rate fluctuations. They highlight that an increase in income will lead to larger investments in bonds and the investor will enjoy the benefits of economies of scale. They assumed that the individual agent receives an income payment once per period and that the entire receipts of the agent are expended at a constant rate over the period. Then, the agent will hold some assets at every time period, except the final time period when last expenditure is made. The agent incur a brokerage fee every time wealth is switched between assets (money and bond only) and that the aim of the individual is to determine that level of bond holdings, which will jointly maximize the returns from interest income and minimize brokerage cost (Tobin, 1958).

2.2.3 McKinnon and Shaw Theory of Demand for Money

McKinnon and Shaw (1973) challenged the dominant theoretical positions of Keynes, and the structuralist economists on the ground that the crucial assumptions in these models are erroneous in the context of developing countries. They, therefore, advocated financial liberalization and development as growth enhancing economic policies. They argued that policies such as interest rate ceiling, higher reserve requirement, directed credit policies, and discriminatory taxation of financial intermediaries had harmful effects on economic growth. McKinnon and Shaw theory stated that, a low or negative real rate of interest discourages savings and hence reduces the availability of loanable funds, constrains investment, which in turn lowers the rate of economic growth. On the contrary, an increase in the real interest rate may induce the savers to save more which enables more investment to take place and positively affects economic growth (Fry, 1995).

McKinnon and Shaw (1973) advanced the theory of financial liberalization as an alternative to the harmful restrictive policies. The financial liberalization policies were aimed at liberalizing interest rates by switching from an administered interest rate setting to a market based interest rate determination; reducing controls on credit by gradually eliminating directed and subsidized credit schemes; developing primary and secondary securities markets; enhancing competition and efficiency in the financial system by privatizing nationalized commercial banks. It suggested a basic complementarity between the accumulation of money balances and physical capital accumulation.

According to McKinnon-Shaw (1973) model, the success of the financial liberalization process depends on the following hypothesis: (i) the effective deepening of the financial

sector, (ii) a positive correlation between savings and the real interest rate, and (iii) a perfect complementarity between the money demand and investment. The argument is that potential investors must accumulate money balances prior to their investment. The lower the opportunity cost of accumulating real money balances or the higher the real deposit rate of interest, the greater is the incentive to save.

The McKinnon's complementarity hypothesis is reflected in the demand for money function below:

$$M/P = f(Y, I/Y, d\text{-}\pi^e) \quad (2.2)$$

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

The ratio of gross investment to GNP can also be expressed as:

$$I/Y = f(r, d - \pi) \quad (2.3)$$

Where; r -is the average return on physical capital, thus, the complementarity is expressed as;

$$\frac{\partial(M/P)}{\partial(I/Y)} > 0 \quad (2.4)$$

$$\frac{\partial(M/Y)}{\partial(d - \pi e)} > 0 \quad (2.5)$$

Equations (2.4) and (2.5) suggests that it is not the cost of capital, but the availability of finance that constrains investment in financially repressed economies. The partial derivative of equation (2.4) represents the money demand for investment, an increase in investment rate lead to an increase in money demand, while the partial derivative of equation (2.5) demonstrates that an increase in real deposit rate lead to an increase in investment because financial constraints are relaxed (Fry, 1995).

Shaw (1973) on the other hand discarded Keynes' finance motive and the neoclassical monetary growth model in favor of the debt-intermediation view. There are significant differences in the financial systems in developed and developing countries. For instance, developed countries possess sophisticated financial institutions, which facilitate

intermediation between savers and investors, contrary to developing countries. Therefore, Shaw (1973) constructed a monetary model, in which money is backed by productive investment loans to the private sector and that the amount of money stock, in relation to the level of economic activity, is positively related to the extent of financial intermediation between savers and investors through the banking system. He concluded that improved financial intermediation through financial liberalization and financial development increases the incentive to save and invest thereby raising the average efficiency of investment (Fry, 1995).

2.2.4 Financial Innovation and Demand for Money

The theoretical literature on financial innovation of demand for money emerged from empirical work of financial innovation by Goldfeld and Sichel, (1990). The years in which standard money equations broke down witnessed the creation of a number of assets that appeared to be very close substitutes of demand deposit, including accounts and security repurchase agreements, as well as the development of a variety of new cash management techniques used by firms to economize on their real balances. As a result, Goldfeld and Sichel findings launched an extensive program directed at repairing the conventional specification by taking the effects of financial innovations on the demand for money into account (Ireland, 1992).

There are major financial innovations and theories that emphasize specific sources of financial innovation. Lewis and Mizen (2000) explained that the effect of financial innovation on the demand for money depends on the sort of innovation taking place. They provided three reasons, which explained how financial innovation impacts the demand for money. First, they indicated that some innovations change the absolute and the relative costs of holding various financial assets, as well as reducing the transaction costs associated with exchanging of a financial asset for another. Secondly, financial innovation had eroded the distinction between banks and other financial intermediaries and between intermediated transactions and market ones. Thirdly, some new financial assets created by innovation are close substitutes for the traditional medium of exchange assets, which is included in the definition of money. As a result, the elasticity of substitution for money rises thereby increasing the interest elasticity of demand.

Kasekende and Nikolaidou (2014) argued that mobile money not only had a positive effect on money demand but also leads to a decrease in the interest rate elasticity of demand.

2.2.5 Money Supply Multiplier Theory

Money multiplier approach is one of the approaches which try to explain the money supply process. According to Coats and Khatkhate, (1979) the stock of money is the outcome of the behavior of the public, the financial sector, the ministry of finance and the central bank. The money multiplier concept helps to understand this interrelationship and the role of the central bank in it. The starting point is the central bank balance sheet particularly its liabilities side where there are components of the monetary base including currency in circulation and total reserves holding of banks. To understand linkages between monetary base and various measures of money supply is to express broader measures of money supply us a product of monetary base and a money- multiplier (Walsh, 2003).

The money multiplier includes several variables. The main ones are the currency ratio which reflects the demand for currency by the public and depends on individual preferences in light of cost and benefits of holding cash rather than demand deposits (Handa. 2009). The ratio of reserves held to deposits required by the Central bank to maintain minimum cash reserves in proportion to their deposit Goodhart, (1989) and the ratio of reserves in excess of those required.

Changes in component variables of the money multipliers affect the value of the multiplier and ultimately the money supply. Factors like increase in currency ratio which cause a systematic absorption of the central bank reserves in the process of credit deposit creation generated by an increase in the monetary base will reduce the magnitude of the multiplier (Papademos and Modigliani, 1990). Similarly, an increase in reserve ratio and excess reserve, reduce the multiplier. Hence, higher currency ratio and reserve ratio dampen money creation process and consequently decrease money supply.Components of the money multiplier namely the currency ratio, the reserve ratio, excess reserve ratio and time deposit ratio are behavioral as they depend on the behavior of non-bank, public and banks though the central hank policies can indirectly influence those ratios Walsh, (2003)

The currency ratio is the public demand for currency relative to demand deposit and is a major source of fluctuations in money supply (Handa. 2009). Because of uncertainty on

frequency of withdrawals, loan repayment or fluctuations on yields from various assets, the commercial banks also determine their demand for reserves against the demand deposits given the required reserve ratio (Papadcmos and Modigliani, 1990). Various factors influence the portfolio choices of commercial banks and the public. Starting with the latter, different authors outlined the main determinant of the public demand for currency. Papademos and Modigliani (1990) argued that interest rate on demand and time deposit, interest rate on government securities, income and wealth. Handa (2000) added charges on demand deposit The theory postulates a negative relationship between the public demand for currency and the interest rate on alternative assets. Besides empirical evidences suggest a negative relationship between real income and the currency ratio (Papademos and Modigliani. 1990), yet (Handa, s2000) suggested a positive relationship since an increase in real income lead to an increase in transaction.

On the other side, commercial banks can hold reserves in excess of the legally required ones, and can borrow from other banks or the central bank The demand for reserves depends on the required reserve ratio, the return on reserves or return of substitutes, the frequency of withdrawals and the risks associated with banks assets. Desired level of excess reserves is negatively related to the rate of return on bank assets and positively related to the rate of return on bank's reserves and the discount rate (Papademos and Modigliani, 1990). The frequency of withdrawals and other risks associated with uncertainties on banks assets arc positively related to demand for excess reserves. It is evident that among the components of the above multiplier, there are behavioral variables.

From the above discussion, it is clear that changes in monetary base, currency deposit ratio, time deposit ratio and reserve deposit ratio influence changes in broad money supply. Therefore, increased volume of *M-pesa* and ATMs transactions will affect the multiplier hence influencing money supply indirectly.

2.3 Empirical Literature Review

Several studies have been conducted examining the impact of financial innovation on money demand and supply in the developed and developing countries

Akinbobola (2012) quantitatively analyzed the dynamics of money supply, exchange rate and inflation in Nigeria. The paper utilized secondary data that was obtained from the

International Financial Statistics (IFS), of all variables investigated in the model. The sample covered quarterly data from 1986:01 to 2008:04. The model was estimated using Vector Error Correction Mechanism (VECM). The empirical results confirmed that in the long run, money supply and exchange rate had significant inverse effects on inflationary pressure, while real output growth and foreign price changes have direct effects on inflationary pressure. The possible justification for the inverse effect of money supply on price level is that inflation may not be due to aggregate demand pressure but rather due to failure in the supply chain of goods both from the domestic and foreign supply outlets. Empirical deductions also signify the presence of significant feedback from the long run to short run disequilibrium. However, there exists a causal linkage between inflation, money supply and exchange rate in Nigeria. Akinbobola (2012) only concentrated on the causal relationship without explaining other factor such as financial innovation affected money supply. Therefore, this study investigated how financial innovation affects both Money demand and supply.

Odularu and Okunrinboye (2009) assessed the impact of financial innovation on the demand for money in Nigeria using the Engle and Granger Two-Step Cointegration technique. The results show that financial innovations have not significantly affected the demand for money in Nigeria. The insignificant results however can be attributed to the variable use. In the study, they used number of ATMs as a proxy for financial innovation. Using number as opposed to volume can lead to insignificant results since not all transactions are captured. This study used volume of ATMs transactions and results obtained were significant.

Godslove, (2011) investigated interest rates and the demand for credit in Ghana between 1970 and 2007 using a vector autoregressive model. The study suggested that repressive high interest rates in the 1980s in Ghana disrupted effective financial intermediation. Even though the interest rates were still high since the year 2000, it was lower than that of previous decades. The results indicated that interest rates have a positive impact on domestic credit in the short-run and a negative impact in the long- run. He concluded that while increases in real lending rate may not immediately hamper the demand for credit, they might eventually lead to a fall in the demand for credit in the long run. Godslove, (2011) did not explain the factor causing increase in credit creation.This study therefore investigated on how financial

innovations such as Mpesa and ATMs increase credit creation through cash ratio hence increasing money multiplier and subsequent money supply.

Mannah-Blankson and Belnye (2004) examined the impact of financial innovation, resulting from the Financial Sector Adjustment Program (FINSAP) in Ghana on money demand using cointegration and error correction modelling. The findings from the study showed a long run demand for real money balances in Ghana, driven by income, inflation, exchange rate and financial innovation, with financial innovation exerting a positive influence on the money demand in the long-run. The above study only concentrated on demand for money ignoring money supply side. This study studied effect of financial innovation on both money demand and supply of economy.

Bilyk, (2006) Using the Vector error correction model (VECM) investigated and estimated the relationship between financial innovations and the demand for money in Ukraine, using monthly data from 1997-2005. The results revealed the significance of financial innovations on both narrow and broad money (M1 and M2) respectively. The impulse-response analysis indicated that the impact of financial innovations was stronger in the narrow demand for money specifications. In addition, the study found a positive impact of financial innovations on money demand in Ukraine in the long run and a negative impact in the short-run. The above study did not investigate supply side of the economy. This study incorporated money supply while investigating on effect of financial innovation in Kenyan economy.

Maniragaba, (2011) examined the effects of financial liberalization on the money demand and economic growth using yearly data from 1978-2008 in Uganda. The study investigated financial sector reforms in Uganda following financial liberalization measures, like interest rate deregulation, reduction in direct credit, implementation of prudential rules, privatization of state owned banks, reduction in entry requirements, liberalization of securities markets and international financial liberalization. Employing the error correction method, the study found a positive long-run effect of financial liberalization on the demand for money in Uganda. The above study was done in Uganda which lags behind Kenya on matters of financial innovation. This study concetrated on Kenya since it is the most developed country in East Africa as far as financial innovation is concerned as per CBK, (2015).

Mabuku, (2009) investigated the stability of money demand in Namibia for the period 1993-2006 using the Engle Granger and cointegration technique. Key determinant variables, such as real output, which is a proxy for income, inflation, exchange rates and interest rates as opportunity cost variables were utilized. (Mabuku, 2009) concluded that interest rates and inflation rates had negative significant impacts on money demand, while income and exchange rates had significant positive effects on money demand. The analysis was more on cointegration between two or more-time series and missed the estimation of indigeneity among the variables of interest. The above study did not consider financial innovation as a factor affecting money demand. This study investigated effect of financial innovation on money demand thus covering the above gap.

Kipsang, (2003) Using VECM and data for the period 1970-2011investigated the Determinants of Money Demand in Kenya. He found that Financial innovation had no significant effect on money demand. The insignificant results could be attributed to the use of number of registered *M-pesa* and number of ATMs. This study used volumes of *M-pesa* and ATM transactions.

Khan and Hye, (2011) estimated the role of financial liberalization on the demand for money in Pakistan using annual data for the years 1971 – 2009.To capture the effect of financial liberalization in the model, the study used time trends instead of dummy variables that capture structural breaks. Using the cointegration and auto regressive distributed lag (ARDL), the study estimated long run equilibrium relationship between broad money and composite financial liberalization index along with other determinants of demand for money such as GDP, real deposit rate and exchange rate. Results indicated existence of a long run money demand function in respect of broad money and that financial liberalization positively affected the demand for money in the long-run as well as short-run. The study had ignored the supply side of the economy. This study factored effects of financial innovation on both money demand and supply.

Misati *et al.* (2010) examined the role of financial innovation on the monetary policy transmission in Kenya using Two Stage Least Squares (2SLS) and monthly data covering the period, 1996-2007. He established that financial innovation dampens the interest rate channel of monetary transmission mechanism. The paper was motivated by the fact that the rapid financial innovation in the country could have contributed to possible implications on

monetary transmission mechanisms, which would necessitate constant revision of policy and instruments, targeting frameworks and operating procedures to enhance monetary policy effectiveness. The study focused on the interest rate channel through which the Central Bank implements monetary policy which significantly changes from including the financial innovation variable in a money demand function. Instead of examining the role of financial on interest, the study ought to have examine how financial innovation affects money demand directly a thing this study did.

King'ori, (2003) studied the determinants of money velocity in Kenya for the period 1992 – 2002 by determining four velocity functions of money as currency in circulation, narrow money, broad money and extended broad money. Using the cointegration and error correction models, the study established long-run relationship and short run dynamics. The results of the study revealed that short run money velocity as highly influenced by financial innovations and the exchange market; while real interest rate had lesser effect. Inflation rate did not have any significant effect on money velocity. The real per capita income had inverse relationship with money velocity. King'ori (2003) though established a long-run relationship and short run dynamics, the study did not explain how the said velocity affects money supply. This study has clearly elaborated how money velocity influences money supply through the money multiplier effect.

Mbiti *et al.* (2012) used Safaricom data to compute *M-pesa* velocity in Kenya. They found that mobile money had a minor systematic effect on monetary policy in Kenya due to the fact that mobile money is sufficiently small. They however argued that this conclusion may change in the future as mobile money progresses to more than a payment platform hence increasing the number and values of mobile money. The above study only *computed M-pesa* velocity in Kenya without explaining how the said velocity affected money market. This study examined the effect of such velocity to money demand and supply in Kenyan economy.

Kasekende and Nikolaidou, (2014) investigated the development of financial innovation and its impact on money demand in the region using panel data estimation techniques for 34 Sub-Saharan Africa countries between 1980 and 2013.They found that mobile money not only has a positive effect on money demand but also leads to a decrease in the interest rate elasticity of demand. The study was done for 34 Sub-Saharan Africa countries between 1980 and

2013.This study specifically concentrated on Kenyan economy only for the period 2008-2016.

Nyalihama, (2011) Using VECM and time series data for the period January 1995 to September 2009 investigated the Determinants of Money Supply in Rwanda. The study found that in short run changes in money supply are outcome of individuals and banks in loans deposit supply process and National Bank of Rwanda had limited power to impose control on money supply via monetary base manipulation while in the long run it had relatively more power. Hence the Post Keynesian endogenous money hypothesis was confirmed in short run but in the long run findings could neither reject nor confirm it. This study improved from that of Nyalihama (2011) since it was able to link financial innovation to money supply. Financial innovation influences money multiplier through means such as cash ratio, reserve ratio, behavior of financial institutions and depositors which in turn affect the money multiplier. Money multiplier finally affects money supply in the economy.

2.4 Theoretical Framework

This study was based on the Keynesian Theory of Demand for Money and Friedman Quantity Theory of Money. Keynes criticized the Cambridge equation because it neglects the role of interest rates in determining the demand for money. He proposed an alternative expression of the demand for money, which he named the liquidity preference. Keynes identified three motives why people demand money, which are transaction motive, precautionary motive and speculative motive. According to the Keynesians, the transaction motive describes the necessity of holding cash to bridge the gap between receipts and planned regular payments. The Keynesians suggested that people also hold some cash for unplanned activities, such as paying unexpected bills, and this is known as the precautionary motive of holding money. The Keynesians suggested that both transaction and precautionary motives depend on the level of income. The last motive of holding money identified by Keynes is the speculative motive, of which individuals demand money if they expect the market value of alternative assets to fall. Hence the speculative motive for holding money arises from the desire to maximize wealth and it depends on the rate of interest (Laidler, 2010). Therefore, Keynes theory is useful in this study since people require money for the above three motives as highlighted. The three motives namely: transaction, precautionary and speculative are the

main factors which influence people in spending money either by use of Mpesa, ATMs or both hence affecting money demand and supply in the economy.

Keynes specified the demand for money as follows:

$$Md = k(Y) + L(r) \quad (2.6)$$

Where: M^d is demand for money, k(Y) is the transaction and the precautionary motive which depends on the level of income (Y), $L(r)$ is the speculative motive which depends on interest rate (r). Keynesians stress that the demand for real money balances is negatively related to interest rates, which implies that the demand for real money balances increases with a decrease in interest rate. However, the demand for real money balances is positively related to real income and demand for real money balance increases with an increase in real income.

Friedman essay, "The Quantity Theory of Money—A Restatement" published in 1956 restated the old quantity theory of money. For a better understanding and appreciation of Friedman's modern quantity theory, it is necessary to state the major assumptions and beliefs of Friedman.

Friedman stated that quantity theory was a theory of demand for money and not a theory of output, income or prices. Secondly, Friedman distinguished between two types of demand for money. In the first type, money is demanded for transaction purposes. It serves as a medium of exchange. This view of money is the same as the old quantity theory. But in the second type, money is demanded because it is considered as an asset. Money is more basic than the medium of exchange. It is a temporary abode of purchasing power and hence an asset or a part of wealth. Friedman treats the demand for money as a part of the wealth theory. Thirdly, Friedman treated the demand for money just like the demand for any durable consumer good. The demand for money depends on three factors :(a) The total wealth to be held in various forms (b) The price or return from these various assets and (c) Tastes and preferences of the asset holders Friedman, (1956).

Friedman considered five different forms in which wealth can be held, namely, money (M), bonds (B), equities (E), physical non-human goods (G) and human capital (H). In a broad sense, total wealth consists of all types of income. By income Friedman means aggregate nominal permanent income which is the average expected yield from wealth during its life time. Wealth holders distribute their total wealth among its various forms so as to maximize

utility from them. They distribute the assets in such a way that the rate at which they can substitute one form of wealth for another is equal to the rate at which they are willing to do. Accordingly, the cost of holding various assets except human capital can be measured by the rate of interest on various assets and the expected change in their prices. Thus Friedman said that there are four factors which determine the demand for money. They are: price level, real income, rate of interest and rate of increase in the price level Friedman, (1956)

In Friedman's modern quantity theory of money, the supply of money is independent of demand for money. Due to the actions of the monetary authorities, the supply of money changes, whereas the demand for money remains more or less stable. It means that the amount of money which people want to have as cash or bank deposits is more or less fixed to their permanent income. If the central bank purchases securities, people who sell securities to the central bank receive money and this leads to an increase in their cash holdings. People will spend this excess money partly on consumer goods and partly by purchasing assets. This spending will reduce their cash balances and at the same time there is a rise in the national income Friedman, (1980).

On the other hand, when the central bank sells securities, the money holding of the people reduces, in relation to their permanent income. Therefore, they will try to increase their cash partly by reducing their consumption and partly by selling their assets. This will reduce national income. Thus in both cases the demand for money remains stable. If demand for money is given, it is possible to predict the effects of changes in the supply of money on expenditure and income. If the economy is at less than full employment level, an increase in the supply of money raises the expenditure, output and employment levels. This is only possible in the short run Friedman, (1980)

2.5 Conceptual Framework

Figure 2.2 below shows a diagrammatic representation of the relationship among the variables. The variables on the left hand side were treated as independent variables which included: volume of *M-pesa* transactions, volume of ATMS transactions, inflation, interest rate, bank rate and GDP. The right hand side variables are Money demand and Money supply which are the dependent variables, whereas those variables in between the dependent and independent variables are the intervening variables namely: Foreign policies, foreign exchange fluctuations, Fiscal policies and politics.

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Volume of *M-pesa* transactions was expected to influence money demand negatively since increase in volume of *M-pesa* transactions would mean that people would be holding more money in cash balances and thus requiring less cash hence demand dropping. This also applies to the increase in the volume of ATMs transactions. Interest rate, inflation, GDP and bank rate are control variables. Interest rate was expected to lead to decline in money demand since investors will not be excited to invest their money in assets but instead will hold them in cash form. High interest rate was expected to lead to decline in money demand and money supply. High bank rate was expected to to make credit accessibility expensive hence discouraging borrowers and as a result increasing money supply. Low bank rate was expected to increase money supply to the economy as a result of increased borrowing. Inflation was expected to have a negative impact on the money demand and supply in the economy. GDP was expected to have a positive influence on both money demand and supply since there would be high money circulation due to improved economy and investments. Foreign policy, politics, and foreign exchange fluctuations are intervening variables. They affect money demand and supply indirectly. Change in foreign policy such as withdrawal of grants would lead to decline in money supply and the same time increasing money demand. A country experiencing political instability due to political competition is likely to have high rate of money supply due to lack of stable government to control money supply through central bank and through money multiplier. This would result in inflation. Foreign exchange fluctuations affect money demand and supply indirectly. Unstable foreign exchange fluctuations discourage investor who become worried in investing in that country. This is because it becomes difficult in predicting the returns on investments due to fluctuations. This reduces money demand and money supply in the country.

The relationship among the above variables has been demonstrated in the following diagram:

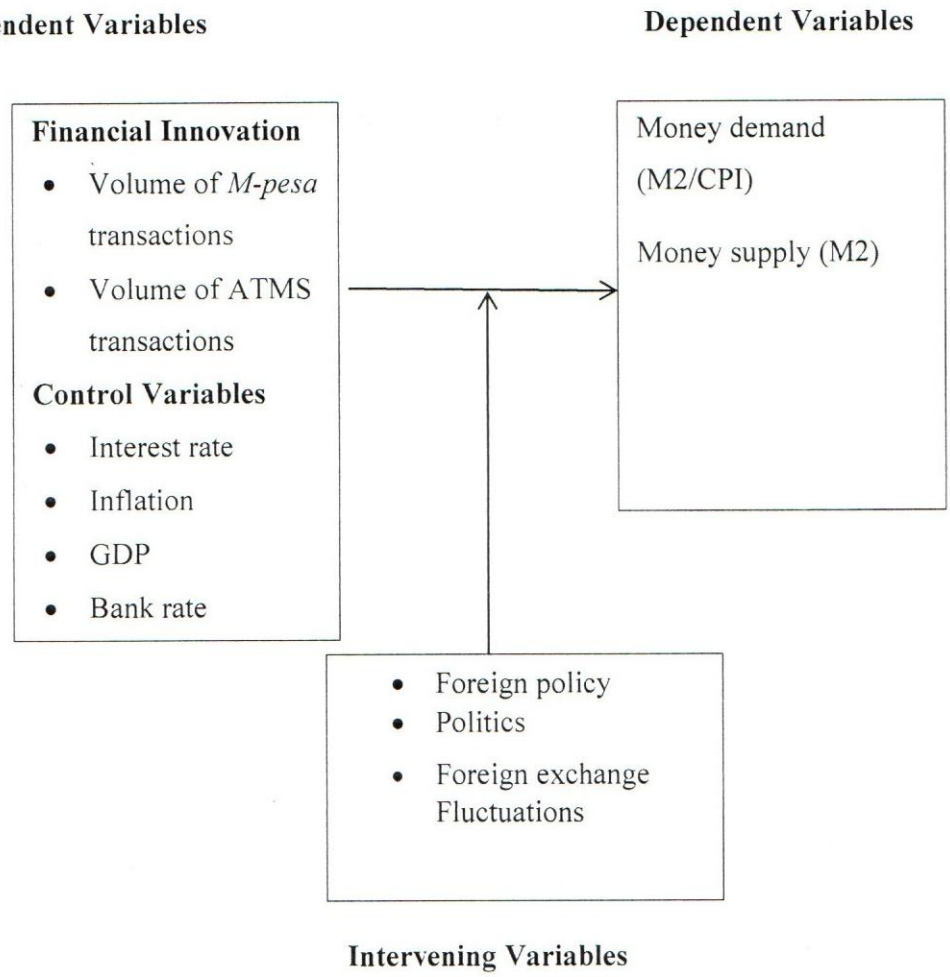

Figure 2.1: Conceptual Framework Showing the Relationship among the Variables

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodological base that was used in this study. Specifically following are addressed: research design, area of study, methods of data collection, data sources, method of analysis and model specification.

3.2. Research Design

The historical research design was adopted for the study. Wiersma (1986) stated that historical research is the type of research design that deals with critical inquiry into past events. This helps to produce an accurate description and interpretation of those events. The study therefore is in agreement with Wiersma (1986) since the concerned data is about past events.

3.3 Study Area

The area of the study was Kenya covering the period of 2008-2016. This time period was chosen based on data availability. *M-pesa* was first introduced in Kenya in 2007 and the first financial report was released in 2008. According to The Master Plan Study for Kenyan Industrial Development (2007), Kenya lies astride the equator in Eastern Africa between Somalia and Tanzania and bordering the Indian Ocean as shown in the figure 3.1 below.

Kenya was of specific interest in this study because it was the first country to introduce mobile money and it has the largest number of mobile money users in the world (World Bank, 2010). Davidson and Pénicaud (2012) worldwide mobile money survey indicates that 80 percent of 2011 mobile money transactions were processed in East Africa. Moreover, Kenya, Uganda, Madagascar and Tanzania have more registered mobile money users than bank accounts. The study was also interested in country specific policies.

Figure 3.1 Map of Kenya

Source: https://www.mapsofworld.com accessed on 10 November 2018.

3.4 Data Analysis and Presentation

Data is quantitative and therefore descriptive and inferential statistic was employed in the analysis. Oso and Onen (2009) explained that inferential analysis is used to draw conclusions concerning the relationships and differences found in research results. The results obtained

were presented in tables. They described tables and figures as useful in presenting findings because they can summarize a lot of information in a small space.

Kothari (2004) explained descriptive statistics to mean a design that describes the state of affairs of phenomenon. He implied that descriptive statistics allows a researcher to observe a phenomenon. Isaac and Michael (1977) stated that a descriptive research systematically describes the facts and characteristics of a given population or area of interest, factually and accurately.

3.5 Model Specification

Vector Error Correction Model

Cointegration regression only considers the long-run linkages between the level series of variables, while the Error Correction Model (ECM) is developed to measure any dynamic adjustments between the first differences of the variables. A simple error correction term is defined by:

$$\varepsilon = y_t - \beta X_t \tag{3.1}$$

Where β is the cointegrating coefficient, and ε_t is the error term from the regression of y_t on x_t Then the Error Correction Model (ECM) is simply defined as:

$$\Delta y_t = \alpha \varepsilon_{t-i} + \gamma \Delta x_t + u_{it} \tag{3.2}$$

Where u_t is *i.i.d.* and the first difference of y_t can be explained the lagged ε_{t-i} and Δx_t. ε_{t-1} is the one period lagged value of the residuals from estimation of equilibrium error term, or in another word, a disequilibrium error term occurred in the previous period. For cointegrated series, the error correction term ε_{t-1} which represents the speed of adjustment toward the long-run values, offers an added explanatory variable to explain the first difference of y_t. The equation above is a single equation of ECM which can be also used in multivariate system. The error correction model (ECM) can be extended to the following equations:

$$\Delta LnMD_t = \beta_0 + \beta_1 \Delta LnMD_{t-i} + \beta_2 \Delta LnMPS_{t-i} + \beta_3 \Delta LnATM_{t-i} + \beta_4 \Delta LnINTER_{t-i} + \beta_5 \Delta LnINFL_{t-i} + + \beta_6 \Delta LnGDP_{t-i} + \beta_7 ECT_{t-i} + u_t \tag{3.3}$$

$$\Delta LnMS_t = \alpha_o + \alpha_1 \Delta LnMS_{t-i} + \alpha_2 \Delta LnMPS_{t-i} + \alpha_3 \Delta LnATM_{t-i} + \alpha_4 \Delta LnBR_{t-i} +$$
$$\alpha_5 \Delta LnINFL_{t-i} + +\alpha_6 \Delta LnGDP_{t-i} + \alpha_7 ECT_{t-i} + u_t \quad (3.4)$$

Equations (3.3) and (3.4) presents the ECM, in which each variable is explained by itself and other variables of concern in the model. Where;

$LnMD_t$ is natural log of real money demand; $LnMS_t$ is natural log of money supply; $LnMPS_t$ is natural log of Volume of *M-pesa* transactions; $LnATM_t$ is natural log of Volume of ATMs transactions; $LnINTER_t$ is natural log of interest rate, $LnINFL_t$ is natural log of inflation, $LnGDP_t$ is natural log of GDP, $LnBR_t$ is natural log of Bank rate, $ECT_{t-i}$is the lagged error correction term departure from the long-run cointegrating relations between these four variables. μ_{it} error terms and (i=1,2...n). β and α are parameter estimates.

3.6 Diagnostic Tests

3.6.1 Unit root Test

A stochastic process is said to be stationary if its mean and variance are constant over time and the covariance between the two time periods depends only on the lag between the two time periods and not the actual time at which the covariance is computed. In order to avoid spurious and inconsistent results, stationarity test is necessary in time series data. Unit root is a widely popular test of stationarity or non-stationarity over the past several years Gujarati and Porter, (2009). The following hypothesis was tested; $H_0 : \delta = 0$ was used to indicate unit root exists (time series is non-stationary) $H_1 : \delta < 0$: time series is stationary. The study adopted Augmented Dickey Fuller test (ADF) in testing for the unit root. ADF test is a reliable option for unit root testing since its results are very good especially in the case of time series with bigger number of observations Dickey, (1979). Data was de-trended by differentiating thus making it stationary.

3.6.2 Johansen Cointegration Test

Cointergration refers to the long-run linear movement of two non-stationary variables integrated on the same order. Cointergartion test establishes whether there are non-stationary variables move together in the long-run. Variables will be cointegrated if they have a long-term or equilibrium relationship between (or among) them. This study applied Johansen-Cointegration test. (Ssekuma, 2011) argued that Johansen procedure builds cointegrated variables directly on the maximum likelihood estimation instead of relying on OLS

estimators and is able to detect more than one cointegrating relationship if present. The number of cointegrating vectors in Johansen procedure were detected by the use of two likelihood ratio tests namely; the trace test and the maximum eigenvalue.

Cointegration portrays long-run association among variables. The nature of the equation plays a role in testing for cointegration in a single equation. Johansen approach was utilized as it shows the number of co-integrating equation in a system.

The starting point of the Johansen's method in a VECM model of order p is given by;

$$Yt = \mu + A1Yt - 1 \ldots + ApYt - p + \varepsilon t \quad (3.5)$$

Where Y_t is an $n\chi 1$ vector of variables that are integrated of order one I (1) and is a vector of innovations.

The Trace and the Maximum Eigen values tests under the Johansen method are shown in equation 3.5 and 3.6 respectively.

$$J_{trace} = -T \sum_{i-r+1}^{n} Ln\ (1 - \lambda i) \quad (3.6)$$

$$J_{max} = -T\ (Ln - \lambda i\ ) \quad (3.7)$$

Where T is the sample size and λi is the *ith* largest canonical correlation. The trace test tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of n co-integrating vectors. The maximum eigenvalue test, on the other hand, tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of co-integrating vectors.

3.6.5 Post Estimation Diagnostic Tests

3.6.5.1 Test for Autocorrelation

Autocorrelation or serial correlation refers to the case in which the error term in one-time period is correlated with the error term in any other time period. Classical linear regression assumes that such correlation does not exist. As a result of a crucial limitation of Durbin-Watson (DW) statistic, that it becomes invalid when applied to a regression equation which includes a lagged dependent variable among its regressors and cannot test for higher order autocorrelation, the Breusch-Godfrey (LM) test was employed. The null hypothesis states that there is no autocorrelation of error terms of different time periods. The alternative hypothesis states that there is autocorrelation of error terms of different time periods. Problem of autocorrelation was corrected by use of the general linear squares (GLS).

3.6.5.2 Test for Heteroscedasticity

Heteroscedasticity occurs when the variance of the error term is not constant. The problem can be due to measurement errors. Though heteroscedasticity does not lead to biased parameter estimates, it can cause standard errors to be biased resulting to biasness in test statistics and confidence interval. This study employed Modified Wald test for Heteroscedasticity Test.

3.6.5.3 Test for Multicollinearity

Multicollinearity refers to a case in which two or more explanatory variables in the regression model are highly correlated making it difficult to isolate their individual effects on the dependent variable. Variance Inflation Factor (VIF) was used in detecting multicollinearity. Gujarati and Porter, (2009) argued that the rule of thumb is that if Variance Inflation Factor (VIF) exceeds 10, that variable is said to be highly collinear.

3.6.4 Justification of the Variables, Measurement and Sources of Data

This study used secondary data, collected from Central bank of Kenya, Kenya National Bureau of Statistics, Safaricom and World Bank. These institutions are the major sources of information concerning most data of interest in this study.

3.6.4.1 Money Demand (MD)

The real money demand was computed by dividing the nominal money demand (M2) with average prices (CPI). M2/CPI was used as a measure of money demand because a broader measure of money is more appropriate for modeling purposes because it is less distorted by financial deregulation and innovations and has a more reliable relationship with income (Subbaraman, 1993). Data was obtained from the World Bank.

3.6.4.2 Money Supply (MS)

This study adopted broad money definition which according to World Bank (2013) is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper M2. Data was obtained from the World Bank.

3.6.4.3 Volume of *M-pesa* Transactions

The variable *M-pesa* was used based on the fact that a large percent of Kenyans is using it as a means of banking hence influencing money demand and supply in the economy. *M-pesa* users in April 2011 reached 14 million (40 percent of Kenya's population) and mobile phone-based transfers were equivalent to 11 percent of GDP (The Economist, June 2010). Data was obtained from Safaricom.

3.6.4.4 Volume of ATMs Transactions

ATMs facilitate the access to money since a person can deposit or withdraw money at any time without being restricted. This influences the amount money demand and supply in the economy. Sichei and Kamau (2012) captured the effect of financial innovation on money demand using the number of ATMs as a proxy for financial innovation. Many Kenyans have adopted ATMs as a means of making transactions. Data was collected from Central Bank.

3.6.4.5 Interest Rate

The interest rate indicates the rate at which people borrow money from the commercial bank. Interest rate was used in money demand since it influences money demand. The demand for money is mainly influenced by the level of prices, the level of interest rates, and the level of real national output (real GDP) and the pace of financial innovation Mankiw (1999). Data was obtained from World Bank.

3.6.4.6 Bank rate

Bank rate essentially is the interest rate at which commercial banks in borrow money from the central bank. Central Bank uses Bank rate in controlling the amount money supply in the economy. Data was obtained from the CBK.

3.6.4.7 Inflation

Consumer price index (CPI) –annual % was adopted as a measure of inflation in Kenya. According to Patnaik (2010) CPI is a statistical time-series measure of a weighted average of prices of a specified set of goods and services purchased by consumers. It is a price index that tracks the prices of a specified basket of consumer goods and services, providing a measure of inflation. Data was obtained from Central Bank.

3.6.4.8 Gross Domestic Product

Gross Domestic Product measures the final value of goods and services produced in a country within a year. The study used GDP as a proxy for income, income is considered as a scale variable in the specification of the money demand equation. Bilyk, (2006) empirical evidence indicated a positive effect of income on the demand for money function in Ukraine. Data was obtained from Kenya National Bureau of Statistics.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter reports the study findings by presenting the descriptive statistics and correlation of the variables to provide the general characteristics of the variables in terms of mean, range, standard deviation and the correlation between variables. Time series data diagnostic tests are also carried out to check on the stationarity and cointergration of the variables. The regression analysis of time series data using Vector error correction model was applied.

4.2 Descriptive Statistics

Table 4.1 below represents descriptive statistics of selected variables. The following statistics were generated namely mean, minimum, maximum and standard deviation.

Table 4.1: Descriptive Statistic of Selected Variables.

	lnmd	lnms	Lnmps	lnatm	lninter	lnbr	lninfl	Lngdp
Valid	9	9	9	9	9	9	9	9
Mean	1.57	3.69	2.66	7.19	2.79	2.26	1.98	8.20
Minimum	0.32	3.59	1.08	5.01	2.61	1.79	1.16	7.93
Maximum	2.38	3.77	4.51	8.2	3.00	2.83	2.89	8.89
Standard Deviation	0.60	0.64	1.08	1.25	0.143	0.30	0.56	0.28

Where;

LnMD = natural log of Money demand

LnMS = natural log of Money supply

LnMPS = natural log of Volume of *M-pesa* Transactions

LnATM = natural log of Volume of ATM Transactions

LnINTER = natural log of Interest rate

LnBR = natural log of Bank rate

LnINFL = natural log of Inflation

LnGDP = natural log of Gross domestic product

The results show that volume of *M-pesa* transactions and Volume of ATMs transactions have relatively larger variation compared to the other variables. Volume of *M-pesa* transactions ranges between 1.08 and 4.51 while volume of ATMs transactions ranges from 5.01 and 8.2. This means that volume of *M-pesa* Transactions has relatively high volatility compared to other variables hence most likely to affect both money demand and money supply. This may be attributed to easy access to money either through mobile phones hence increasing money demand and supply in the economy.

On the other hand, results from the table shows that volume of ATMs transactions has relatively high volatility. This may be attributed to the facts that money is accessible through ATM cards without any restrictions. An individual can access money from the bank at any time and any place as long as there is ATM machine.

4.3 Correlation Matrix

Table 4.2: Correlation Matrix Showing the relationship between the Dependent Variables and the Independent Variables.

	lnmd	lnms	lnmps	lnatm	lnintr	lnbr	lninf	lngpd
LnMD	1							
LnMS	0.59**	1						
LnMPS	-0.50*	0.58*	1					
LnATM	0.02*	0.20*	-0.59	1				
LnINTR	-0.38*	0.39**	0.22	0.77	1			
LnBR	-0.34*	0.33**	0.37	-0.20	-0.50**	1		
LnINFL	-0.06*	-0.19*	-0.21	-0.09	-0.17	0.49	1	
LnGDP	0.38*	0.20**	0.91	-0.77	0.06	0.22	0.17	1

Where:

Key:

** = **Significant at 10% Significance level (2-tailed)**

* = **Significant at 5% Significance level (2-tailed)**

From Table 4.2 above, Lnintr has weak negative correlation of 0.38 with LnMD at 5% significance level. As the interest rate decreases, money demand increases and vice versa. If interest rates are low, bond prices will rise. When bond prices are high, financial investors

will become concerned that bond prices might fall hence keeping their wealth inform of cash. That suggests that high bond prices and low interest rates would increase the quantity of money held for speculative purposes. Conversely, if bond prices are relatively low, it is likely that fewer financial investors will expect them to fall still further. They will hold smaller speculative balances. Therefore, it expected that the quantity of money demanded for speculative reasons will vary negatively with the interest rate.

LnBR and LnMS have a weak negative correlation of -0.33 significance at 5% significance level. This means that as Bank rate increases, money supply also increase in the economy and vice versa. Increase in bank rate leads to an increase in the interest paid by commercial banks to the central bank. This leads to an increase in interest rate charged by commercial banks to individuals hence lowering money supply in the economy.

LnINFL has weak negative correlation of -0.06 and -0.19 with LnMD and LnMS at 5% significance level respectively. This shows that as inflation increases both money demand and supply also decrease and vice versa. This is attributed to government activities in trying to control inflation in the economy hence reducing amount of money in circulation.

LnGDP has weak positive correlation of 0.38 and 0.20 with LnMD and LnMS at 5% significance level respectively. This shows that as gross domestic product both money demand and supply also increases. This is due improvement in country's GDP hence leading to increase in national income. Increase in national income makes the economy stable hence leading to an increase government spending and subsequent increase in money demand and supply.

LnMPS exhibits a strong negative and positive correlation with both LnMD and LnMD having correlation coefficient of 0.50 and 0.58 respectively. The correlation is statistically significance at 5% significance level. This implies that as volume of *M-pesa* transactions increase, money demand decrease while money supply in the money market increase. This is attributed to easy access to credits and liquid cash through mobile phones. There exists a weak correlation of 0.02 between LnATM and LnMD which is significance at 5% significance level. This means that as volume of ATM transactions increase, money demand also increases. This is due to reduction in transaction cost with reduced travel distance and waiting time. Thus individuals in country will have to desire to keep money in cash since

they can get any time the need arises through ATM cards. On the other hand, positive weak correlation of 0.20 between LnATM and LnMS significance at 5% significance level means that as volume of ATM transaction increase, money supply also increases. Increase in volume of ATM transactions leads to increase in Money supply due to increased money flow in the economy.

4.4 Econometric Tests

4.4.1 Unit root Test

Stationarity in this study was tested using the Augmented Dickey-Fuller (ADF) test by Dickey and Fuller (1979). The two hypotheses used in conjunction with these tests are reflected as H_0 and H_1 representing the null and alternative hypotheses, respectively.

H_0: Unit Root (non-stationary)

H_1: No unit root (stationary)

The Augmented Dickey Fuller stationarity test was conducted in the model using the equation with a constant and a trend and the results presented in the table 4.3 and 4.4 respectively.

Table 4.3 The Augmented Dickey Fuller (ADF) Test Results

Variable	T-statistics	Critical values (5%)	P-value
LnMD	-4.770	-3.7500	0.0001
LnMS	-2.4350	-3.0000	0.0022
LnAMPS	-0.6490	-3.7500	0.8594
LnATM	-0.3380	-3.7500	0.9200
LnINTER	-2.7980	-3.7500	0.0586
LnBR	-2.3960	-3.7500	0.1428
LnINFL	-5.1110	-3.7500	0.0000
LnGDP	1.3920	-3.7500	0.9971

Table 4.4 The Augmented Dickey Fuller (ADF) Test Results in First Difference

Variable	t-Statistics	Critical Values (5%)	P-Value	Order of integration
ΔLnMD	11.4600	-3.7500	0.0000	I(1)
ΔLnMPS	3.2950	-3.7500	0.0000	I(1)
ΔLnATM	7.7100	-3.7500	0.0000	I(1)
ΔLnINTER	-4.3800	-3.7500	0.0000	I(1)
ΔLnBR	5.5189	-3.7500	0.0000	I(1)
ΔLnGDP	-1.7270	-3.7500	0.0000	I(1)

From Table 4.3, only LnMD LnMS and LnINFL were found to be stationary at 5% significance level. The remaining variables LnMS, LnMPS, LnATM, LnINTER, LnBR and LnGDP were all non-stationary. They were to be differentiated once to remove unit root after which they were tested again and found to be stationary at 5% significance level as shown in Table 4.4.

4.4.2 Johansen Cointegration Test

Variables LnMPS, LnATM, LnINTER, LnBR and LnGDP were found to be non-stationary when subjected to unit root test and any estimation done using them would suffer the problem of spurious results. Therefore, data was subjected to cointergration test for assessment of the suitability of the selected estimation methods. The goal of cointergration test was to establish whether two or more non-stationary variables moved together in the long-run. Since only two variables were found to be stationary, all other variables (LnMS, LnMPS, LnATM, LnINTER, LnBR and LnGDP) which exhibited non-stationarity properties were subjected to cointergration test using Johansen cointergration test. (Ssekuma, 2011) argued that Johansen procedure builds cointegrated variables directly on the maximum likelihood estimation instead of relying on OLS estimators and is able to detect more than one cointegrating relationship if present. The number of cointegrating vectors in Johansen procedure were detected by the use of two likelihood ratio tests namely; the trace test and the maximum eigenvalue.

The test for cointegration implemented in vecrank was based on Johansen's method. If the log likelihood of the unconstrained model that includes the cointegrating equations is significantly different from the log likelihood of the constrained model that does not include the cointegrating equations, we reject the null hypothesis of no cointegration. The results were presented in the table 4.5.

Table 4.5 Unrestricted Cointegration Rank Test (Trace)

Max rank	Eigen Value	Trace Statistic	Critical value
0	-	63.3465	29.68
1	0.9973	21.8474	15.41
2	0.9465	1.3580*	3.76
3	0.1763		

Table 4.5 presents the findings of cointegration tests under the assumption that the underlying trends are of a deterministic nature. In order to assess the sensitivity of cointegration analysis to the alternative specification of the trend parameter, especially, given that unit root tests provide supporting evidence of plausible stochastic trends, the sample series cointegration test was also performed. This was under the assumption that the underlying trends in the variables are of stochastic nature. The qualitative outcome of the cointegration analysis remained the same and did not hinge on the choice of the trend parameter. From table 4.5, when R=0 Trace statistics is 63.3465 which is greater that critical value of 29.68. When R=1, Trace statistics is 21.8474 which is greater than critical value of 15.41 and therefore rejecting the null hypothesis of no cointegration at 5% significance level. Conclusion was that there was no longer a long-run relationship among the dependent variables (LnMD, LnMS) and the non-stationary variables (LnMPS, LnATM, LnINTER, LnBR, and LnGDP). An error correction model, which reconciled the long-run relationship with a short-run association was run.

Table 4.6 below presents regression results obtained after subjecting money demand model to a vector error correction process.

Table 4.6 Overall Regression Results of Money Demand Based on VECM.

Variable	Coefficient	Std.Error	T-statistics	P-value
LnMPS	-0.2130	0.0796	-2.6759	0.0000
LnATM	1.5534	0.7499	2.0715	0.0010
LnINTER	-0.7918	0.2978	-2.6600	0.0000
LnGDP	0.0140	0.0071	1.9618	0.0021
Breausch-Godfrey	AR (1) process: Chi-Squared = 7.00			
LM test of autocorrelation:	Prob > Chi-Squared = 0.0082			
	AR (2) process: Chi-Squared = 0.358			
	Prob > Chi-Squared = 0.8042			
Modified Wald test				
for Heteroscedasticity:	Chi-Squared (1) =1.29			
	Prob> Chi-Squared = 0.000			
Variance Inflation Factor (VIF) Test				
for Multicollinearity:	Mean VIF= 2.52			
	R-Squared = 0.6875			

4.5 Regression Results and Discussion

4.5.1 Volume of *M-pesa* Transactions and Money Demand

From Table 4.6, Coefficient of volume of *M-pesa* transactions is -0.2130 and statistically significant at 1% significance level. A unit decline in volume of *M-pesa* transactions leads to 0.2130% decrease in money demand. Volume of *M-pesa* transactions is inversely proportional to money demand and an increase in volume of *M-pesa* transactions subsequently leads to a decline in money demand. *M-pesa* encourages people to feel safe about keeping funds in their *M-pesa* accounts for fairly extended periods of time. Mobile money also affords an easy and cost friendly means of moving money. This explains a decline in money demand every time there is an increase in volume of *M-pesa* transactions.

M-pesa transactions increase cash in circulation and hence individuals move away from holding money in form of liquid assets (M1) into to less liquid assets (M2 or M3) and as a result the demand for money is reduced. The findings are in consistent with those of Kasekende and Nikolaidou (2014). The results concur with Keynesian theory of money demand and specifically transactionary demand for money. The transactions demand for money arises from the medium of exchange function of money in making regular payments for goods and services. According to Keynes, it relates to the need of cash for the current transactions of personal and business exchange. It is further divided into income and business motives. The income motive is meant to bridge the interval between the receipt of income and its disbursement.

Similarly, the business motive is meant to bridge the interval between the time of incurring business costs and that of the receipt of the sale proceeds. If the time between the incurring of expenditure and receipt of income is small, less cash will be held by the people for current transactions, and vice versa. There will, however, be changes in the transactions demand for money depending upon the expectations of income recipients and businessmen. It is for the above reason that *M-pesa* has contributed to decline in money demand since people can easily access cash through phone any time a need arises without incurring time and travel expenses.

4.5.2 Volume of ATM Transactions and Money Demand.

Table 4.6 results shows a positive coefficient of 1.5534 of Volume of ATM transactions on money demand at 5% significance level. This is consistence with the expected results since an increase in volume of ATM transactions is expected to lead to an increase in demand for money. A 1% increase in volume of ATM transactions leads to an increase in money demand by 1.5534%. Volume of ATM transactions affect money demand positively and therefore they are directly proportional. Increase in number of ATMs significantly increases the frequency of money demand. ATM transactions affect optimal cash holding in the sense that it reduces waiting and time cost. Therefore, people with ATM cards will be willing to spend money since it readily accessible. This will lead to increase in demand for money in cash balances hence increasing aggregate money demand in the economy. The results contrast those obtained by Kipsang (2003) which found that number of ATM transactions did not have significant effect to the money demand. This could be attributed to the fact that he used

number of ATM transactions as opposed to the volume of ATM transactions.

4.5.3 Interest Rate and Money Demand

Table 4.6 results shows that the coefficient of Interest Rate is -0.7918 for the money demand. The coefficient is statistically significant at 1% significance level. This means that 1% increase in Interest Rate leads to 0.7918% decline in money demand. This is true for the speculative demand for money as highlighted by Keynesian. In the General Theory, Keynes argued that expectations about future bond prices tend to be sticky. A rise in bond prices causes more investors to join the bear brigade and so increases the aggregate demand for money. Speculative demand for money is inversely related to the rate of interest. The higher the rate of Interest, the smaller will be speculative demand for money and vice versa. If market rate of interest is very high and everyone expects it to fall in the future (rise in price of bond) thereby anticipating capital gain from bond holding, people will convert their money into bonds. This will lower speculative demand for money. On the contrary, if the rate of interest is low and people expect it to rise in future (fall in price of bond) anticipating capital loss from bond holding, people convert their bonds into money in order to avoid future capital loss. They hold up money balance thinking that income from non-monetary assets like bond will be low and so the cost of money holding will also be low. Thus, speculative demand for money becomes very high so much so that when the rate of interest declines to minimum, say, 3%, speculative demand for money becomes infinite (perfectly elastic). This pushes the economy into liquidity trap and the speculative demand curve becomes flat. Thus the results are consistent with Keynesian theory of speculative demand for money. The results obtained also concurs with the findings of Mabuku (2009) in which he found that interest rate had negative significant impacts on money demand.

4.5.4 GDP and Money Demand

From the regression results in Table 4.6 the coefficients of GDP in relation to money demand is positive 0.0140 which is statistically significant at 5%significance level. This means that 1% increase in GDP leads to 0.0140% increase in money demand. An increase in real GDP increases incomes throughout the economy. The demand for money in the economy is therefore likely to be greater when real GDP is greater. Transaction demand for money rises with an increase in nominal GDP. Thus if the amount of goods and services produced in the economy rises while prices of all products remain the same, the total GDP will rise and

people will demand more money to make the additional transactions. On the other side if the average prices of goods and services produced in an economy, then even if the economy produces no additional products, people will still demand more money to purchase the higher valued GDP, hence the demand for money to make transactions will rise. The results of this study are in agreement with the findings by Kipsang, (2003). GDP is a key determinant of the money demand in Kenya.

From regression results presented in the Table 4.6, coefficient of determination (R^2) of money demand is 0.6875 which is 68.75%. This means that 68.75 changes in the money demand is accounted for by volume of *M-pesa* transactions, volume of ATM transactions, interest rate, inflation and GDP. The remaining 32.25% changes in money demand is explained by other factors outside the model. The model is good since high percentage of changes is explained by factors in the model.

Breausch-Godfrey LM test of autocorrelation for AR (1) process results presented in the Table 4.6 shows a Chi-Squared of 7.00 and P-value of 0. 0086. Chi-Squared value is greater than P value hence rejecting null hypothesis of no correlation. This confirmed presence of serial correlation. Model was refitted with two lags included as regressors and then Breausch-Godfrey LM test was run after which AR (2) process indicating that the null hypothesis of no autocorrelation is accepted since P-value is greater than Chi-Squared value. A modified Wald test was carried out to test for heteroscedasticity and the results presented in Table 4.6. Robust standard errors model was run before the test was carried to solve for the problem of Heteroscedasticity. The P-value for the modified Wald test is 0.000 which is less than 0.05 implying that the null hypothesis is rejected and therefore the residuals are homoscedastic. Multicollinearity test was done by use of Variance Inflation Factor (VIF). Gujarati and Porter, (2009) argued that the rule of thumb is that if Variance Inflation Factor (VIF) exceeds 10, that variable is said to be highly collinear and vice versa. Table 4.6 shows multicollinarity test results for the model. Mean VIF is 2.52 which is much far from 10. The study therefore found that multicollinearity had reduced since it cannot be fully eliminated

Table 4.7 below presents regression results obtained after subjecting money supply model to a vector error correction process.

Table 4.7 Overall Results Regression of Money Supply Based on VECM.

Variable	Coefficient	Std.Error	T-statistics	P-value
LnMPS	0.0340	0.0183	1.8600	0.0000
LnATM	0.3260	0.1450	2.2483	0.0020
LnBR	-0.2155	0.1231	-1.7506	0.0011
LnGDP	0.3564	0.1093	3.2608	0.0000
Breausch-Godfrey LM test of autocorrelation:	AR (1) process: Chi-Squared = 0.120 Prob > Chi-Squared = 0.7288			
Modified Wald test for Heteroscedasticity:	Chi-Squared (1) =1.83 Prob> Chi-Squared = 0.001			
Variance Inflation Factor (VIF) Test for Multicollinearity:	Mean VIF= 5.85 R-Squared = 0.9960			

4.6 Regression Results and Discussion

4.6.1 Volume of *M-pesa* Transactions and Money Supply

From Table 4.7, Coefficient of volume of *M-pesa* on Money supply is 0.0340 which is statistically significant at 1% significance level. An increase in volume of *M-pesa* transactions by 1% leads to an increase in money supply by 0. 0340%. This shows that Volume of *M-pesa* transaction is directly proportional to money supply which is consistent with the theory of money supply. Financial innovations such as *M-pesa* increases the pace of monetary transactions thus increasing cash in circulation. This leads to increase in transactions velocity hence increase in money supply. However, Mobile money transfer service such as *M-pesa* does not add to money supply growth but only increases the frequency with which the same amount of cash is availed in the market hence increasing the money supply. The results are in consistent with Friedman theory of quantity theory of

money and those findings by Ndung'u, (1999). Increase in Volume of *M-pesa* transactions which is a form of financial innovation will always lead to an increase in money supply in the Kenyan economy.

4.6.2 Volume of ATM Transactions and Money Supply

Table 4.7 presents a positive coefficient of 0.3260 of Volume of ATM transactions on money supply at 5% significance level. A 1% increase in Volume of ATM transactions leads to 0.3260% increase in money supply. The size of the nation's money supply is determined by its central bank. In Kenya, the central bank is responsible in controlling money supply. If all money is in form of currency, the money supply can be expanded if the central bank takes newly minted currency and uses it to buy financial assets from the public or directly form the government itself. To reduce the money supply, the central bank can sell financial assets to the public or the government, taking currency out of circulation. However, in this case, it is the volume of ATM transactions which is determining the money supply in the economy through use of ATM cards. The introduction of automatic teller machines, which allows people to withdraw cash from the bank as needed, makes deposits relatively more convenient. That means people hold less cash and more deposits, reducing the currency-deposit ratio. This causes the money multiplier to increase, which causes the money supply to increase. This is in agreement with the money multiplier theory. While Sichei and Kamau (2012) acknowledged that financial innovations and developments may have impacted on the monetary aggregates and the stability of money demand in Kenya, the study did not include a variable to measure financial innovations and developments. Therefore, this study tried to cover that gap by using volume of ATMs transactions in investigating the role of financial innovation on Money supply. The results obtained are as hypothesized by Sichei and Kamau (2012.

4.6.3 Bank Rate and Money Supply

Results from Table 4.7 shows 0.2155 negative coefficient of bank rate in relation to money supply. The coefficient is statistically significant at 1% significance level.1% increase bank rate will lead to 0.2155% decline in money supply. Bank rate is the rate that central bank charges the commercial bank. An increase in Bank rate means that Central bank is charging high interest rates on commercial banks. Commercial banks reciprocate by increasing the interest rates charged to customers on loans. This leads to decline in money supply in the

economy. Central bank mostly uses this policy when there is high money supply in the economy hence leading to inflation. The central bank raises the Bank rate hence lowering money supply. Therefore, the results obtained in this study are in line with the economic theory. The results are in line with the finding by King'ori (2003) though he found that the rates had little influence on Money velocity. This could be attributed to the fact that the study had adopted number of registered Mpesa and ATMs as proxy of financial innovation as opposed to volume which captures the actual customers who made transactions.

4.6.4 GDP and Money Supply

Lastly, Table 4.7 presents 0.3564 coefficients of GDP in relation to money supply and statistically significant at 5%significance level. This means that a 1% increase in GDP leads to 0.3564% increase in money supply. Increase in a country's GDP leads to an increase in the national income. Improved national income means that government will have more money to spend in development of infrastructure such as roads. This makes more money available to the people hence increasing the money supply. Improved GDP also leads to industries raising wages and salaries of its employees who later uses the money in buying commodities from the market hence reducing money supply. Therefore, the results obtained in this study are in agreement with the theory of money demand and supply. The results obtained are in line with the expectations since an increase in GDP is expected to increase money supply in the economy. They are also consistent with findings by Friedman, (1975).

From Regression results presented in the Table 4.7, Money supply model has coefficient of determination (R^2) of 0.7960 which is 79.6%. This means that 79.6% variations in the money supply is accounted for by volume of *M-pesa* transactions, volume of ATM transactions, bank rate, and GDP. The remaining 0.4% variations in money supply are explained by other factors outside the money supply model. The model is good for estimation since 79.6% of variations is explained by factors in the model while a small percentage of 0.4% variation is explained by other variables outside the model.

Breausch-Godfrey LM test of autocorrelation for AR (1) process presented in Table 4.7 has Chi-Squared of 0.1200 and P-value of 0. 7288. Chi-Squared value is less than P value hence accepting null hypothesis of no autocorrelation. A modified Wald test was carried out to test for heteroscedasticity and the results presented in Table 4.7. Robust standard errors model was run before the test was carried to solve for the problem of Heteroscedasticity. The P-

value for the modified Wald test is 0.001 which is less than 0.05 implying that the null hypothesis is rejected and therefore the residuals are homoscedastic. Multicollinearity test was done by use of Variance Inflation Factor (VIF). Gujarati and Porter, (2009) argued that the rule of thumb is that if Variance Inflation Factor (VIF) exceeds 10, that variable is said to be highly collinear and vice versa. Table 4.7 shows multicollinarity test results for the model. Mean VIF is 5.8500 which is from 10. The study therefore confirmed presence of little multicollinarity since it cannot be fully eliminated.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the study findings contained in the preceding chapters. Based on the findings a number of conclusions are drawn and recommendations made. present conclusions and outlines recommendations based on the findings. Areas for further research are also suggested.

5.2 Summary

The main focus of this study was to establish the effect of financial innovation on money demand and supply in Kenya. The study used volume of *M-pesa* transactions, volume of *M-pesa* transactions, interest rate, bank rate, inflation and GDP in the model for analysis. This study distinguished itself from previous ones by using volume of transactions as opposed to Number of *M-pesa* and ATMs. The study also examined both Money demand and Supply of the economy.

Unit root test was conducted using the augmented Dickey Fuller test. Money supply and inflation in their natural logs were found to be stationary while the rest of the variables non-stationary but became stationary after differencing once. Johansen Cointegration Test was later conducted and the results showed that the variables were cointergrated hence establishing a linear long-run relationship among the variables. Breausch-Godfrey LM test for autocorrelation was carried out and autocorrelations were found for AR (1) process. Multicollinearity test was done by use of Variance Inflation Factor (VIF). Mean VIFs were found to be far below 10 hence proving absence of multicollinearity among variables. Modified Wald test was carried out to test for heteroscedasticity and the result showed that the residuals were homoscedastic.

Regression was run after error correction process using ECM. Results showed that Volume of *M-pesa* transactions which is a form of financial innovation had a coefficient of negative 0.2130 and positive 0.0340 on money demand and supply respectively. It was established that Volume of *M-pesa* transactions was inversely proportional to money demand and an increase in volume of *M-pesa* transactions lead to decline in money demand. Additionally, Volume of *M-pesa* transactions had a direct proportionality to the money supply. Volume of ATM transactions had a positive coefficient 1.5534 and 0.3260 of both money demand and supply.

5.3 Conclusion

This study established that Volume of *M-pesa* Transactions had influence on money demand in the Kenyan economy. The results showed a negative relationship between volume of *M-pesa* transactions and money demand indicating that the people with *M-pesa* accounts are likely not to be interested in holding money in cash since they can easily access money from their phones whenever need arises. This is in agreement with Keynesian argument that people would require money for three motives namely: Speculative, transactionary and precautionary. The same motives remain but people are not worried since they can access money from their phones easily. This reduces the transitionary costs, time cost as well as the transportation cost incurred when travelling to the banking halls. This explains why people are not excited in holding cash balances.

From the results obtained in chapter 4, it is clear Volume of ATM transactions ha a positive relationship with money demand. This means that Increase in volume of ATM transactions increases money demand in the economy. Increase in number of ATMs significantly increases the frequency of money demand.

One of the motive of holding money identified by Keynes is the speculative motive. Individuals demand money in cash balances if they expect the market value of alternative assets to fall. Hence the speculative motive for holding money arises from the desire to maximize wealth and it depends on the rate of interest. Money demand is therefore affected by the interest rate and this affects investments. This could be due to the investor wanting to keep their wealth inform of bonds.

Results showed that GDP had a positive relationship with both money demand. Transaction demand for money rises with an increase in nominal GDP. Thus if the amount of goods and services produced in the economy rises while prices of all products remain the same, the total GDP will rise and people will demand more money to make the additional transactions. On the other side if the average prices of goods and services produced in an economy, then even if the economy produces no additional products, people will still demand more money to purchase the higher valued GDP, hence the demand for money to make transactions will rise.

This study established that Volume of *M-pesa* Transactions had a positive influence on money supply in the Kenyan economy. Financial innovations such as *M-pesa* increases the pace of monetary transactions thus increasing cash in circulation.

Volume of ATM transactions had a positive influence on money supply. This means that an increase in volume of ATM transactions leads increase money supply in the economy. People feel that since they have ATM cards, they can easily withdraw the money whenever the need arises. Thus they are not troubled in carrying huge amount of money in cash form. With the introduction of ATMs, a person can visit a super market and do the shopping without worry. The person just needs to swap the cards and thus making the payments. This explains the reason behind increase in money supply as a result of financial innovation.

The negative relationship between bank rate and money supply is due to the fact that the high the bank rate, the more commercial banks will raise the interest on loans. Increased interest rates by commercial banks discourage people from borrowing loans hence causing decline in the amount of money supply in the economy.

Finally, results showed that GDP had a significant positive relationship with money supply. Increase in a country's GDP leads to an increase in the national income. Improved national income means that government will have more money to spend in development of infrastructure such as roads. This makes more money available to the people hence increasing the money supply. Improved GDP also leads to industries raising wages and salaries of its employees who later uses the money in buying commodities from the market hence increasing money supply.

5.4 Policy Recommendations

Based on the results obtained from this study, it is clear that financial innovation has a great impact on both money demand and supply in Kenyan economy. This is attributed to large number of people with *M-pesa* accounts thus doing huge *M-pesa* transactions and as a result affecting both money demand and supply. The government therefore needs to come up with some policies on how it can regulate the amount transactions through means such as ATMs and *M-pesa*. This will ensure that the money market is not distorted by increased money demand and supply therefore remaining stable.

Kenyan Government should develop policies to regulate money accessibility inform of credits through mobile phones. There should be a standard rate of interest which should be charged to all customers borrowing loans through mobile phones. High interest rate will reduce the number of people borrowing and accessing loans through mobile phones hence reducing money demand in the economy

Government of Kenya should also regulate money the amount of transactions done through the ATMs. This will reduce the demand for money as a result of reduced transactions hence controlling money demand in the economy.

Kenyan government should set a mechanism to regulate money transactions through mobile phones such as *M-pesa* . Reduction in volume of *M-pesa* transactions will reduce the money multiplier subsequently reducing money supply in the economy.

Lastly, Kenyan government should control the issuance of ATMs machines since the study established that an increase in Volume of ATMs transactions increase money supply through the money multiplier. Therefore, the government is supposed to advocate for reduction in the number of ATMs in case of increase in money supply in the economy and increase in number of ATMs transactions in the case of decreased money supply in the economy.

5.5 Areas of Further Research

This study concentrated on the effect of financial innovation on money demand and supply. The study improved from the previous ones since it used the volume of *M-pesa* transactions and volume of ATMs transactions as opposed to earlier studies which had used number *M-pesa* and ATMS respectively as proxy for financial innovation.

However, this study was not able to incorporate other mobile money such as Airtel money, Orange money and Equitel because by the time of the study there was no data available. Therefore, a further research that incorporates Airtel money, Orange money and Equitel needs to be considered in future. This study also studied effect of financial innovation on the aggregate economy. A further study to establish effect of financial innovation on individual persons is also recommended.

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