

**EFFECT OF FINANCIAL INNOVATION ON MONEY DEMAND IN THE EAST
AFRICAN COMMUNITY**

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**A Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements for
the Master of Arts Degree in Economics of Egerton University**

EGERTON UNIVERSITY

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented in this university or any other for the award of any degree

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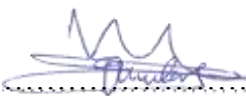
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DEDICATION

This thesis is dedicated to my parents, Mr. Samwel Cheruiyot and Mrs. Grace Cheruiyot, my siblings, and my friends.

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ABSTRACT

Tremendous changes have been witnessed in the East African Community's (EAC's) macroeconomic landscape over the past few years. For instance, several forms of financial liberalizations have been witnessed in the EAC over the years. These changes can shift various parameters of the money demand model. Many previous empirical studies examined the effect of scale and opportunity cost of holding money variables on money demand. However, there are some that left out financial innovation which is one of the key factors influencing money demand. Additionally, they are just country specific studies and used time series data analysis technique. It is in this backdrop that a cross-country case study that examines the effect of financial innovation on money demand function was carried out using the recent data and a different analysis technique which is panel data analysis. The objective of the study was to examine the effect of mobile money and ATMs on money demand in the EAC. The study's control variables were real GDP and interest rate. The study's theoretical framework was Keynesian theory of money demand and adopted a historical research design. The study used secondary data for the period 2007 to 2020 and this data was obtained from the World Bank and International Monetary Fund. Both descriptive and inferential analyses were carried out. Levin-Lin-Chu test for panel unit root was done and all the study variables were found to be stationary at level. Hausman specification test was carried out and the results of this particular test indicated that fixed effects (FE) model was the preferred model. Wooldridge test for serial correlation indicated that autocorrelation was not a problem in the regression analysis. The results of modified Wald test for heteroskedasticity also indicated that heteroskedasticity was not a problem in the regression analysis. Breusch-Pagan LM test of independence was also conducted and the results showed that there was no cross-sectional dependence. The results of balanced panel fixed effects regression analysis indicated that mobile money, ATMs, and real GDP were affecting money demand positively and their effects were also statistically significant. However, interest rate affected money demand negatively. Mobile money and ATMs were proxies for financial innovation whereas real GDP and interest rates were control variables. Therefore, it was observed that financial innovation has had a positive effect on money demand in the EAC. The findings of this study might be of great importance to monetary authorities and policy makers in the EAC. Future research studies can expand the period of study similar to this one and also increase the number of countries involved.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADF: Augmented Dickey Fuller

AIC: Akaike Information Criteria

ARDL: Autoregressive Distributed Lag

ATM: Automated Teller Machine

CBK: Central Bank of Kenya

CPI: Consumer Price Index

EAC: East African Community

ECM: Error Correction Model

FI: Financial Innovation

GDP: Gross Domestic Product

IMF: International Monetary Fund

LDCs: Least Developed Countries

NBFIs: Non-Bank Financial Institutions

OLS: Ordinary Least Squares

USD: United States Dollar

VECM: Vector Error Correction Model

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

One of the most important prerequisites or inputs for formulating and implementing monetary policy is money demand. It is, therefore, important to examine money demand and try to get an understanding of the relationship between money demand and its determinants. Money demand is the desire to hold financial assets either in the form of bank deposits or cash (Goldfeld & Sichel, 1990). Economic agents specifically individuals (households) are usually motivated to hold money for various motives that include transaction, precautionary and speculative motives. These three motives hence drive the economic agents to demand money in various forms. It is also important to note that money provides liquidity to economic agents by facilitating transactions and can also earn interest. The demand for money usually stems from the trade-off between liquidity benefit of holding money and the interest benefit of holding other equivalents of money (Handa, 2009). Money demand is influenced by several factors.

Financial innovation (FI) is one of the recent factors that have been found to have a greater influence on money demand at the global, regional, and national level. FI is a crucial factor in the development of the financial sector and economic growth and it includes aspects such as financial regulations/de-regulations and technological procedures (Chipeta & Muthinja, 2018; Kipsang, 2013). According to Frame and White (2014), FI can be grouped into both products and processes. Examples of financial processes include financial markets liberalization and securitization. On the other hand, some of the examples of financial products are MPESA, internet banking, debit cards, ATMs etc. (Kipsang, 2013).

Various forms of financial innovations can have different effects on the demand for money (Kasekende, 2016). For instance, new financial innovations such as ATM, debit cards or mobile money (M-PESA) is likely to improve the efficiency and minimize transaction costs involved (Wahyunda, 2021). The money that would have been held in form of cash would now be replaced by these financial innovations. This, in turn, would result in a decline in the demand for cash. Similarly, as economic agents such as households move away from more liquid assets (cash) to demanding less liquid assets (mobile money or ATM card money), they are more

likely to demand less money (Chukwunulu, 2019). In contrast, new financial innovations could potentially result in an increase in the demand for money if payments systems are efficient, but individuals are likely to demand more liquid assets (Dunne & Kasekende, 2018). For example, in the case of mobile money (MPESA), individuals will demand both cash and mobile money via the use of mobile phone technology but do not initially shift from more liquid assets to less liquid assets.

1.1.1 An Overview of Financial Innovation and Money Demand Globally

The demand for money at the global level has increased extensively (Mlambo & Msosa, 2020). This is because a higher demand for money is likely to result in huge economic growth (Mlambo & Msosa, 2020). Generally, the trend of money demand among several countries globally has changed drastically over the past few years. One factor attributed to these changes in the trend of money demand is the continued developments in the financial sector (Dunne & Kasekende, 2018). The financial sector across several countries globally has experienced huge technological developments in the last couple of years. Some of these developments in the financial sector include automated teller machines (ATMs), improved payment systems and money transfer systems, automatic bill payer accounts, credit and debit cards etc. Substitution between cash and the various kinds of financial innovations such as mobile money is taking place globally (Mlambo & Msosa, 2020). In addition, there has been a tendency to move towards a less expensive and more efficient payments system (Mlambo & Msosa, 2020). The main reason as to why new financial innovations have been embraced across the globe is their easiness and effectiveness. For example, it has resulted in reduction in transaction costs.

1.1.2 An Overview of Financial Innovation and Money Demand in Africa

One of the major characteristics of financial markets across various African countries is that they are not well developed. As a result, economic agents such as households often depend on informal techniques to access financial services. However, in the past few years, Africa has seen development of various forms of financial innovations such as ATM cards, debit cards, and mobile money. Mobile money is a financial innovation that was developed in Kenya (Dunne & Kasekende, 2018). These financial innovations have a greater potential of improving access to financial services by individuals. For instance, mobile money, in particular, has a potential of lowering transaction costs and this could enable households to demand more money in form of

mobile money (Mwangi, 2014). Just like what is being witnessed globally, financial innovations in Africa have increased the demand for less liquid money.

The empirical country case studies that have been done in Africa have found financial innovation to be an important variable in influencing money demand. Many empirical studies in Africa have established both positive and negative significant relationship between financial innovation and money demand both in the short-run and in the long-run.

1.1.3 An Overview of Financial Innovation and Money Demand in the EAC

In the past few years, the EAC has experienced huge financial reforms that have strengthened its financial sector in an attempt to boost its economic growth. This explains the development of various financial innovations and, particularly, mobile money (MPESA). Improved technology in the communications industry to a larger extent has improved financial services. Mobile money is a form of financial innovation that was first introduced in Kenya in 2007 by Safaricom, a mobile network company. MPESA enables individuals to transact for instance, transfer, deposit or save money using mobile phone without necessarily having a bank account (Jack & Suri, 2011). MPESA has been successful in Kenya and has spread quickly to several EAC countries (GSMA, 2022). Additionally, the EAC has been successful in mobile money usage since its introduction in Kenya with over eighty percent of all mobile money transactions processed in the EAC (Pénicaud, 2012). In addition to the financial reforms, another possible reason for the development and success of mobile money in the EAC is the widespread use of mobile phones in the region. Mobile money is, therefore, one of the major forms of financial innovations influencing money demand in the EAC.

Just like what is happening across the globe and Africa, financial innovation is playing a major role in influencing money demand in the EAC. As discussed above, financial innovation has changed the specification of the money demand function. Financial innovation has also lessened the relative amount of money being held in form of cash hence positively affecting velocity of money (Dunne & Kasekende, 2018). Several empirical studies have found out that money demand is relatively stable in the EAC region with financial innovation being a significant factor influencing money demand.

The most notable form of financial innovation in the EAC includes the ATMs. The number of ATMs has been steadily increasing since when it was first introduced in various EAC countries since the early 1990s. There were about 2,400 ATMs spread all over Kenya by the year 2020 (IMF, 2022). The number of ATMs that were spread all over Uganda by the year 2019 were about 950 whereas those that were spread all over Tanzania by the year 2015 were about 1,780 (IMF, 2021). The number of ATMs in Rwanda in 2020 was 334. In 2016, the number of ATMs in Burundi was 81 (IMF, 2022). The number of ATMs in various EAC countries have been increasing rapidly over the last decades. The amount transacted through the ATMs has steadily increased as more individuals in the EAC now prefer to use ATMs when transacting. This is because ATMs are more accessible and more cost effective.

Another notable form of financial innovation that has revolutionized the EACs financial sector is the mobile money. Mobile money has been very successful and has spread to various EAC countries since when it was first introduced in Kenya in 2007 (GSMA, 2022). The success in outreach of the mobile money is attributed to a large network of agents who have resulted in an increase in the access points for financial services. For instance, by the end of 2020, Kenya had over 22 million individuals with mobile money accounts (IMF, 2022).

The amount transacted via mobile money has been increasing in the EAC. For instance, in 2020, the number of mobile money transactions in Kenya amounted to 1.86 billion transactions (IMF, 2022). The COVID-19 pandemic in 2020 resulted in many economic agents in Kenya preferring to hold money in form of mobile money and also transacting using mobile money and internet banking. This was due to government directive that encouraged the use of mobile money and internet money when transacting and discourage the use of cash (notes and coins) as measure to counter the spread of COVID-19. This particular directive can thus account for the increase in mobile money transactions in Kenya in 2020. In 2015, the number of mobile money transactions in Tanzania amounted to 1.39 billion transactions (IMF, 2022). In 2020, the number of mobile money transactions in Uganda amounted to 3.5 billion transactions and 800 million transactions in Rwanda (IMF, 2022). In 2018, the number of mobile money transactions in Burundi amounted to 575 million transactions (IMF, 2022). This trend is expected to continue increasing in the EAC in the years to come. This is due to the fact that mobile money is one of the recent forms of financial innovations that is highly preferred by the economic agents in the EAC.

1.2 Statement of the Problem

Financial innovation being one of the major determinants of money demand has been found to have diverse effects on money demand both in the short-run and in the long-run. There are some studies that have found a significant negative impact of financial innovation on money demand while others have established a significant positive relationship between financial innovation and the demand for money. This, therefore, implies that the relationship between financial innovation and money demand can either be inverse or direct. Many researchers have also come to a conclusion that for a money demand function to be well specified and stable, it should consist of financial innovation as one of the variables. It is, therefore, important to account for critical factors influencing money demand when formulating a money demand model. For instance, if financial innovation is not accounted for, then the money demand model would not be well specified resulting in biased estimates. This will render the model inefficient for prediction and policy making.

The EAC has experienced enormous developments in its financial sector following the financial liberalizations and reforms of interest and exchange rates between 1980s and 1990s as evidenced by the introduction of new financial products such as debit cards and ATMs during the 1990s and mobile money in 2007 (Mawejje & Lakuma, 2019). However, despite these recent developments, there are few empirical studies that have tried to explore the effect of financial innovation on money demand in the EAC as a regional economic bloc. Hence, in the EAC as a regional economic bloc, limited research has been done to investigate the effect of financial innovation on money demand. There are few studies that have formulated a money demand model for the EAC.

Furthermore, most of the studies that have examined this particular subject in the EAC are country case in nature and used time series data that might have some limitations. It is against this backdrop that this study was a cross-country case study and used panel data as an attempt to correct the limitations associated with using time series data. This study, therefore, specified a money demand model for the EAC regional bloc that incorporated financial innovation since the uptake on existing forms of financial innovation has increased with several other financial innovations likely to emerge in the coming years.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of the study was to examine the effect of financial innovation on money demand in the EAC.

1.3.2 Specific Objectives

The following were the specific objectives of the study:

- i) To investigate the effect of mobile money on money demand in the EAC.
- ii) To determine the effect of ATMs on money demand in the EAC.

1.4 Research Hypotheses

The following were the research hypotheses:

- i) There is no significant effect of mobile money on money demand in the EAC.
- ii) There is no significant effect of ATMs on money demand in the EAC.

1.5 Significance of the Study

Financial innovation which is one of the key determinants of money demand have important implications for monetary policy in the EAC region. This is because many EAC countries still utilize monetary aggregates targeting. This study was, therefore, significant in that getting to understand the manner in which financial innovation might positively or negatively impact money demand might guide the EAC's Central Banks in formulating and implementing appropriate monetary policies. This essentially means that the findings of this study greatly informed the monetary policy framework in the region by addressing the situation whereby various monetary policy targets and objectives have been consistently missed or not achieved in the EAC. These targets and objectives include low level of inflation, appropriate exchange rate, high GDP growth rate, price stability, and higher level of investment and savings. The findings of the study, therefore, provided a platform for the formulation and implementation of an effective monetary policy in the EAC. The findings of this study also contributed a lot to the body of knowledge on the evolution and dynamism in the monetary framework in the EAC

hence useful for researchers who might wish to carry out an empirical research study concerning this subject in the future.

1.6 Scope and Limitations of the Study

The study specified a money demand model that takes into account financial innovation. The model was estimated using balanced panel data fixed effects technique. The proxies that were used to represent financial innovation were mobile money and ATMs. The effect of financial innovation on money demand in the EAC was considered using a panel of four countries (Kenya, Uganda, Tanzania, and Rwanda) for the period 2007 to 2020. This particular period was chosen because reliable and comprehensive data are available. Other key determinants of money demand that were included when specifying the money demand model for the EAC were the level of national output (real GDP) and interest rate. These variables acted as control variables in the study. Real GDP was also as a proxy for income which is a scale variable in the specification of money demand model. On the other hand, interest rate represented the opportunity cost of holding money variable in the specification of money demand model. The study was limited by the unavailability of mobile money data for Burundi and South Sudan. The mobile money data for these two countries was not available in the reliable international data depositories such as World Bank and the IMF. This made it impossible to include the two countries when coming up with the money demand function for the EAC.

1.7 Definition of Terms

Automated Teller Machine: An electronic device that enables individuals who have accounts with financial institutions such as banks to carry out financial tasks such as cash withdrawals, deposits, fund transfer, or getting account information without requiring the help of a bank professional.

Financial Innovation: Technological advances which facilitate access to information, trading and means of payment characterized by the emergence of new financial products and services, new forms of organization, complete, and more developed financial markets.

Gross Domestic Product: The market value of all official recognized final goods and services produced within a county in a year, or over a given period of time.

Mobile Money: Mobile phone-based application that enables individuals to receive money and transfer money using their mobile phones. It was launched in Kenya in 2007 by the leading telecommunications operator Safaricom.

Monetary Policy: This consists of actions and decisions taken by the monetary authority (Central Bank) of a country to control the supply of money using various instruments and monetary tools such as open market operations and interest rate with an aim of achieving various objectives such as promoting economic growth and price stability.

Money Supply: This is the total amount of money that is in circulation at a given period of time.

Money Demand: This is the desire to hold financial assets that are in the form of bank deposits or cash.

M0 and M1: They are also referred to as narrow money. They usually consist of currency (notes and coins) that are in circulation and other equivalents of money (demand deposits) that can be easily converted into cash.

M2: They are also referred to as broad money. They include M1 plus savings, short-term time deposits in banks and twenty-four-hour money market funds.

M3: They are also referred to as broad money. They include M2 plus long-term time deposits, fixed deposits, and money market funds with a maturity period of more than twenty-four hours.

Panel data: A set of observations combining both time series and cross-sectional data in analysis at a more than one time period.

East African Community: In this particular study it refers to countries that include Kenya, Tanzania, Uganda, and Rwanda.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of related literature on the effect of financial innovation on money demand. This section examines available literature on the subject of financial innovation that has been articulated by various researchers. The areas that include theoretical literature and empirical literature will be addressed. The literature review also comprises of the theoretical and conceptual frameworks. The reviewed literature was used as a basis to examine the current trends on financial innovation and money demand.

2.2 Theoretical Literature Review

There exist various money demand theories. This study examined the following theories that relate money demand to its determinants:

2.2.1 Classical Money Demand Theory

The classical economists postulated that money is a medium of exchange and came up with the transaction motive for holding money, which depicts or illustrates the significant relationship that exists between the quantity of money in circulation and the volumes of price and transactions. This resulted in the development of quantity theory of money demand, which perceives income as the key determinant of money demand Serletis (2007). The quantity theory of money demand was developed by Fisher (1911). This particular theory was explained using the equation of exchange. According to this theory, the demand for money in an economy is solely a function of the volume of transactions taking place in an economy (Fisher, 1911). Economic agents particularly households, therefore, demand money solely to meet their transaction purpose and the more money households require for transactional purpose, the more the money will be demanded. The relationship between the demand for money and the amount of transaction is expressed in the following equation:

$$MV = PT \tag{2.1}$$

Where:

M is the quantity of money

V is the transactional velocity of money

P is the price level

T is the volume of transactions

Fisher (1911) argued that individuals demand money for only one purpose, which is transaction purpose. He also believed that the demand for money is inelastic to changes in interest rate. The Cambridge school economists later modified the Fisher's equation and came up with a different functional form of the old equation. They did so by replacing volume of transactions (T) with output (Y). The modification was necessary because there is a challenge inherent with the original Fisher's equation. The challenge is that it is difficult to account for the number of transactions in an economy. Hence, output (Y) is used as a proxy for transactions (T) because the more an economy produces output, the more goods and services are transacted (bought and sold). With this particular modification by the Cambridge economists, the equation of exchange becomes:

$$MV = PY \quad (2.2)$$

The above equation is transformed into the quantity theory of money demand by solving for the real money balance (M/P) and hence the equation is rewritten as:

$$M/P = \frac{1}{V}Y \quad (2.3)$$

Equilibrium in the money market is attained when the quantity of real money supplied M/P is equal to the demand for real money balances $(M/P)^d$ and $1/V$ is equal to k . It is important to note that k is a constant that reflects both the technological and institutional features of an economy which are stable during the short-run. The quantity theory of money demand is hence expressed as:

$$(M/P)^d = kY \quad (2.4)$$

Finally, the expression of the quantity theory of money demand indicates that the demand for money is solely a function of income and many empirical studies have found out that this relationship is stable over time. This is the key major strength of this particular theory.

However, one of the weakness of this particular theory is that it does not incorporate other determinants of money demand such as financial innovation.

2.2.2 Keynesian Money Demand Theory

Keynes (1936) developed liquidity preference theory of money demand. Keynes (1936) modified the quantity theory of money that was developed by the classical economists to include the interest rate. In doing so, Keynes argued that households hold money for three main motives: the transaction motive, the precautionary motive, and the speculative motive (Keynes, 1936). The role of money as the medium of exchange is reflected in the transaction demand and precautionary demand for money. This can be interpreted to mean that income plays a major role in determining money demand. On the other hand, the role of money as a store of value is reflected in the speculative demand. Household decide between holding money either in form of cash or bonds. This makes interest rate a significant variable in the specification of money demand model (Sriram, 1999). Contrary to Fisher, Keynes argued that the there are two key factors influencing the demand for real money balances. The two factors are income and interest rate. Also, according to Keynes, the number of transactions is a positive function of income and hence if income increases, the demand for real money balances is also expected to increase for both transactional and precautionary motives. Moreover, Keynes opined that money demand for speculative motive is interest rate elastic since interest rate is one of the opportunity cost of holding money variables. Hence, the Keynesian money demand function is expressed as:

$$\left(\frac{M}{P}\right)^d = f(i, y) \quad (2.5)$$

According to the equation above, the demand for real money balance is a function of two factors namely income and interest rate. Money demand is inversely related to interest rate (r) and positively related to income (y). Keynes further argued that the transactional velocity of money (V) is not fixed but instead it is positively related to interest rate and usually fluctuates.

One of the major strengths of this particular theory is that it helped to elaborate the reasons why people demand money. However, one of the weakness of this theory is that it left out financial innovation when explaining the motives for holding money.

2.2.3 Transaction (Inventory) Theories of Money Demand

Inventory (transaction) theories of money demand are grouped under the post-Keynesian money demand theories. They stress on the role of money as a medium of exchange (Serletis, 2007). Inventory theories of money demand take into consideration money demand for transactional purposes. One of the most well-known inventory theories of money demand is the Baumol-Tobin inventory model. Baumol (1952) and Tobin (1956) developed an approach that explains the demand for money by analyzing the costs and benefits associated with holding money. The benefit of holding money is the liquidity while the cost of holding money is the interest that is forgone.

According to Baumol-Tobin theory, while economic agents such as households receive income after a certain period, say after one month, they transact at a constant rate over that particular period. The economic agent (in this case the household) can decide either to hold his/her income and then use it for transaction purposes or save his/her income in an interest-earning savings account or invest it in other interest-earning assets like bonds. However, there is usually a trade-off between the costs associated with holding income and the transaction costs associated with converting interest-earning assets into money. Hence, the optimal strategy for an individual is to hold a certain portion of his/her income in form of cash and the remaining portion in form of interest-earning assets like bonds. As per the Baumol-Tobin model, the optimal average demand for money is expressed as:

$$\frac{M^d}{p} = \sqrt{cY/2r} \quad (2.6)$$

Where:

M^d is the money demand

c is the cost of converting interest-earning assets like bonds into money

r is the nominal interest rate

p is the price level

Y is the income

Therefore, the main argument of the Baumol-Tobin inventory model is that transaction demand for money has a direct relationship with income (Y) and an inverse relationship with nominal interest rate (r) earned on alternative assets like bonds. Moreover, the transaction costs involved when converting wealth between money and interest-earning assets also has a direct relationship with the demand for money. For instance, the introduction of ATMs, mobile money, and internet banking are all associated with the decrease in transaction costs. Thus, more wealth is likely to be held in the form of interest-earning assets such as bonds and less in the form of cash. According to the Baumol-Tobin inventory model, the income elasticity of money demand is 0.5 while the interest rate elasticity of money demand -0.5. This means that money demand should go up by 5% when income rises by 10% and money demand should decrease by 5% when interest rate rises by 10%.

Inventory theories of money explains the liquidity theory of money since they indicate that money demand is directly related to income and inversely related to interest rate. Various forms of financial innovations such as mobile money and ATMs have resulted in economic agents holding less money in form of cash. These forms of financial innovation have resulted in an increase in the portion of demand deposits at the expense of currency (notes and coins) holdings.

One of the strengths of transaction theories of money demand is that they help to explain how the cost of holding money in form of other financial assets such as demand deposits is reduced by the introduction of various financial innovations such as mobile money and ATMs. This particular theory was, therefore, an anchor in this particular study since it paid more attention on the role of financial innovation as a major determinant of money demand.

2.2.4 Portfolio Theories of Money Demand

Another group of post-Keynesian money demand theories is the portfolio theories of money demand. Portfolio theories lays emphasis on the function of money as a store of value (Serletis, 2007). Portfolio theories of money demand postulates that economic agents hold money as part of their portfolio of assets since money is one of the assets among several other assets and it provides a unique combination of returns and risks than other financial assets. Friedman (1956)

and Tobin (1958) are credited with developing the most well-known portfolio theory of money demand.

According to portfolio theories of money demand, money is treated just like any other asset. Moreover, portfolio theories of money demand use the assets demand theory to come up with the money demand theory. Furthermore, portfolio theories consider the demand for money to be a function of the return and risk provided by money and by other alternative financial assets such as bonds that economic agents can hold instead of money. Additionally, portfolio theories consider the demand for money to be a function of wealth. This is because the size of wealth of an economic agent determines the amount of the portfolio to be allotted between money and other alternative financial assets. The version of money demand can thus be expressed as:

$$\frac{M^d}{P} = f(W, Y_p, r_b - r_m, r_e - r_m, \pi^e - r_m, U) \quad (2.7)$$

Where:

$\frac{M^d}{P}$ is the demand for real money balances;

Y_p is permanent income (Friedman's measure of wealth)

r_m is the expected return on money

r_b is the expected return on bonds

r_e is the expected return on common stock (equity)

π^e is the expected rate of inflation

W is the proportion of human wealth and non-human wealth

U is the institutional factors such as mode of wage payments and bill payments

Since the demand for assets goes up as wealth of an economic agent increases, the demand for money is also directly related to permanent income. This is because as wealth increases, the portfolio of assets is also expected to increase. The proponents of portfolio theories of money

demand identified three main types of assets that are held by economic agents in their portfolios. They include bonds, goods and stocks.

The proponents of portfolio theories of money demand also argue that the incentive to hold money depends on the attractiveness of these assets compared to holding money. The expected returns on these assets are inversely related to money demand. As r_e or r_b increases, the demand for money reduces since it becomes less attractive to hold money compared to holding either stocks or bonds. Furthermore, a rise in expected inflation also decreases the demand for money because money becomes less attractive as its real value depreciates when inflation rises.

One of the strengths of portfolio theories of money demand is that they take into consideration financial innovations. They explain how money is held in various forms of financial assets such as mobile money and card money (ATMs).

2.3 Empirical Literature Review

The subject concerning the determinants of money demand has elicited attention among many researchers in both the developed countries and LDCs. Researchers in developed countries pioneered the empirical studies on money demand. There has also been a considerable interest in the LDCs.

Several studies have been carried out to examine the impact of financial innovation on money demand in both the developed and developing countries. Researchers in the EAC have used various proxies to measure financial innovation. For instance, Sichei and Kamau (2012) used ATMs, Ndirangu and Nyamongo (2015) used time deposit ratio/currency outside banks, and Munene (2018) used volume of M-PESA and ATM transactions as proxies for financial innovation.

Bilyk (2006) used the VECM to investigate and estimate the relationship between financial innovations and the demand for money in Ukraine. Monthly data from 1997 to 2005 was used and the findings revealed the importance of financial innovation in influencing money demand. The impulse-response analysis showed that the impact of financial innovations was stronger in the narrow demand for money. Additionally, the study established a negative impact of

financial innovation on money demand in Ukraine in the short-run and a positive impact in the long run.

Odularu and Okunrinboye (2009) used the Engle and Granger two-step cointegration technique to assess the impact of financial innovation on the demand for money in Nigeria. The findings indicated that financial innovations have not had a significant impact on money demand in Nigeria. This finding contradicts many empirical studies that found a significant impact of financial innovation on money demand.

Khan and Hye (2011) conducted a study to estimate the role of financial liberalization on money demand in Pakistan. The annual data for the period between 1971 and 2009 was used. The study used time trends instead of dummy variables that capture structural breaks. Using cointegration and ARDL approach, the study estimated long-run equilibrium relationship between money demand and composite financial liberalization index along with other determinants of demand for money such as GDP, exchange rate, and real deposit rate. The findings indicated that financial liberalization positively affects the demand for money both in the short run and in the long run.

Maniragaba (2011) used the ECM to investigate the effect of financial liberalization on the money demand and economic growth in Uganda using annual data from 1978 to 2008. Some of the measures of financial liberalization used include interest rate deregulation, implementation of prudential rules, reduction in direct credit, privatization of state-owned commercial banks, liberalization of securities markets and international financial liberalization, and reduction in entry requirements. The study found a positive impact of financial liberalization on money demand in in the long run.

Suliman and Dafaalla (2011) applied both cointegration and ECM to estimate the determinants of narrow money demand in Sudan. Annual observations for the period between 1960 and 2010 were used. The study found out that there exists significant long-run and short-run relationship between money demand and its determinants. The findings of this study are consistent with the results of various empirical studies.

Kipsang (2013) applied both cointegration and ECM techniques to examine how factors such as price levels, interest rates, real GDP, exchange rate and the pace of financial innovation affects demand for money in Kenya using data from 1970 to 2012. The study found that financial innovation process which was measured as the ratio of M2 to M1 had no impact on real money demand balances. The short run and long run estimation results of this particular study also indicated that only inflation and GDP are significant determinants of money demand in Kenya. This implies that that increased inflation and increased GDP increases the demand for money and vice versa in Kenya. The study recommended that policies aimed at increasing the GDP in Kenya should be pursued. The study also recommended the use of monetary aggregates M3 as a policy tool to target inflation because money demand is significantly influenced by inflationary factors in Kenya.

Mwangi (2014) analyzed the effect of financial innovation on money demand in Kenya using error correction model. The study used published quarterly secondary data for the period 2000 to 2012. The data was obtained from the Kenya National Bureau of Statistics (KNBS) and Central Bank of Kenya (CBK) database. Some of the proxies for financial innovation that were used included mobile phone money transfer, automated teller machines (ATMs), and agency-banking. The findings of the study revealed that advances in electronic technology have transformed the monetary landscape in a significant way. He also observed that financial innovation has had a positive effect on money demand in Kenya both in the short run and in the long run.

Nakamya (2014) investigated the effect of financial innovation in form of new transaction technologies on demand for narrow money (M1) in Uganda. The study assessed the effect of automated teller machines (ATMs) and electronic funds transfers (EFTs) on the demand for narrow money in Uganda. The study established that both ATMs and EFTs have resulted to increase in the demand for narrow money in Uganda. The income elasticity of money demand was positive. The positive effect of ATMs and EFTs can be interpreted to mean that there are welfare gains from reduced transaction costs involved.

Aggarwal (2016) empirically analyzed India's money demand function. Using quarterly data for the period 1996 to 2013 and employing dynamic OLS technique, he established that short-

term interest rate and GDP has a significant positive effect on money demand in India. He, therefore concluded that short-term interest rate and GDP are the key determinants of money demand in India.

Aliha *et al.* (2017) conducted a study to find out the effect of ATMs on money demand globally. Using panel data, the results revealed that the sensitivity of money demand to ATMs is low. They concluded that ATMs has less significant impact on the demand for money globally.

Shiva and Durai (2017) attempted to answer the question whether the use of debit and credit cards affect money demand and seigniorage in India. Using ARDL approach, cards usage data and macroeconomic data from April 2005 to September 2014, the study found out that the use of credit cards is has a negative effect on money demand in India. The study also established that the use of debit cards has a positive effect on the demand for money in India.

Alih *et al.* (2018) used DOLS and FMOLS techniques to investigate the relationship between financial innovation and money demand in Malaysia. The results indicated that that financial innovation has a positive significant impact on the demand for money in the long-run in Malaysia.

Dou (2018) examined the determinants of money demand in China. The empirical findings indicated that some of the key determinants of money demand in China include income, expected inflation rate, and interest rate. The study also established that other factors that include currency substitution, financial innovation, capital mobility, and government debt play a relatively less significant role in influencing the demand for money in China. This is because China's monetary and financial system has been undergoing reforms over the years.

Kasekende and Nikolaidou (2018) investigated the development of financial innovation and its impact on money demand in the Sub-Saharan Africa region. Using panel data estimation techniques for thirty-four Sub-Saharan Africa countries between 1980 and 2013, the findings indicated that mobile money which is one of the recent forms of financial innovation not only

has a positive effect on money demand but also leads to a decrease in the interest rate elasticity of money demand.

Munene (2018) employed the VECM to examine the effect of financial innovation on money demand in Kenya for the period between 2008 and 2016. This particular study found a positive significant relationship between financial innovation and money demand which was statistically significant at five percent level of significance. The study recommended that the government should intervene by regulating the number of transactions done via ATMs and mobile money. The study also recommended that government intervene by regulating credit accessibility through mobile money and ATMs. The final recommendation of this particular study was that the government intervene in the financial sector by setting minimum interest rate to be charged by all money lenders irrespective of the means and sector. These recommendations were aimed at ensuring a stable monetary system hence stable economy.

Hussaini and Yusuf (2019) conducted a study to find out the determinants of money demand in five Asian countries. The findings showed that GDP per capita has a positive significant effect on money demand at one percent level in Thailand, Malaysia, Singapore and Philippines. However, the study established an insignificant effect of GDP per capita on Money demand in Indonesia. Another finding of this study was a negative significant relationship between inflation and money demand in Thailand, Malaysia, and Philippines. However, Singapore and Indonesia presented insignificant results regarding the relationship between inflation and money demand. The study also found a positive significant effect of interest rate on money demand at ten percent level in Thailand, Indonesia, and Philippines while Singapore and Malaysia have an insignificant relationship between interest rate and money demand. Lastly, the study found a positive significant relationship between exchange rate and money demand in Thailand, Malaysia, Singapore and Philippines while Indonesia has a negative insignificant relationship.

Neewhord (2019) adopted an ARDL approach to specify a money demand function for Sierra Leone. The study incorporated financial innovation and tested the stability of Sierra Leone's money demand function. The study's period was between 1966 and 2016. The long-run empirical results indicated that financial innovation directly affects money demand in Sierra Leone. Moreover, the study established that financial innovation is indirectly related to money

demand in the short run. Lastly, the study found out that money demand function for Sierra Leone was stable.

Adil *et al.* (2020) conducted a study to find out the effect of financial innovation in India. The developed money demand function was estimated using the linear ARDL approach and cointegration. This study found out that financial innovation plays a very significant role in the specification and stability of money demand model. This implies that financial innovation is a significant variable in the specification of money demand model.

Mbazima-Lando and Manuel (2020) conducted a study to investigate the impact of financial innovation on money demand and draw implications for monetary policy in Namibia. The study adopted the Engle-Granger two-step co integration methodology and various tests were carried out to test the stability of the money demand function. The study used time series data for the period between 2002 and 2019. The findings of this study revealed that money demand in Namibia is mainly influenced by interest rates and prices. The study also found out that Namibia's money demand function is unstable both with and without the inclusion of a financial innovation variable. The instability of Namibia's money demand function implies that the current monetary policy framework in Namibia does not exclusively depend on full control of the broad money aggregate. This is attributed to the fixed exchange rate regime in the country. Another finding of this study was that financial innovation has a significant impact on money demand in Namibia. The study recommended enhanced responsiveness and awareness of the monetary authority to the impact financial innovation might have on major monetary aggregates, variations in their definitions and potential effects on the monetary policy transmission mechanism since financial and economic transactions become more complicated in an increasingly digitized economy.

Mlambo and Msosa (2020) used GMM panel technique to examine the effect of financial technology on money demand in some selected African states. The findings showed that various forms of financial technology such as ATMs and mobile money have a significant negative impact on money demand. The results of this study indeed confirm that financial innovation plays a significant role in influencing money demand.

Muchlisin (2021) used VECM and secondary time series data for the period between 2010 and 2019 to examine the effect of financial innovation on money demand in Indonesia. The data was obtained from Bank Indonesia and Central Bureau of Statistics. Using two proxies of financial innovation (ATM transactions and electronic money), the study found out that the effect of ATM transactions on money demand in Indonesia is positive at 1% significance level. The study also found out that an increase in ATM transactions will increase the demand for money in Indonesia. Additionally, the study established that electronic money negatively affects money demand in Indonesia at one percent significance level. Therefore, as the use of electronic money increases, the demand for liquid money (cash) will decrease.

2.4 Theoretical Framework

This study was grounded on the Keynesian theory of money demand. Keynes was one of the economists who criticized the Cambridge equation. This is because it was realized that Cambridge equation ignored the important role played by interest rate in influencing money demand. He, therefore, suggested an alternative way in which money demand function could be expressed, which he referred to it as the liquidity preference.

Keynes outlined three main reasons as to why economic agents such as households demand money. These motives include transaction motive, precautionary motive and the speculative motive. The transaction motive describes the necessity of holding cash to bridge the gap between receipts and planned regular payments. Precautionary motive of holding money describes the necessity of holding some cash for unplanned activities, such as paying unexpected bills.

The Keynesian economists suggested that both transaction and precautionary motives depend on the level of income. The third motive of holding money identified by Keynes is the speculative motive. This particular motive describes the necessity of holding money if they expect the market value of alternative assets to fall. The speculative motive for holding money, therefore, arises from the desire to maximize income and it depends on the rate of interest (Laidler, 2010).

Keynes specified the money demand function as follows:

$$M^d = k(Y) + L(r) \quad (2.8)$$

Where: M^d is the demand for money

$K(Y)$ is the transaction and precautionary motive depending on the level of income (Y)

$L(r)$ is the speculative motive which depends on interest rate (r).

The Keynesian theory of money demand was hence significant in the study since people demand money for the above three outlined motives. Therefore, the three motives namely: transaction, precautionary and speculative are the key factors that influence individuals to demand money either through mobile money or ATMs hence having an impact on money demand in the economy.

2.5 Conceptual Framework

Independent Variables and Control Variables

Dependent Variable

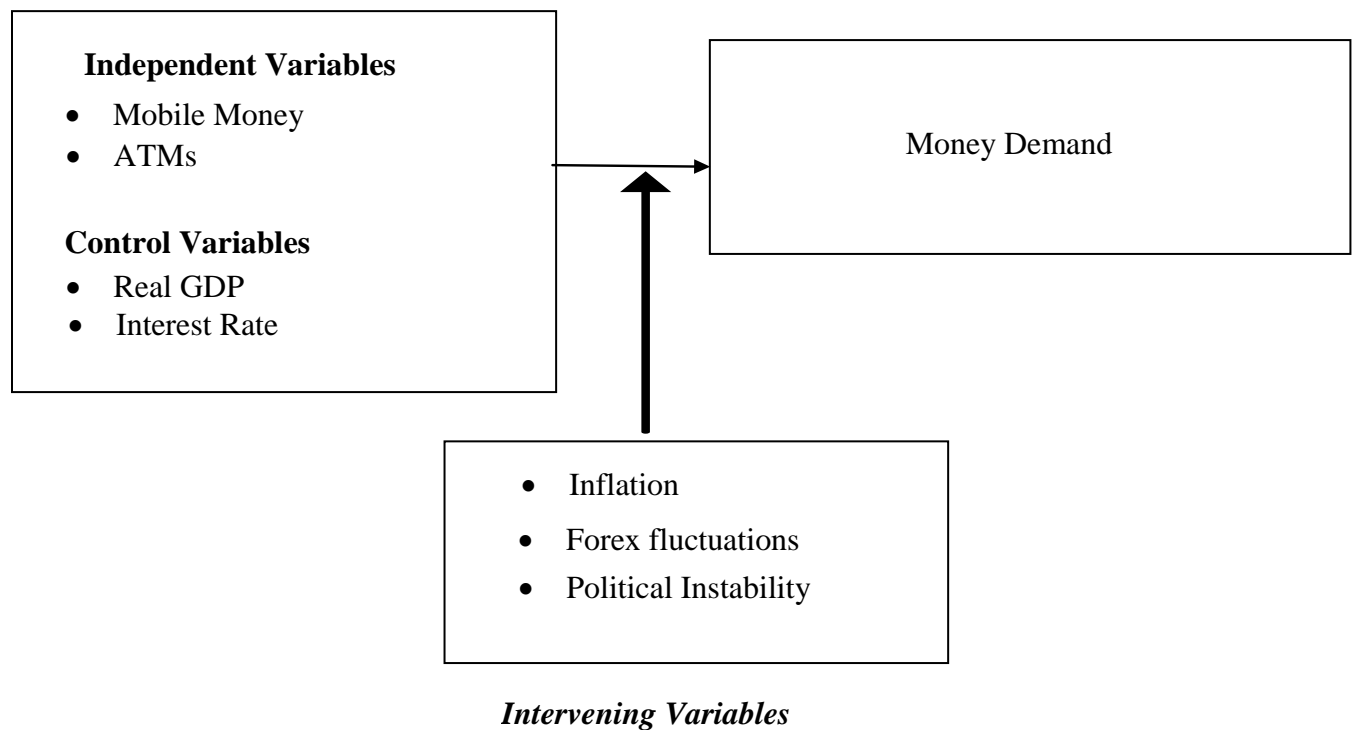


Figure 2.1: Conceptual framework.

The model above shows both the dependent, independent and control variables in the study. The variables on the left side are the independent and control variables. On the other hand, the variable on the right side is the dependent variable. The dependent variable is money demand which was measured in terms of real money balances M2 (broad money). The independent variables are financial innovation (which was measured in terms of volume of mobile money transactions and volume of ATMs transactions). The control variables are real GDP and interest rate. It was expected that financial innovation would have a positive effect on the demand for money. This is because as mobile money and ATMs transactions increase, the more the economic agents will demand money held in mobile form (mobile money) and card form (ATM). It was also anticipated that real GDP (which represents income, a scale variable in the specification of money demand model) will have a significant positive impact on money demand. This is because increase in GDP due to improved economic performance would lead to corresponding increase in money demand. However, it was expected that interest rate (an opportunity cost of holding money variable in the specification of money demand model) will have a significant negative effect on money demand. This is because an increase in interest rate increases the cost of borrowing money by economic agents. This will, thus, discourage economic agents from demanding money. There are intervening variables which can have a counteracting effect on the dependent variable. They include monetary policy, inflation, forex fluctuations, and political instability.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the research design, specification of the model, justification and measurement of variables, data type and sources, panel data analysis, and diagnostic tests.

3.2 Research Design

The study employed historical research design. Historical research design is the type of research design that is concerned with critical inquiry of past events (Wiersma, 1986). Historical research design was used in that it captured the trend of money demand in the EAC.

3.3 Study Area

The EAC is found within the African continent and lies in the Sub-Saharan Africa region (EAC, 2021). The EAC is the regional intergovernmental organization of the Republics of Kenya, Uganda, Tanzania, Burundi, Rwanda, and South Sudan with its headquarters in Arusha, Tanzania (EAC, 2022). The location of EAC region is between 28°45' E 41°50' E and 5°30' N 12°0' S (EAC, 2022). The EAC aims to widen and deepen cooperation or integration among its member states and other regional economic communities in, among others, political, economic and social matters for their mutual gains (EAC, 2022). The treaty that led to establishment of the EAC was signed on 30th November 1999 and entered into force on 7th July 2000 following its ratification by the original three member states – Kenya, Tanzania, and Uganda. Rwanda and Burundi acceded to the EAC Treaty on 18th June 2007 and became full members of the EAC with effect from 1st July 2007 (EAC, 2022). The EAC became a fully-fledged customs union in January, 2010 and started operating as a common market 6 months later in July, 2010 (EAC, 2021). The consolidation on the customs union and smooth running of the operations of the EAC as both a common market and monetary union to a greater extent will rely on availability of reliable, accurate, comparable, and timely data for purposes such as planning, monitoring and evaluation. Additionally, if the monetary union protocols of the EAC are successfully adopted and implemented, it will be easy and effective to monitor the macroeconomic performance of the EAC. Hence this study examined one of the macroeconomic variables in the EAC by analyzing the effect of financial innovation on money demand in the EAC.

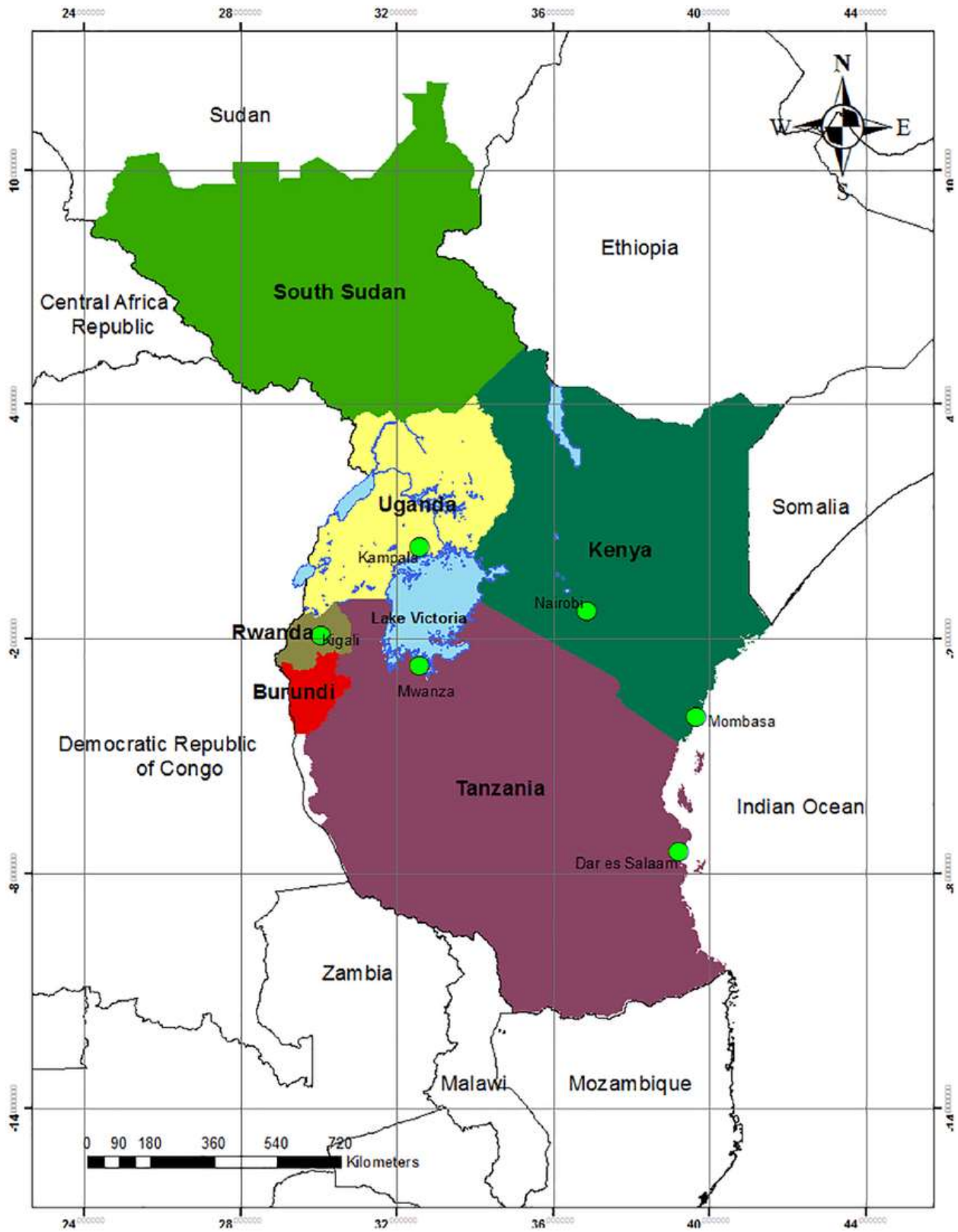


Figure 3.1: Map of the EAC.

Source: Tyner (2018)

3.4 Data Analysis

This particular research study employed panel data analysis technique. The panel data setting addresses the issue of omitted variable bias by including a significant variable (which is financial innovation) in the specification of money demand model for the EAC. Given the significance of dynamics and the potential for heterogeneity in estimating a money demand function for the EAC, several panel data analysis methods were used. Analysis of the effect of financial innovation on money demand was performed using the balanced panel fixed effects (FE) model. This model is capable of analyzing cross-sections (various countries) and time series (various time periods) simultaneously, each with one dependent and multiple independent variables. Another advantage of the balanced panel FE model is that it addresses the problems of endogeneity, multicollinearity and omitted variable bias. One assumption of the balanced panel FE model is that the differences among cross sections can be captured using the constant term. The balanced panel FE model was thus geared at controlling for unobservable country effects and time-invariant effects.

3.4.1 Descriptive Analysis

To understand the trend and behavior of the variables, this study employed descriptive analysis. Descriptive statistics provided simple summaries concerning the sample and the measures. The measures of central tendency that were employed is mean. The measures of variability included maximum, minimum, standard deviation, skewness and kurtosis. The skewness test was used to demonstrate whether the distribution is concentrated to a central value (symmetric) or has long tails (asymmetric). Pearson Correlation (r) was used to analyze the degree of association between the dependent variable and independent variables. Further, the test for peakness (Kurtosis) was done to show how the variable distribution is peaked relative to normal distribution.

3.4.2 Specification of the Model

The money demand model for this particular research study was specified generally as follows:

$$M_{it}^d = f(MOB_{it}, ATM_{it}, GDP_{it}, INTR_{it}) \quad (3.1)$$

$$M_{it}^d = \beta_0 + \beta_1 MOB_{it} + \beta_2 ATM_{it} + \beta_3 GDP_{it} + \beta_4 INTR_{it} + \mu_i + v_t + \epsilon_{it} \quad (3.2)$$

$$i = 1, 2, \dots, N, t = 1, 2, \dots, T$$

Where:

M_{it}^d is the demand for real money balances, expressed as M2

MOB_{it} is the number of mobile money transactions (proxy for financial innovation)

ATM_{it} is the number of ATMs (proxy for financial innovation)

GDP_{it} is the gross domestic product (proxy for income; represents the scale variable in the specification of money demand model)

$INTR_{it}$ is the interest rate (represents the opportunity cost of holding money variable in the specification of money demand model)

μ_i is the country fixed effects

v_t is the time fixed effects

ε_{it} is the error term and is used to capture the unexplained variations in the model

$\beta_0, \beta_1, \dots, \beta_3$ are parameters to be estimated

Subscripts i and t represents country and time period respectively

The above money demand model was specified in logarithmic form. This is in alignment with the general agreement in literature that the logarithmic form is the most functional form (Sriram, 1999). Hence the natural logarithms (ln) of the target variables were taken when the estimating the money demand model. This allowed for the coefficients of the regression to be treated as elasticities. Another advantage of expressing the variables in natural logarithmic form is that it minimizes some of the econometric problems such as heteroscedasticity and also help attain stationarity in the lower order of integration (Gujarati, 2004).

Thus, the above money demand equation (3.2) became;

$$\ln M_{it}^d = \beta_0 + \beta_1 \ln MOB_{it} + \beta_2 \ln ATM_{it} + \beta_3 \ln GDP_{it} + \beta_4 \ln INTR_{it} + \mu_i + v_t + \varepsilon_{it} \quad (3.3)$$

3.4.3 Variable Definition, Justification, Measurement and Sources of Data

The use of panel data estimation techniques results in the combination of time series data with cross sectional data. Combining cross-section with time series data is advantageous. First, it is necessary when analyzing money demand especially in the EAC. This is because the demand for money in most of the EAC countries varies substantially over time. The time-series component of the variables under study offers important information ignored in cross-sectional research studies. Secondly, the use of panel data allowed increasing the sample size hence the gain in the degrees of freedom which is particularly of great essence when a relatively large number of regressors are used in the model. Finally, panel data estimation help improve upon the issues that are not addressed by cross-sectional data. Such issues include controlling for country specific effects and potential endogeneity of the regressors (Plasmans, 2005).

Money demand (M^d) which was the study's dependent variable was measured using broad money (M2). M2 was used since it is more appropriate for modeling purposes. M2 is also generally less affected by financial deregulations and innovations and has a more reliable relationship with income (Subbaraman, 1993).

Financial innovation was the study's independent variable. FI is the technological advances that facilitate access to information, trading and means of payment, and to the emergence of new financial products and services (Kipsang, 2013). FI was measured using the number of mobile money transactions and the number of ATMs. It is important to note that mobile money and ATMs have become more common in the EAC's financial sector hence representing major technological innovations in the EAC's financial system.

The gross domestic product (GDP) is the total market value of all final goods and services produced in a country in a given year (Mankiw & Summers, 1986). Real GDP is usually used in many empirical studies as a proxy for income. Income is usually considered as a scale variable in the specification of the money demand model (Bilyk, 2006). Real GDP was one of the control variables in the study. The real GDP was measured using current US Dollars.

The interest rate (INTR) indicates the rate at which people borrow money from financial institutions such as commercial banks. Interest rate is usually considered as an opportunity cost of holding money variable in the specification of the money demand model. Interest rate was also another control variable in the study. Mankiw (2008) opines that the level of interest rate is one of the factors that influence money demand. The interest rate data was obtained from the World Bank.

This study utilized secondary panel data set of four EAC countries namely Kenya, Uganda, Tanzania, and Rwanda. Secondary data is cheaper, readily available, and easy to access (Kothari, 2004). Published data and records from international data repositories were the most preferred secondary source of data. The data was obtained from international data repositories such as World Bank and the IMF. Data collection schedule was used when collecting the data.

3.5 Pre-Estimation Panel Diagnostic Tests

3.5.1 Panel Unit Root Test

The panel unit root test is usually carried out to find out whether the panel regression model is stationary or non-stationary. Whether a variable is stationary or not depends on the presence of a unit root. If a variable has a unit root, it is considered to be non-stationary and if not, then it is considered to be stationary. Macroeconomic panel data generally have a stochastic trend which can be removed by differencing. Panel unit root test is done in order to minimize the chances of spurious regression findings and misleading output with no economic meaning (Greene, 2012). If the findings are spurious, the standard error of the analyzed variables is likely to become biased and inefficient. Another consequence of spurious results is both the t-ratio and p-value becoming void leading to ambiguous results that have no economic meaning (Gujarati, 2004).

Some of the standard tests for panel unit root include Phillips - Perron (PP) test, Harris-Tzavalis (HT) test, Levin-Lin-Chu (LLC) test, Augmented-Dickey Fuller (ADF) test, and Im-Pesaran-Shin (IPS) test. The study used the LLC test to confirm the presence of a panel unit root. This particular test is suitable for data sets with smaller number of panels like in this particular study.

3.5.2 Panel Cointegration Test

Panel cointegration test is important for the analysis of ECMs. Panel cointegration regression estimation is applied to account for cointegration relations existing between non stationary panel data variables. Panel cointegration test is important in that it is able to solve problems that are likely to arise when estimating variables that are non-stationary (Granger *et al.*, 1995).

If the study variables are found to be non-stationary, panel cointegration tests developed by Kao and Chiang (2001) and Pesaran *et al.* (2001) can be applied. This is because these tests does not involve pre-testing the variables to find out their order of integration since the test can be done regardless of whether the variables are only an I(0) or I(1) or both (Pesaran *et al.*, 2001).

3.5.3 Hausman Test

The Hausman (1978) specification test is generally used to decide between applying either a fixed or random effects model. Fixed effects (FE) model is used whenever a researcher is only interested in analyzing the effect of the variables that change over time. FE explores the relationship between predictor and outcome variables within an entity e.g., a person, company, country etc. On the other hand, random effects (RE) model assumes that the error term of an entity is not correlated with the predictor variables hence allowing for time-invariant variables to act as explanatory variables. Therefore, in the RE model, one is supposed to specify the individual characteristics that might or might not influence the predictor variables. However, one challenge with the RE model is that some variables might not be available, resulting in omitted variable bias in the model. One notable advantage of the RE model is that it allows generalizing the findings beyond the sample used in the model (Baum, 2006).

3.6 Post-Estimation Panel Diagnostic Tests

The findings of panel estimation are said to be biased, inefficient, and inconsistent if econometric problems such as, misspecification of the model, heteroskedasticity, serial correlation and correlation of error term exist in the panel regression model. Therefore, panel post-estimation diagnostic test is essential to ensure that the panel regression model is free from these econometric problems.

3.6.1 Test for Serial Correlation

Serial correlation (autocorrelation) is one of the violations of the assumptions of classical least squares. Autocorrelation occurs when the observations of the error term are uncorrelated with each other. Serial correlation is likely to occur in all types of data i.e., cross sectional series data, time series data, and panel data set. Autocorrelation results in the expected variances of the coefficients of the model becoming biased and inconsistent hence hypothesis testing will no longer be valid. Additionally, when serial correlation occurs, the t-statistics will tend to be higher and the value of R^2 will be overestimated in the model. There are various methods that can be used to test for autocorrelation. They include Breusch-Godfrey autocorrelation Lagrange Multiplier (LM) test and Wooldridge test.

The autocorrelation test that was used in this study is the Wooldridge test. This is because this particular test allows for the case where higher order lagged dependent variable is included as the explanatory variable (Newey & West, 1987). Wooldridge test is also able to determine higher orders of serial correlation as well as the lagged dependent variable. This is in contrast to Durbin-Watson test. Some of the ways of eliminating autocorrelation is to identify factors causing autocorrelation, using the generalized least squares (GLS) estimator, generalized differencing, and employing heteroskedasticity and autocorrelation (HAC) panel robust standard errors (Dougherty, 1992; Ivanov & Lutz, 2005).

3.6.2 Test for Heteroskedasticity

Heteroskedasticity is also another violation of the assumptions of the classical least squares. It occurs when the size of the error term is not constant hence the disturbance term varies across the values of the regressors. Hence, the t-values for the coefficients cannot be depended on. The test that was conducted to find out the presence of heteroskedasticity is modified Wald test. Heteroskedasticity can be corrected using HAC panel robust standard errors technique (Driscoll & Kraay, 1998; Newey & West, 1987).

3.6.3 Test for Cross-Sectional Dependence

Cross-sectional dependence is the inter-dependence between cross-sectional units in a panel data set. Many empirical studies have established that cross-sectional dependence is a problem in large panels with long time series (more than 20 years). However, this is not much of a problem

in small panels (few years and large number of cases). This problem leads to least square estimators becoming inefficient and renders conventional t-test and f-tests (that use variance-covariance estimators) invalid. This study, therefore, employed Breusch-Pagan LM test of independence. This test's null hypothesis posits that there exists no correlation of residuals across the entities while the test's alternative hypothesis is that there exists correlation of residuals across the entities.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the descriptive statistics results (mean, standard deviation, skewness etc.) and correlation results. The results of pre-estimation panel diagnostic tests (panel unit root test, panel cointegration test, Hausman test) and post-estimation panel diagnostic tests (tests for serial correlation, heteroskedasticity, and cross-sectional dependence) are also presented. Finally, the inferential statistics results with respect to the variables in the research objectives and hypotheses are presented and discussed.

4.2 Descriptive Analysis

4.2.1 Descriptive Statistics

Table 4.1: The Results of Descriptive Analysis

Variable	LnMD	LnMOB	LnATM	LnGDP	LnINTR
Observations	70	70	70	70	70
Mean	12.6575	8.117991	2.893297	10.42753	6.26149
Std. Deviation	0.5799723	1.247272	0.5042573	0.3729989	0.49814
Skewness	-0.160163	-0.970614	-1.425691	-0.539627	-0.23157
Kurtosis	1.716660	2.583068	5.268332	2.188044	2.892326
Probability	0.129877	0.010060	0.000000	0.119067	0.000000
Sum	708.8199	454.6075	162.0247	583.9414	321.6128
Sum Sq. Dev.	18.50023	85.56283	13.98515	7.652050	10.64142
Minimum	11.57934	5.450541	1.20412	9.609405	5.95126
Maximum	13.50179	9.547402	3.452247	11.00288	7.21794

Where,

LnMD is the natural log of money demand

LnMOB is the natural log of mobile money

LnATM is the natural log of automatic teller machines

LnGDP is the natural log of real gross domestic product

LnINTR is the natural log of interest rate

From the Table 4.1 above, the mean of money demand is 12.6575. This implies that on average, the demand for money in the EAC between 2007 and 2020 was 12.6575. The standard deviation is 0.5799723 which can be interpreted to mean that between 2007 and 2020, the demand for money in the EAC was deviating from the mean by 0.5799723. The minimum of money demand in the EAC for the period 2007 to 2020 was 11.57934 while the maximum of money demand for the same period was 13.50179. This means that the range of money demand in the EAC for the period 2007 to 2020 was 1.92245.

The mean for the number of mobile money transactions is 8.117991. This implies that the average number of mobile money transactions in the EAC between 2007 and 2020 was 8.117991. The standard deviation for the number of mobile money transactions is 1.247272. This means that for the period 2007 to 2020, the number of mobile money transactions in the EAC deviated from the mean by 1.247272. The minimum number of mobile money transactions in the EAC is 5.450541 while the maximum number of mobile money transactions is 9.547402. This means that for the period 2007 to 2020, the range of number of mobile money transactions in the EAC was 4.096861.

For the case of the number of ATMs, the mean is 2.893297. This can be interpreted to mean that for the period 2007 to 2020, the average number of ATMs in the EAC was 2.893297. The standard deviation is 0.5042573. This implies that between 2007 and 2020, the number of ATMs in the EAC deviated from the mean by 0.5042573. The minimum number of ATMs in

the EAC for the period 2007 to 2020 was 1.20412 while the maximum number of ATMs was 3.452247. This is interpreted to mean that the range for the number of ATMs in the EAC between 2007 and 2020 was 2.248127.

Looking at the case of real GDP, the mean is 10.42753. This implies that for the period 2007 to 2020, the EAC's real GDP was on average at the level of 10.42753. The standard deviation of the real GDP is 0.3729989. This means that between 2007 and 2020, the EAC's real GDP was deviating from the mean by 0.3729989. The minimum of the real GDP is 9.609405 while the maximum is 11.00288. This means that for the period 2007 to 2020, the range of the real GDP in the EAC was 1.393475.

The mean for the interest rate is 6.26149. This means that for the period 2007 to 2020, the EAC's interest rate was on average at the level of 6.26149. The standard deviation of the interest rate is 0.49814. This means that between 2007 and 2020, the EAC's interest rate was deviating from the mean by 0.49814. The minimum of the interest rate is 5.95126 while the maximum is 7.21794. This means that for the period 2007 to 2020, the range of the interest rate in the EAC was 1.26668.

Table 4.1 above also shows that the study used a total of 70 observations. The large number of observations in a panel regression model is meant to avoid the analysis problem of different sample sizes in a relatively small sample (Vidyattama, 2010). Compared to all the study variables, the number of mobile money transactions has a larger standard deviation. This suggests that the number of ATMs is highly volatile compared to other variables in the study. However, generally the level of volatility of all the study variables is low. The standard deviation for all the study variables (the standard summary statistics for disparities over time) shows sufficient variable variant over a certain duration across the panel backing regression analysis.

Skewness is the tilt in the distribution series. All the study variables exhibited a negative skewness. This means that more observations were concentrated on the left side. Negatively skewed distributions are characterized by long left tail, which can be interpreted to mean a higher probability of extremely negative results from the variables of this particular study.

Extreme positive or negative skewness means that the EAC's monetary landscape can experience extreme values (either money demand being positively or negatively affected) due to change in the explanatory variables.

Kurtosis examines the relative flatness or peakness of a distribution with regard to normal distribution. A normal distribution has a kurtosis of three. If kurtosis of a distribution is three and its skewness is zero, then the distribution is considered to be normal. As shown in Table 4.1 above, all the variables in this study have a kurtosis of less than three except the number of ATMs and this implies that their distribution has values that are widely spread around the mean and the probability for extreme values is less than that of a normal distribution. The number of ATMs has a kurtosis of 5.268332 (greater than three) which means that its distribution has values that are concentrated around the mean and thicker tails, therefore, a high probability of extreme values. A high kurtosis of this particular variable (the number of ATMs) implies that the EAC countries are likely to experience occasional extreme effect on money demand (money demand either being positively or negatively affected) with regard to ATMs influencing money demand.

4.2.2 Correlation Results

Correlation is the measure of the degree of linear association between variables. It also shows the direction of relationship between variables. A correlation coefficient of zero mean that study variables have no linear relationship among themselves. Moreover, a correlation coefficient that is greater than zero depict a positive linear relationship.

A correlation coefficient of less than zero implies a negative linear relationship between the variables. In this study, Pearson Correlation (r) which is the most commonly used bivariate correlation method, was used to find the strength and direction of the linear relationship between the study variables.

The correlation results are presented in Table 4.2 below.

Table 4.2 Correlation Matrix

	LnMd	LnMob	LnATM	LnGDP	LnINTR
LnMd	1.0000				
LnMob	0.5162*	1.0000			
LnATM	0.5326*	0.7637*	1.0000		
LnGDP	0.5646 *	0.6631*	0.9250*	1.0000	
LnINTR	-0.5419*	0.7216*	0.8217*	0.7569*	1.0000

* Correlation is significant at five percent level (2-tailed)

From the Table 4.2 above, the correlation coefficient between the number of mobile money transactions and money demand is 0.5162. This implies that there is a fairly strong positive relationship between the number of mobile money transactions and money demand in the EAC. As the number of mobile money transactions increases, money demand also increases and when the number of mobile money transactions decreases, money demand also decreases. The positive correlation of 0.5162 between the number of mobile money transactions and money demand is statistically significant at five percent level. This positive relationship is attributed to ease of access to money through mobile phones.

For the case of the number of ATMs and money demand, the correlation coefficient is 0.5326. This means that there is a fairly strong positive relationship between the number of ATMs and money demand in the EAC. As the number of ATMs increases, the demand for money also increases and as the number of ATMs decreases, money demand also decreases. The positive correlation of 0.5326 between the number of ATMs and money demand is statistically significant at five percent significance level. This positive relationship can be attributed to decrease in transaction costs as one uses ATM, and reduced travel distance and waiting time in order to access money. Therefore, individuals in the EAC will desire to hold money in form of ATM cards since they can get any time the need arises.

The correlation coefficient between real GDP and money demand is 0.5646 implying that there is a fairly strong positive relationship between real GDP and money demand. When the level of real GDP increases, the demand for money also increases and when the amount of income

decreases, money demand also decreases. The positive correlation between real GDP and money demand of 0.5646 is statistically significant at five percent level. The positive relationship can be explained by the fact that when real GDP increases the demand for money held for transaction, speculative and precautionary purposes will also increase. The positive relationship between money demand and GDP can also be attributed to improvement in the EAC's GDP hence leading to increase in national income. Increase in national income leads to economic stabilization which in turn results in an increase government expenditure and subsequent increase in the demand for money.

For the case of interest rate and money demand, the correlation coefficient is -0.5419. This means that there is a fairly strong negative relationship between interest rate and money demand in the EAC. As the rate of interest increases, the demand for money decreases and as the level of interest rate decreases, money demand increases. The negative correlation of -0.5419 between the level of interest rate and money demand is statistically significant at five percent significance level. This negative relationship between interest rate and money demand can be explained by using the concept of speculative motive for holding money. For instance, if the individuals anticipate that the prices of financial assets such as bond will fall, they will prefer to hold their financial assets in form of cash. The demand for money in form of cash will thus increase. However, if the individuals anticipate that the prices of financial assets such as bond will rise, they will prefer to hold their financial assets in form of bonds. The demand for money in form of cash will thus decrease.

4.3 Pre-Estimation Panel Diagnostic Tests

4.3.1 Panel Unit Root Test

Panel unit root test was carried out to determine the order of integration of study variables i.e. finding out whether the study variables were stationary or non-stationary. It is important to underscore that non-stationarity of time series data is one of the commonly encountered econometric problems in any regression analysis. Non-stationary variables, therefore, results in inconsistent estimates and spurious regression results hence meaningless inferences that make no economic sense. The Levin-Lin-Chu panel unit root test was employed to find out the stationarity of the study variables. LLC test is suitable for data sets with smaller number of

panels as it is the case for this particular study. The following are hypotheses that this particular test is based on:

Ho: Panels contain unit roots

Ha: Panels are stationary

The Table 4.3 below shows the panel unit root test results:

Table 4.3: Results of Levin-Lin-Chu Panel Unit Root Test

Variable	Levin-Lin-Chu test at		Order	LLC test P value at Level	LLC at First difference		Order
	Level				Unadjusted t	Adjusted t	
<i>LnMD</i>	-3.5996	-3.2185	I(0)	0.0006	–	–	–
<i>LnMOB</i>	-10.5427	-9.0935	I(0)	0.0000	–	–	–
<i>LnATM</i>	-8.0796	-5.4553	I(0)	0.0000	–	–	–
<i>LnGDP</i>	-4.2753	-3.4374	I(0)	0.0003	–	–	–
<i>LnINTR</i>	-6.3421	-4.2190	I(0)	0.0000	–	–	–

Order (Order of Integration)

All at one percent level of significance

Table 4.3 above shows the results of panel unit root test. All the study variables i.e., money demand, mobile money, ATMs and GDP were found to be stationary at level and statistically significant at one percent level. The p-value for the natural log of money demand, mobile money, ATMs and GDP are zero at levels. Since the p-value is lower than the conventional critical value of 0.05, we therefore, reject the null hypothesis and conclude that the study variables do not contain unit roots and are hence stationary. This implies that all the study variables are integrated of order zero I(0).

4.3.2 Panel Cointegration Test

Cointegration refers to the long-run linear relationship between two non-stationary variables (that become stationary after differencing) and have to be integrated of the same order. One of

the most commonly used panel cointegration test is the one that was proposed by Pedroni (2004). Unlike other panel cointegration tests such as Kao (1999), Maddala and Wu (1999), and westerlund (2007), a peculiar characteristic of Pedroni (2004) test is that the test is comprehensive and allows for heterogeneity in the intercepts and coefficients of the cointegrating equations and thus it is a superior technique. Additionally, the strength of the test lies in its ability to overcome the bias associated with small sample size as well as the problems of more than one cointegrating relationship.

It is important to underscore that after differencing, variables tend to lose long-run relationship and so panel cointegration test is usually carried out to establish whether variables have got long-run relationship after differencing. However, from the panel unit root test results in Table 4.3 above, the dependent variable (money demand) and independent variables (mobile money, ATMs, GDP and interest rate) are already stationary $I(0)$. This, therefore, implies that there was no cointegration since the variables are integrated of the same order (zero). In this case, all the variables are stationary at level meaning that there was no need to conduct co-integration test in this particular study.

4.3.3 Hausman Test

Hausman (1978) came up with a specification test to determine whether to use fixed effects (FE) or random effects (RE) regression model. FE model explores the relationship between the predictor and outcome variables and so FE model helps in removing the effect of time invariant features from the predictor variables thus making it easier to assess the net effect of the predictor variables. For instance, macroeconomic instabilities in a country can have effect on the demand for money and so FE model will help control the effect of macroeconomic instabilities on money demand.

The RE model assumes that entity error term is not correlated with predictor variables hence allowing for time invariant variables to play a significant role as explanatory variables. Additionally, in the RE model, variation across entities is assumed to be random and uncorrelated to the independent (predictor) variables included in the model. Therefore, if there is a reason to believe that differences across entities have some effect on the dependent

variable, then RE model can be used. The Hausman specification test was thus carried out based on the following hypotheses:

Ho: Preferred model is random effects (RE) model

Ha: Preferred model is fixed effects (FE) model

The results of Hausman test were obtained as follows:

Table 4.4: Hausman Test Results

Variable	(b) Fixed	(B) Random	(b-B) Difference	Sqrt(diag(v_bv_B))
Ln MD	1.0966	0.8533	0.2432	-
Ln MOB	-0.2622	0.3159	-0.5781	0.1697
Ln ATM	-1.0918	-0.9728	-0.1190	-
Ln GDP	5.3647	1.6134	3.7513	3.0019
Ln INTR	1.0432	0.2357	0.8075	-

$$\text{Chi}^2 (5) = 5.12$$

$$\text{Prob}>\text{chi}^2 = 0.02754$$

If the p-value is significant (i.e., p-value is less than 0.05), then we reject the null hypothesis and decide to use fixed effects model. However, on the other hand, if the p-value is insignificant (i.e., p-value is greater than 0.05), then we reject the alternative hypothesis and decide to use random effects model. From the results in Table 4.4 above, p-value is 0.02754 implying that the p-value is significant, hence we reject the null hypothesis make a decision to use the fixed effects (FE) model.

4.4 Post-Estimation Panel Diagnostic Tests

4.4.1 Test for Serial Correlation

Serial correlation or autocorrelation is an econometric problem caused by correlation between error terms of different time periods. Autocorrelation in linear panel models causes biased

standard errors and makes the estimators inefficient. Wooldridge test (2002) was used to test for serial correlation. The hypotheses of Wooldridge test (2002) are stated as follows:

Ho: There is absence of first order serial correlation

H_A: There is presence of first order serial correlation

The results for Wooldridge test (2002) for serial correlation were as follows:

$$F(1, 4) = 41.501$$

$$\text{Prob} > F = 0.0637$$

From the results above, the p-value is greater than 0.05 (i.e. p-value is equal to 0.0637) and so the alternative hypothesis of presence of first order serial correlation was rejected at ten percent significance level. This implies that autocorrelation was not a problem in the regression results. Therefore, it was concluded that the regression results were free from this particular econometric problem hence the findings were deemed reliable.

4.4.2 Test for Heteroskedasticity

Heteroskedasticity is also another common econometric problem that occurs when the error terms do not have constant variance across observations. This is problem is caused by errors of measurement and other factors such as sub-population differences. Heteroskedasticity results in standard errors being biased hence unreliable confidence intervals and test statistic values. The modified Wald test for heteroskedasticity was employed to carry out heteroskedasticity test. The hypotheses for modified Wald test were stated as follows:

Ho: There is absence of heteroskedasticity i.e., variance across observations is constant

H_A: There is presence of heteroskedasticity i.e., variance across observations is not constant

The results of modified Wald test were as follows:

$$\text{Chi}^2(5) = 13.91$$

$$\text{Prob} > \chi^2 = 0.0728$$

If the p-value is less than 0.05, we reject the null hypothesis at ten percent significance level and conclude that there is presence of heteroskedasticity i.e., variance across observations is not constant. However, on the other hand, if the p-value is greater than 0.05, we reject the alternative hypothesis at ten percent level and conclude that there is absence of heteroskedasticity i.e., variance across observations is constant. From the results of the modified Wald test above, the p-value is greater than 0.05 (i.e. p-value is equal to 0.0728) and so the alternative hypothesis of presence of heteroscedasticity was rejected at ten percent significance level. This means that heteroskedasticity was not a problem in the regression analysis. Therefore, we can conclude that the regression results were reliable.

4.4.3 Test for Cross-Sectional Dependence

Cross sectional dependence occurs when there is inter-dependence among cross sectional units. Cross sectional dependence results in least square estimators becoming inefficient. This problem also renders conventional t-test and f-test (that use variance-covariance estimators) invalid. Breusch-Pagan LM test of independence was used to test for cross sectional dependence. The hypotheses of Breusch-Pagan LM test of independence test were as stated below:

Ho: There exists no correlation of residuals across entities

H_A: There exists correlation of residuals across entities

The results of Breusch-Pagan LM test of independence were as follows:

$$\chi^2 (5) = 15.483$$

$$\text{Prob} = 0.0618$$

From the results of Breusch-Pagan LM test of independence above, the p-value is greater than 0.05. Therefore, we accept the null hypothesis at ten percent significance level and conclude that there exists no correlation of residuals across entities. This implies that there was no cross-sectional dependence in the regression analysis. This, in turn, means that the least square estimators that were obtained were efficient and also conventional t-test and f-tests that used variance- covariance estimators were valid.

4.5 Inferential Analysis

4.5.1 Financial Innovation and Money Demand in the EAC

This particular part covers the testing of the hypotheses regarding money demand and financial innovation in the EAC. Money demand was measured using real money balances (broad money, M2). Financial innovation was measured using two variables namely: mobile money and ATMs. The study used GDP (which is the proxy for income) and interest rate control variables. The analysis of money demand and financial innovation was based on panel data. This was because panel data has various advantages such as controlling for econometric problems such as endogeneity, multicollinearity, heteroscedasticity, and omitted variable bias. Panel data also explores data across time. Balanced panel fixed effects model was applied and the findings were as follows:

Table 4.5: Balanced Fixed Effects Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.833675	1.178176	0.707598	0.4825
Ln MOB	0.375593**	0.061479	6.110204	0.0000
Ln ATM	0.1736245 **	0.075138	2.310400	0.0210
Ln GDP	0.2638872 ***	0.074385	3.578784	0.0000
Ln INTR	-0.532659**	0.206059	-2.584983	0.0125
Root MSE	0.060214	R-squared		0.889025
Mean dependent var	12.65750	Adjusted R-squared		0.887681
S.D. dependent var	0.579972	S.E. of regression		0.064371
Akaike info criterion	-2.531829	Sum squared resid		0.203040
Schwarz criterion	-2.278660	Log likelihood		77.89121
Hannan-Quinn criter.	-2.433676	F-statistic		735.9505
Durbin-Watson stat	0.638787	Prob (F-statistic)		0.000000

*** 1% significance level, ** 5% significance level, * 10% significance level

The constant is 0.833675. This can be interpreted to mean that without variables like mobile money, ATMs, GDP and interest rate, the demand for money in the EAC remains at the level of 0.833675. The p-value of the constant is 0.4825 and since that the p-value is greater than 0.05, this means that the constant is not statistically significant at ten percent level.

The adjusted R^2 is 0.887681. This means that 88.7681% of the changes on the dependent variable (money demand) in the EAC are explained by the explanatory variables (mobile money, ATMs, GDP and interest rate) included in the model. The model was of good fit.

4.5.2 Effect of Mobile Money on Money Demand in the EAC

This sub-section presents the findings that meet the study's first objective which was to investigate the effect of mobile money on money demand in the EAC.

From the regression results above, the coefficient of mobile money is 0.375593. This implies that a one percent increase in the number of mobile money transactions leads to 0.375593% increase in money demand in the EAC. Since the p-value (0.0000) of mobile money is less than 0.05, it means that 0.375593% increase in money demand is statistically significant at five percent level. This, in turn, means that there is a positive relationship between mobile money and money demand in the EAC.

This positive relationship between mobile money and the demand for money could be attributed to increased number of mobile money accounts and mobile money agents in the EAC which leads to increased number of mobile money transactions hence increase in the amount of mobile money held in form of mobile money. The increase in the amount of money held in form of mobile money results in increase in the demand for less liquid money which is in this case, money in mobile and internet form. Additionally, mobile money is safe and easy to use when making daily transactions. The findings are also in line with the economic theory. Keynesian theory of money demand outlines three motives for holding (demanding) money. One of the motives for holding money in form of mobile money is transaction motive. It is important to underscore that transaction demand for money arises from the role of money as a medium of exchange. Money which is held in mobile form is used by economic agents in daily transactions such as making payments for goods and services purchased.

Another factor that can be attributed to the positive relationship between mobile money and money demand in the EAC is decreased transaction costs. Some of the transaction costs that are involved when using mobile money include the cost of sending money and the cost of withdrawing money. Since its inception, the costs that are incurred when one is using mobile money has been decreasing over the years. This has become attractive to economic agents who now prefer to use mobile money since the transaction costs are now much lower than before. This, in turn, will increase the demand for money held in mobile form.

The COVID-19 pandemic in 2020 might have also contributed to increased demand for money held in mobile and internet form in the EAC. This is because during COVID-19 pandemic many EAC countries came up with measures such as discouraging the use of liquid cash (notes and coins) with an aim of countering the spread of COVID-19. The EAC residents were urged to use mobile money when making their transactions. This, in turn, led to increase in the number of transactions made via mobile money. The final outcome of this was increased demand for money held in less liquid form (mobile form) hence increase in the overall level of money demand in the EAC (GSMA, 2022).

The results on the positive effect of mobile money on money demand coincides with the findings of previous researchers such as Mwangi (2014) who analyzed the effect of financial innovation on money demand in Kenya for the period 2000 - 2012. One of the proxies for financial innovation that the study used included mobile phone money transfer. The study used published quarterly secondary data obtained from the Kenya National Bureau of Statistics (KNBS) and CBK database. He found out that mobile phone money transfer among other recent forms of financial innovation have had a positive effect on money demand in Kenya both in the short run and in the long-run. Nakamya (2014) investigated the effect of financial innovation in form of new transaction technologies on demand for narrow money (M1) in Uganda. The study assessed the effect of mobile money (proxied using electronic money) which is one of the recent forms of financial innovations on the demand for narrow money in Uganda. The study established that mobile money among other recent forms of financial innovation has resulted to increase in the demand for narrow money in Uganda. Kasekende and Nikolaidou (2018) investigated the development of financial innovation and its impact on money demand in the Sub-Saharan Africa region using panel data estimation techniques for

thirty-four Sub-Saharan Africa countries between 1980 and 2013. Their findings also indicated that mobile money which is one of the recent forms of financial innovation has a significant positive effect on money demand Sub Saharan Africa region. The findings of these previous empirical studies were, therefore, similar to the findings of this particular study.

This particular study has also found a similar result to the one of Wahyunda (2021) who studied the effect of financial innovation on the demand for money in Indonesia during the period 2010 to 2019 using VECM and found that the electronic money which is an equivalent of mobile money has a positive impact on the demand for money in Indonesia. Since many previous studies have established a positive effect of mobile money (one of the recent forms of financial innovation) on money demand, then it implies that financial innovation has had a positive impact on money demand. All these results of previous research studies indicated that mobile money among other recent forms of financial innovation had positive effect on the demand for money hence they are similar to the finding of this particular study.

4.5.3 Effect of ATMs on Money Demand in the EAC

This subsection presents interpretation and discussion of findings related to the study's second objective which was to determine the effect of ATMs on money demand in the EAC.

From the balanced fixed effects regression results in Table 4.5 above, the coefficient of ATMs is 0.1736245. This implies that a one percent increase in the number of ATMs leads to an increase in money demand by 0.1736245%. The p-value is 0.0210 and being that it is less than 0.05, it means that the 0.1736245% increase in money demand is statistically significant at five percent level. These results imply that there is a positive relationship between ATMs and the demand for money. This is consistent with the expected findings since an increase in number of ATMs will lead to increased number of transactions done via ATMs. This, in turn, is expected to lead to an increase in the demand for money held in form of ATM cards. The coefficient is positive and conforms to economic theory specifically the Keynesian theory of money demand which outlined the three motives for holding money (transaction, speculative and precautionary). As the number of ATMs increase, the number of ATM transactions also increase hence increase transaction money demand.

The positive effect of ATMs on money demand in the EAC can be attributed to the fact that an increase in the number of ATMs significantly leads to increase in the frequency of money demand. The increased number of transactions done via ATMs is attributed to the increase in number of ATMs in the EAC. It is important to note that when the number of transactions done through ATMs increase, the demand for money also increase. The number of ATM transactions affect optimal cash holding of economic agents in the sense that it leads to a reduction in time and waiting cost. Therefore, economic agents will be willing to transact any time they want by withdrawing money in ATMs. As the number of ATMs increase, they will be readily accessible by economic agents. This will lead to increase in demand for liquid money (cash money).

Additionally, many economic agents in the EAC can now use their ATM cards to pay for goods and services. This form of financial innovation that has enabled economic agents to conveniently pay for goods and services using ATM cards can be attributed to the increase in number of transactions done using ATM cards. This, in turn, leads to increase in the demand for money held in card form (ATM cards). This, therefore, explains the positive relationship between the number of ATMs and money demand in the EAC. Since ATMs is another form of financial innovation, then it can be said without any doubt that there exists a positive relationship between financial innovation and money demand in the EAC.

This particular finding that ATMs has a positive effect on money demand coincides with the findings of Nakamya (2014) who investigated the effect of financial innovation in form of new transaction technologies on narrow money demand (M1) in Uganda. One of the recent forms of financial innovations that the study used to assess the effect on money demand is ATMs. The study found out that ATMs among other recent forms of financial innovations has resulted to increase in the demand for narrow money in Uganda. The other study that found a similar result to this study is that of Munene (2018) who employed the VECM to examine the effect of various forms of financial innovation on money demand in Kenya. One of the proxies of financial innovation that the study used is ATMs. The study established a positive significant relationship between ATMs and money demand. The findings of this study are also similar to that of Mwangi (2014) who examined the effect of financial innovation on the demand for money in Kenya for the period 2000 to 2012. One of the proxies for financial innovation that the study used is ATMs. Using published quarterly secondary data obtained from the Kenya

National Bureau of Statistics (KNBS) and CBK database, the study found out that ATMs among other recent forms of financial innovation have had a positive effect on the demand for money in Kenya both in the short run and in the long run.

Another researcher who has a result similar to the one for this study is Muchlisin (2021) who examined the effect of financial innovation on money demand in Indonesia during the period 2010 to 2019. Using ATM transactions as one of the proxies of financial innovation, the study established that the effect of ATMs on money demand in Indonesia is positive at one percent significance level. Many previous empirical studies have established a positive effect of ATMs (one of the recent forms of financial innovation) on money demand. Therefore, this implies that financial innovation has had a positive impact on money demand in the EAC.

4.5.4 Effect of Real GDP on Money Demand in the EAC

This sub-section presents discussion of results related to the first control variable, real gross domestic product (GDP).

For the case of GDP, the coefficient is 0.2638872. This means that a one percent increase in GDP results in a 0.2638872% increase in money demand. The p-value is 0.0000 and since it is less than 0.05, it implies that the increase in money demand by 0.2638872% as a result of a one percent increase in GDP is statistically significant at five percent level. This, in turn, means that there is a direct relationship between real GDP and money demand.

This finding is positive and conforms to Keynesian theory of money demand. In this study, real GDP was used as a control variable and a proxy for income. Keynes argued that there are two key factors influencing the demand for real money balances and one of them is income. Also, according to Keynes, the number of transactions is a positive function of income and hence if income increases, the demand for real money balances is also expected to increase for both transactional and precautionary motives.

The positive relationship between real GDP and money demand implies that the demand for money in an economy is likely to increase when real GDP increases. Transaction money demand rises with an increase in GDP. Hence, if the level of output i.e., amount of goods and

services produced in an economy rises while prices of all goods and services remain constant, the total GDP will also rise and economic agents will demand more money to make the additional transactions. On the other hand, if the prices of goods and services produced in an economy rise, economic agents will still demand more money to purchase the higher valued output, hence the demand for money to make transactions will also increase. This explains the reason for positive relationship between GDP and money demand.

The finding of this study (the positive effect of real GDP on money demand) is similar to the finding of Kipsang (2013) who applied both cointegration and ECM techniques to examine how factors such as price levels, interest rates, real GDP, exchange rate and the pace of financial innovation affects demand for money in Kenya. The study found out that GDP is a significant determinant of money demand in Kenya. Both Mwangi (2014) and Munene (2018) also established that GDP has a significant positive effect on money demand. Therefore, real GDP being a significant variable should not be left out when specifying a money demand function.

4.5.5 Effect of Interest Rate on Money Demand in the EAC

This sub-section presents discussion of results related to the second control variable, interest rate.

For the case of interest rate the coefficient is -0.532659. This means that a one percent increase in interest rate results in a 0.532659% decrease in money demand. The p-value is 0.0125 and since it is less than 0.05, it implies that the decrease in money demand by 0.532659% as a result of a one percent increase in interest rate is statistically significant at five percent level. This, in turn, means that there is an inverse relationship between interest rate and money demand.

These findings conform to Keynesian theory of money demand. In this study, interest rate GDP was used both as a control and the opportunity cost of holding money variable. Keynes opined that there are two key variables that influence demand for real money balances and one of them is interest rate. Also, according to Keynes, the number of transactions is a negative function of interest rate and hence if interest rate increases, the demand for real money balances is expected to decrease for both motives.

The finding of this study (the negative effect of interest rate on money demand) is similar to the finding of Kipsang (2013) who applied both cointegration and ECM techniques to examine how factors such as price levels, interest rates, real GDP, exchange rate and the pace of financial innovation affects demand for money in Kenya. The study found out that interest rate is a significant determinant of money demand in Kenya. Both Mwangi (2014) and Munene (2018) also established that interest rate has a significant negative effect on money demand. Therefore, interest rate being a significant variable should not be left out when specifying a money demand function.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

This particular chapter presents the summary of the findings contained in the preceding chapter. Based on the findings of this study, several conclusions can be drawn and policy implications discussed. Areas of further research are also recommended.

5.2 Summary

The general objective of this particular study was to examine the effect of financial innovation on money demand in the EAC. Historical research design was employed with panel data analysis while the data were obtained from secondary sources. The study period was 2007 to 2020. It is during this period that the EAC's financial sector had undergone tremendous changes that resulted in financial sector development and various forms of financial innovations emerging. For instance, mobile money (M-PESA) was developed during this particular period and the number of transactions done via ATMs increased tremendously. These developments and innovations in the EAC's financial sector have led to ease of access to various financial goods and services, decreased transaction costs and improved the manner in which resources are allocated. These developments in the EAC's financial sector also impact the manner in which the economy respond to monetary policy. This, therefore, poses a challenge to EAC's central banks as they formulate and implement monetary policies aimed at achieving stability and efficiency in the financial sector.

Real GDP and interest rate are standard macroeconomic variables that were used as control variables. Real GDP represented income which is a scale variable in the specification of money demand function while interest rate represented the opportunity cost of holding money variable in the specification of money demand model. On the other hand, mobile money and ATMs are variables that were used to represent financial innovation. This was done with an aim of taking into account the effect of financial innovation on money demand in the EAC. Including these variables (mobile money and ATMs) enabled us to examine the effect of these various forms of financial innovations on money demand in the EAC. The empirical analysis was carried out

using balanced panel fixed effects (FE) technique. Empirical investigation established that both mobile money and ATMs have positive effect on the money demand in the EAC.

The results of descriptive analysis indicated that the study variables had low volatility. On the other hand, the results of correlation analysis showed that there were positive correlations between the dependent variable and the independent variables. Levin-Lin-Chu panel unit root test was done and all the study variables were found to be stationary at level. Additionally, their stationarity was found to be statistically significant at five percent level. Since all the variables (dependent and independent variables) were stationary at level, cointegration test could not be carried out. For cointegration test to be carried out, the dependent variable and the explanatory variables should not be integrated of the same order.

Hausman (1978) specification test was carried out and the results of this particular test indicated that fixed effects (FE) model was the preferred model. The results of Wooldridge test (2002) for serial correlation indicated that autocorrelation was not a problem in the regression analysis. The results of modified Wald test for heteroscedasticity indicated that heteroscedasticity was not a problem in the regression analysis. The regression model was, therefore, free from these econometric problems. Breusch-Pagan LM test of independence was also conducted and the results showed that there was no correlation of residuals across entities in the regression analysis.

The results of balanced panel fixed effects regression analysis indicated that the explanatory variables (mobile money, ATMs, real GDP) were affecting money demand positively and their effects were also statistically significant. However, interest rate was found to significantly affect money demand negatively.

5.3 Conclusions

The aim of this study was to determine the effect of financial innovation on money demand in the EAC. The proxies for financial innovation that were used included mobile money and ATMs. The results showed a significant positive relationship between the number of mobile money transactions and money demand. Similarly, the results indicated a significant positive relationship between number of ATM transactions and money demand. It was, therefore,

concluded that there is significant positive relationship between financial innovation and money demand in the EAC.

The various forms of financial innovations that have emerged in the EAC's financial sector have resulted in introduction of new financial goods and services. These new financial products have led to increase in the efficiency of the EAC's financial sector hence complicating the monetary environment in which monetary policy is implemented. It is important to underscore that money demand is an important prerequisite in the formulation and implementation of monetary policy. Money demand is thus sensitive to changes that might occur in the monetary environment hence all the variable that affect money demand should be continuously reviewed. We can also conclude that one the variables that affect money demand that should be continuously reviewed is financial innovation. This is because various forms of financial innovation have emerged with others likely to emerge in some years to come.

The findings this study largely concur with the findings of previous theoretical and empirical research studies that financial innovations have a significant impact on money demand. Firstly, this means that it is important for the monetary authorities in the EAC to include financial innovation when carrying out monetary aggregates targeting framework. Secondly, it implies that it is important to include financial innovation when estimating the EAC's money demand function. If financial innovation is not included in the model, then money demand model would not be well specified resulting in biased estimators. This will render the model inefficient for prediction and policy making.

The monetary authorities in the EAC should ensure that they keep a keen check on the ever-changing monetary aggregates that might cause structural changes in monetary environment. Such monitoring will allow adjustments to be made to monetary aggregates in case of emergence of new forms of financial innovations that might significantly affect the demand for money. It is important to underscore that new and emerging forms of financial innovations can help improve the efficiency of the financial sector. For instance, various forms of financial innovations have made it easier for economic agents to make transaction i.e., improved payment systems. However, at the same time, financial innovation might complicate the monetary environment in which monetary policy is implemented. This is because financial

innovation is a significant variable influencing money demand and money demand is usually taken into consideration when formulating and implementing monetary policy. If the monetary environment in which monetary policy is implemented becomes complicated, then the outcome will be monetary authorities in the EAC finding it difficult to pursue effective monetary aggregates targeting framework. This, in turn, will result in failure to achieve monetary policy objectives such as price stability, economic growth, and maintaining low level of inflation in the EAC. The monetary authorities in the EAC are, therefore, faced with an uphill task of strengthening efficiency and effectiveness in an economic and financial environment that is ever changing.

The control variable used in the study (real GDP and interest rate), gave results consistent with theoretical and previous empirical studies. The study found a positive relationship between real GDP and money demand in the EAC. Since GDP was used as a proxy for income, the findings imply that GDP is a good proxy for income. Income is a scale variable in the specification of money demand function. The study also found a negative relationship between interest rate and money demand in the EAC. Interest rate is an opportunity cost of holding money variable in the formulation of money demand function.

5.4 Policy Recommendations

Having carried out the study and found a significant positive relationship between financial innovation and money demand in the EAC, there are some policy implications that these findings might have. Firstly, the findings of this study have policy implications on the formulation and implementation of a policy aimed at promoting financial sector development and effectiveness in the EAC. The governments of EAC countries needs to ensure that their financial sectors continue developing and are effective. They can do so by endeavoring to stabilize the macroeconomic environment in which sound policies are formulated and implemented by the fiscal and monetary authorities. This will, in turn, create a stable macroeconomic environment that drives financial deepening as well as development of new financial products in the EAC's financial sector. Additionally, the EAC governments should formulate and implement policies aimed at promoting and improving financial intermediation in the EAC. For instance, the EAC governments should consider reducing tax levied on the financial sector and provide incentives for its development. There is also need to do away with

some unnecessary bureaucratic procedures in the process of financial intermediation. This is because bureaucracy among other factors increase transaction costs. Therefore, doing away with some unnecessary bureaucratic procedures will lower the transaction costs. The EAC governments should also formulate and implement a policy aimed at attracting more participants in the financial sector. Such participants can include the private sector (investors) and non-governmental organizations (NGOs). By attracting more participants in the financial sector, the EAC's financial sector will deepen hence making it more dynamic and agreeable to any monetary policy that is implemented.

Secondly, the findings of this study have policy implications on the manner in which monetary aggregates and money demand function should be estimated or specified by the monetary authorities and researchers respectively. The findings of the study revealed the relative significance of financial innovation as a variable in the specification of the money demand model for the EAC. It is evident that there is increased financial access deepening in the EAC via various forms of financial innovations such as mobile money and ATMs. In this study, these two forms of financial innovation were used as proxies for financial innovation. Since financial innovation was found to be a significant variable influencing money demand, it is important for the monetary authorities to account for financial innovation in the estimation of monetary aggregates. The researchers should also incorporate financial innovation in the specification of money demand model. If the researchers do not include financial innovation when estimating the money demand model, then the estimated model would not be well specified. This will result in misspecification of the model hence biased estimators. This will, in turn, render the model unreliable for prediction and policy making.

Thirdly, the findings of this study have policy implications on money and its equivalents. New forms of financial innovations have made it possible to easily convert liquid money (such as cash money, currency) to electronic forms (such as mobile money, M-PESA). However, this tends to blur how to distinguish monetary assets from and non-monetary assets. It is, therefore, prudent for the monetary authorities in the EAC to come up with measures that will ensure that they have an effective control of the monetary base since new forms of financial innovations are likely to emerge.

Finally, the findings of this study have policy implications on financial innovations regulatory frameworks. The study established that mobile money is currently the most commonly used form of financial innovation in the EAC. The number of mobile money users and transactions done via mobile money have, therefore, been increasing tremendously over the years. The EAC governments, thus, needs to come up with regulatory frameworks aimed at regulating, harmonizing and protecting economic agents using various forms of financial innovations such as mobile money (M-PESA). For instance, they can enact laws that regulate the transaction costs involved when economic agents transact using M-PESA. This will protect economic agents from being exploited by the providers of mobile money services. Moreover, many economic agents who hold money in mobile money form and ATM card form have reportedly lost their money through electronic money fraud. The EAC governments should, therefore, enact laws aimed at countering electronic money fraud. By doing so, possible financial loss by economic agents using financial innovations such as mobile money and ATMs will be averted. However, it is important for the EAC governments to consider involving international financial partners such as IMF and World Bank when developing such regulatory frameworks

5.5 Areas for Further Research

This particular study was limited to examining the effect of financial innovation on money demand in the EAC. Thus, there are some important areas of monetary economics that this study did not examine. They include the effect of financial innovation on money multiplier in the EAC, the effect of financial innovation on money in circulation, the stability of money demand function in the EAC, and the effect of financial innovation on money velocity in the EAC. These outlined areas could be possible areas for future research.

Future research studies should be done on many countries. This study only examined the EAC which consist of only six countries. For instance, the future research can try to examine the effect of financial innovation on money demand in Africa. This will involve African countries hence increase in the number of countries involved. Further research studies can also try to determine the effect of financial innovation on economic growth in the EAC. Finally, an empirical study should be conducted to establish whether financial crises in the financial sector are attributed to some forms of financial innovations in the financial sector.

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APPENDICES

Appendix A: Publication



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Effect of Financial Innovation on Money Demand in the East African Community

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Tremendous financial changes have been witnessed in the East African Community's (EAC's) macroeconomic landscape over the past few years. These changes can shift various parameters of the money demand model. Many previous empirical studies examined the effect of scale and opportunity cost of holding money variables on money demand. However, most of them left out financial innovation which is one of the key factors influencing money demand. Additionally, they are just country specific studies and used time series data analysis technique. It is in this backdrop that a cross-country case study that investigates how financial innovation affects money demand function was carried out using the recent data and a different analysis technique which is panel data analysis. The objective of the study was to examine the effect of mobile financial innovation on money demand in the EAC. The study used secondary data for the period 2007 to 2020 and this data was obtained from the World Bank and International Monetary Fund. Both descriptive and inferential analyses were carried out. Levin-Lin-Chu test for panel unit root was done and all the study variables were found to be stationary at level. The results of balanced panel fixed effects regression analysis indicated that mobile money, ATMs, and real GDP were affecting money

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Appendix B: Data Analysis Output

(A) Panel Unit Root Test for Money Demand

. xtunitroot llc mdd

Levin-Lin-Chu unit-root test for mdd

H0: Panels contain unit roots Number of panels = 4
Ha: Panels are stationary Number of periods = 14

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 7.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-3.5996	
Adjusted t*	-3.2185	0.0006

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(B) Panel Unit Root Test for Mobile Money

. xtunitroot llc mmm

Levin-Lin-Chu unit-root test for mmm

H0: Panels contain unit roots Number of panels = 4
Ha: Panels are stationary Number of periods = 14

AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 7.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-10.5427	
Adjusted t*	-9.0935	0.0000

.

(C) Panel Unit Root Test for Automatic Teller Machines

. xtunitroot llc atm

Levin-Lin-Chu unit-root test for atm

H0: Panels contain unit roots Number of panels = 4
 Ha: Panels are stationary Number of periods = 14

AR parameter: Common Asymptotics: N/T -> 0
 Panel means: Included
 Time trend: Not included

ADF regressions: 1 lag
 LR variance: Bartlett kernel, 7.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-8.0796	
Adjusted t*	-5.4553	0.0000

.

(D) Hausman Test Results

Variable	(b) Fixed	(B) Random	(b-B) Difference	Sqrt(diag(v_bv_B))
Ln MD	1.0966	0.8533	0.2432	-
Ln MOB	-0.2622	0.3159	-0.5781	0.1697
Ln ATM	-1.0918	-0.9728	-0.1190	-
Ln GDP	5.3647	1.6134	3.7513	3.0019
Ln INTR	1.0432	0.2357	0.8075	-

E. Balanced Fixed Effects (FE) Regression Results

Dependent Variable: MDD

Method: Panel Least Squares

Sample: 2007 2020

Periods included: 14


Cross-sections included: 4


Total panel (balanced) observations: 70

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.833675	1.178176	0.707598	0.4825
Ln MOB	0.375593**	0.061479	6.110204	0.0000
Ln ATM	0.1736245**	0.075138	2.310400	0.0210
Ln GDP	0.2638872***	0.074385	3.578784	0.0000
Ln INTR	-0.532659**	0.206059	-2.584983	0.0125
Root MSE	0.060214	R-squared		0.889025
Mean dependent var	12.65750	Adjusted R-squared		0.887681
S.D. dependent var	0.579972	S.E. of regression		0.064371
Akaike info criterion	-2.531829	Sum squared resid		0.203040
Schwarz criterion	-2.278660	Log likelihood		77.89121
Hannan-Quinn criter.	-2.433676	F-statistic		735.9505
Durbin-Watson stat	0.638787	Prob (F-statistic)		0.000000

*** 1% significance level, ** 5% significance level, * 10% significance level


Appendix C: Research Permit from National Commission for Science, Technology and Innovation (NACOSTI)


REPUBLIC OF KENYA


NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

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