Effect of Electronic Money on Velocity of money in Kenya

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

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ABSTRACT

The purpose of this study is to determine the effect that electronic money has on the velocity of money in Kenya as well as its determinants. The study uses income, exchange rates, expected inflation, interest rates and financial innovation as the determinants of velocity in the model. Monthly time series data from the period 2009-2016 is used and autoregressive distributed lag (ARDL) model is implemented with six measures of velocity of money as the dependent variable. The measures include velocity of; narrow money (M1), narrow money less electronic money (M1-EM), broad money (M3), broad money less electronic money (M3-EM), electronic money(EM) and quasi-money (M2). Exchange rate and the number of bank branches were significant in determining all the velocity measures in the long run, with a positive and negative relationship respectively. The presence of electronic money was found to reduce the positive relationship of velocity with exchange rate while the relationship of velocity with the number of bank branches became more positive. This means that increased use of electronic money may help to curb the effects of exchange rate fluctuations while at the same time it increases the velocity of money as more people get access to financial services. The study concludes that the issuance of electronic money should be controlled and closely monitored so as to avoid adverse effects to the monetary system and economy.

CHAPTER 1

INTRODUCTION

1.1 Background

One of the first studies on velocity of money was by Irving Fisher (1911) who came up with the equation of exchange. Fisher defined velocity of money as the average number of times a year money is exchanged for goods. Electronic money (e-money) on the other hand is an electronic store of monetary value on a technical device that may be widely used for making payments to entities other than the e-money issuer. The device acts as a prepaid bearer instrument which does not necessarily involve bank accounts in transactions. (European Central Bank, 2017)

The velocity of money concept is rooted in the Quantity Theory of Money which gives the equation of exchange (MV = PY) (Fisher, 1911). This can also be written as MV=GNP. Velocity of money (V) is therefore measured as the ratio of an economies' output (GNP) to an economies' money supply (M) (Rami, 2010) .Irving Fisher proposed that velocity is determined by the institutional and technological features within an economy that affect the ways in which individuals conduct transactions. Fisher and however took the view that they wouldn't cause rapid changes in velocity, and therefore velocity would normally be constant in the short run. The implication of this is that an expansionary monetary policy need not be questioned because it would certainly affect nominal output levels. Variability in the velocity values has, however, proved this theory to be erroneous. The Keynesian school argues that velocity is a highly fluctuating variable which is significantly affected by economic policies. As a result, changes in velocity could nullify the effects of monetary policy (Okafor et al, 2013)

Prior to the fall of the Bretton Woods System, M1 money supply was thought to be stable in the industrialized countries. However, since 1974 M1 money demand function started over predicting the demand for money, a phenomenon which Goldfeld (1976) termed as 'missing money'. These concerns were heightened during the 1980s because the velocity

of money was being under-predicted. Economists have since questioned the continued pursuit by central banks of monetary targets. The total money supply is determined by the quantity of money combined with the rate of flow of currency (velocity of money) (Gill, 2010). Unpredictability of velocity is the key reason policymakers in the United States and elsewhere have given for abandoning monetary targeting (Omar, 2010).

Electronic money is the electronic alternative to cash. It is monetary value that is stored electronically and can used for making payment transactions. E-Money can be held on cards, devices, or on a server and is usually issued by a financial institution in exchange for physical cash. Some examples are pre-paid cards, electronic purses, such as M-PESA in Kenya, or web-based services, such as PayPal. Electronic money can therefore serve as an umbrella term for a number of more specific electronic value products and services (Firpo, 2009). M-Pesa, a mobile money service operated by the telecommunications company Safaricom in Kenya, allows users to deposit money onto their telephone handsets, transfer electronic money to another user, and withdraw cash at various agents throughout the country. The system is safer, cheaper, and far faster than the money transfer systems that it replaced (Weil, 2013)

Berensten (1997) observed that the emergence of electronic money as it is widely used in economic activities could affect central bank's power. He argued that that the increased use of electronic money would reduce the monetary authorities' ability to control money supply by increasing the velocity of money, decreasing reserves, and decreasing international monetary control. Various literature analyses the impact of electronic money on the central bank's ability to control money supply. This literature is controversial on this, with one school arguing that increased usage of e-money would make it difficult for central banks to supervise and measure monetary base (Kobrin, 1997), (Friedman, 1999). The other strand holds a more optimistic view on electronic money and state that the fears for the future of monetary policy are overstated. An example is Helleiner (1998) who states that electronic money is unlikely to pose a significant threat to the power of government. Woodford (2000) also states that e-money is unlikely to interfere with the conduct of monetary policy.

According to Cassoni and Ramada (2013) who studied electronic money in Uruguay, the enhanced safety and lower transaction costs inherent to electronic money are the reasons why there is increased demand for it at the household level. Cassoni and Ramada(2013) also explain that e-moneys wide acceptance among productive agents is fostered by its improved operational and administrative efficiency. All of these factors would lead to increases in the money velocity, and hence price levels/inflation. Rahn (2000) also concluded that the velocity of money is affected by the increased use of electronic money. The increase in velocity is however considered by Rahn to be "gradual and obvious" and hence needs a compensating adjustment in base money by the Central bank.

According to Tak (2002), electronic money will reduce the time and space expenses of payment settlement transactions (transaction costs), and increases the volume of transactions by due to convenience, as transactions will occur in real time across thousands of miles. While increased velocity is a good thing the inability to measure it accurately when electronic money is not considered in monetary aggregates decreases the federal reserves' ability to effectively implement monetary policy goals. (Mohamad Al-Laham, 2009) also came to the same conclusion in Jordan: that the increased use of electronic money increases the velocity of money.

El-Gawady(2009) in Egypt conducted a study on the impact of e-money, which included all prepaid cards and online payment systems such as PayPal. He found that if E-money spreads slowly, the decrease in the seignorage income and thus the decrease in the Balance Sheet of central banks will be insignificant. El-Gawady however noted that rapid uptake of e-money would generate an increase in money velocity and a rise in the money multiplier. The higher money multiplier and velocity would both imply an increase in money supply and hence inflation. The main objective of this study is to test if this is the case for electronic money in Kenya as well.

Macha (2013) conducted a study for Tanzania, and found that the money demand parameter estimates became unstable with the introduction of Mobile money. He

concluded that mobile money has an impact on money demand and hence on the velocity of money. Contradictory to this, Nyamongo and Ndirangu(2013) found that the fast pace of financial development had not caused shifts in the long run money demand function, and therefore hadn't undermined the conduct of monetary policy in Kenya. Nyamongo and Ndirangu however noted that the period of fast financial development is also associated with an unstable and volatile money velocity and money multiplier. They found that the velocity of money reduced from about 2.5 in January 2007 declining gradually until 2009, and thereafter, more rapidly to about 2.0 in 2010. The velocity of money had then remained constant since then to the time of their study in 2013. The money multiplier had however been rising from 5.0 in 2007 to about 6.5 in mid-2013. The short coming of this study is that it did not proxy financial innovation using electronic money usage in the money demand function in spite of it being a rapidly growing innovation in Kenya.

The Forecast of velocity is important in determining the target for growth of nominal money supply, but this generally comes down to judgmental extrapolations of trends in velocity. This approach is justified only when the velocity of money appears to follow a stable trend, otherwise it could cause adverse misallocation of resources in the economy. (Okafor et al,2013). For example, during the 1980s in the US, the Federal Reserve relied on the upward trend of velocity and they were able to pursue monetary targeting accurately. There was however a change in the trend, leading them to overestimate velocity with the implication of a temporary shortage of money. (Okafor et al,2013). Consequently, Poole (1988) among others, considered it unwise just to rely on a 30-year old trend, instead of carefully examining the underlying determinants. These determinants may as well have varying effects on the velocity of money due to electronic money, and it is these relationships that this paper seeks to explore.

This paper assumes that income velocity is a fair approximation of transaction velocity. It should however be noted that such an assumption is debatable. For instance, Tao(2002) states that income velocity systematically understates the transaction velocity and based on his research results he concludes that we cannot substitute one for the other.

1.2 Research objective

To determine the effect that electronic money has on the velocity of money in Kenya.

1.3 Research questions

1. What are the significant determinants of the velocity of money in Kenya?
2. What influence does electronic money have on the determinants of velocity of money?

1.4 Problem statement

While the estimation of financial innovations' impact on the demand for money function has received considerable attention from economists in Kenya such as Nyamongo (2013) and Kamau (2012), the velocity of money, which is a major variable towards accurate estimation of demand for money has not received much attention. The importance of the velocity of money in monetary policy could be better captured by the statement of Selden ,1956) where he explains that a given change in the quantity of money will have varying effects on the level of prices and income, depending on the behavior of monetary velocity. Friedman (1959) restated the quantity theory and pointed out the importance of money to output by pointing at the relevance of velocity behavior. He explained that successful estimation of velocity would cause monetary changes to be generating predictable changes in spending. Velocity of money is therefore crucial in determining if short term monetary policy is effective at all (Van den Ingh, 2009).

In the developing economy, issues such as financial innovations, deepening of the financial sector, monetization policy, growth of GDP, among others, have contributed to the fluctuating behavior of velocity (Okafor et al, 2013). The variation in velocity has implications for monetary policy particularly for central banks that use the monetary targeting framework. An unstable velocity makes the forecast of optimal monetary aggregates difficult; thereby affecting the basis of monetary policy decisions .Economists care about velocity as it shows the degree to which money supply contributes to the aggregate demand of an economy. The amount of money supply as well as its speed of circulation link money to the economic activity in an economy. Therefore, velocity of

money combined with the money multiplier are very crucial in the design and implementation of credible monetary policy (Okafor et al, 2013).

Mobile money is the most widely used form of electronic money in Kenya.The value of mobile money transactions in Kenya has risen from 732 billion in 2010 (23% of GDP) to 2.8 trillion in 2015(45% of GDP) (Central Bank of Kenya 2017). Findings by Cassoni ans Ramada, (2013) among others on e-money may suggest that these large values of mobile money usage have increased the velocity of money. If electronic money has a much higher velocity than other types of money, then it would be possible that conventionally measured monetary aggregates are underestimating the money supply. This is because the monetary aggregates only measure the physical currency and don't take into account the electronic money issued against some of this currency, which may have higher velocity. Knowing the determinants of velocity of money and the way in which electronic money affects these determinants would lead to effective forecasts of velocity given the rapid rise in the usage of electronic money.

The December 2016 monetary policy statement for Kenya also noted that unstable outcomes on velocity of money and the money multiplier are associated mostly with financial innovations such as the mobile money platforms which have continued to affect the design and conduct of monetary policy (Central Bank of Kenya (CBK), 2016). In view of the foregoing, this paper empirically investigates the impact of electronic money on income velocity.

1.5 Motivation/justification

The setting up of legitimate monetary policy programs requires the understanding of the behaviour of velocity of money and its determining factors. This plays a major role in maintaining stable inflation and hence promoting economic growth in a country (Akinlo, 2012). Velocity of money shows the relationship between money, income and price. The amount of money supply in an economy leads to different spending levels dependent on the nature of velocity of money (Rami, 2010). Velocity of money is therefore crucial in

setting monetary policy. A decrease in money supply aimed at reducing inflation is not likely to work if it is offset by an increase in the velocity of money.

Kenya is of specific interest in this study because of large value mobile money transactions. Kenya was the first country to introduce mobile money and it has the largest number of mobile money users in the world (Davidson and Pénicaud, 2012). Given the limited number of studies on electronic money and money velocity, this paper contributes to the relevant literature by re-estimating the Kenyan money velocity including not only the standard monetary measures but also electronic money, which includes the country specific innovation, mobile money.

If velocity and income are known in advance, the federal reserve can control the price level by choosing the appropriate level for the money stock. To do so, however, two conditions must be met; The velocity of money must be predictable and stable, and; The central bank must be able to determine the money stock (Berensten, 1997).

During the transition to a cashless society (development of e-money), measures of velocity may become less stable. This could complicate monetary policy decision making for countries that rely on monetary aggregates as targets because they would be more difficult to define and achieve (Jordan-Stevens, 1996). This paper therefore considers the velocity of electronic money due its increasingly widespread use and its effect on the determinants of velocity of money and hence whether this has undermined the conduct of monetary policy in Kenya.

CHAPTER 2

LITERATURE REVIEW

2.1: Theoretical literature review

The concept of the quantity theory of money was first discussed in the 16th century. As large amounts of gold and silver from the Americas came into Europe and minted into coins, there was a resulting rise in inflation. This led economist Henry Thornton in 1802 to assume that more money causes more inflation and that an increase in money supply does not necessarily mean an increase in economic output. The original theory was considered orthodox among 17th century classical economists and was overhauled by 20th-century economists Irving Fisher, who came up with the equation of exchange (MV = PY). (Mishkin, 2016)

The Quantity Theory of Money gives a relationship between price and the money supply, which is set by the monetary authority. John Maynard Keynes challenged the theory in the 1930s, stating that an increase in money supply may lead to a decrease in the velocity of circulation and that real income, the flow of money to the factors of production, would increase. Therefore, the velocity could vary in response to changes in supply of money. It was conceded by many economists after that Keynes' idea was accurate. Keynes established that the main determinants of velocity were the nature of banking and industrial organization, social habits, the distribution of income between different classes and the effective cost of holding idle cash. (Mishkin, 2016)

The Cambridge School worked on the quantity theory equation and placed emphasis on monetary holdings used to facilitate expenditures. The equation was modified to $M = kPY$ where $k=1/v$ which represents the average cash balances as a fraction of nominal income PY. This changed focus to the determinants of the demand for money rather than the effects of the changes in money supplied. In essence, the Cambridge equation gives the relationship between the average cash balances during a period to the level of income in the same period. (Mishkin, 2016)

Prior to 1930, the quantity theory of money assumed V and Y to be constant at least in the short run. This was based on the assumption that output is not influenced by the changes in the supply of money because the output of an economy is dependent on resources such as land, labor, and capital. The classical economists therefore postulated that velocity of money is fairly constant because the economic and social activities which affect factors of production do not change in the short term. However, the Keynesian economists argued that the velocity of money is not constant and varies to offset changes in money supply. The monetarists, on the other hand, led by Milton Friedman advised against treating velocity of money as a constant parameter and examined those variables that could influence the level of velocity (Okafor et al, 2013).

The monetarists led by Milton Friedman based its arguments on the assumption of the inherent stability of the private sector and flexibility of prices. They argued that due to the dependency of velocity or economic policies, it has high fluctuations in the long-run; hence its behaviour is less predictable. Due to fluctuations of real factors and structures of the society, the changes maintain a smooth path, which increases its stability and predictability (Okafor et al, 2013).

The monetarists concluded that velocity could be regarded as a stable function of rates on different financial and physical assets. The main thrust of their argument is that the equilibrium associated with full employment in the labour market, under the neoclassical school, does not exist, due to rigidity of wages. They stressed that the velocity of money is severely affected by demand management policies; hence, it is a non-stationary variable. Furthermore, they argued that the movements of velocity are opposite to the movement of money-supply (Okafor et al, 2013).

Several arguments that explain money demand have been brought forward. Older theories such as the classical economists, argue that the velocity of money is fairly constant and that the main determinant of money demand is income. This theory has changed with time with the advancement by Keynesians who include interest rate as another determinant of money demand (liquidity preference theory). This theory states that there are three

motives for holding money, which include the transaction/business motive, the precautionary motive and the speculative motive (Serletis, 2007)

The transaction demand for money is associated with the level of income and money serves as a means of exchange for goods and services. Similarly, the precautionary money demand is dependent on the level of income but it is associated with the level of uncertainty. However, the speculative demand for money mainly focuses on the level of interest rates. Money is considered a store of value and individuals could choose to hold either money or bonds. Therefore, bond prices and hence money demand are highly dependent upon the interest rate (Serletis,2007). Interest rates are negatively associated with money demand according to Keynesians and as a result a rise in interest rates is not only associated with a reduction in money demand but a rise in velocity. Put differently, an increase in money demand could lead to a decline in velocity due to less spending while a decrease in money demand could lead to an increase in velocity. In other words, unlike the classical economists, the Keynesians argued that the velocity of money is not constant (Serletis, 2007).

New money demand theories have also been introduced, examples being the transactions and portfolio theories of money demand. The transactions theories such as the Baumol-Tobin model, the shopping time model and cash in advance model all assume that money serves as a medium of exchange. The portfolio theories such as Tobin's theory of liquidity preference assume the role of money as a store of value (Serletis, 2007)

2.2 Empirical literature review

One of the earliest empirical studies on velocity of money was by Garvy (1959) who examined the structural aspect of the money velocity focusing on the factors that determine variations in the velocity of money apart from interest rates. Garvy concluded that the long-run effects that increase the transaction velocity of money are mostly in the corporate sector, and include actions taken to reduce the delay in payment (mail float) as well as to economize on balances by centralizing money holdings, by a better synchronization of payments flows, and by temporary investment of excess cash and

reserves. These features could be affected by electronic money, such as the reduction in delay of payments, which could influence the fluctuations in velocity of money.

Bordo and Junong (1981, 1987, 1990, and 2004) using data from long time period looked at the behavior of velocity among various of developed countries. Bordo and Junong discovered that velocity declined in these countries in periods of monetization and then went up with financial innovations and deregulation. Increased monetization in a country would take place such that velocity declines as demand for transaction balances grows more rapidly than income. They used currency-to-money as a measure of monetization. The degree of financial development was measured as the ratio of total non-bank financial assets to total financial assets. According to them, the trend in velocity can be interpreted better in terms of the evolutionary technical progress taking place in the financial sector of the country over a long time horizon rather than a few short-term changes on which others had studied. (Akinlo, 2012). Bordo and Jonung (1987) found that since the late 19th century until World War II, velocity had kept a downward trend in five industrialized countries; USA, England, Canada, Sweden and Norway. Velocity however experienced an upward trend in the post-war period, hence proving the conventional theories of constant velocity wrong. They attributed these findings to developments in the money and capital markets, banking system expansion, technical progress in the financial sector and changes in fiscal and monetary policy decision making.

Gordon et al (1997) investigated the trend in velocity with quarterly data for a period covering 1960 –1997 using a general equilibrium model. They found that expansive fiscal policy or increased money supply pulled agents into real assets, whereas contractionary policy would induce agents to shift into nominal assets including money. Expansive monetary policy would heighten the opportunity cost of holding money, leading agents to substitute money with real assets with the implication that short term velocity is increased. This may be useful to consider, as Kenya continues to pursue an expansionary fiscal policy.

2.2.1 Determinants of velocity of money

One the earliest papers that attempted to establish the determinants of velocity was Ezekiel and Adekunle (1969) who examined the behavior of income velocity of currency, narrow money and broad money for 37 economies with varying degrees of growth. They found that the income of the country and velocity of money were inversely related for the three forms of velocity. Their results showed that as per capita income went up, the velocity of money either decreased or remained constant, which contradicts the quantity theory where income is positively related to velocity. Khan (1973) for Pakistan also established that per capita income was negatively related to velocity. However, this changed when other independent variables were included into the function. The results indicated a negative relation between the number of bank branches and velocity of money. This meant that the growth in banking resulted in a decrease of velocity of money due to increased savings and time deposits compared with other forms of liquid wealth. The rate of inflation and the size of the monetized sector had positive relationship with velocity of money (Akinlo, 2012).

Short (1973) in a research on West Malaysia and Singapore established that the inverse relationship of per capita income with velocity of money was amplified by the variation in monetary habits. The research concluded that a rise in either interest rate or expected rate of inflation led to an increase in velocity and vice versa. The study also revealed that as the number of bank branches increased, the velocity of money to went up, which was contradictory to (Khan,1973).

In sub Saharan Africa, studies on the velocity of money include; (Killick and Mwega ,1993), (Anyanwu ,1994), (Ndanshau ,1996), and (Mukisa ,1998) among others. Killick and Mwega (1993) studied velocity of money in Kenya. They found that past demand for money was the main factor determining velocity. Other determinants found to be significant included expected inflation and interest rate. Their results were consistent with results from previous studies by Darrat (1985) and Kanga (1985). Anyanwu (1994) research in Nigeria over 1960-1992 looked at the velocity of M1 and concluded that interest rate, inflation rate, real GDP, exchange rate, and financial deregulation had an

influence on the income velocity of money. Ndanshau (1996) in a research for Tanzania during 1967-1994 showed that the anticipated rate of inflation was inversely related to velocity, though weakly while real interest rate was also significant. Mukisa (1998) in another research investigated the determinants and behavior of velocity for Uganda during the period 1980-1997. The velocity of M3 money stock was found to be stable and financial innovation was a significant determinant of velocity. The results based on broad money velocity showed that income elasticity was negative. Previous values nominal interest rates and inflation rates were also found to be significant.

Some of the more recent studies on the determinants of velocity of money include; (Gill, 2010), (Duczynski ,2004) ,(Leão ,2005) (Akhtaruzzaman ,2008) (Adam *et. al* ,2010), (Rami, 2010) and (Akinlo ,2012) for Africa. Gill (2010) examined the determinants of the income velocity of money in Pakistan for the period 1973/4 to 2005/6 (33 years) using the Johansen cointegration technique. The study found that real income (per capita real GDP), financial development (91-day Treasury bill ratio), consumer price index (inflation) and interest rate (call money rate) all had a positive relationship with the velocity of money. Accordingly, it concluded that the constancy of the velocity of money does not hold in the changing economic situation of Pakistan and should be taken into account in formulating an effective and credible monetary policy in the economy.

Duczynski (2004) conducted a research to establish the variables that affected money velocity in developed economies and Latin-American economies between 1975 and 2000. in the long term, the velocity was established to be varying in both regions. First lag interest rate was found to be more significant than the present periods' interest rates. The influence of interest rates on the velocity of money was established to be more significant in Latin-American countries than in the developed economies. Komijani and Nazarian (2004) studied the pattern of money velocity in Iran during the period 1968 to 1979. They found out that velocity decreased during the instability of the Iraq war. They explained the post-war upward trend in velocity as being caused by technical efficiency of the payments systems and steps taken to develop the countries' capital market.

Leão (2005) attempted to provide an alternative explanation to the pro-cyclical behavior of velocity by using data over the period 1982 to 2003. He distinguished between expenditures related to durable consumption, export and investment goods on the one hand (DGEI), and expenditures related to non-durable goods and services (NDGS) on the other. Following this, he explained the pro-cyclical behavior of velocity in terms of the increasing share of the DGEI in total expenditures during expansions and decreasing during downturns. These findings were further confirmed by Barros et al (2007). They showed that increases in the weight of investment and durable consumption in total expenditure raise the velocity of both narrow and broad money.

Akhtaruzzaman (2008) studied money velocity in Bangladesh for during 1973 – 2007. He established that real GDP growth and financial development (demand deposit-time deposit ratio) negatively influenced the velocity for M1 and M2. This reflected the early stages of economic and financial development in the economy. The two variables contributed to half of the variance in income velocity. Rami (2010) studied money velocity in India using data between 1972 and 2004. The established that velocity of M3 was very predictable. Structural variables such as population of banks and degree of monetization were found to be significant in velocity M3 but the level of monetization was established to be insignificant in influencing velocity of M1.

Adam *et. al* (2010) attempted to forecast the velocity of income in Tanzania in view of the importance of the variable for a central bank that uses monetary targeting framework. They employed four different models namely: rolling trend estimator, moving average growth estimator, a simple random walk with drift; and a reduced form VAR model. Their results showed that the vector autoregressive model, based on structural money demand equation, outperformed the various univariate approaches both within sample and over a short period out - of - sample horizon. Consequently, they concluded that the existence of a stable cointegrating relationship between velocity and the determinants of money demand suggests that VAR-based forecast may have substantial value in monetary program formulation.

Another study was performed by Sitikantha and Subhandhra (2011) on the determinants of the income velocity of money using a reduced form VAR model. They reported that conventional determinants of velocity such as GDP, interest rate and financial deepening (credit to GDP ratio) were statistically significant for the Indian data. They however concluded that it wouldn't be prudent to use parameters to forecast velocity, especially over times of uncertainty that could cause a structural shift of the velocity from its medium-term trend.

In a study by Akinlo(2012) on financial development and income velocity in Nigeria; there was a positive relationship between velocity and income growth. This, according to the paper, indicates that the economy is at later stages of growth. Akinlo found out that exchange rate had an inverse relationship with velocity of money in the short run. The opportunity cost variables (interest rate and expected rate of inflation) were found to be insignificant in the short term. He established that the positive effect of the financial innovation variable (demand deposit-time deposit ratio) arose from the encouragement for the use of currency substitutes that lowers money demand and increases velocity of money. Akinlo therefore concluded that any attempt by monetary authorities to print more money would increase inflation.

Fishers quantity theory can also be interpreted in terms of the demand for money, the quantity of money that people want to hold. Because the quantity theory of money tells us how much money is held for a given amount of nominal spending, it is, in fact, a theory of the demand for money (Mishkin, 2016) .The purpose of this study is to establish the effect that electronic money has on the velocity of money and its determinants. Since the velocity of money function used in this study is derived from the money demand function, it is important to look at the literature on money demand and its determinants.

2.2.2 Money demand

There is a role velocity of money plays in the stability of money demand. This has prompted research on how money demand function can be expressed using velocity. Velocity is another way in which money demand function can be expressed (Siklos, 1993). Contrary to velocity, money demand has attracted a large number of researchers, mainly

due to its easy to understand formulation and interpretation. There are contradictory findings on the stability of money demand. Recently, various studies using different model specifications and estimation techniques have increased. While the quantity theory of money depicts a stable and predictable money demand, empirical evidence seems to depict mixed results.

The results on the stability of demand for money are also mixed for the case of Kenya. Darrat (1985), Mwenga (1990), Adam (1992) and more recently Kiptui (2014) indicate a stable money demand function while Kamau(2012) and Nyamongo(2013) find that money demand in Kenya is unstable in the short run. Njenga (2013) studied the money demand in Kenya during 1980 to 2011. The research used different measures of money supply against real GDP, nominal interest rates, and real exchange rate. The study found that the money demand function was stable. However, results showed that after 2007, the money demand function was not stable. This could imply that introduction of M-Pesa influenced the money demand, as the was introduced in 2007.

Financial innovation

Mwega (2012) in a study in Kenya showed that financial innovation such as Mobile–Money, deposit taking micro financing institutions (DTM's), and agency banking had promoted financial sector expansion by reducing transaction costs, hence ultimately increasing growth of the private sector in the country. New innovations may cause misspecification of the money demand despite their positives such as efficiency and reduced transaction costs (Arrau et al, 1995). This suggests that excluding financial innovations would result in erroneous money demand results (Lieberman, 1977).

Inclusion of financial innovation as a determinant of money demand could help solve issues such as autocorrelated errors, persistent over prediction and biased parameter estimates (Arrau *et al*, 1995). Various measures have been used as a proxy for financial innovation. Some examples are ATM concentration, dummy variables capturing periods of innovation, growth rate in private sector credit, M2/M1, M3/M1 and bank concentration which is applied in this study.

Kasekende & Nikolaidou (2016) investigated the influence of mobile money on demand for money in Kenya. They found a positive relationship between mobile money and money demand. They also established that mobile money causes an increase in the interest rate elasticity of money demand. Kasekende & Nikolaidou (2016) explained that this was because mobile money like all electronic money, is backed by deposits in commercial banks. Because mobile money is an alternative form of currency, i.e. electronic money and not necessarily an alternative form of asset other than cash, there is an incentive to use this alternative form of currency due to its desirable characteristics as a means of exchange and hence the demand for money increases.

Kasekende & Nikolaidou (2016) also found that there was a long run relationship between money demand and its determinants with inclusion of mobile money. This meant that mobile money may have affected the Kenyan financial sector more than the standard measures of financial innovation. This was however only the case with the use of real M1 as a measure for money demand. They concluded that it is difficult to predict how fast mobile money is likely to grow and influence monetary aggregate targeting. The effect of e-money on elasticities of the determinants of velocity will also be investigated in this study.

Income, interest rate, exchange rates

In addition to financial innovation, variables such as income, interest rates and exchange rates are often included in the money demand equations. Income plays an important role in explaining money demand and is often captured using Gross Domestic Product(GDP). The results often follow the money demand theory that predicts a positive relationship between income and money demand, however, the results tend to be mixed when it comes to the magnitude predicted by theory.

Interest rates are usually used as a proxy for the opportunity cost of holding money. According to the literature on money demand, the effect of the opportunity cost is expected to be negative. Various measures have been used to represent the opportunity cost of holding money such as the long-term government bond yield, Inflation and the Treasury Bill rate in the case of Sichei and Kamau (2012); Inflation is sometimes used to represent

the opportunity cost of holding money due to factors such as underdeveloped financial markets, unregulated interest rates and lack of reliable data on interest rates. This is particularly true in countries where the financial system is not well developed. Bordo and Junong (1990) recommend using expected inflation in an economy where interest rate is not free to respond to the market forces (regulated economy). In this study both the interest rate and expected inflation have been used to capture the full opportunity cost of holding money.

The exchange rate is also an important variable in determining the demand for money specifically in open economies. The effect of exchange rate on demand is ambiguous with studies such as that of Narayan *et al* (2009) on South Asia finding a positive influence of exchange rate on demand for money while other findings such as Kumar et al (2013) finding an inverse relationship. The relationship with exchange rate is depends on whether wealth effects or substitution effects are caused by changes in exchange rates. If there is a wealth effect, the sign of the exchange rate would be positive meaning that a depreciation in the exchange rate leads to an increase in foreign assets by domestic residents and thus a rise in wealth and hence an increase in money demand (Dobson and Ramlogan, 2001). If the sign of the exchange rate is negative, however, then it means that money demand is would fall because of individuals exchanging local currency for foreign (substitution effect)

2.2.3 Electronic money

One of the latest studies on electronic money is that by Qin,(2017) He came to a similar conclusion as Berensten (1996) who argued that the increased uptake of electronic money would eventually decrease the federal reserves' ability to control money supply, increase the velocity of money, decrease reserves, and decrease international monetary control. Reddy (2002) and Berensten (2002) argued that the emergence of electronic money would reduce central bank's ability to control base money and money multipliers, thereby affecting the money supply. They reached the same conclusion as Solomon (1997) who argued that electronic money is widely used in economic activities which could affect banking supervision, monetary policy, supervision of payment system and the stability of

the financial system. He pointed out that electronic money should be counted in the total money supply directly. David Weil (2012) found that the effects of mobile money were at the time nugatory, but they also noted that developments could have significant Implications for monetary policy. According to Walker (2015) electronic money aids in channeling funds to where they are most useful, which smooths consumption of many households as well as providing a source of capital for investments during liquidity constraints. This could be an indication of the effect that electronic money has on the way velocity of money is influenced by income. One of this paper's contributions is that it sheds light on the importance of the household's intertemporal decisions due to mobile money on the velocity variations.

However, not all scholars believe that electronic money would impact the money supply. Charles Fressman (2002) pointed out that electronic money would replace a portion of base money and affects the money multiplier, but that this effect is limited and cannot impact the central bank's control on money supply. Because of this, Fressman did not think electronic money would impact money supply. In addition, Freeman examined this problem in a very short time period and without reserve requirement. His report said central banks would be influenced by electronic money in a very short time period, not long term. Charles Goodhart (2000) reached a similar conclusion to Freeman that electronic money only replaced a very small part of base money. He however stated that this part of base money which was replaced would have a significant impact.

Tak (2002) stated that it would be difficult to measure corresponding changes in velocity because the income circulation velocity is obtained from the ratio of a term-end money supply and national income from that period. Tak felt that it was therefore difficult for the circulation velocity resulting from this calculation to reflect effective money flows from electronic settlement properly. Tak also stated that the velocity of money will increase if electronic money is first adopted as a major form of money and second added to the aggregates used to compute the velocity of money. El-Gawady (2009) in a study in Egypt argued that the central banks must include E-money in monetary aggregates so that the spread of E-money may lead to a corresponding change in the velocity of money.

Guang You Zhou (2005, 2007, and 2009) studied electronic money on currency velocity, the effect of electronic money on money multiplier and the great challenge of electronic currency in the financial market. Zhou argued that the emergence of electronic money increased the speed of currency circulation. According to the Fisher equation, when other factors remain constant, the emergence of electronic money will have a positive impact on money demand. In other word, the emergence of electronic money increased the money demand. Moreover, Guang You Zhou (2011) examined the relationship between electronic money and inflation. He pointed out that the impact of electronic money on inflation is mainly reflected in two aspects: amplification effects and acceleration effects. At the same time, Zhou chose relevant sample data from 1990 to 2009 in China, and through the construction of an electrometric model, verified his hypothesis. As a result, Zhou pointed out that the inflation effect of electronic money is significant.

Cho and Miles (2007) found a downward trend in velocity in Korea which was a bit of a mystery, given that velocity is usually expected to rise over time as the payments system evolves. This was however attributed to monetization of the economy. Roseline Nyakerario Misati (2010) noted that financial innovation in Kenya had in fact weakened the monetary transmission mechanism. According to Isaac Mbiti (2011) this was not a concern in 2011, because M-Pesa was not as widely used. Aron (2015) found an indication that mobile money may reduce inflation, which reflected a positive impact on productivity. According to Neda Popovska-Kamnar (2014) electronic money transactions are cheaper which causes an increase in the number of transactions, and hence an increase in the speed of money. Neda concluded that e-money is useful, but only to the level that the central bank could control or measure the monetary aggregates.

From the above, it can be seen that electronic money has been found to have a positive effect on the demand for money as well as a positive effect on the velocity of money. The relationship between demand for money and velocity is however thought to be negative and therefore the total effect of electronic money will depend on the extent to which these variables as well as their determinants are affected by the use of e-money.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the procedures and methodologies that was used in implementing the research study to come up with conclusions regarding the relationship between electronic money, velocity of money and its determinants.

3.2 Research Design

The main aim of this study is to evaluate the influence of electronic money on the effect of determinants of velocity of money in Kenya. Time series data and methodology is implemented with the use of a multivariate co-integration and error correction model. Secondary data from Central Bank of Kenya, World bank, Federal Reserve Bank of St. Louis and Kenya National Bureau of Statistics was used in the investigation.

3.3 Data collection

The main type of data that was used for the study is monthly time series data, measured in Kenyan shillings, which is limited to the period from 2009 to 2016. All data are natural log-transformed in the study. Description of the variables used is presented in the table below:

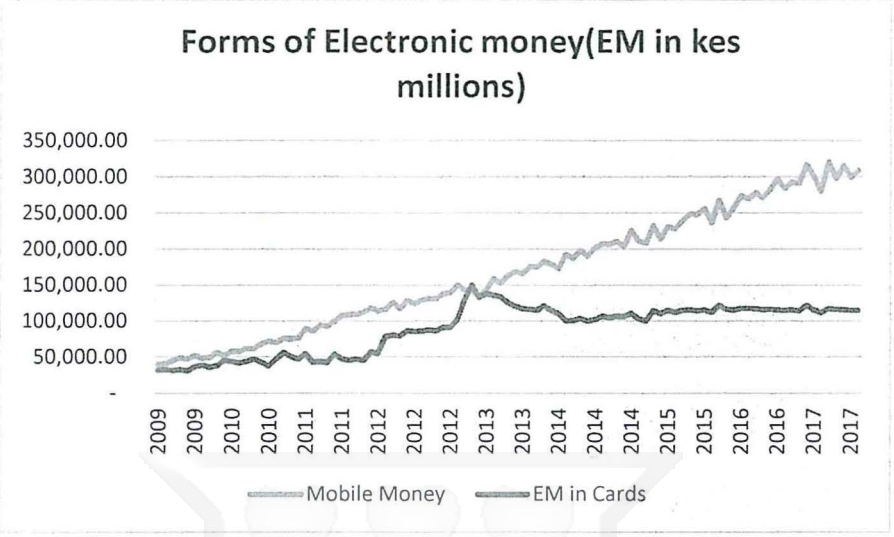
Type	Variable	Measure	Description
Independent variables	Velocity of money	V1	Money supply is taken as narrow money (M1)
		V2	Money supply is assumed to be electronic money (EM)
		V3	Money supply is taken as quasi-money (M2)
		V4	Money supply is M1 without electronic money (M1-EM)
		V5	Money supply is broad money (M3)
		V6	Money supply is broad money less e-money(M3-EM)
Explanatory variables	Real GDP per capita	Income	The real output or real GDP of the economy divided by the population.

	Interest rates	Opportunity cost	Interest rates are represented by T-bill rates
	Institutional factors	Financial deepening	Number of bank branches in Kenya
	Exchange rate	KES/USD	This represents the real exchange rate adjusted for inflation.
	Expected inflation	Opportunity cost	Measure of opportunity cost of holding money, based on adaptive expectation of inflation.
	ε_t		Residual

According to Zhou (2010) Electronic money has blurred boundaries between financial assets. Users can change their electronic money to any financial asset such as savings and other long-term investments. However, electronic money is primarily part of M1 and M0 as it is obtained in exchange for deposits which can be demanded at any time. It is also liquid and therefore part of M0. For this reason, it is deducted from M1 in one model and M3 in another in order to assess its impact. Real GDP per capita is used as it represents the average income of individuals

The prominent form of electronic money was mobile money, electronic money issued by telecommunications companies, as can be seen from the chart below. Electronic money in cards include ATM cards, prepaid cards, charge cards, credit cards, Debit cards and point of sale machines P.O.S which use payments technology companies such as Visa and Mastercard.

Figure 1. E-Money balance.



3.4 Data Analysis

3.4.1 Model Specification

This chapter explains in detail the methodology used to assess the effect of electronic money on the effect determinants of the velocity of money. The methodology used is from the modern quantity theory approach by (Friedman, 1959). This theory is used because it is consistent with Keynesian and Cambridge versions of money demand and also includes other factors in assessment of the income velocity function. This study therefore combines the classical economists' theory with Friedman's demand for money specification.

The classical equation for velocity can be represented as:

$$V = \frac{P \times Y}{M^s} \qquad \text{or} \qquad V = \frac{GDP}{M^S}$$

Where M^s is money supply. Real money supply $\left(\frac{M^d}{P}\right)$ is a function of various variables;

$$\frac{M^d}{P} = f\left(Y^{\alpha_1}, R^{\beta_2}, {i_r}^{\beta_3}, \pi^{e\beta_4}, \theta^{\beta_5}{}_t\varepsilon\right)$$

$$M^d = P\left[\left(Y^{\alpha_1}, R^{\beta_2}, {i_r}^{\beta_3}, \pi^{e\beta_4}, \theta^{\beta_5}{}_t\varepsilon\right)\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

With the equilibrium condition, (M^s=M^d) the model is:

$$V = \frac{P \times Y}{M^s} = \frac{P \times Y}{M^d} = \frac{P \times Y}{P\left[f\left(Y^{\alpha_1}, R^{\beta_2}, i^{\beta_3}, \pi^{e^{\beta_4}}, \theta^{\beta_5}{}_t\varepsilon\right)\right]}$$

$$V = Y^{1-\alpha_1}, R^{-\beta_2}, i_r{}^{-\beta_3}, \pi^{-\beta_4}, \theta^{-\beta_5}{}_t\varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Transforming this into log linear form yields:

$$\boldsymbol{lnV_t = \beta_o + \beta_1 lnY_t + \beta_2 lnR_t + \beta_3 lni_t + \beta_4 ln\pi_t^e + \beta_5 ln\theta_t + \varepsilon^*} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where $\boldsymbol{\beta_o}$ is the intercept. Other variables at time t are represented by:

$(1 - \alpha_1) = \beta_1$ is the coefficient

Y_t is income

R_t is the exchange rate

i_t is the interest rate

π_t^e represents expected inflation

θ_t represents financial deepening

ε_t is the residual where $\varepsilon \backsim iid(0, \sigma^2)$

Equation 3 forms the basic equation for analysis. Six measures of velocity will be used as dependent variables.

$$V_1 = \frac{GDP}{M1} \qquad V_2 = \frac{GDP}{EM} \qquad V_3 = \frac{GDP}{M2} \qquad V_4 = \frac{GDP}{M1 - EM} \qquad V_5 = \frac{GDP}{M3}$$

$$V_6 = \frac{GDP}{M3 - EM}$$

Where M1, M2, and M3 are measures of money supply and EM is the balance of electronic money outstanding. Money supply as measured by M2-EM was not included as the wide and narrow measures less electronic money are sufficient to draw conclusions. According to Central Bank of Kenya (2016) M1 is a measure of narrow money (currency in circulation and demand deposits), M2 is quasi money (M1 plus term deposits) and M3 is broad money (M2 plus private sector deposits with NBFIs). The development of the

financial system will be proxied by the population of bank branches. This was chosen as a proxy because it captures financial inclusion (The degree to which individuals have access to financial services).

For analysis, ARDL model is chosen due to the order of integration of the various variables. Augmented Dickey Fuller (ADF) and Phillips Peron tests are used to test for stationary and determine the order of integration, which is determined to be I(1) for all except V2, which is I(0). Six regression models are estimated with V1, V2, V3, V4, V5, and V6 as independent variables. F statistics and adjusted R-square are used to assess the degree to which the model can be relied on for prediction. Higher adjusted high level of adjusted R-squared and F-statistics indicate stability of the model.

The second objective is to investigate the impact of electronic money on the determinants of money velocity. To come up with a result for this objective, all six regression models are used and the significance of each explanatory variables specified in equation 3 are assessed with their parameters.

The Schwartz and Akaike Information Criterion (AIC) are used to determine the optimum number of lags. Thereafter, the model specified in equation 3 is estimated. Various diagnostic tests are conducted, including Durbin Watson and Breusch-Godfrey LM test to test for presence of serial correlation. Heteroskedasticity tests such as Breusch-Pagan-Godfrey and white test are used to test for the presence of heteroskedasticity in the error term. Ramsey stability test, adjusted R squared and F statistics are used to evaluate the stability and reliability of each model.

3.4.2 Unit Root tests

Using normal significance tests, a significant relationship can be shown between two variables despite the fact that none in reality exists. This happens when two variables are non-stationary. A regression between them leads to spurious results. This study uses a conventional unit root test- Augmented Dickey-Fuller test (1979).

The reason for subjecting the macroeconomic variables series individually to unit root analysis is that individual economic time series may not be stationary, but there may be cases of linear combination among them. This means that non-stationary economic time series could produce stationary relationships if they are cointegrated. If the residuals of the variables do not contain unit roots, the econometric relationship among the variables could be co-integrating.

For the Augmented Dicky-Fuller (ADF) test, consider a simple AR(1) process:

$$\boldsymbol{y_t = \rho y_{t-1} + x_t \delta + \varepsilon_t}$$

Where y_t is the observed variable, $x_t$are optional exogenous regresses which may consist of constant or a constant and trend, ρ *and* δ are parameters to be estimated, and $\varepsilon_t$is assumed to be white noise with zero mean and constant variance. If $\rho \geq 1, y_t$ is a non-stationary series and the variance of y_t increases with time and approaches to infinity. Conversely, if $\rho \leq 1, y_t$ is a stationary series.

On subtracting y_t on both sides of the equation, we get:

$$\Delta y_t = \alpha y_{t-1} + x_t + \varepsilon_t$$

Where $\alpha = \rho - 1$

The null and alternative hypothesis can be written as;

H_o; $\alpha = 0$ (y_t is unit root)

H_a; $\alpha < 0$ (y_t is stationary)

The study is evaluated using a conventional t_{ratio}test for α.

$$\boldsymbol{t_\alpha = \frac{\alpha^\gamma}{se(\alpha^\gamma)}}$$

Where $\alpha^\gamma$is an estimate of α and se is the standard error.

In addition to the Augmented Dickey-Fuller, the Phillips Peron test will also be used as an additional unit root test. In statistics, the Phillips–Perron test assesses whether a time series is integrated of order 1. It builds on the Dickey–Fuller test of the null hypothesis $H_o; \alpha = 0$.

Just as the augmented Dickey–Fuller test, the Phillips Perron test considers the fact that the process generating data for y_t might have a higher order of autocorrelation than is shown, making y_{t-1} endogenous and thus invalidating the Dickey–Fuller t-test. While the augmented Dickey–Fuller test addresses this issue by introducing lags of Δy_t as regressors in the test equation, the Phillips–Perron test makes a non-parametric correction to the t-test statistic

This test is robust test is robust with unspecified autocorrelation and heteroscedasticity in the disturbance process of the test equation. Davidson and MacKinnon (2004) however report that the Phillips–Perron test performs worse in finite samples than the augmented Dickey–Fuller test. These two tests are therefore used together for accurate results.

CHAPTER 4

RESULTS AND DISCUSSION

4.1: Introduction

This chapter presents the findings of the data analysis and their interpretations. It starts off with the trending of the variables and descriptive statistics. Monthly data for the period Jan 2009- Dec 2016 was used in the analysis. All variables were log transformed as in the equation. The data on the number of bank branches (per 100,000) in Kenya was obtained from the federal reserve bank of St. Lois. Data on real GDP per capita was obtained from world bank and data on all other variables was obtained from the Central Bank of Kenya website as well as their monthly economic indicators reports.

4.2: Descriptive statistics

The table below shows the summary statistics of the main variables that have been included in the model. These include the mean, median, maximum, minimum, standard deviation, skewness and kurtosis of the monthly data observed.

Table 1. Descriptive statistics

	No. of branches	Exchange rate	Expected inflation	Interest rate	GDP per cap.	V1	V2	V3	V4	V5	V6
Mean	1.69	4.47	1.94	2.05	11.30	-0.82	0.49	-1.53	-0.47	-1.69	-1.56
Median	1.69	4.46	1.89	2.14	11.31	-0.80	0.34	-1.50	-0.46	-1.68	-1.55
Maximum	1.86	4.66	2.98	3.08	11.40	-0.48	2.16	-1.18	-0.10	-1.34	-1.25
Minimum	1.51	4.31	1.16	0.47	11.16	-1.22	-0.17	-1.96	-0.83	-2.13	-1.98
Std. Dev.	0.10	0.09	0.46	0.52	0.07	0.19	0.53	0.21	0.14	0.21	0.19
Skewness	-0.15	0.36	0.49	-1.15	-0.48	-0.27	1.31	-0.31	-0.13	-0.28	-0.47
Kurtosis	1.89	2.13	2.73	4.62	2.27	2.29	4.45	2.26	3.28	2.21	2.47
Obs.	96	96	96	96	96	96	96	96	96	96	96

Analysis of the symmetry indicates that none of the series are perfectly symmetric, the most symmetric being v1 with skewness of -0.13 and the number of branches with -0.15.

Interest rates are highly negatively skewed due to the Monetary policy signals that successfully stimulated declines in short term interest rates during the second half of 2010 (Central bank,2010). V2(velocity of EM) is highly positively skewed due to recent sharp increases in use of electronic money such as M-pesa.

All series are platykurtic, except interest rates and velocity of electronic money, which are leptokurtic, indicating the presence of outliers. For interest rates this may have been caused by the same reduction in 2010 as well as sharp increases during the 2012 election period. The graph below is a plot of all the logs of the variables which seems to be stationary due to the transformation.

4.3: Correlation analysis

Correlation matrix is an important indicator of a linear association of the variables and helps in determining the strengths of association in the model. It can also help in deciding which variable(s) to drop from the equation.

High correlation between real GDP per capita and exchange rate as well as the number of branches may indicate that the variable should be dropped to avoid the problem of multicollinearity. The correlation is an indication that more financial services are sought as income increases. GDPs high correlation with the exchange rate supports some of the exchange rate determination theories, such as the monetary approach to exchange rates, which predicts that higher growth rates in a country lead to an appreciation of this country's currency.

The number of bank branches has a high correlation with the exchange rate as well as velocity of electronic money. Most of the velocity measures have a high correlation with each other due to the common variables of GDP and money supply used in their calculation.

Table 2. Covariance/ correlation analysis

1)Covariance / *2)Correlation*	No. of branches	Exchange rate	Expected inflation	Interest rate	Real GDP per capita	V1	V2	V3	V4	V5	V6
No. of Branches	0.010										
	1.000										
Exchange rate	0.008	0.009									
	0.873	1.000									
Expected inflation	-0.005	0.005	0.212								
	-0.105	0.111	1.000								
Interest rate	0.022	0.020	0.122	0.271							
	0.414	0.413	0.511	1.000							
Real GDP per capita	0.007	0.006	-0.001	0.012	0.005						
	0.953	0.917	-0.029	0.324	1.000						
V1	-0.010	-0.007	0.006	-0.026	-0.007	0.034					
	-0.546	-0.374	0.074	-0.272	-0.563	1.000					
V2	-0.042	-0.028	0.048	-0.098	-0.028	0.082	0.281				
	-0.794	-0.569	0.198	-0.357	-0.779	0.829	1.000				
V3	-0.012	-0.007	0.010	-0.033	-0.008	0.037	0.091	0.042			
	-0.563	-0.382	0.110	-0.313	-0.553	0.983	0.838	1.000			
V4	0.000	0.000	-0.005	0.000	-0.001	0.021	0.025	0.021	0.020		
	-0.026	0.017	-0.072	0.002	-0.100	0.790	0.336	0.738	1.000		
V5	-0.012	-0.008	0.008	-0.038	-0.008	0.038	0.094	0.043	0.022	0.044	
	-0.576	-0.403	0.083	-0.347	-0.566	0.982	0.844	0.999	0.727	1.000	
V6	-0.009	-0.006	0.004	-0.030	-0.006	0.034	0.076	0.038	0.021	0.039	0.036
	-0.474	-0.327	0.051	-0.310	-0.472	0.973	0.759	0.989	0.805	0.989	1.000

4.4: Unit root test

The Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981) test is used to assess the stationarity of time series. The choice of the optimum number of lags for the ADF test was based on the Schwarz information criterion.

Table 3. Stationaritv tests

Stationarity test								
		ADF			PP			
Variable		Test statistic	Critical value	P-value	Test statistic	Critical value	P-value	Conclusion
v1	Level	-2.46	3.5	0.128	-1.672	-3.5	0.44	Non-Stationary
	1st difference	-4.157	3.5	0.001	-8.44	-3.5	0	Stationary
v2	Level	-3.685	3.5	0.006	-4.2433	-3.5	0.001	Stationary
v3	Level	-2.397	-1.944	0.1455	-0.0487	-1.944	0.664	Non-stationary
	1st difference	-2.0762	-1.944	0.037	-3.298	-1.944	0.0012	Stationary
v4	Level	-0.76	-2.59	0.1089	-0.79	-2.59	0.37	Non-stationary
	1st difference	-10.09	-2.59	0.000	-10.184	-2.59	0.000	Stationary
v5	Level	-0.297	-2.59	0.5761	-0.035	-2.59	0.0013	Non-stationary
	1st difference	-2.18	-2.59	0.0288	-3.265	-2.59	0.591	Stationary
v6	Level	-0.408	-2.59	0.534	-0.257	-2.59	0	Non-stationary
	1st difference	-2.5248	-2.59	0.0119	-4.259	-2.59	0.934	Stationary
Exchange Rate	Level	0.9494	-2.59	0.9081	1.1426	-2.59	0	Non-stationary
	1st difference	-6.704	-2.59	0	-6.704	-2.59	0.3201	Stationary
Expected inflation	Level	-1.0868	-2.59	0.249	-0.9089	-2.59	0	Non-stationary
	1st difference	-5.2887	-2.59	0	-5.2539	-2.59	0.5043	Stationary
Interest rate	Level	-0.4986	-2.59	0.498	-0.483	-2.59	0	Non-stationary
	1st difference	-4.2035	-2.59	0	-7.43	-2.59	1	Stationary
No.of branches	Level	12.495	-2.59	1	11.4089	-2.59	0	Non-stationary
	1st difference	-9.084	-3.5	0	-4.3173	-2.59	0	Stationary

As seen from the table above, all the variables are integrated of I(1) (stationary on first difference) except velocity of electronic money which is stationary at level, I(0).

None of the data are found to be I(2), which is important for the credible application of the Autoregressive Distributed Lag (ARDL) model's-integration analysis is therefore applied to determine the relationship among the variables.

4.5: Cointegration analysis

4.5.1 Diagnostics Results

The results show that all the models could be relied on because the F-statistics in all models was significant. The adjusted R-squared for all models is close to 1, indicating the in-sample success of the regression equation in forecasting the dependent variable (goodness of fit).

Breusch-Godfrey serial correlation LM tests for all models had a p-value larger than 0.05. This means that the null hypothesis of no autocorrelation was accepted at 5% confidence level for all the models. The results of the Breusch-Pagan-Godfrey test for heteroskedasticity also all had a p-value greater than 0.05 apart from V2, hence accepting the null hypothesis of no heteroskedasticity at 5% confidence level. For V2, the p-value was 0, showing presence of heteroskedasticity and therefore the Newey-west estimator was applied to rectify this.

The Ramsey test for stability had p-values greater than 10% for all the models, indicating that there were no non-linearities/misspecification in any model. The Bounds test for all models had an f-statistic greater than the upper bound at the 5% critical level on the Pesaran bounds test table. The null hypothesis of no long run relationship was therefore rejected for all the models. Therefore, the long run form could be interpreted for all models.

4.5.2 Estimation results

The error correction term (CointEq(-1)) is negative and significant for all models, which implies that the process is converging in the long run to the equilibrium relationship. Therefore, the long run relationship can be interpreted for all the models.

Table 4. ARDL Model Estimation results (Jan 2009-Dec 2016)

Form of Velocity	M3	M3-EM	EM	M1	M1-EM	M2
Model	4,1,0,2,2	3,4,0,0,0	2,0,1,0,4	4,1,0,2,1	3,1,4,2,4	4,0,0,2,1
	coeff	*coeff*	*coeff*	*coeff*	*coeff*	*coeff*
SHORT RUN COEFFICIENTS						
D(V(-1))	0.2331**	0.2272**	-0.2287***	0.0846		0.2252**
D(V(-2))	0.3209***	0.3487***		0.192*		0.3765***
D(V(-3))	0.2173**			0.1679*		0.2394**
D(Exchange Rate)	-0.02064	-0.0978	0.464**	-0.0869	-0.047	0.135***
D(Expected Inflation)	-0.00794*	-0.012**	-0.1705**	-0.0061	-0.021	-0.0051
D(Interest rate)	0.00392	-0.0016	-0.0434	-0.001	0.0087	-0.0016
D(Interest rate(-1))	-0.0189**			-0.0372**	-0.057**	-0.017**
D(No. of bank branches)	0.7393	-0.2135***	4.376***	1.576	-0.464***	0.917**
D(No. of bank branches(-1))	1.1287**		2.6316			
CointEq (-1)	-0.0284***	-0.032**	-0.112**	-0.049**	-0.114***	-0.0309***
D(Exchange Rate(-1))		0.1351			-0.205	
D(Exchange Rate(-2))		0.1466			0.318	
D(Exchange Rate(-3))		-0.2979***			-0.573	
D(No of bank branches(-2))			-6.3203**			
D(No of bank branches(-3))			6.319***			
D(Expected Inflation(-1))						
D(Expected Inflation(-2))						
D(Expected Inflation(-3))						
LONG RUN COEFFICIENTS						
Exchange Rate	5.61097**	8.8614**	4.149***	4.578**	5.109***	4.371**
Expected Inflation	-0.2799	-0.3785	-0.05	-0.124	-0.186	-0.1654
Interest Rate	0.0824	-0.0507	-0.388**	0.1028	0.1303	0.0655
No. of bank branches	-4.9986***	-6.7183**	-2.47**	-3.799**	-4.077**	-4.4293***
C	-18.196**	-28.905**	-13.686**	-14.982*	-16.272***	-13.514**
Adj. R-squared	0.996	0.993	0.9701	0.98	0.9212	0.996
	1892.81	1132.03	269.59	378.597	97.77	2221.02
F Stat	0	0	0	0	0	0
Ramsey Reset	0.298	0.6807	0.1489	0.3571	0.1137	0.3324
	0.3565	0.2991	0.6943	0.3131	0.48	0.2536
LM	0.2918	0.2462	0.6516	0.255	0.43	0.2039
	0.1899	0.0521	0.1019	0.3863	0.204	0.1652
Heteroskedasticity	0.4003	0.2546	0	0.1652	0.14	0.3295

, ** and * indicate significance at 10%, 5% and 1% levels, respectively.*

Short-run

The first research question asked to assess the factors that affect velocity of money. In the short run, the velocity of (M3-EM) is negatively related to expected inflation (-0.012). However, with electronic money, this relationship becomes more positive (-0.00794). This may indicate that electronic money causes velocity to increase more with inflation in the short run.

Also, in the short run, interest rate in the previous period affects velocity of M3 negatively (-0.02). This shows that as interest rate decreases in the previous period, people will borrow and spend more hence increasing velocity of money in the next period. As the number of branches in the previous period increases, the velocity of M3 increases in the following period by (1.13), which may be due to more financial transactions due to increased financial deepening.

Without Electronic money, the number of branches affect velocity of M3 negatively (-0.2135). This indicates that Electronic money may be the factor that causes a positive increase in M3 as the number of branches increase. This can also be seen from the strong positive significant relationship between the number of bank branches and the velocity of electronic money (4.38 in the current period and 6.32 in the 3rd lag).

Increase in the exchange rate also affects velocity of (M3-EM) negatively (-0.3) three periods ahead. This means that as the exchange rate against the US dollar increases(depreciates), the velocity of M3 without electronic money decreases after three months. Contrary to this, the exchange rate affects the velocity of electronic money alone positively (0.46). This is an indication that electronic money is significant in determining the extent of the substitution effect in the event of exchange rate fluctuations.

All three lags of the velocity of M3 affect it positively. This is consistent with findings by (Killick and Mwega,1993) who found that past demand for money was a major factor affecting velocity in Kenya. Without electronic money, only two lags of the dependent variable are significant. This may be an indication that Electronic money increases the

rate at which the velocity is affected by previous values of itself. The velocity of M1 with electronic money is also determined by lagged values of itself, while the velocity of M1 without electronic money is not affected by lagged values.

The lagged interest rate affects the velocity of M1, M1-EM, and M2 negatively. This shows that in the short run, a decrease in interest rate causes an increase in spending in the next period. This is consistent with theory and findings by (Duczynski,2004) who also found that the first lag of interest rate had higher significance than current interest rates in determining velocity. With electronic money, the relationship of M1 with interest rate is slightly more positive in the short run (from-0.06 without EM to -0.04). The number of bank branches has a significant negative relationship with velocity of M1 without electronic money, while it is positive but insignificant with electronic money. This shows there is a decrease in the use of physical currency as bank branches increase in number.

The exchange rate and the number of bank branches both have a significant positive effect on the velocity of M2, evidence of substitution effect and financial access respectively.

Long-run

For the long run relationship, the regression results in the table indicate that the coefficient of exchange rate was positive and significant in all models. This is evidence of the substitution effect. When the exchange rate increases, individuals substitute/change their wealth to foreign currency due to fear of losses, hence increasing the velocity of money.

In the long run, electronic money decreases the positive relationship of the velocity of M3 with exchange rate. This shows that the other components of M3, such as time deposits and money market funds, are significantly positively related to the exchange rate.

The number of bank branches was also significant and negative for all the models in the long run, an indication of the replacement of physical banking with online banking and mobile banking as financial deepening (number of bank branches) increases. This in turn reduces the amount of cash that people need to hold. This finding is consistent with

findings by Khan (1973) in Pakistan who also found a negative relationship and attributed it to the increased savings and time deposits compared with alternative types of liquid wealth. Akhtaruzzaman (2008) also found an inverse relationship for Bangladesh.

The interest rate has significant negative relationship with velocity of electronic money in the long run. A one percent decrease in the interest rate causes the velocity of electronic money to increase by 39%. This may be because people demand more money as the opportunity cost decreases and therefore electronic transactions increase.

For velocity of M1, just as with M3, the positive relationship with exchange rate is increased when electronic money is deducted. This could be an indication that the introduction of electronic money reduces the substitution effect. This can be explained with the fact that electronic money is denominated in and can only be exchange for the local currency. Therefore, it is not so involved in the process of conversion to foreign currency as exchange rate fluctuates, as most people ask their bank to convert their savings/deposits directly.

The negative effect of the number of branches on velocity of both M3 and M1 increases without electronic money, indicating that introduction of electronic money has a positive effect on the relationship. Also, in the short run, the number of branches had a very significant positive relationship with velocity of electronic money. This shows that less individuals are using physical currency as financial access increases in the long run as electronic money is preferred. This could also be an indication to conclude that electronic money does indeed increase the velocity of money.

The insignificant relationship between the rate of inflation and velocity of money in the long run may for all the models that inflationary pressure may have positive effects as it would influence economic activity without necessarily affecting money demand function (King'ori, 2003).

CHAPTER 5

SUMMARY AND CONCLUSION

5.1: Summary

This study investigated the determinants velocity of money and compared them to the determinants of velocity with electronic money. The research methodology was based on various theories and past research which state that income velocity is affected by various factors including income growth, inflation, interest rates, exchange rates, and the structure and level of financial development.

Monthly time series data for the period of January 2009 to December 2016 was used in the investigation. The findings indicate that the exchange rates and the level of financial development (proxied by the number of bank branches) both have a significant long run effect on all measures of velocity. Exchange rate significance shows that international factors may have an influence on the stability of money demand.

From the results it can be seen that electronic money changes the effect of certain variables on the velocity of money. For example, it causes velocity of M3 to increase more when there is inflation in the short run. This may be due to the ease with which transactions can be conducted due to the reduced transaction costs, and therefore more people will spend, causing more money to chase fewer goods. Electronic money increases the rate at which the values of velocity of M1 and M3 are affected by previous values.

A decrease in interest rate causes the velocity of narrow money (M1),quasi-money (M2), and broad money (M3) to increase in the next period as people borrow and spend more in the short run. Electronic money decreases this effect of interest rates on velocity of M1 in the short run, which may be an indication that interest rates don't affect electronic money transactions.

Without electronic money in the short run the number of bank branches has a negative relationship with the velocity of M1 and M3, while with electronic money the relationship

is positive in the first lag. Electronic money therefore amplifies the rate at which velocity of M3 increases as the number of bank branches increases in the short run This also applies in the long run whereby the relationship between financial deepening and velocity is more positive with electronic money.

As the number of bank branches increase over time, people are also abandoning physical banking for electronic banking such as the use of phones and the internet to transfer and withdraw money. The use of electronic money therefore has a positive influence on the rate at which the number of bank branches increases velocity of M3 as well as M1, and hence it can be concluded that in general, electronic money increases the income velocity of money.

Velocity of M2 also has a significant positive relationship with both the number of bank branches and the exchange rate in the short run, due to increased transactions due to deepening and the substitution effect respectively.

In the long run, other components of M3 are affected more than electronic money by exchange rate. This may be due to institutional funds and forms of "hot money" that fluctuate rapidly in response to exchange rate movements. The effect is also the same for M1, whereby the positive relationship with exchange rate is decreased with electronic money. This may indicate that electronic money is not used as much in the process of converting local to foreign currency, as such transactions are done through direct bank trades. The level of electronic money units therefore remains stable in the long run, even as the exchange rate depreciates.

Decrease in interest rates causes an increase in the velocity of electronic money, due to more spending, however interest rate doesn't have any significant relationship with any other velocity measure in the long run. Expected inflation was also found to have no significant effect on all measures of velocity in the long run.

5.2: Conclusion

The main findings revealed that financial innovation and deepening in Kenya has changed the way people transact by reducing the use of physical forms of payment as more and more people use electronic money due to its desirable characteristics.

Forms of electronic money change the effect of the determinants of velocity. For expected inflation, the relationship becomes more positive with inclusion of electronic money in the short run, which may mean that electronic money causes people to spend more during periods of inflation. The effect of interest rates is also more positive with electronic money in the short run. These two variables represent the opportunity cost of holding money and therefore an increase is thought to reduce money demand and increase velocity. It can therefore be concluded that electronic money reduces the effect of opportunity costs of holding money on velocity of money. This is a positive thing for the monetary authority, as it means that electronic money will reduce the effects of overreactions to changes in interest rates and inflation.

Electronic money reduces the substitution effect of exchange rate in the long run. This may imply that individuals are less willing to substitute electronic money units for foreign currency and therefore there is increased money demand, which may also be due to wealth effects as explained by (Dobson and Ramlogan, 2001). Also, the effect can be attributed to the fact that electronic money is not so involved in the process of currency conversion, as agents would have to convert the electronic money to local currency first.

The relationship of velocity with the proxy for financial development (no. of bank branches) is more positive with electronic money which indicates the growing popularity and use of electronic money as more people gain access to financial services. It also shows that electronic money increases the speed of circulation due to its liquid nature and low transaction costs.

Interest rate as an opportunity cost affects velocity of electronic money negatively in the long run. This is due to the ease with which transactions can be conducted, hence enabling individuals to react to economic signals more efficiently. This may help to enhance interest rate signals by the monetary authority.

5.3: Recommendations

The data shows that constant velocity doesn't hold and should be taken into account in formulating policy, as it is the tie between the goods and services in an economy and the medium of exchange, which is regulated and monitored by the monetary authority. Electronic money has the potential to reduce central bank currency (Berensten, 1997). The monetary authority should have control over all issuance of money and therefore apply a prudential supervisory framework to electronic money issuers so as to maintain stability of money supply.

Given that Kenya imports more than it exports and considering the increased liberalization, globalization and opening of the economy, the monetary authority should take into account the impact of electronic money on how velocity and demand for money are affected by depreciation of the exchange rate. This would ensure that the effective money supply is kept in check during times of potential capital flight such as an election period.

The monetary authority should make use of the interest rate channel to control the velocity of electronic money and hence control inflation by affecting the demand for money. In addition, expected inflation was an insignificant determinant of velocity in the long run, therefore, the central bank can focus on the objective of economic growth while allowing a reasonable level of inflation. In the short run, however, they should consider the fact that electronic money may cause an increase of the velocity of money in response to increased inflation, as this would temporarily increase inflation further.

Lastly, structural factors (proxied by number of bank branches) are highly significant to velocity of money, this means that the central bank should come up with policies to

monitor financial sector growth so as to ensure that the money demand function remains stable.

The Monetary authority should consider the impact of electronic money due to its high liquidity and low transaction cost. Kenya's central bank should refer to other developed countries' laws and regulations on electronic money, and combining with Kenya's own situation can develop prudential laws and a framework for regulation. Because electronic money accelerates the flow of money, central bank should ensure that electronic money is kept equivalent to bank deposits and require electronic money deposit reserves (Qin, 2017) .In addition, the central bank should provide deposit insurance for electronic money to ensure that it can still be exchanged for physical cash incase banks lose their deposits. (Qin, 2017)

A further area of research that would conclude the impact of electronic money on money supply is the impact of electronic money on the money multiplier. Electronic money could increase the money multiplier because the cash that banks gain in exchange for their electronic money can be used for loans and other investments. This is a situation whereby banks are drawing in all the base money by persuading individuals to use their electronic money instead which is more liquid and convenient. This way, banks have more money to invest while easily meeting their reserve requirement. This situation is worse when e-money is issued as consequence of credit (Mohamad Al-Laham, 2009) as it is not backed by a part of base money.

5.4: Limitations

The major limitation encountered in this research study was data limitation whereby data on electronic money prior to 2009 was not available. This necessitated the use of monthly as opposed to quarterly data due to the short time span. Annual nominal GDP had to be interpolated to monthly using the Denton interpolation method on E-views 9.

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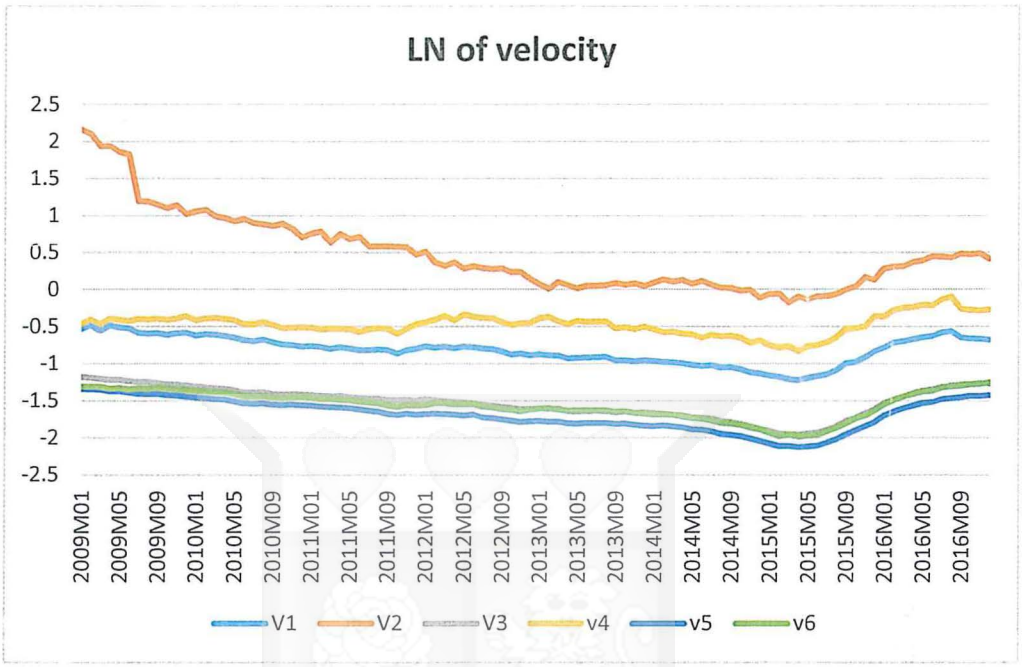
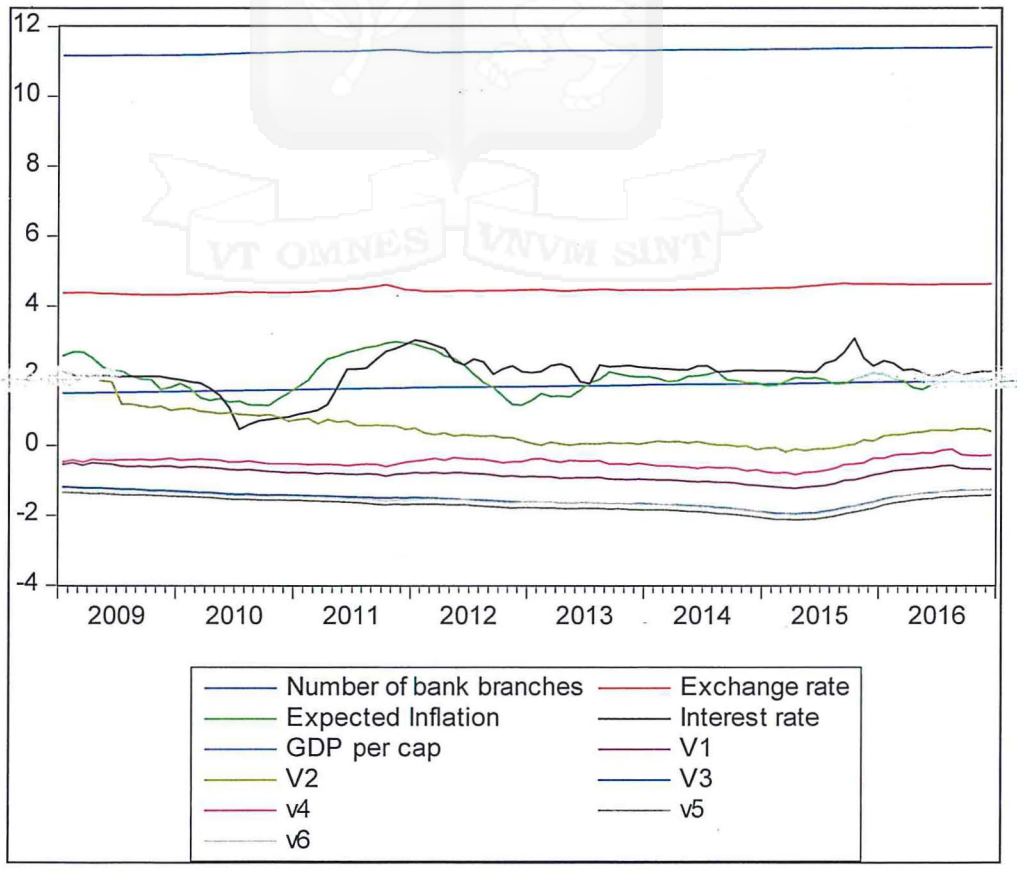
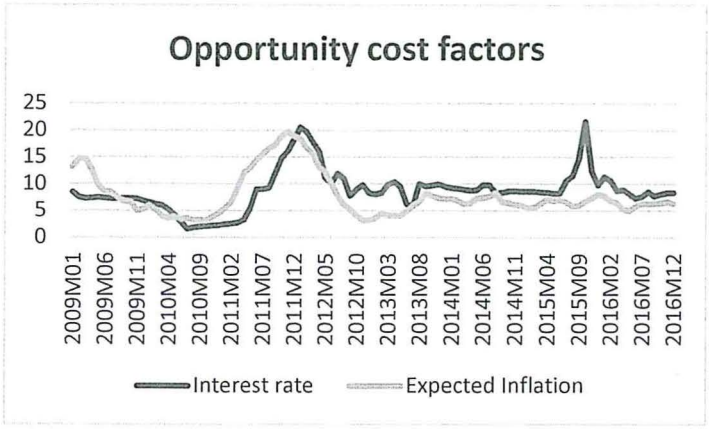
APPENDIX

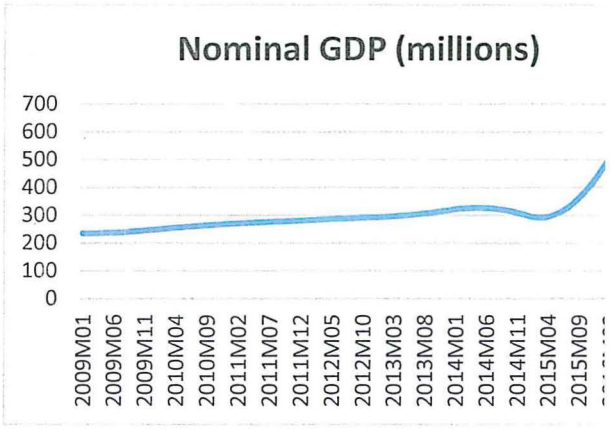
Charts of variables

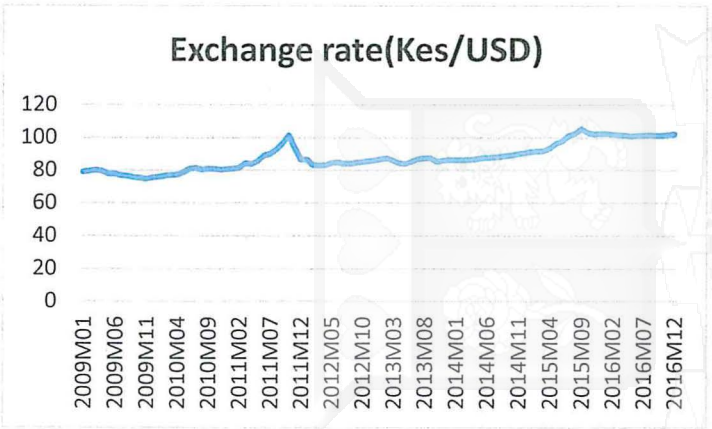


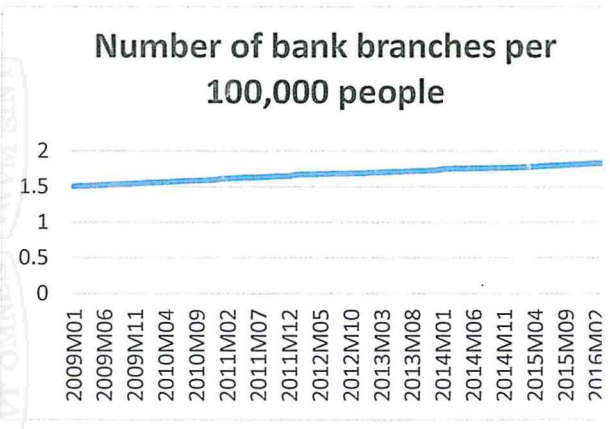
LN of all variables




Opportunity cost factors
25
20
15
10
5
0
2009M01
2009M06
2009M11
2010M04
2010M09
2011M02
2011M07
2011M12
2012M05
2012M10
2013M03
2013M08
2014M01
2014M06
2014M11
2015M04
2015M09
2016M02
2016M07
2016M12
Interest rate
Expected Inflation


Nominal GDP (millions)
700
600
500
400
300
200
100
0
2009M01
2009M06
2009M11
2010M04
2010M09
2011M02
2011M07
2011M12
2012M05
2012M10
2013M03
2013M08
2014M01
2014M06
2014M11
2015M04
2015M09


Exchange rate(Kes/USD)
120
100
80
60
40
20
0
2009M01
2009M06
2009M11
2010M04
2010M09
2011M02
2011M07
2011M12
2012M05
2012M10
2013M03
2013M08
2014M01
2014M06
2014M11
2015M04
2015M09
2016M02
2016M07
2016M12


Number of bank branches per 100,000 people
2
1.5
1
0.5
0
2009M01
2009M06
2009M11
2010M04
2010M09
2011M02
2011M07
2011M12
2012M05
2012M10
2013M03
2013M08
2014M01
2014M06
2014M11
2015M04
2015M09