

**THE EFFECT OF DIGITAL FINANCE ON MONEY DEMAND IN  
KENYA**

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X50/89089/2016**

**A research project submitted to the School of Economics, University of Nairobi in partial  
fulfillment of the requirements for the award of degree of Master of Arts in Economics**

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**DECLARATION**

This research project is my original work and has not been presented for the award of a degree in any other university or institution of higher learning.

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**APPROVAL**

This Research Project has been submitted for examination with my approval as the University Supervisor.

Signature..... Date.....

DR. PETER MURIU

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## **DEDICATION**

I dedicate this Research Project to all my family members and friends who have motivated and encouraged me throughout the entire study period

## **ACKNOWLEDGMENT**

In the course of my study at the University of Nairobi, it has taken the grace of God and his guidance to successfully complete and get this far. Sincere thanks to Dr. Peter Muriu who has devoted his effort to guide and supervise my project.

I acknowledge the support from the entire School of Economics for their support during my study period.

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## **ABSTRACT**

This study was motivated by the increased number of mobile money transactions which has direct implications on money multiplier, financial depth, velocity of money and the conduct of monetary policy in Kenya. The study sought to investigate the effect of digital finance on the demand for money in Kenya. The study utilized time-series data covering the period 2007Q2 to 2018Q4. Estimation results reveals that digital finance negatively influences money demand. Therefore, financial developments have changed the monetary policy landscape in Kenya, with a decrease in the overall proportion of the unbanked population with a combined and sustained gradual decline in the currency circulating outside the banks.

## **LIST OF ABBREVIATIONS AND ACRONYMS**

CBK	Central Bank of Kenya
ADF	Augmented Dickey-Fuller
GDP	Gross Domestic Product
ATM	Automated Teller Machine
KNBS	Kenya National Bureau of Statistics
CPI	Consumer Price Index
T-Bill	Treasury Bill
OLS	Ordinary List Square
QTM	Quantity Theory of Money
WDI	World Development Indicator

## TABLE OF CONTENTS

<b>DECLARATION</b> .....	ii
<b>DEDICATION</b> .....	i
<b>ACKNOWLEDGMENT</b> .....	ii
<b>ABSTRACT</b> .....	iii
<b>LIST OF ABBREVIATIONS AND ACRONYMS</b> .....	iv
<b>LIST OF TABLES</b> .....	vii
<b>LIST OF FIGURES</b> .....	viii
<b>CHAPTER ONE:INTRODUCTION</b> .....	1
1.1 Background of the Study .....	1
1.2 Financial Innovation and Money Demand in Kenya .....	1
1.3 Mobile Banking .....	8
1.4 The Implications of Mobile Banking .....	9
1.5 The Statement of the Problem.....	10
1.6 Objectives of the study.....	11
1.7 Significance of the Study .....	11
1.8 Organization of the Study .....	12
<b>CHAPTER TWO:LITERATURE REVIEW</b> .....	13
2.1 Theoretical Literature.....	13
2.1.1 The Fisher’s Quantity Theory of Money .....	13
2.1.2 The Liquidity Preference Theory .....	14
2.1.3 The Baumol-Tobin Model .....	16
2.1.4 Modern Quantity Theory of Money (QTM) .....	16
2.2 Empirical Literature .....	17
2.3 Overview of Literature.....	22
<b>CHAPTER THREE:METHODOLOGY</b> .....	23
3.1 Introduction.....	23
3.2 Conceptual Framework.....	23
3.3 Model Specification .....	23
3.4 Measurement and Variables Definitions.....	24
3.5 Pre-estimation Tests.....	25
3.5.1 Unit Root Test for Stationary .....	25

3.5.2 Test for Multicollinearity .....	25
3.5.3 Test for Normality.....	26
3.5.4 Test for Autocorrelation.....	26
3.5.5 Test for Heteroscedasticity.....	26
3.6 Data Sources and Collection.....	26
<b>CHAPTER FOUR:EMPIRICAL FINDINGS.....</b>	<b>27</b>
4.0 Introduction.....	27
4.1 Descriptive Statistics.....	27
4.2 Correlation Analysis .....	28
4.3 Pre-estimation Tests.....	28
4.4 Estimation Results .....	31
4.5 Diagnostic Tests.....	32
4.6 Distribution of the Residuals. ....	32
<b>CHAPTER FIVE:CONCLUSION .....</b>	<b>34</b>
5.1 Introduction.....	34
5.2 Summary of the key findings.....	34
5.3 Policy Implications .....	34
5.4 Conclusion .....	34
5.5 Areas for Further Research .....	35
<b>REFERENCES.....</b>	<b>36</b>



## LIST OF TABLES

Table 1: M-Pesa Mobile Transactions in 2007 .....	6
Table 2: Variables, Definitions, Measurement, and Expected Signs.....	25
Table 3: Descriptive Statistics (in million Kenya shillings) .....	27
Table 5: Results of the Augmented Dickey-Fuller Unit Root Test .....	30
Table 6: Estimation Results .....	31
Table 7: Breusch-Godfrey LM test for autocorrelation .....	32
Table 8: Heteroscedasticity.....	32
Table 9: Residual Normality Test.....	33

## **LIST OF FIGURES**

Figure 1: M-Pesa Transactions in 2007 .....	4
Figure 2: Mobile Money Value of Transactions (in Kes Millions) in 2007 .....	5
Figure 3: Monthly M-Pesa Transactions, Accounts and Value from 2007 to 2018 .....	7
Figure 4: Ease of Payment experimented Via School Fees Payment .....	9
Figure 5: Conceptual Framework .....	23

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of the Study

Demand for money can be described by how much wealth an individual is willing and able to hold as money at any one given point. The concept has further been explained by different economic viewpoints. The widely recognized ones being the Keynesian Liquidity Preference Theory on demand for Money and the popular Classical Approach to Money demand. The principles of Classical Economics and the demand for money is mainly contained in the Irving Fishers Quantity theory. The Proponents of the classical thought believed that transactions create demand for money. Money does not have inherent utility but its demand arises from the need to transact. This school emphasizes on the money as a medium of exchange. They simplify this definition through the equation of exchange. The Keynesian view can be explained as a reinforcement of Irving fisher's understanding of money demand. According to Keynes, the objective of holding money is either to transact, speculate or for precautionary reasons. These reasons are determined further by the proportions of income dedicated to each. According to Judd and Scadding (1982), the importance and the significance of the concept of demand for money is a phenomenal one. It carries a greater weight in evaluating the causes of a shift of demand for money function and why such fluctuations endanger the economy's macroeconomic stability. A stable demand, therefore, is what matters to monetary policymakers. When the regulator is looking at the regulation of the money supply, it must examine the predictability of the demand function in order to establish targets that are stable. This cannot be effective and efficient in the absence of a stable demand function.

### 1.2 Financial Innovation and Money Demand in Kenya

According to Błach (2011), the role of financial innovation is undisputable and encompasses new processes of converting financial challenges into opportunities. His view is that financial innovation not only improves the transfer of monetary resources but also facilitate risk reduction, improves competitiveness in the financial industry and contributes to the improved financial returns. The definition of this financial term is therefore wide and no single definition is universal. Blach (2011) underlines what a robust financial innovation would mean to a modern-

day model of doing business transactions by pointing on the possibilities that would otherwise slow the flow of funds, foreign exchange earnings, transfers and distribution of resources that arises from benefits of financial innovation if such innovation were not in present-day economies.

According to Aspara, et al., (2012), dynamism in the financial sector is a source of critical inquiry. Major shifts and reorganization of the financial sector have been experienced, a great transformation has been realized on the account of changes in regulations as well as digitalization and globalization. Such changes have extremely enlarged the scope of attention and expanded the experience of different customers and the financial industry-shifting them from the use of technology only as a mere factor that facilitates procedures internally to becoming a key constituent popular in completing transactions. Therefore, an economy where technology enhancement has sieved through the financial markets and institution in form of innovation, facilitating transfers and becoming a major support factor in the exchange of money, it becomes necessary such innovation drives money demand in the Kenyan economy.

According to Shirakawa (2011), financial innovation has been a continuous process. More advanced innovations are still being revealed and successfully we have witnessed a significant replacement of the bank teller by Automated Teller Machines (ATM) and the introduction of magnetic chipped plastic cards, have become increasingly preferable to cash. However, in Kenya financial innovation has not stopped with the use of ATMs and plastic cards. Instead, Kenya stands out as a leader in the use of digital money through its own innovation of M-Pesa. As more people tend to prefer using M-Pesa in both transactions, saving and lending, the effect on money demand may be positive or negative.

The description of financial innovation is wide and no single word can be concluded to have covered the scope of innovation particularly from financial perspective. However, the meaning always converges to creating new financial technologies, financial instruments or tools that facilitate the functioning of financial markets and institutions. From this basis, Tufano (2003) observes financial innovation products as new financial tools while innovations in the financial processes comprise the innovative ways of financial products' distributing, pricing or executing the transactions. Innovations in finance, therefore, encompass the creation of new services, new products and formulation of new processes of production and new organizational procedures

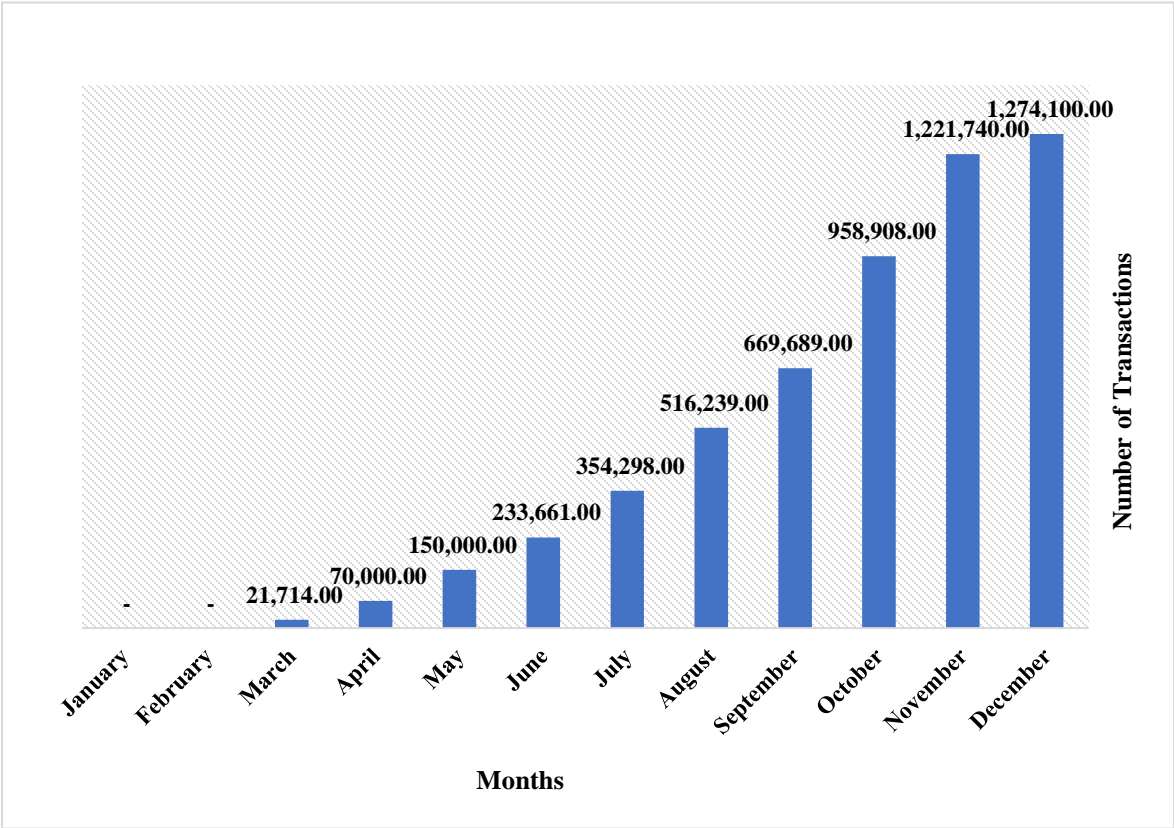
according to Frame and White (2014). These notable systems of innovations are seen to be major contributors to the acceleration money channels in the Kenyan economy.

Similar to Lerner and Tufano's (2011) study findings, it is vital to note that financial innovations that are consistently part of the daily operations of the financial sector in the Kenyan economy especially in digital finance have placed Kenya in the heart of global attention and sparked massive intellectual inquisitiveness in the research world. So as to appreciate these gains and advancements the outcome of this study proper consideration. Remarkably, although substantial studies in the financial innovations field have been conducted. Several studies have targeted the products of financial innovations in countries that are developed (Lerner and Tufano, 2011). As a result, financial innovations that have emerging and widely used in countries that are developing in general particularly in Kenya have been given wide neglect. In contrast, wherever they are studied, the weight has been put on coming up with descriptive statistics which cannot provide a qualitative relationship between digital finance and money demand.

Many developing countries are in the search of crucial avenues that create value and improve productivity towards the national income. Part of these efforts to grow the economy has been drafting policies that encourage innovation, boost the growth of productive skills and improve value addition as well as enhance aggregate demand. Mobile transfers have been lauded as one of the common ways of transferring money over a mobile network, creating demand for money and improving demand for goods services. Kenya for the last 10 years has experienced significant growth in financial innovation, especially in mobile transfers. An example of financial innovations in Kenya is the introduction of M-Pesa transfers in Kenya that is credited to one publicly owned company; Safaricom Limited. M-Pesa was first introduced in 2007 as an innovative method payment and a channel of money transfer. The service involves registration at an M-Pesa registered Agent for customers using the Safaricom Kenya Limited Mobile network lines with a national identity card or any other legally-recognized method of identification such as the use of an alien card, military identification card or a passport. After registration, one can follow simple instructions on the transfer of money through the mobile network and one registered user to another in a different geographical location through the mobile network. Further, the technology supports withdrawal and deposits of money at M-Pesa registered agents and at designated ATMs points, payment of goods and services through short message technology and finally payment for utility bills. Today this financial stride remains the largest

financial innovation or method of digital finance in Kenya and East Africa. This significant stride towards financial innovation-based solutions to money transfer has contributed to a wide range of recognition. This is the case in the Kenyan financial segment and also in the world at large (Gikunda, Abura, and Njeru, 2014).

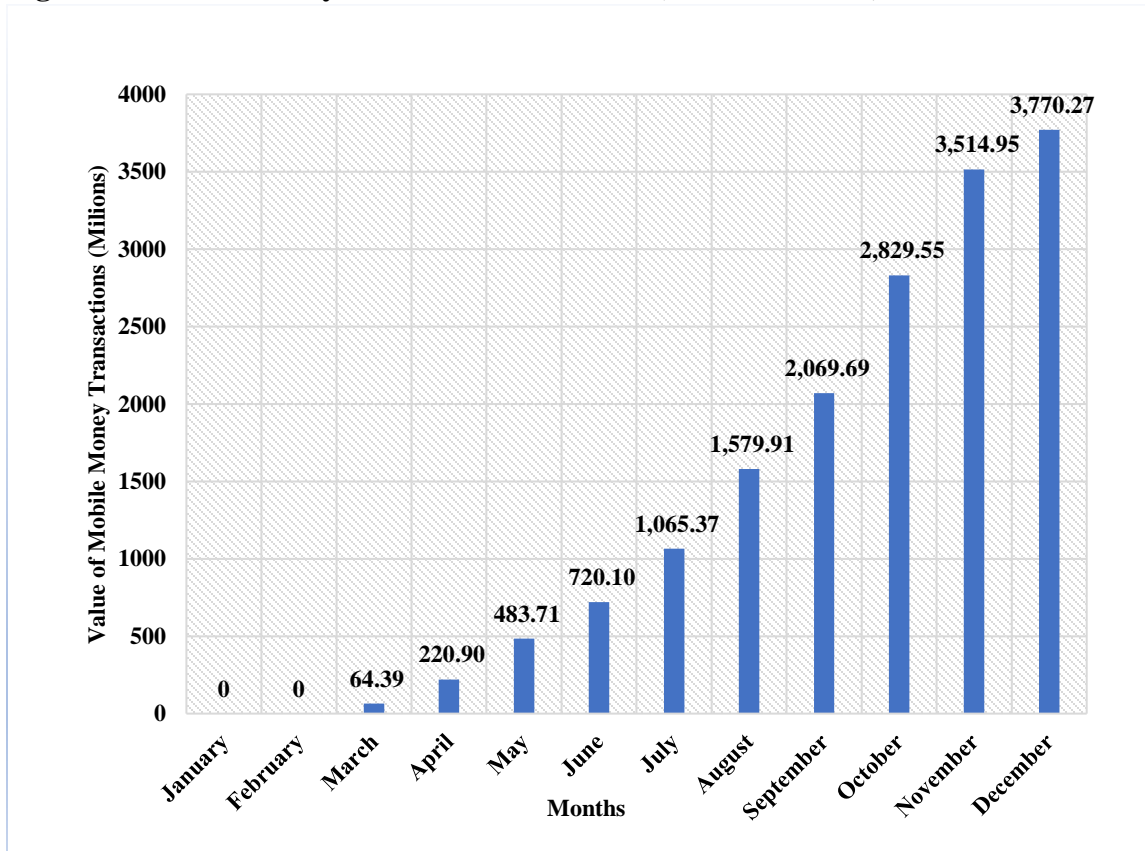
**Figure 1: M-Pesa Transactions in 2007**



Source: Central Bank of Kenya (2019)

Figure 1 demonstrates a significant growth of M-Pesa transactions in the first 10 months following its launch. It indicates a growing demand for mobile money and an increased volume of transactions directly linked to mobile money. From the trend line, one can deduce that M-Pesa was the financial solution in the financial sector that was missing in the previous years.

**Figure 2: Mobile Money Value of Transactions (in Kes Millions) in 2007**



Source: Central Bank of Kenya (2019)

Figure 2 illustrates the value of M-Pesa transactions in 2007 alone. On its introduction, the value of the transaction via M-Pesa records a monthly visible incremental trend. From the demand for money point of view, every transaction creates demand for money according to Keynes and Irving Fisher. This has a direct influence on the aggregate demand and the economy's GDP. With an increase in income, the ability to transact increases and therefore the transaction demand for money increases leading to advancement growth in national productivity to meet the demand (Central Bank of Kenya, 2019).

**Table 1: M-Pesa Mobile Transactions in 2007**

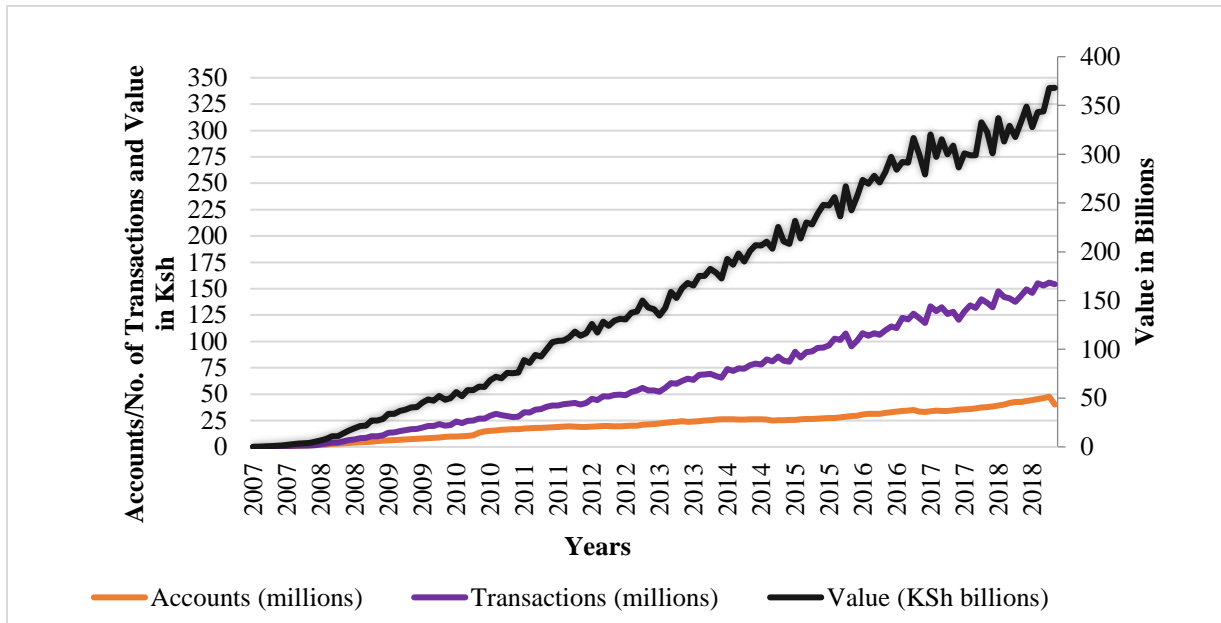
<b>Year</b>	<b>Month</b>	<b>Agents</b>	<b>Accounts (Millions)</b>	<b>Transactions (Millions)</b>	<b>Value (Billions)</b>
2007	March	307	0.020992	0.021714	0.0643905
2007	April	362	0.054944	0.07	0.220896
2007	May	447	0.107733	0.15	0.483709
2007	June	527	0.175652	0.233661	0.720102
2007	July	681	0.268499	0.354298	1.06537
2007	August	819	0.432555	0.516239	1.57991
2007	September	960	0.635761	0.669689	2.06969
2007	October	1196	0.875962	0.958908	2.82955
2007	November	1379	1.1332	1.22174	3.51495
2007	December	1582	1.34527	1.2741	3.77027
<b>Total</b>			<b>5.050568</b>	<b>5.470349</b>	<b>16.3188375</b>

Source: Central Bank of Kenya, 2018

The first year of introduction saw a registration of 1582 M-Pesa agents throughout the country. This translated to 5.05million M-Pesa accounts opened in the same year. From 2007, nearly 5.47 million transactions were carried out in 10 months following the launch with the value of transactions rising every month to a total of Ksh16.31Billions in its first year of introduction.



**Figure 3: Monthly M-Pesa Transactions, Accounts and Value from 2007 to 2018**



Source: Central Bank of Kenya (2019)

Figure 3 illustrates a consistent rising trend from 2007 to 2018 in the mobile money transactions, the number of the accounts opened and the value of transactions made since the launch of now largest and widely adopted telecommunication supported transfers on the virtual M-Pesa platform. This trend suggests that as the population grows, demand for money increases, triggering growth in transactions and therefore transactions via M-Pesa. From figure 3 therefore, we can conclude that every single month since inception from 2007 to 2018, the number of subscribers has been increasing (Central Bank of Kenya, 2019)

From March 2017 to March 2018, cash transacted through mobile money rose to a historic sh3.7 trillion. The central bank of Kenya attributes this growth to increased uptake of mobile loans. Similarly, this period reports a significant rise in annual value for mobile money growth that has never been reported in previous years which is Ksh 219 billion. Although two main mobile network operators facilitate these transactions, Safaricom controls more than 75% of these mobile money transactions (Jack, Ray and Suri, 2013).

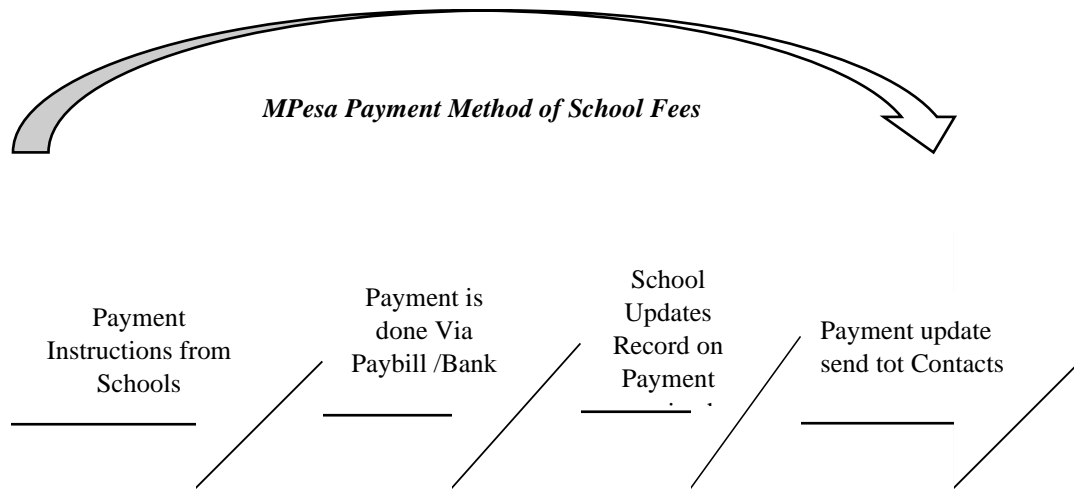
### **1.3 Mobile Banking**

The history of M-Pesa in Kenya is very important in defining various stages of mobile banking in Kenya. Although during the adoption of this messaged based money transfer mobile banking was uncommon, annual increases in the number of registered customers on mobile have initiated significant strategies in the banking industry based on transfers from account holders to M-Pesa registered customers. Additionally, a partnership of the largest mobile network (Safaricom) and major banks (CBA and KCB) has seen the creation of though expensive mobile loans like M-Shwari but convenient short-term loans (Micheni, Lule and Muketha, 2013).

The foundation of M-shwari can be traced back to a Swahili word meaning “make things smooth or good”. The letter M is coined to mean a mobile product that got a node since its launch through a joint partnership by one of the active Kenyan banks; Commercial Bank of Kenya and Safaricom Plc in November 2012. The product allows Kenyans to withdrawal and deposits money to savings in a virtual mobile account for no transaction fees. The customers can also access loans via M-shwari based on their savings for a period of not more than one month. Interests of 7.5% on these loans are paid on a monthly basis. The introduction of M-shwari also motivated the creation of the KCB M-Pesa account which is a mobile-based account offering loans at significantly low interest of 1.08% per month and a one-off negotiation fee of 2.5%. The product also offers interest income at 6.5% annually for customers with a fixed savings plan (Cook and McKay, 2015).

According to Cook and McKay (2015), while the objective of mobile banking is to create flexibility on the part of the customers by accessing banking products through their phones, mobile money and mobile banking has significantly increased demand for products due to its capability to allow customers to pay for goods via their mobile phones, withdraw money from their bank accounts or financial institutions, access loans through their phones and facilitate transfer of funds from one individual to another individual, and from different geographical locations or regions.

**Figure 4: Ease of Payment experimented Via School Fees Payment**



**Source: Financial Services Deeping Report, 2019**

### **1.4 The Implications of Mobile Banking**

The increased use of mobile money can be attributed to the security and the convenience of transacting from anywhere and anytime. Further, it aids in the distribution of income. A report compiled by the Kenya Financial Sector Stability Report in 2019, reveals a significant improvement in the level of financial deepening and inclusion that is supported by the collective and an increasing number of mobile money subscribers. In Kenya, nearly three out of every four people (75%) are reported to have owned a network supported sim card and a mobile M-Pesa account by 2017. In 2017, the value of transactions via mobile money network increased from 35 million in 2016 to 37.4million in 2017 translating to 8% growth in 2017 compared to 19% in 2016. In the same year, 18% of adult mobile owners reported having borrowed from mobile loan providers giving an indication that demand for digital loans is on the rise especially for the low-income borrower’s cohort. This convenient access to digital loans is reported to have increased payment ability for education by 5% according to Financial Sector Deepening (2019).

The use of mobile banking gives an increasing trend since its first year following its adoption. It presents a financial innovation that is widely adopted and majorly used for the following main reasons; for mobile banking (M-shwari, savings, deposits, loan requests), payment; through Lipa na M-Pesa payment service, payment for utility bills and mobile money transfers. Its growing number of subscribers presents a challenge for the monetary policymakers in the role of inflation

control, stabilizing the demand for money and regulation of payment systems and money transfers (Central Bank of Kenya, 2019).

### **1.5 The Statement of the Problem**

Monetary policymakers use monetary aggregates to settle on the most suitable targets for the economy with the objective of establishing an economy that is free of distress, less of a high inflation rate and which guarantees general stability in terms of macroeconomic policies. So that these objectives are achieved, the status of the demand for money function must be put into consideration (Adewele, 2012). From a monetary policy perspective, the interaction between and consequential equilibrium of money demand and money supply is useful in determining the level of equilibrium interest rates in a free financial market scenario. This in effect is critical input in the formulation of monetary policies. Such policies should incorporate predictability and promote stability of demand for money function. This stability is meant to fix some major monetary aggregates and promote the ability to withstand both internal and external shocks. It is therefore imperative to study the significance of stability of money demand.

Many studies have been done in the area of financial innovation and the demand for money. Some of these are; Rao and Kumar (2009); Andersen (1985), Gbadebo (2010), Buckley and Malady (2015), Villasenor, Darrell and Lewis (2015). Most of these studies seem to be biased towards the supply-side and ignoring the money demand side which is also influenced by financial innovation. Further, others have used Automated Teller Machines as a measure of financial innovation. There is no conclusive study on digital money and the effects of digital money on the money demand function. This study, therefore, seeks to investigate the effect of mobile money on money demand with a bias on M-Pesa.

For instance, according to Rao and Kumar (2009), many countries have invested in macroeconomic stabilization and mainly rely on the money demand stability to establish predictions of the effects of these policies on the interest rates, the national outputs, and the inflation. Using the findings from these estimations, they further reduce the possibility of untamed inflation in the large economy.

Based on Andersen (1985), to date, we still witness nonexistence of consensus on the issue of money demand function stability. And therefore, we can conclude that there are still doubts

about the assumptions surrounding the monetary targeting visa viz the creation of a predictable and stable balance that should be maintained on the money supply and nominal income.

We achieve macroeconomic stability in order to support productive activity and achieve key economic objectives usually supported by raising the rate of employment, controlling inflation and improving GDP. From the findings of existing literature, stability or rather instability of money demand has been analyzed from the velocity of income contributed by changes in interest rates level. Further, demand function can also shift as a result of new developments or unstable parameters such as financial innovation or unexpected deregulation that accelerate interest elasticity and affects monetary aggregates held at different levels of interest rates.

Previous studies have relied on ATM as a measure of financial innovation according to Frame and White (2004), this measure is not conclusive and ignores other financial innovations like digital finance. Further, none of the previous studies has estimated the effect of mobile telecommunication supported transactions on money demand leaving digital finance as a neglected area while actually, financial innovation such as mobile supported transactions can influence the stability of the demand money. This study addresses questions that arise on whether digital finance is a vital driver of demand for money.

### **1.6 Objectives of the study**

The main objective was to assess the effect of digital finance on money demand

Specifically, the analysis determines;

- i. The effect of digital finance on money demand
- ii. The impact of GDP on money demand
- iii. The effect of inflation on demand for money.
- iv. The influence of the Treasury bill rate on money demand.

### **1.7 Significance of the Study**

Money demand is a fundamental channel of economic stabilization. It influences the formulation of monetary policies critical for inflation targeting, aggregate demand, and macroeconomic management. Understanding the link between mobile money and the money demand generates appropriate knowledge on the formulation of monetary policies for economic regulation. This

paper serves the purpose of adding to the literature of Money Demand and the implications of mobile money demand on Demand for money.

The findings of the study inform the administration of monetary authorities on the role of digital finance in the financial markets and its implications on the demand for money in the Kenyan Economy.

The results further emphasize the role of telecommunication-based transfers on future innovation focus on what effects mean to Kenyan financial deepening and inclusion.

The implications of a destabilized economy are poor macroeconomic management. Stability in the economy controls various indicators whose significance is increased productivity. This study points to the importance of regulating digital finance to avoid negative shocks to the economy.

The study contributes to the knowledge creation and management by addressing various existing gaps in the literature

## **1.8 Organization of the Study**

The literature review is discussed in Chapter two of this study. The literature review is divided into theoretical and empirical literature as the last section of the chapter with a summary or overview. Chapter three presents the methodology used in both theoretical and model specifications to estimate the study results, the variables and data definition, data types and sources are also presented in chapter 3. The findings are presented in chapter four of the report. It provides descriptive statistics and model estimation results. The final section of the paper summarizes the conclusions and presents policy recommendations based on the results and finally areas of further research.

# CHAPTER TWO

## LITERATURE REVIEW

### 2.0 Introduction

Parts of chapter two are classed into a theoretical framework, review of the empirical literature, and an overview of the literature. The first part reviews theories on demand for money, the second part presents a review of empirical studies with a bearing on the demand for money and part three presents a brief overview of the literature.

### 2.1 Theoretical Literature

Demand for money has existed over years with several researchers offering different explanations for changes in its demand, factors that drive these changes and the evidence from early years on why the demand for money is important. From these different views, three main theories of demand for money have been put forward by distinguished early economists.

#### 2.1.1 The Fisher's Quantity Theory of Money

Fisher's theory explains the historical perspective of money demand. In a sequence of equations Fisher tried to explain the vital determinants of aggregate income and how these determinants affect the aggregate income. However, the theory concludes that unlike other theorists, there is little or no effect of the interest rates on demand for money.

From this assumption, the amount of money  $M$  spent with the final goods and services produced in an economy (Fisher, 1911)

According to Fisher, the national income is determined by the product of Price and aggregate output is as shown.

$$P * Y \text{-----(i)}$$

Where

*P is the price level and Y is the aggregate output*

Linking the two variables is the velocity  $V$  which describes the rate of turnover of money.

$$V = \frac{P * Y}{M} \text{-----(ii)}$$

From equation (iii) then;

$$M * V = P * Y \text{-----(iii)}$$

According to Fisher (1911), Institutions in an economy can determine the level of velocity exogenously and therefore this parameter can be treated as constant.

Quantity Theory of Money, further observes that movement in the quantity of money is driven by changes in income and this illustration can be seen from  $MV = PY$ . Wages and prices according to Fisher were completely flexible and therefore  $Y$  remained at full employment. Assuming that  $Y$  is a constant in the short run when  $M$  doubles  $P$  also doubles in the short-run while holding  $V$  and  $Y$  as constants.

$$M = 1/v(PY) \text{-----}$$

--(iv)

But  $1/v$  is a constant say  $k$

$$\text{Therefore } Md = kPY \text{-----}$$

-(v)

Fisher (1911) concluded that equation (iv) is the Quantity theory of money demand.

From equation (iv), changes in the quantity of money can be influenced by two major factors which include, the price level in the economy and the final goods and services produced in an economy. However, this view changes in Equation (v) in which the right-hand side provides the national income.

From the above equations, QTM concludes that the quantity of money is solely influenced by national income and not the interest rates as it is claimed by other economists.

### 2.1.2 The Liquidity Preference Theory

The liquidity preference theory is credited to a renowned early economist John Maynard Keynes. His theory is widely documented in the famous book under the title; “The General Theory of Employment, Interest and Money 1936”. The Money demand equation presented in his book is presented in the functional form of two variables;

$$Money\ demand = Money\ demand(Income, Interest\ Rates)$$

Keynes observed that, while money is important in carrying out transactions, the level of transaction demand does not entirely determine the demand for money. He holds a similar view in this regard to that of Fisher (1911). However, in his speculative demand, Keynes explains that



people are uncertain about the changes in the future and therefore, hold money for speculative purposes about the market changes in the future.

*The Transaction Demand*

Money is needed to carry out transactions. This is a basis of transaction demand for money. This means that individuals should have cash or money in order to have control over goods and services implying that income has directly influenced the level of transactions that individuals carry out for a given period. This relationship is summarized in the functional form;

$$M^t_d = g(Y) \dots \dots \dots (1)$$

The Keynesian view is consistent with the classical definition of money that, money is used as a medium of exchange, it is therefore required to facilitate transactions and therefore, creates demand (Ahmad,1977).

*Precautionary Demand for Money*

Precaution areas the word sounds arise from the demand created by unforeseen future uncertainties that require holding of cash or money balances. These future reasons could a change in technology that requires businesses to replace machinery, prolonged sickness or accidents. This according to the Keynesian view can be categorized as sources of precautionary demand for money which in his observations is influenced by national income.

$$M^p_d = g(Y) \dots \dots \dots (2)$$

This means that when incomes are high, individuals and businesses tend to commit a higher proportion of their income to future contingencies.

Liquidity Preference theory concludes that precautionary and transaction demand for money are proportions of national income.

*Speculative Demand for Money.*

Keynes (1956) analyzed the behavior of an individual and how they store their wealth. Based on his analysis, investors are interested in storing wealth either as bonds or money. The relationship between bonds (interest-bearing bonds) is negative and people expect that when such interests are high, they will fall and the bond prices will rise and therefore convert their bonds into money.

Contrariwise, people expect interest rates to rise when they are low, and the prices of bonds to fall thereby holding money as a store of wealth becomes more attractive than bond (Carvalho) In his explanation for the speculative demand, Keynes modeled the speculative demand for money as;

$$M^s d^s P^s = f(i, Y) \text{-----}$$

(i).

Where;

$$M^s d^s P^s = \text{Demand for money}$$

$i$  = interest rates

$Y$  = National income

### 2.1.3 The Baumol-Tobin Model

Two separate observations from Baumol (1952) and Tobin (1956) resulted in the model of demand for money. Their independent models lead to the conclusion that cash demand is influenced by interest rates. Baumol-Tobin's view is that interest rates are an opportunity cost of holding money. When these rates rise, less money is spent on purchases and more is invested in interest-earning assets (Baumol, 1952; Tobin, 1956).

Consequently, the demand for money is negatively related to interest rates. A description is presented inequation 1.

$$m^s d^s p^s = f(\text{Income, interest rates}) \text{-----}$$

-(1)

### 2.1.4 Modern Quantity Theory of Money (QTM)

Friedman's Quantity Theory of Money developed from a different viewpoint. The theory observes that, in order to fully explain the demand for money, opportunity cost of holding money wealth as must be included as a determinant of demand for money. While the principal objective of money was to carry out transactions or either choose the ways in which one can store wealth, Friedman's view is that permanent income, returns from interest-bearing bonds, the returns from financial assets, returns from equity and the expected inflation with an economy can explain fluctuations or shifts in money demand function. These determinants according to Friedman (1959) can be expressed in a functional form as follows;

$$M^d/P = f(y_p, r_b - r_m, r_e - r_m, \delta e - r_m)$$

Where;  $M^d/P$  is the definition of demand for real money balances and  $y_p, r_b - r_m, r_e - r_m, \delta e - r_m$  represent the permanent income, the expected returns on bonds, money, equity, the expected inflation rate respectively (Friedman, 1959).

$M^d/P$  therefore, relates positively with the permanent income and negatively with the expected returns for equity, bonds, expected inflation relative to the demand for money.

## 2.2 Empirical Literature

The subject of demand for money has existed over the years. Different views have been presented by different researchers in the importance of financial innovations on the demand for money. Interestingly, many of these studies have neglected the demand side of money and reluctantly failed to address critical problems arising from the demand function. In the wake of ever-advancing technologies, we expect changes in transfers of money to evolve. This is not different in Kenya.

According to Valadkani (2008) demand for money can be modeled from using key determinants such as interest rates, inflation, real effective exchange rates, and inflation. Using panel data from 1975-2002 and upon estimating the effects determinants of money demand. The conclusion revealed that money demand is strongly sensitive to changes in inflation. This effect can be explained from the point of view of inflation being a cost to purchase. Inflation, reduces the ability to pay. It erodes the purchasing power of individuals income and therefore one can buy less of goods for the same level of income when inflation is high than the purchases which can be made by the same level of income at low inflation levels. Valadkani (2008) further advises that inflation should be controlled in order to achieve the overall macroeconomic stability objectives of any economies. Further, the findings reveal rather consistent outcomes as Odularu and Okunrinboye (2009) Interestingly, the author concludes that there is a negative effect of the exchange rate and the interest rates on the demand for money. The explanation of this finding can be regarded as the role of storing wealth as money or interest-bearing interest.

The rate of mobile money usage has been increasing for the last few years. High number of transactions have been recorded by the transfers from relatives to family members and the

payment of goods and services through a short message code commonly referred to as “lip na M-Pesa”. Jack et al. (2013), reports that this rise has been driven by a significant 70% access to M-Pesa accounts in Kenya since its first launch in 2007. This rate however significantly improves with gradual population growth and receives high liquidity levels, cheap and convenient transfers provided by slightly over 35,000 M-Pesa agents across the country. Based on a panel household survey data they examined the implications of using M-Pesa on the size and the level of remittances through a comparison of the M-Pesa usage and the credit received or paid through M-Pesa by users and non-M-Pesa users. They conclude that remittances increase for M-Pesa users than for non-M-Pesa users. The explanation to this is that, despite the slow usage of mobile transfers via M-Pesa by non-users, they tend to have a lower frequency of usage than it is for non-users.

Financial innovation has received a major boost in recent days. This was the motivation of Dunne and Kasekende (2018) to estimate how financial innovation impacts the demand for money. The employed panel data from the Sub-Saharan African region. They conclude that an economy that is supported by financial innovation is likely to experience expansion. Innovation in the financial sector must be encouraged because it fastens transfers, improves efficiency in transfers and motivates transactions that create aggregate demand. Their conclusion supports that of Ignacio and Radcliffe (2011) that mobile communications tend to spur demand for money, triggering increased transaction and the entire effect is reflected in the national aggregate demand. They point that we can experience as large as twice the effect of the mobile-based transaction in countries whose development is at the initial stages than those whose systems of transfers and payment have already evolved. The same view was shared by (Mannahand Belyne, 2004) when their results point to increased economic production in the Indian States that had improved mobile telecommunication penetration that those which had poor telecommunication networks. These impacts are attributed to the convenience mobile phones create in an economy as their adoption significantly leads to an increase in the level of transactions.

According to Evansand Pirchio (2014), developing countries tend to experience increased financial access to mobile money banking. In the majority of financial institutions like microfinance, the initial investment and regulations in this innovation can be significant and therefore act as a barrier to its initial usage. From their findings the importance of this tool in

poverty reduction, job creation and also as a way of saving. Evans and Pirchio (2014) further recommend a coordinated effort by the government to subsidize the development and further adoption of local mobile money tools and infrastructure and further create enabling policies for further financial access flexibility and economic advancement.

Following its launch in 2007, M-Pesa rapidly became a recognized payment method of choice across Kenya. Some of the reason behind its fast and swift adoption was the reduced risks associated with mobile money banking compared to the traditional and informal payment methods, the security of holding money in digital form further implied a lower risk than holding such in cash, and the convenience of using M-Pesa for payment of bills and to carry out transactions were cheaper than long bank transfer processes. By the year 2011, 70 percent of adult Kenyan according to Jack and Suri (2014) owned a mobile money account. This was already a significant subscription for mobile transfer but M-Pesa significantly changed the landscape of payments in the Kenyan economy.

Report by Central Bank of Kenya (2017) as presented indicated that mobile money transactions were rapidly growing with a growth of 21 percent between December 2016 and December 2017. These transactions as completed by customers involved payment of bills, airtime top-up and completing other transactions through their mobile money accounts. Such people demand money and prefer keeping it in their accounts. It was reported that the year 2017 showed new dawn by recording a significant shift where mobile money was used to serve as a saving tool for money as it earns interest. This report suggests that more people demand money for the purpose of earning interests.

In their review paper, Dunne and Kasekende (2018) sought to appreciate the rationale of financial modernization in the form of innovations in Sub-Saharan Africa by investigating the African capability in mobile money. In their findings, they note that the implications of different models of mobile money have different implications. Each of them is unique in its performance. For instance, they noted that the introduction of credit cards, debit cards, and ATMs can negatively influence demand for cash. In many areas of the study region, money that was originally stored in cash is transferred to the banks and gradual withdrawals serve the purpose of holding cash. This further reduced the costs of financial access and risks of holding cash while at

the same time enhancing efficiency in financial access and transfers. In contrast, financial innovations could also trigger a rise in money demand by creating more liquid assets like the Kenyan mobile telecommunication-based transfers where there is increased demand for electronic money through the use of cell phone technology but without curtailing the access to liquid assets.

Several other studies conducted by Hye (2009), Nagayasu (2012); Alvarez and Lippi (2009) have all focused on the analysis of the influences of financial innovation involving the adoption of mobile money in the then Kenyan economy. Alvarez and Lippi (2009) specifically the link between the transaction demand for cash and financial innovation with an objective unraveling how individuals' transaction motive of holding money was impacted by mobile money. Although it has been difficult to measure the effect of financial innovation, mobile money which is one of the growing innovations is quantifiable by looking at the amounts of cash held and transactions are undertaken using it. The studies indicate that people who have access to this innovation have gone a notch higher to not only transfers but also saving using them as most of them prefer to use a method that is convenient. Mobile money, therefore, influences the demand for money by creating convenience. People would prefer holding their cash more in a way that is convenient to help them transact as the need arises.

In their study, Sichei and Kamau (2012) established that mobile money differs from other existing financial innovations. Their effects are significantly different on the demand for money upon a deep inquiry. In the past, the majority of financial innovations that exist have always been anticipated to affect the demand for money negatively. This is because using mobile money, people tend to change from the habit of holding cash to assets and therefore demand less money. In contrast, the development of mobile money has become an alternative cash form with it viewed e-money which is not a physical or another monetary asset which are less liquid. Therefore, as the usage of mobile money continues to increase, money demand is also increasing indicating a positive relationship between mobile money and money demand.

According to Ndirangu and Nyamongo (2014), it is becoming more vital to reexamine the steadiness of demand for money particularly within Kenya whereby mobile money should be considered an exceptional innovation. The wide adoption and usage of M-Pesa or digital money

in Kenya and in transactions has created special interest for researchers especially in finance since it's the first nation to adopt and operationalize digital transfers and recognize it as a legal payment method. A further study by Davidson and Penicaud (2012) concluded that countries in East Africa such as Kenya, Tanzania, and Madagascar recorded higher mobile money account registrations than account registered in the banking sector. This shows that people would feel comfortable holding money in their mobile money accounts.

Jack, Suri and Townsend (2010) in their study found out that even commercial banks have been working with telecommunication companies with a view of improving financial services. Although it is not mandatory that a bank account holder will register for mobile money, it is most probable that a mobile money user might opt to use both bank account and virtual M-Pesa mobile money account to transact. The use of both accounts according to them can ease the transfer of money from user's bank accounts to their M-Pesa accounts without having to directly or physically show up at the bank's teller for withdrawal or transactions. This move has since convinced people to use mobile money more often than they use bank accounts. In Kenya, a local study on the perception of mobile money tells Kenyans to hold a reserve of money for emergencies even without considering such as savings. Electronic money has revolutionized channels of payments to a significant population in Kenya. This has triggered a mass of innovation with countless prospects of accessing other forms of financial services through telecommunication-based money. With electronic and mobile-based money being connected with the user's bank account which has become the trend today, it is expected that more people will prefer holding their cash in their bank account. This is because many people are assured of getting money as fast as they need it due to the convenience created by mobile money in accessing the bank accounts (Johnson, Brown and Fouillet, 2012)

Alvarez and Lippi (2009) studied the importance of financial innovation on the transaction motive for holding cash with an aim of with a view to unearthing how this transaction motive of keeping money among individuals was affected by mobile money. The study established that measurement of the financial effect on demand for cash is subjective and therefore difficult in quantifying such effect. However, mobile money which is one of the growing innovations is quantifiable by looking at the amounts of cash held and transactions are undertaken using it. The study indicates that individuals who are able to access digital money have gone not only transfer

money using this innovation but also save using them as most find it as a convenient method of holding their cash.

### **2.3 Overview of Literature**

The importance of money demand function is one of a national outlook. From a theoretical perspective, the observation of Keynes that demand money is a component of three motives; transaction, precautionary and speculative motives still hold today. However, the channel of this demand is the question that still lingers in many economic inquiries and mainly adopts different views. From the above literature, it is evident that little attention has been given to the impact of M-Pesa (Digital Finance) on money demand function. The above-reviewed literature suggests that on at the point of adoption, we may experience partly positive and partly negative effects of financial innovation on money demand, particularly in the developing countries. However, this effect tends to become positive when its adoption increases. The larger effect is on the transaction demand than it is for other motives such as the precautionary motives. (Kasekende,2016),Ignacio and Radcliffe (2011), Mannah-Blankson and Belyne, (2004),Evans and Pirchio (2014),Dunne and Kasekende (2018) however suggest that despite vast financial innovations, some individuals will still consider traditional forms of wealth storing and transaction and therefore negate the advanced benefits of digitalizing their transactions.

Hye (2009), Nagayasu (2012) and Alvarez and Lippi (2009) Alvarez and Lippi (2009) took a more inclusive approach to financial innovation encompassing different forms of innovations and view financial innovation as a saving tool as opposed to a facilitator of demand for money. According to Kamau and Sichei (2012), it has been established that mobile money is different from other existing financial innovations and that understanding its impact on demand for money is, therefore, a gap that needs to be filled. The study viewed that with mobile money being treated as financial innovation, several financial innovations have always had a negative impact on money demand negatively.



## CHAPTER THREE

### METHODOLOGY

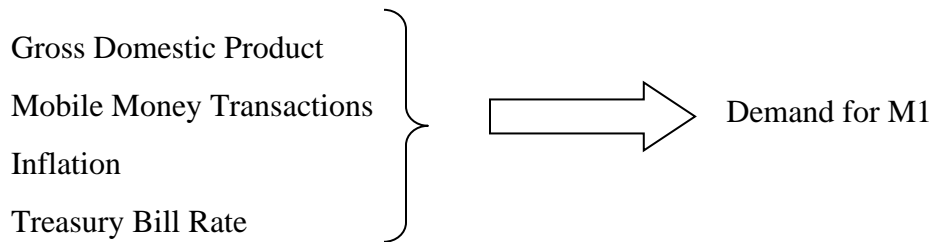
#### 3.1 Introduction

Chapter three discusses the methodology to be used in the estimation of results. This is classed into a theoretical framework, the model specification/the analytical model, the definition, measurement and a priori signs of the variables data to be used in the model estimation and the data sources.

#### 3.2 Conceptual Framework

Miles and Huberman (1994) explains the importance of having a conceptual framework that links the independent variables to the dependent variable. They argue that in order to establish whether a variable affects another, one should be capable of showing this relationship in a conceptual framework.

Figure 5: Conceptual Framework



#### 3.3 Model Specification

This study targets to estimate the effect of mobile money on demand for money M1 borrowing from Friedman's Quantity demand theory and Keynes (1956). The economic model is therefore specified as follows;

$$M^d_t = f(\text{Gross Domestic Product}, \text{Inflation}, \text{Tbill Rate}, \text{Mobile Transactions}_t)$$

Where

$$M^d_t = \text{Demand for money}$$

More formally, the estimation equation is specified as follows:

$$l\_DEMFORM1 = \beta_0 + \beta_1 l\_GDP + \beta_2 l\_INFNRATE + \beta_3 TBILLRATE + \beta_4 l\_VOLMOBTRNSC + \varepsilon_t$$

Where

*DEMFORM1* is the demand for money

*GDP*= Gross Domestic Product

*INFNRATE*=Inflation rate

*TBILLRATE*= treasury bill rate

*VOLMOBTRNSC*=The volume of mobile money transactions

$\varepsilon_t$  = the error term

### **3.4 Measurement and Variables Definitions**

M1 is the most liquid of the monetary aggregates described as the deposits in commercial deposits, deposits held at the trade and industry, checkable deposits and the nonbank traveler's checks. This study used M1 as the dependent variable due to its liquidity which also characterizes digital finance. The variable is measured in million Kenyan shillings

Gross domestic product describes the final prices of the goods and services in a country. A higher GDP is likely to trigger consumption or expenditure and therefore increase the level of transactions carried out in a given time period. In this study, we measured GDP in Million Kenyan Shillings.

Digital finance is proxied by the volume of money transactions. It is the indicative rate at which individuals transact using mobile money devices. This variable is measured in millions of units of transactions over a given period specifically quarterly.

The effects of inflation on demand for money has been factored in this report. Inflation is seen as a cost to demand money because it erodes money's purchasing power. The Consumer Price Index (CPI) was introduced as an inflation indicator. This measure has been found to be reliable in prior studies due to its ability to model significant overall price changes in each specific measurement period.

Treasury bill rates are described as a channel of meeting the government budget deficits. This study factors the opportunity cost of holding money by incorporating the 91-day treasury bill as a proxy. The T-Bill is measured using the 91-day treasury bill rate from 2007 to 2018.

**Table 2: Variables, Definitions, Measurement, and Expected Signs**

<b>Variable</b>	<b>Measurement</b>	<b>Expected Sign</b>
<i>Dependent Variable</i>		
Demand for M1	Kenyan Shillings	
<i>Independent Variable</i>		
Gross Domestic Product	Kenyan Shillings	Positive (+)
Mobile Money Transactions	Mobile money Transactions	Positive/Negative (+/-)
Inflation Rate	Percentage	Negative (-)
Treasury bill rate	Percentage	Negative (-)

### **3.5 Pre-estimation Tests**

#### **3.5.1 Unit Root Test for Stationary**

Time series data may reveal some trend or unit-roots for a given period of time. This attribute may render the data non-stationary implying that the economic estimation might contain significant error and therefore inaccuracy. In the presence of this problem, one should detrend the data in order to obtain stationary data required for the model estimation. The study used the Augmented Dickey-Fuller Test to investigate the existence of non-stationary data (Hall, 1994).

H0: Time series data is non-stationary

H1: Time series data is stationary

We reject the null hypothesis after establishing a stationary time series data.

#### **3.5.2 Test for Multicollinearity**

It is desirable to estimate the linearity of independent variables in time series data. Collinearity should be corrected when detected between the independent variables used in a study. This was done using the correlation matrix and its significance judged by how large or small such linear coefficients based on the output (Schroeder, Lander, and Levine-Silverman, 1990).

### **3.5.3 Test for Normality**

According to D'Agostino, Belanger, and D'Agostino (1990) examination of the normality test relied on skewness and kurtosis test to establish whether the data significantly differs from the joint kurtosis and skewness of a normal distribution.

### **3.5.4 Test for Autocorrelation**

According to Brockwell and Davis (2016), a problem of autocorrelation found in many time series economic data can lead to underestimation of the standard errors which are used to compute the t values. This can render the findings in time series data invalid and also yield an incorrect conclusion. This study adopted the Breusch-Godfrey LM autocorrelation test to test and correct the existence of autocorrelation.

### **3.5.5 Test for Heteroscedasticity**

Heteroscedasticity is a problem in time series data. It arises when variances of the error terms vary over time. Therefore, to objectively form a valid inference in time series data, the error terms of the fitted variable should have a constant variance. We employed the Breusch-Pagan/Cook-Weisberg approach to examine the carryout heteroscedasticity (Waldman,1983).

## **3.6 Data Sources and Collection**

This study relied on secondary data drawn from Kenya National Bureau of Statistics, The Central Bank of Kenya, World Bank Development Indicators from 2007 q2 to 2008 q4(KNBS).

## CHAPTER FOUR

### EMPIRICAL FINDINGS

#### 4.0 Introduction

This chapter is divided into four main sections. The first portion presents the descriptive statistics, the second part reports the results of the unit root test and the subsequent section describes the output of the empirical analysis.

#### 4.1 Descriptive Statistics

Table 3 presents the summary statistics. Descriptive statistics explain the key attributes of the data sample. From Table 3, the mean of demand for M1 is 14.5884, the mean of GDP is 13.59684, the mean for Mobile Money transactions is 4.4659 the inflation is 4.8864, the Treasury Bill rate is 7.7364 and. The mean gives the average values of different observations. Standard deviations measure the degree of variability of the observations from their average values. The smaller the deviations or variability the better the variable. The standard deviation of Demand for M1, GDP, Mobile Transactions, Inflation, Treasury bill rate were;0.4641,0.3947,1.5390,0.264 and 1.1246 respectively. When discussing descriptive statistics, it is important to capture the effect of large and small observations. These two variables aid in estimating the range of observation by subtracting the minimum value from the maximum value. From Table 3, The minimum values of the variables of the study were 13.7782, 12.6747, -0.7985,4.362 and 4.78 for MI, GDP, Mobile Money Transactions, Inflation, and Treasury Bill Rate respectively and maximum values are; 15.2796,14.0177,6.1401,5.2671 and 9.73 respectively.

**Table 3: Descriptive Statistics (in million Kenya shillings)**

Variables	Obs	Mean	Std.Dev.	Min	Max	Joint Skewness/Kurtosis Test
Log M1	47	14.5884	0.4641	13.7782	15.2796	0.1582
Log GDP	47	13.5968	0.3947	12.6747	14.0177	0.0124
Log Mobile Money Transactions	47	4.4659	1.5390	-0.7985	6.1401	0.3769
Log Inflation	47	4.8864	0.2640	4.3626	5.2671	0.0279
Treasury Bill Rate	47	7.7364	1.1246	4.78	9.73	0.2098

Distribution of a sample can inform the choice of model choice in a study. The normal distribution assumes that a sample has been selected from a population that is normally distributed. A normality test was carried out using Skewness and Kurtosis test and most of the variables are normally distributed.

#### 4.2 Correlation Analysis

The objective of correlation analysis was to identify and correct for multicollinearity of independent variables. Table 4 presents the correlation matrix of the independent variables. Except for GDP and Mobile Money Transactions, all other variables did not show a significant linear relationship. GDP and Mobile money transaction correlation coefficient of 0.9367 was above 0.50. In order to avoid the problem of multicollinearity, the study estimated two OLS equation. Model A with Mobile Money transactions as a response variable and Model B with GDP as an independent variable.

**Table 4: Correlation Matrix**

	Log GDP	Log Mobile Transaction	Log Inflation	T-bill rate
Log GDP	1.0000			
Log Mobile Transactions	0.9367	1.0000		
Log Inflation	0.4930	0.4056	1.0000	
T-bill rate	0.2759	0.3649	0.4674	1.0000

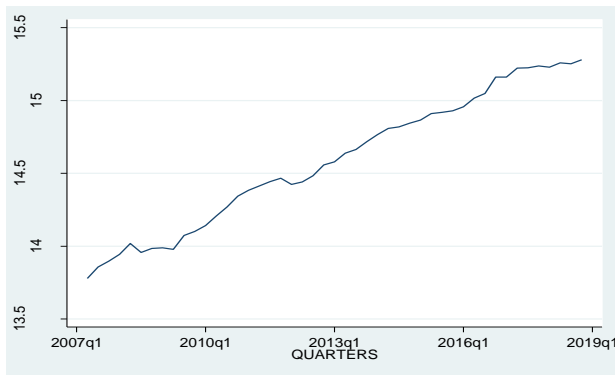
#### 4.3 Pre-estimation Tests

##### *Stationarity Tests.*

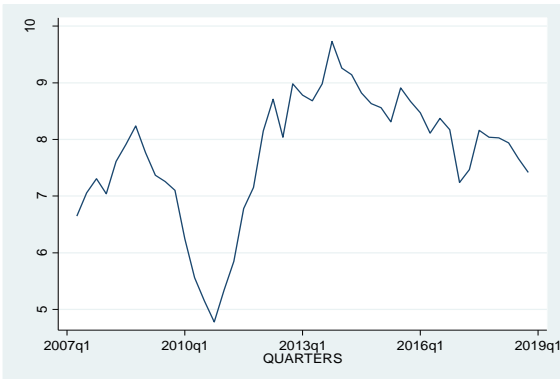
We investigated the existence of unit roots in order to satisfy the assumptions of the classical OLS regression assumptions that all explanatory variables should be stationary covariance, with means value of zero and a standard deviation of 1, and thus to prevent a spurious regression in the analysis of economic data.

*Graphical Analysis of time Series*

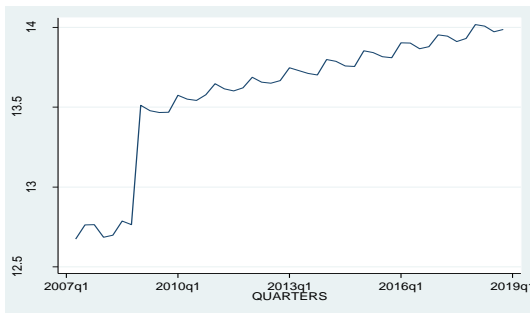
**(a) Log M1**



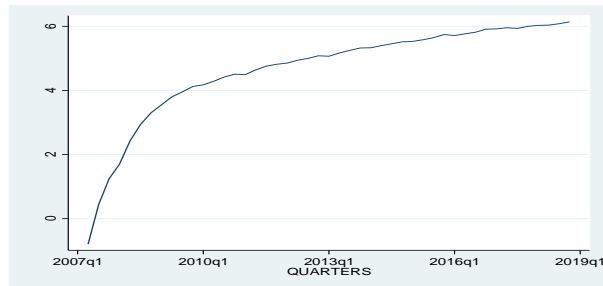
**(b) Treasury Bill Rates**



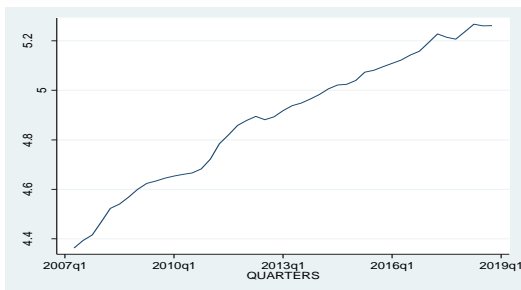
**(c) Log GDP**



**(d) Log Mobile Money Transactions**



**(e) Log Consumer Price Index (Inflation)**



The ADF test for unit roots was carried out to test the presence of unit roots. The choice of unit ADF is based on its consistency and accuracy of examining the presence of unit roots over time. This has therefore been confirmed as a reliable test. The basis for ADF tests is that it tests the null hypothesis (H0) against the alternative (H1) hypothesis;

H<sub>0</sub>: Economic variables have unit roots

H<sub>1</sub>: Economic variables do not have unit roots:

**Table 5: Results of the Augmented Dickey-Fuller Unit Root Test**

<b>Level with Intercept</b>					
<b>Variable</b>	<b>ADF: t statistic</b>	<b>1%</b>	<b>5%</b>	<b>10%</b>	<b>Remarks</b>
	<b>Level</b>				
<b>Log M1</b>	-1.154	-3.607	-2.941	-2.605	Not I(0)
<b>Log GDP</b>	-2.237	-3.607	-2.941	-2.605	Not I(0)
<b>Log Mobile Money Transactions</b>	-15.995	-3.607	-2.941	-2.605	I(0)
<b>Log Inflation</b>	-2.811	-3.607	-2.941	-2.605	I(0)
<b>Treasury Bill Rates</b>	-1.593	-3.607	-2.941	-2.605	Not I(0)
	<b>At 1<sup>st</sup> diff.</b>				
<b>Log M1</b>	-6.991	-3.614	-2.944	-2.606	I(1)
<b>Log GDP</b>	-7.545	-3.614	-2.944	-2.606	I(1)
<b>Treasury Bill Rates</b>	-5.464	-3.614	-2.944	-2.606	I(1)

Table 5 summarizes the results of the ADF unit root test results.

The dependent variable is demand for M1. At the level is the variable is non-stationary. We therefore cannot reject the null hypothesis from the results presented in Table 5 and conclude that there is enough evidence to support the presence of unit roots at 1%, 5% and 10%. Levels of complexity. The dependent variable test statistics were found to be -1,154 against the vital values of -3,607,-2,941 and -2.605 for 1%,5% and 5% levels of significance.

The GDP test statistic was -2.237 against the critical values -3.607, -2.941 and -2.605. The null hypothesis of the presence of unit roots could not, therefore, be rejected at 1 %, 5%, and 10% levels. We concluded that GDP is non-stationary at the three levels of significance.

Mobile Money transactions null hypothesis of the presence of unit roots was rejected at 1%,5% and 10% levels of significance. The test statistics of -15.995 against the critical values of -3.607, -2.941 and -2.605. This variable is therefore found to have a constant mean and variance at levels.

Inflation was found to be stationary at a 10% level of significance with a test statistic of -2.811 against the critical value of -2.605. The variable is found to have constant variance and mean and therefore stationary.

Treasury bill rate (91day Treasury Bill Rate) null hypotheses are found to be non-stationary with a test statistic of -1.593 respectively against the critical values of -3.607, -2.941 and -2.605. The variable was found to have changing variance and mean and therefore nonstationary.

Spurious regression is a problem that arises when estimation relies on non-stationary data to generate economic conclusions. This problem is avoided by transforming Log M1, Log GDP and Treasury Bill rates to stationary by differencing. At first difference, the variables become stationary (see Table 5)



#### 4.4 Estimation Results

Table 6 presents the OLS estimation results. The estimation results demonstrate that Mobile money transactions is a central factor in determining the demand for money. The variable negatively influences demand for money demand (M1) and is significant at a 1% level of significance. A one percent increase in the number of mobile transactions leads to a 0.8324% decrease in the demand for M1. This finding is consistent with Dunne and Kasekende (2018) and Sichei and Kamau (2012) who concluded that the majority of financial innovations that exist have always been anticipated to affect the demand for money negatively. This is because using mobile money, people tend to change from the habit of holding cash to assets and therefore demand less money.

Inflation and Treasury bill rates significantly explain the demand for M1. Inflation negatively influences demand for M1. This suggests that a one percent increase in inflation contributes to a 1.85% decline in demand for M1. Higher GDP treasury bill rate triggers the demand M1. GDP is not a significant factor in explaining the demand for M1.

**Table 6: Estimation Results**

<u>Variable</u>	<u>Model A</u>	<u>Model B</u>
D. Log GDP	0.0265 (0.7070)	
Log Mobile Money Transactions		-0.8324715 (0.0000) *
D. Treasury Bill Rate	0.2188369 (0.0000) *	-0.0622499 (0.3440)
Log Inflation	-1.85427 (0.0000) *	-0.0877588 (0.2320)
Constant	-5.784849 (0.0000) *	-10.80037 (0.0000) *
F Statistic	5.53239	4.8637
Prob(F)	(0.0026) *	(0.0030) *
R-squared	0.5936	0.5862
Adj.R-Squared	0.5857	0.5728

## 4.5 Diagnostic Tests

### *Autocorrelation.*

In time series data, a problem arises when a variable is high correlated with lagged values of itself. This condition is referred to as serial autocorrection. Therefore, in order to maintain the validity of statistical inference this study used Breusch-Pagan to test the presence of serial autocorrelation. Since p-value 0.2489 is greater than 0.05, we cannot reject the null hypothesis of no serial correlation.

**Table 7: Breusch-Godfrey LM test for autocorrelation**

lags(p)	F	df	Prob > F
1	2.782	(1, 44)	0.2489

Ho: No Serial Autocorrelation

### *Heteroskedasticity*

Heteroscedasticity arises when variances of the error terms vary over time. Therefore, to objectively form a valid inference in time series data, the error terms of the fitted variable should have a constant variance.

**Table 8: Heteroscedasticity**

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of DlogM1

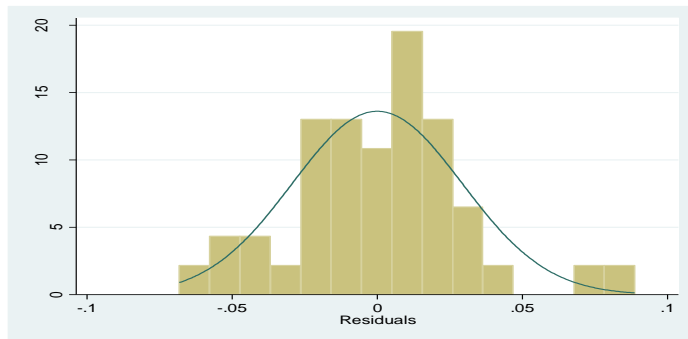
chi2(1) = 0.17
Prob > chi2 = 0.6803

The reported probability of 0.6803 (68.03%) is more than 5%. This implies that the residuals have constant variance and fulfills the critical assumption of OLS regression.

## 4.6 Distribution of the Residuals.

One of the assumptions of the OLS is the normality assumption which states that the residuals from the regression output should follow a normal distribution. A mean of zero and constant variance of 1 is what describes normal distribution. The significance of this assumption is to ensure that the OLS estimators are the best linear unbiased estimators (BLUE). Jarque - Bera test for normality is used for normality on the residuals.

**Table 9: Residual Normality Test.**



Mean	-8.73e-11
Max	0.0887408
Min	-0.0682009
Std. Dev.	0.0293011
Skewness	0.2327
Kurtosis	0.1089
Jarque-Bera normality test:	
Probability	0.1642
Jarque-Bera test for Ho: normality:	

Table 9 presents the results of the normality test. We cannot reject the null hypothesis of normal distribution at least at 16.42 percent. This suggests that the residuals are normality distributed as desired and meets the requirements of the OLS regression.

## **CHAPTER FIVE**

### **CONCLUSION**

#### **5.1 Introduction**

This chapter presents the conclusion of the study. This includes the summary of key findings, policy implications that arise from the study findings, conclusion and areas for further research

#### **5.2 Summary of the key findings**

Motivated by the increasing rate of M-Pesa subscription in Kenya, this study targeted to estimate the relevance of digital finance on demand for money. Digital Finance was proxied by Mobile Money. This objective was achieved using an OLS regression model with quarterly data from 2007 q2 to 2018 q4.

The existing literature both theoretical and empirical literature presented earlier in this study seemed to have both converged and diverging conclusions. Some concluded on a significant and positive influence of financial creativity demand for money while others appeared to give a conclusion of negative and significant effects. This study established that mobile money transactions influences money demand negatively in Kenya. Based on these findings, therefore, the massive adoption of mobile money transactions reduces the demand for currency or cash assets and therefore negatively influences the demand for monetary aggregate M1.

#### **5.3 Policy Implications**

In an economy that is still growing, it becomes necessary to understand what implication changes in payment systems would have in demand for in the control of monetary aggregates. A negative link between digital finance and demand for money implies that the Central Bank needs to align its policy targets in order to monitor and control stability in the economy through the regularization of digital transfers and transactions.

#### **5.4 Conclusion**

Based on the analysis, digital finance is a vital factor that determines the demand for money. This implies that increased uptake or subscription of digital finance reduces the demand for money. Earlier reviewed literature suggested that increased financial innovations can influence

transactions which in turn affects the demand for money. The conclusion of this study, therefore, informs the regulatory authority such as the Central Bank of the need to integrate digitalization of finance into their policy formulation.

### **5.5 Areas for Further Research**

The digitalization of finance is an emerging issue. The implications of such a trend can destabilize the demand for money function. This study was undertaken under the scope and period of time for which volume of mobile money transactions data was available from 2007 to 2018.

There is a need to adopt a wider approach and cover a larger geographical region of East Africa that has now adopted telecommunication-based transfers.

Further and deeper analysis can also be conducted to explore the impact of digital finance on wider monetary aggregates such as M2 and M3

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