Financial Innovations and Monetary Policy in Kenya

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FINANCIAL INNOVATIONS AND MONETARY POLICY IN KENYA[1]

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Abstract

The objective of this study is to analyze the effects of financial innovation in the banking sector on the conduct of monetary policy in Kenya during 1998-2012. The country has witnessed a number of financial innovations during this period. The study focuses on whether these wave of financial innovations have impacted on the transmission mechanism of monetary policy, and if so how. The results show that the innovations have improved the monetary policy environment in Kenya as the proportion of the unbanked population has declined coupled with gradual reduction in currency outside banks. However, the period post 2007 when the country has experienced the fastest pace of financial innovation, is associated with instability in the money multiplier, income velocity of money and the money demand. However, recent trends point towards stabilization pointing to the need for further examination establish whether indeed the break in trend is of structural or transitory in nature. A structural break raises questions on the credibility of the current monetary targeting framework in use in Kenya, in view of which a more flexible framework should be adopted. Overall, the results show that financial innovation has had positive outcomes and seems to improve the interest rate channel of monetary policy transmission.

[1] Disclaimer: The views expressed in this paper are solely those of the authors and do not reflect the views of the Central Bank of Kenya.

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1.0 INTRODUCTION

The term financial innovation has been used in a variety of content to refer to a wide range of changes and developments affecting financial markets. In a narrow sense, the term can be used to refer solely to the introduction of new financial instruments. In a broader sense, it can encapsulate changes in the structure and depth of financial markets, in the role of financial institutions, the methods by which financial services are provided and the introduction of products and procedures in the wake of deregulation.

In recent decades, financial sectors of many countries have undergone significant changes against the background of general trend towards deregulation, globalization, and development of the internet and the resulting explosion of e-commerce. Technological innovation and falling costs in computing and telecommunications, have especially aided growth of the most recent innovations in payments — electronic payments (e-payments). In the history of money, "…there has been only four times that we have changed the way we pay"[3]. In the beginning, there was barter, then coinage; coins to paper; paper to cheques; and then cards. Developments in technology and telecommunication have brought about these changes.

The spread of the financial innovations vary unevenly between countries, partly due to differences in factors such as regulatory frameworks and readiness of telecommunication infrastructure. For instance, while payment services based on the internet and mobile phones are prolific in the advanced economies, in some of the emerging and low-income economies, the pace and development of e-payments appears slow and uneven.

However, in the recent years, mobile technology has flourished throughout the developing world faster than any other technology in history. With this growth comes an equally remarkable surge of messaging services, providing not just a means of personal communications, but also a number of valuable information services, the most impressive being mobile money. The money transfer services are available to millions of previously underserved people, allowing them to safely send money and pay bills for the first time without having to rely exclusively on cash. The global leader in mobile money is Kenya, where mobile network operator Safaricom launched *M-Pesa* in March 2007. Six years into its existence, the amount transacted through the mobile networks between January and September 2013 accumulated to 1.37 trillion – a figure that is very close to the national budget of KShs.1.46 trillion (US$17.5 billion) for 2012/2013 fiscal year, and also a third of Kenya's Gross Domestic Product (GDP) of KShs.3.7 trillion (US$41.8 billion). The rise in the cashless transaction value is attributed to increasing partnerships between banks and mobile service providers. The increased transactions have made Kenya stamp its authority as the leading mobile money market in the world, with very few countries recording success close to Kenya's. This growth in mobile money usage has been credited with a doubling of access to formal financial services from 32 percent in

[3] Observes David Evans, co-author of *"Paying with Plastic: The Digital Revolution in Buying and Borrowing",* D. Evans and R. Schmalensee, MIT Press, 2004.

2006 to 67 percent in 2013 and a decline of those using informal financial services to only 8% from about 33 percent over the same period (FinAccess, 2013).

The country has also experienced an expansion in use of debit cards and Automated Teller Machines (ATMs). In addition, at the institutional level, the Central Bank of Kenya (CBK) has fostered changes in the legal and regulatory framework to promote financial inclusion and e-payment systems as the basis for financial transactions and settlements. The enactment of the National Payment Systems Act of 2011 and the issuance of guidelines for the provision of electronic retail transfers and e-money in 2012; the issuance of the agency banking guidelines in 2010 and licensing of deposit taking micro-finance institutions are a reflection of these efforts.

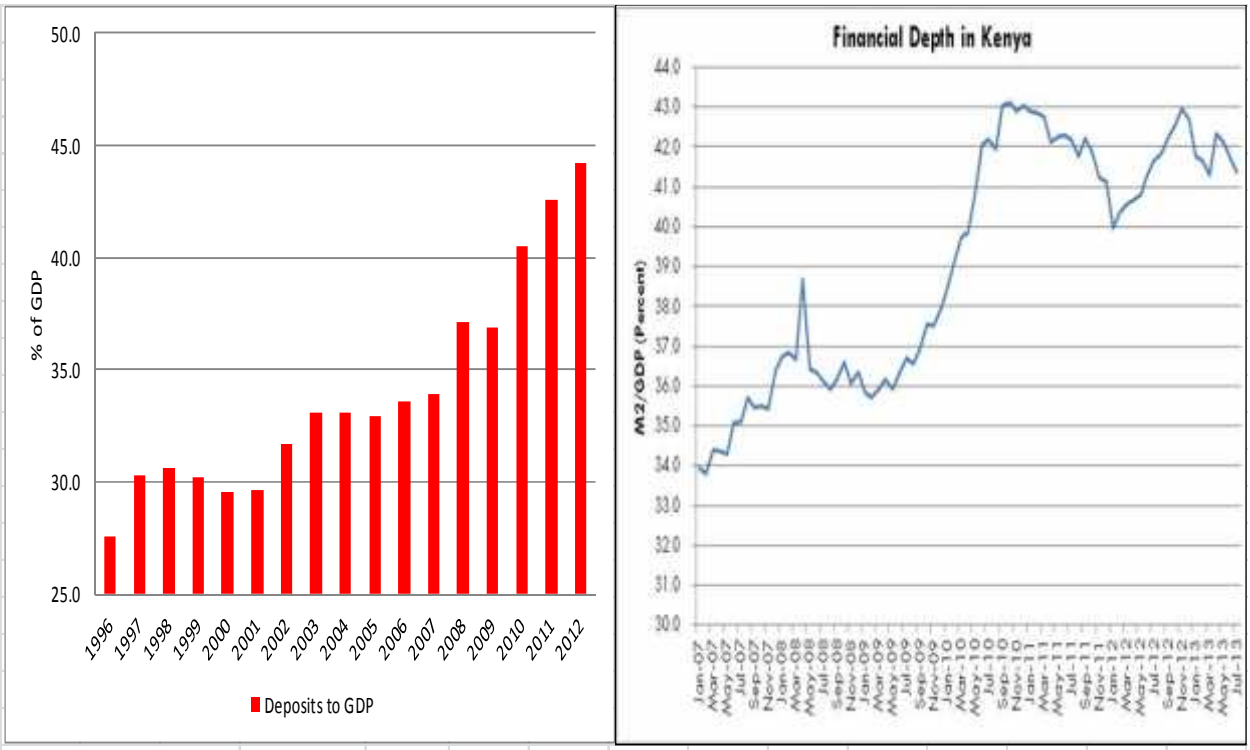
While financial innovations can help to increase the efficiency of the financial system, which facilitates the operation of monetary policy, it can at the same time complicate the environment in which monetary policy operates (Angeloni, *et al*, 2003; Noyer, 2008). The experience of the 2007/8 financial turmoil demonstrates that financial innovation is not a smooth process. The challenges confronting central banks, therefore, are not only directed at the attainment of efficiency, but also the attainment of stability in the financial system. Some financial innovation may affect the way in which the economy reacts to monetary policy, or may affect the information content of the indicators that central banks regularly monitor and that serve as a basis for taking policy decisions. Noyer (2007) observes that "it is clearly not a surprise, at a time of burgeoning financial innovation to observe signs of instability in money demand. New products and new intermediaries tend to blur the distinction between monetary and non-monetary assets and to modify the financial behaviour of economic agents". It's is such effects that this paper explores for Kenya and how they may have impacted on the transmission of monetary policy.

The rest of the paper is organized as follows. Section 2 provides a brief account of recent developments in the banking sector in Kenya and a review of some relevant studies. Section 3 outlines the methodology and data used. Section 4 reports the empirical results, while Section 5 offers concluding remarks and draws policy implications.

2.0 REVIEW OF BANKING SECTOR DEVELOPMENT AND FINANCIAL INNOVATIONS IN KENYA

Financial innovation which has been witnessed in Kenya has come with benefits. As shown on Figure 1, the country's banking sector has been developing. While the ratio of deposits to GDP rose by only 6 percentage points between 1996 and 2007 (from 27 percent to 33 percent), it increased by 11 percentage points between 2007 and 2012, to stand at 44 percent. The ratio of M2/GDP which stood at 34 percent in 2007 increased to approximately 42 percent in 2013.

Figure 1: Banking sector developments in Kenya

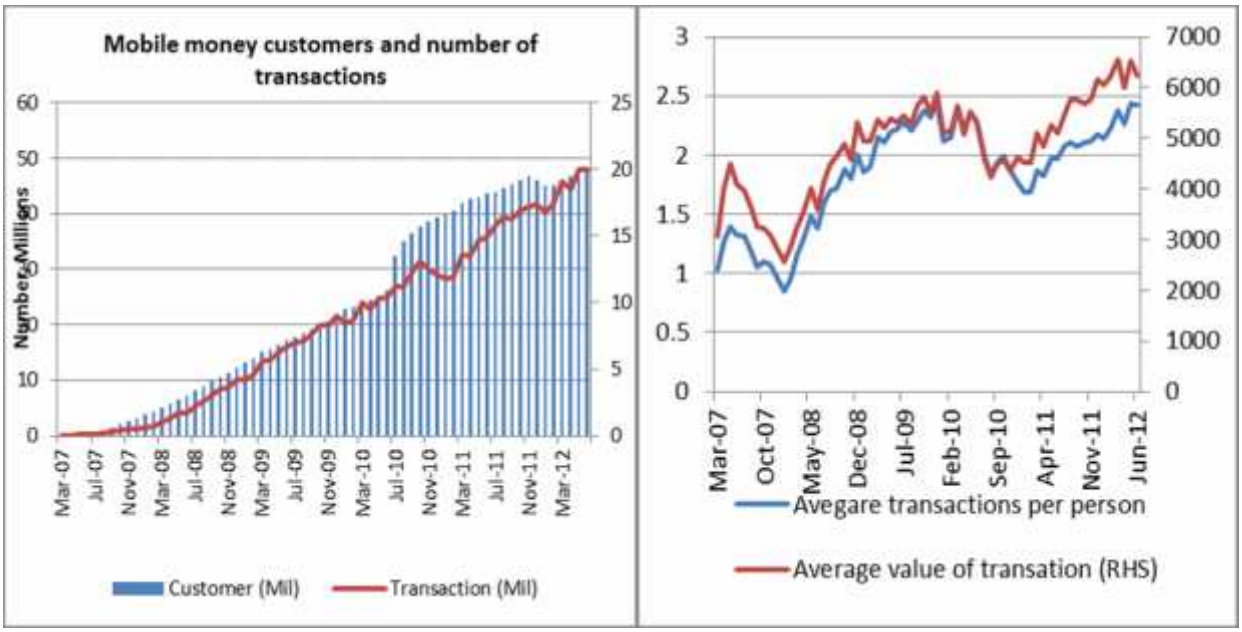


Source: Central Bank of Kenya

Associated with this rapid expansion in the banking sector is a range of financial innovations: the ATMs and debit cards introduced in the late 1990s; the electronic money introduced in early 2007; the agent banking model introduced in mid-2010; and the allowing of deposit taking micro finance institutions (MFI). The number of bank branches in Kenya increased from 465 in 2000 to 1279 in 2012 with the largest increase being recorded after 2007 (Figure A1 in the appendix). A similar trend is observed for ATMs. The number of ATMs increased from a low of 168 machines in 2001 to 540 in 2006 and then to 2381 in 2012. The fast growth period (2007-2012) also corresponds to the expansion of the mobile money transfer services across the country.

Figure 2: Evolution of Mobile Money in Kenya: May 2007-Aug 2013[4]

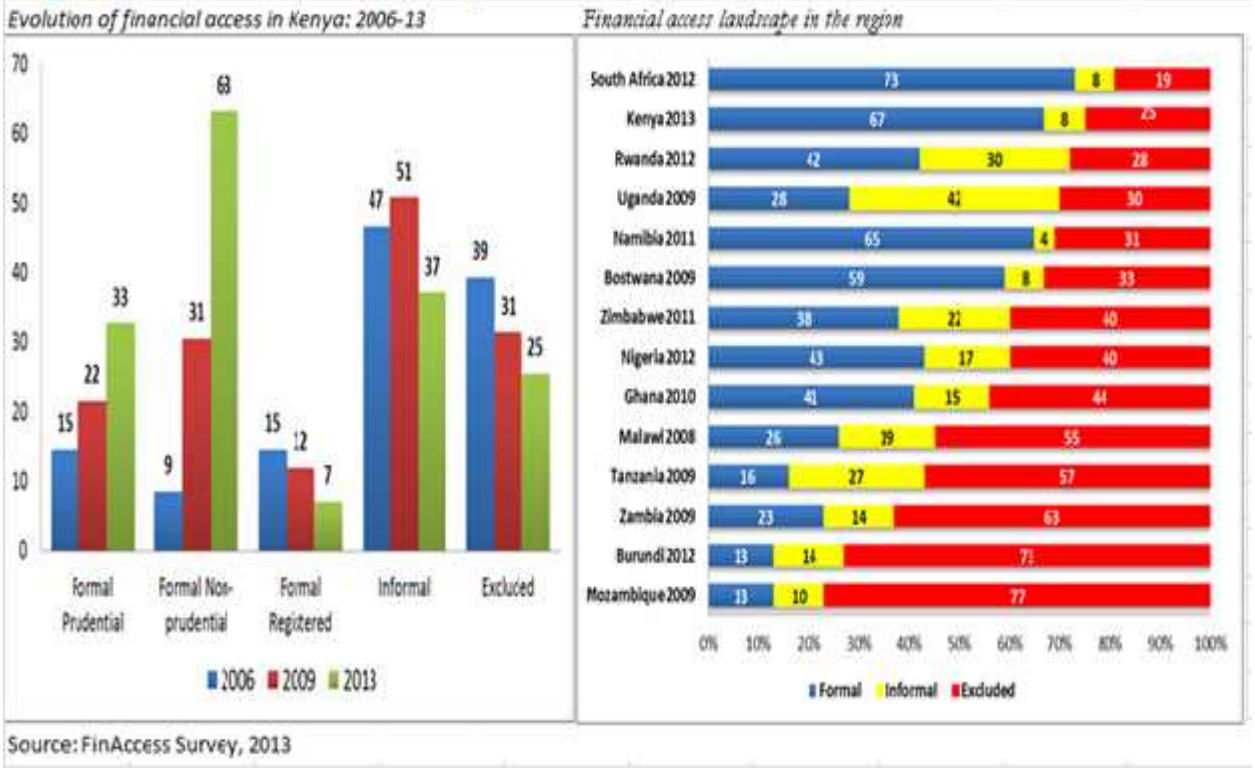
[4] The transaction data is aggregated for all the mobile money services providers. Currently there are 4 mobile telephone operators in Kenya, namely safaricom, Airtel, Orange and YU.



From Figure 2, it is shown that the number of mobile money transactions have increased to about 65 million transactions in August 2013 and the value of transfers has increased to over Ksh 160 billion since the launch in March 2007. In addition, the average number and value of transactions per person has grown tremendously during this time. The success in outreach of the model is attributed to a large network of agents whose number stands at over 108,000 from 307 in March 2007. The agents have increased the access points for financial service. Consequently, the country has experienced a substantial reduction in number of people using informal financial services, from 33 percent in 2006 to 8 percent in 2013, thereby catching up with South Africa on this aspect (Figure 3).

The success of the agency network of the mobile money providers stimulated some reforms in banking sector to provide commercial banks with an avenue to promote financial inclusion. In mid-2010, the CBK unveiled amendments to the Banking Act through Finance Bill 2009 to allow agency banking in Kenya. The guidelines allowed banks to use third parties (agents) to provide certain banking services on their behalf in a cost effective way. The agents are already established businesses offering the banking services over and above their normal business. The services offered by the agents include; cash deposits, cash withdrawals, payments of bills, account balance enquiry and collection of account opening application forms. As at August 2013, 13 commercial banks had been licensed and had consequently contracted 21,286 agents that had facilitated over 65.8 million transactions valued at Ksh. 347.4 billion (US$ 4.09 billion). The agency framework promises to reduce further the unbanked population by extending the formal banking services. From Figure 3, the proportion of the population accessing services from formal prudentially regulated institutions rose from 15 percent to 33 percent between 2006 and 2013.

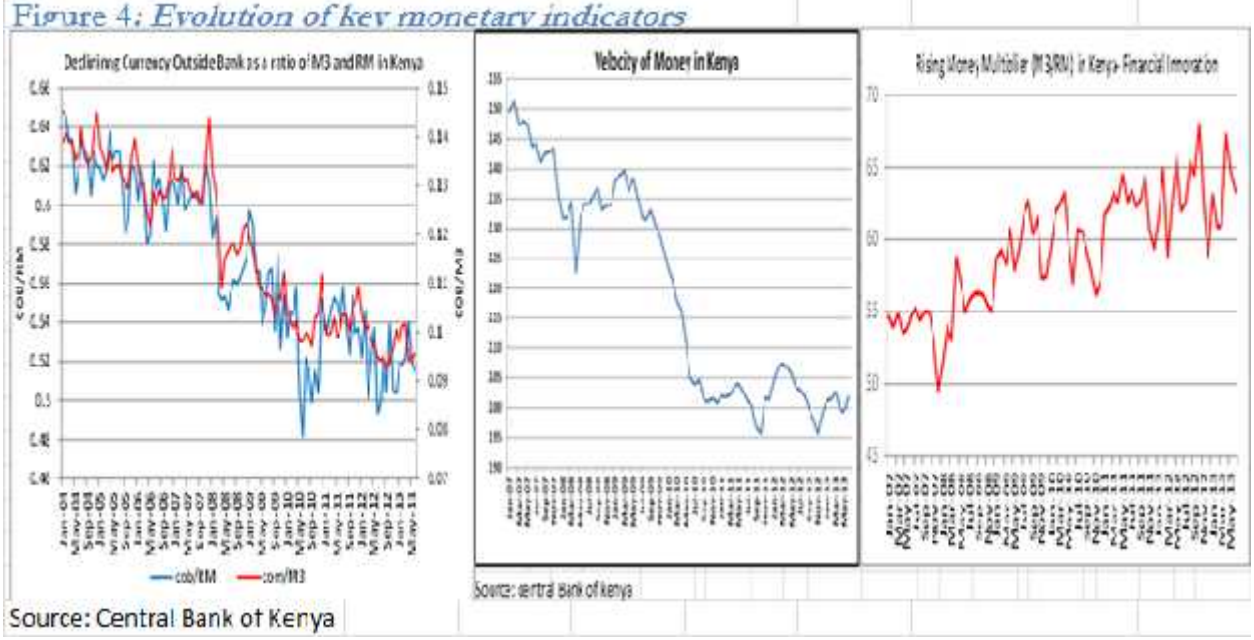
Figure 3: *Financial access landscape*



Source: FinAccess Survey, 2013

These developments in financial access in Kenya during 2006-2013 have positive and negative implications on the conduct of monetary policy. On a positive note, the currency outside banks (COB) has been on a downward trend since 2007. Figure 4, shows that while the ratio of COB to M3 was relatively stable prior to 2007, it started to decline rapidly thereafter suggesting that the proportion of currency within the banking system has been increasing and therefore a greater control of the central bank on the economy. However, the rate of decline of COB to M3 has decelerated since mid-2012.

Figure 4: *Evolution of key monetary indicators*



Source: Central Bank of Kenya

The second panel of Figure 4, shows that the velocity of money has also been on the decline. It stood at about 2.5 in January 2007 declining gradually until 2009 when it declined rapidly to stand at approximately 2.0 in 2010. Thereafter, the velocity of money has remained relatively stable. The third panel in Figure 4 shows the developments of the money multiplier. This has been on an upward trend rising from 5.0 in 2007 to stand at approximately 6.5 in mid-2013. These developments challenge the appropriateness of monetary policy framework in use in Kenya — the monetary aggregate targeting framework which is built around strict assumptions regarding the stability of the money multiplier and velocity of money. These preliminary finding is similar to observations in the Euro area in early 2000s. Noyer (2007) noted that, the demand for M3 in the Euro area showed clear signs of instability since 2001 and a break in the income velocity of M3. A new velocity trend seemed to emerge then with liquidity expanding much more rapidly. By then, the precise role of financial innovation in the observed trends was still unknown and Noyer (2007), noted that taking it into account should help explain the change in money demand.

2.1 The Monetary policy framework in Kenya

Kenya pursues monetary aggregates targeting framework to achieve inflation objective. The framework has remained fairly the same over time with the CBK continuously refining monetary policy operations and procedures to enhance efficiency and effectiveness in a changing financial and economic environment. In formulating monetary programs, the Bank starts with estimating the money demand consistent with the target rate of inflation and GDP growth. This forms the basis for setting desired path for monetary growth to which actual money supply has to conform during policy implementation stage. However, with the time lag in obtaining information needed for effective control of broad monetary aggregates, the CBK formulates its monetary policy implementation strategy on the basis of reserve money-more readily available as liability of the central bank. The reserve money program design is consistent with desired money supply expansion.

Central banks cannot determine directly the rate of monetary expansion. The rate of monetary expansion depends on a multitude of factors outside the immediate sphere of influence of a central bank. This occasions the monetary authorities to identify yet another intermediate target: the interest rate or monetary base. Once the link between the monetary base and the money supply is understood, a strong positive correlation between the evolution of the money supply and that of prices is postulated. This correlation is not always straightforward, because it depends on the stability and predictability of velocity, and, ultimately, on money demand.

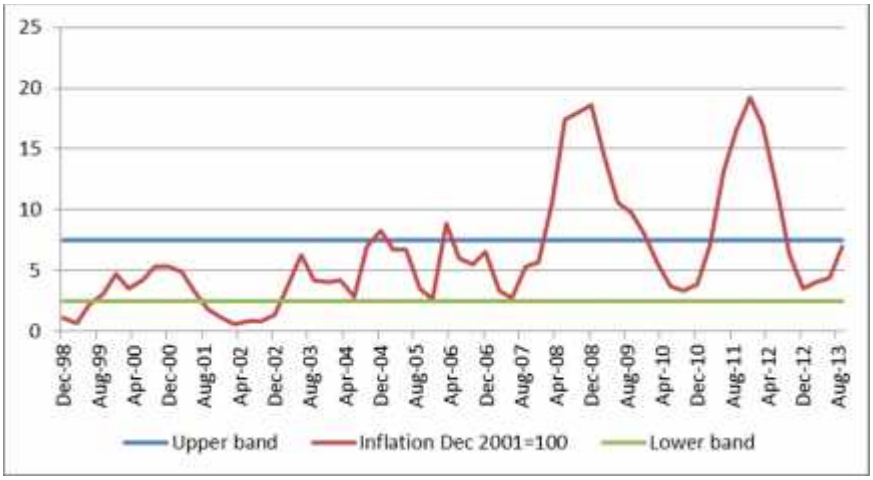
In 2007, the Central Bank of Kenya Act was amended to allow the formation of the Monetary Policy Committee (MPC). The Committee is charged with the responsibility for formulating monetary policy. The MPC meets every sixty days, unless the macroeconomic environment necessitates more frequent meetings. The Committee meets to review the macroeconomic environment on the basis of which a decision is made on the monetary policy stance. This is done, mainly, by setting the central bank rate which is expected to signal and coordinate other rates in the market with a view to stabilizing the economy.

The monetary aggregate framework is conducted via financial programming with the broad money (M3) as the intermediate target while reserve money serves as the operating target. The key tools that the CBK uses to implement the programme are:

- Open Market Operations (OMO) — the bank relies heavily on this instrument.
- Reserve Requirements—currently 4.5 percent.
- Other Instruments—these include rediscount facilities and lender of last resort facility, which are not very popular.

Monetary targeting framework has served the country well with refinement of operations and procedures to enhance effectiveness. The surge in inflation in early 1990s to about 70 percent (the time of first multiparty elections in 1992 led to amendment of the CBK Act in 1996 to give CBK more autonomy to manage monetary policy. Over time, appropriate monetary policy has kept inflation at satisfactory levels supported by prudent fiscal policy except for occasional supply shocks.

Figure 5: Trends in Inflations 1999-2013: 2001=100



2.2 Literature Review

The literature on financial innovation is still evolving as new financial instruments; financial services and operational techniques continue to enter the market. The existing scanty literature has focused on evolution of the financial system in the developed world with few studies focusing on developing countries. Existing studies have analyzed the linkages between general financial innovation and monetary policy, growth and inflation and some analysis of linkages between specific financial innovation products, macroeconomic variables and monetary policy transmission mechanisms. This section briefly presents a survey of some theoretical and empirical work with a bias towards developing economies.

The first strand of literature analyses the impact of electronic money on the central bank's ability to control money supply. This literature is controversial on this aspect, with one line of thought arguing that increasing usage of electronic money would make it difficult for central banks to supervise and measure monetary base (*see* Kobrin 1997, Friedman, 1999). The other strand holds a more optimistic view and note that the fears for the future of monetary policy may be overstated (see Bert, 1996; Helleiner, 1998; Freedman, 2000; Goodhart, 2000; and Woodford, 2000). Notably, Helleiner (1998), observes that "new forms of electronic money are unlikely to pose a significant threat to the power of the sovereign state". Woodford (2000) adds that even if there may be vast changes in e-money, one day, these changes are unlikely to interfere with the conduct of monetary policy. Which view is right?

The main goal of monetary policy is to keep the level of aggregate expenditure in an economy broadly consistent with production capacity; in other words, to guide the ship of state between the dangers of rampant inflation and that of prolonged recession. If electronic money can be expected to have any impact at all on the effectiveness of policy, it will be through its influence on the linkages between central-bank decisions and market spending.

Extensive literature explores the effect of financial innovation on the stability of the money demand function, with a general consensus that evolution of new financial products creates instability in the traditional money demand function. Arrau and De Gregorio (1993) examined the money demand equations in Chile and Mexico. Their results suggested that there is an important permanent component in the demand for money not captured by traditional variables but by financial innovation, which is modeled as an unobservable shock that has permanent effects on money demand. Using market share of credit cards as an indicator of financial innovation, Viren (1992) empirically examined the relationship between financial innovations and currency demand. The results showed that credit card transactions have a strong offsetting effect on currency demand.

A similar study by Al-Sowaidi and Darrat (2006) examined the effects of financial innovations in Bahrain, the UAE and Qatar on the long-run money demand. The study found no undue shifts in the equilibrium money demand relationship despite the fast pace of financial innovation experienced in the three countries. The findings were robust to the measure of the money stock —narrow or broad.

In Korea, Cho and Miles (2007) found a downward trend in velocity which was attributed to monetization of the economy. It is expected that velocity should increase over time as payments

systems evolve or cash management improves. Although financial liberalization may allow agents to minimize cash balances, it also permits greater interest to be paid on many categories of money. The basic argument in the perverse sign observed in the Korean case is based on the fact that, there is increased willingness to hold M2 as income increases. The coefficient of real GDP was more than unity indicating a high level of monetization in the Korean economy.

A few studies exist focusing on the examination of the linkages between financial innovation and the stability of the money demand function in Africa. Using Granger causality and VAR methodologies, Kovanen (2004) examined the determinants of currency demand and inflation dynamics in Zimbabwe. The author measured financial innovation as the ratio of broad money to currency. However, the results from the VAR estimation for financial innovation are not significant. Lungu *et al* (2012) did a similar study using Malawian data but in this case financial innovation has a significant effect on the demand for money in the short run.

Sichei and Kamau (2012) conducted a similar study using Kenyan Data. They used the number of ATMs as a proxy for financial innovation. Their results did not indicate any significant effect of innovations on the demand for money. However, this study used only one measure of financial innovation, which is also not widespread across the country. While acknowledging that the data for other more inclusive measures such as M-*Pesa* may not have been available and adequate in terms of observations to allow plausible empirical investigation, the authors did not explore other financial innovation measures used in previous studies. They, however, demonstrated the instability of money demand post 2007. Weil *et al*., 2012 also showed this instability.

Studies conducted on Kenya in the 1980s and 1990s (*see* Dharat 1985; Mwega, 1990; Adam, 1990) shows that money demand was stable at the time. Of particular interest is a study by Dharat (1985), where special attention was paid to the model specification, its dynamic structure and to its temporal stability. Following this approach the study showed that for both conventional definitions of money (the narrow and broad), the theoretical model fits the Kenyan data quite well, and the variables were all statistically significant and with the anticipated signs. Based on a battery of tests, the results suggested that the estimated money demand equation for Kenya was temporally stable. Turning to the open-economy nature of the money demand model, it was found that the foreign interest rate plays a significant role in the Kenyan money demand equations.

3.0 METHODOLOGY

To investigate the effect of financial innovation on the conduct of monetary policy the obvious starting point is to provide analysis on whether these innovations have led to a breakdown of the various assumptions underlying the monetary aggregates framework in Kenya. The monetary aggregates framework works on the assumption that the money demand is stable. In addition, it assumes that the velocity of circulation and the money multiplier are stable. Therefore to test the effect of financial innovation on the conduct of monetary policy we: (i) test for stability of income velocity of money, money multiplier and the money demand (ii) investigate whether or not the innovations have impacted the monetary policy transmission.

(a) Stability of the velocity of circulation[5] and money multiplier and the money demand

To test the stability of the velocity of circulation and the money multiplier we use a simple model stated as follows:

$$Z_t = \beta_0 + \beta_1 Trend_t + \varepsilon_t \quad (1)$$

Where Z is either income velocity of circulation or the money multiplier, Trend is a trend term and ε is the error term. In this formulation, when the dependent variable is the income velocity of circulation, β_1 is expected to be negative and significant. However, when the dependent variable is the money multiplier β_1 is expected to be positive and significant.

Following the tradition of Dharat (1985); Mwega (1990); Ndung'u (1994), we formulate a demand for money function as follows:

$$\ln\_rm3_t = \alpha_0 + \alpha_1 \ln\_YGDP_t + \alpha_2 TB_t + \alpha_3 \ln\_EXC_t + \varepsilon_t \quad (2)$$

In this formulation, the money demand is a function of a scale variable, in this case real income (ln_YGDP), the interest rate (TB) to reflect the opportunity cost of holding money, usually the 91 day Treasury bill rate is used. In the broad definition of money (M3) we incorporate the exchange rate (Ln_EXC) to reflect the substitution effect of holding domestic and foreign assets when there is exchange rate movement.

(b) Has the monetary policy transmission improved?

To investigate the effect of financial innovations on monetary policy we follow a standard VAR framework. To achieve our objective we use a 5 variable VAR that include the following variables: the log of GDP; the log of the price level (CPI); the log of money supply (M3); the short-term interest rate; the nominal exchange rate (NEER).

Denoting these endogenous variables by:

$$X_t' = [Y_t \quad CPI_t \quad M3_t \quad r_t \quad NEER_t \quad] \quad (3)$$

and the vector of reduced form residuals by ε_t, the benchmark reduced-form VAR can be written as:

$$X_t = \alpha_0 + \alpha_1 t + A(L) X_{t-1} + \varepsilon_t \quad (4)$$

[5] To test the stability of the velocity of circulation we use the quantity theory of money based on the identity: MV=PY, where M is money, V is velocity, P is the price level and Y is the level of income. In this framework V is assumed to be constant due to technological and institutional factors. Based on this reasoning a money demand M/P=1/VY.

Where α_0 is a constant, t is a linear trend, $A(L)$ is an n[th]-order lag polynomial and ε_t is a k-dimensional vector of reduced-form disturbances $\varepsilon_t \equiv \begin{bmatrix} \varepsilon_t^Y & \varepsilon_t^{CPI} & \varepsilon_t^{M3} & \varepsilon_t^r & \varepsilon_t^{NEER} \end{bmatrix}'$ with $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_t') = \sum_\varepsilon$, $E(\varepsilon_t \varepsilon_s') = 0$ for $t \neq s$.

Equation 1 is transformed from the reduced form-model into a structural model by pre-multiplying it by the (kxk) matrix A_0 to yield:

$$A_0 X_t = A_0 \alpha_0 + A_0 \alpha_1 t + A_0 A(L) X_{t-1} + B \nu_t \qquad 5$$

Where $B\nu_t = A_0 \varepsilon_t$ describes the relation between the structural disturbances ν_t and the reduced form disturbances ε_t. Using the AB model we know that the structural disturbances ν_t are uncorrelated with each other, that is, the variance-covariance matrix of the structural disturbances Σ_ν is diagonal. The matrix A_0 describes the contemporaneous relation among the variables in the vector X_t.Without restrictions on the parameters of A_0 and B the structural model is not identified. In this paper identification is by way of recursive approach.

Following the recursive approach for identification requires that the B matrix in Equation 5 is restricted to a k-dimensional identity matrix and A_0 to a lower triangular matrix with unit diagonal, which implies the decomposition of the variance-covariance matrix of the form:

$$\Sigma_\varepsilon = A_0^{-1} \Sigma_\nu (A_0^{-1})'. \qquad 6$$

This decomposition is obtained from the Cholesky decomposition $\Sigma_\varepsilon = PP'$ by defining a diagonal matrix D which has the same diagonal as P and by specifying $A_0^{-1} = PD^{-1}$ and $\Sigma_\nu = DD'$, that is the elements on the main diagonal of D and P are equal to the standard deviation of the respective structural shock.

In this regard, given a k-variable model there are $k!$ possible ordering in total. In this paper we order the variables as follows: real output is ordered first, CPI ordered second; money stock ordered third; short-term interest is ordered fourth, nominal effective exchange rate is ordered fifth and; stock market index is ordered last. Thus the relation between the reduced form disturbances ε_t and the structural disturbances ν_t takes the following form:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ -\alpha_{21} & 1 & 0 & 0 & 0 \\ -\alpha_{31} & -\alpha_{32} & 1 & 0 & 0 \\ -\alpha_{41} & -\alpha_{42} & -\alpha_{43} & 1 & 0 \\ -\alpha_{51} & -\alpha_{52} & -\alpha_{53} & -\alpha_{54} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^Y \\ \varepsilon_t^{CPI} \\ \varepsilon_t^{M3} \\ \varepsilon_t^r \\ \varepsilon_t^{NEER} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v_t^Y \\ v_t^{CPI} \\ v_t^{M3} \\ v_t^r \\ v_t^{NEER} \end{bmatrix} \qquad 7$$

This particular ordering has the following implications: (i) Real GDP does not react contemporaneously to shocks from other variables in the system. (ii) CPI does not react contemporaneously to shocks originating from all factors except real GDP. (iii) money stock (M3) does not react contemporaneously to real GDP but is affected contemporaneously by short-term interest rate, nominal effective exchange rate (iv) the interest is affected contemporaneously by all shocks in the system, except those from the nominal effective exchange rate (v) nominal effective exchange rate is affected contemporaneously by all shocks in the system.

4 EMPIRICAL RESULTS

(a) Univariate analysis

Formal test for stationarity is conducted using the ADF test and the results are reported on Table 1. From the results it is possible to see that all the variables were found to be non-stationary at levels. Differencing yielded stationarity for all the variables.

Table 1: Unit root tests

	Level	First Difference	
Ln_rm1	-0.606	-7.026	
Ln_rm2	1.112	-4.790	
Ln_Rm3	1.332	-4.905	
Ln_rgdp	-0.013	-3.577	
Ln_exch	-1.302	-6.327	
Ln_cpi	-0.185	-7.094	
Tb100	-2.684	-4.775	
	Test critical values:	1 percent level	-3.571
		5 percent level	-2.922
		10 percent level	-2.599

(b) Testing the stability of velocity of circulation, money multiplier and money demand

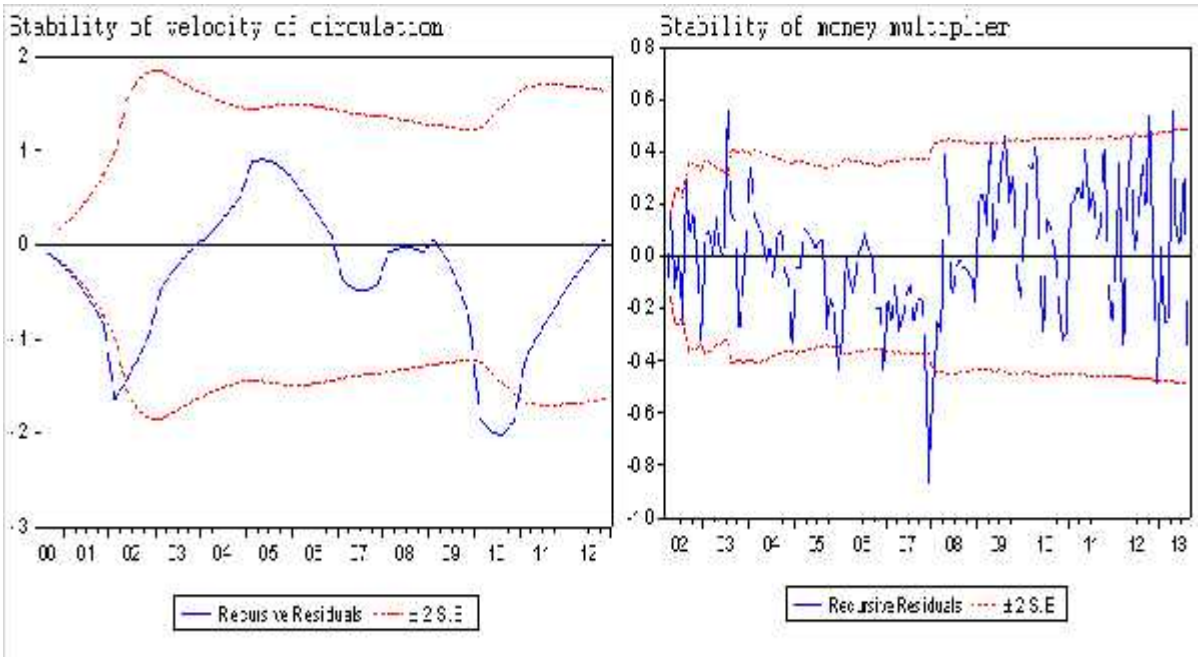
The table below shows the regression results of both the velocity of circulation and money multiplier in Kenya. From the results it is evident that during the period under study the velocity of circulation has a significant trend. The estimated trend coefficient is found to be significant at 1 per cent level of testing; suggesting that every quarter the velocity of circulation has, on average, declined by 0.2 percent. In the case of the money multiplier, the same evidence is adduced. During this time the money multiplier had a significant upward trend during the period of study- the money multiplier was growing at an average rate of 0.01 percent.

Table 2: Estimation results of velocity of circulation and money multiplier

	Dependent variable	
	VEL_M3	MM
Trend	-0.016***	0.010***
	(-20.944)	(20.089)
C	2.802***	5.220***
	(122.322)	(126.480)
R^2	0.89	0.75

Based on these findings, we tested for the stability of the velocity of circulation and the money multiplier as shown in Figure 6 below. From the figure it may be observed that the velocity of circulation experienced instability in the period prior to 2002 and during the period 2009-2010. On the other hand, the money multiplier appears to have experienced instability during the period after 2007. Except for the instability witnessed in the early part of the 2000s, the instability witnessed after 2007 may be attributed to the financial innovations which have taken place in Kenya during this period. Notably, the instability witnessed in 2007, coincides with the introduction of mobile money in Kenya.

Figure 6: stability of velocity and money multiplier in Kenya



(c) The stability of the money demand

To test the stability of the money demand function we use three different definitions of money: M1, M2 and M3. The results of the different specifications are reported in Table 3. Panel A shows the long-run money demand functions. In all the estimations, the estimated coefficients of the real income are found to be positive, as expected, and significant at 1 percent level of significance, and greater than unity in all the specifications. These coefficients, however, vary substantially across different specifications. In the case where money demand is narrowly defined the estimated coefficient is found to be highest at 1.61 while it is lowest in the broad definition of money (M3). The greater than unity income elasticity suggests that during the period under study real income induced higher than proportionate changes in real money balances. The finding in this study is in line with earlier studies that found elasticity of income being greater than unity (Ndung'u, 1994, Sichei and Kamau, 2012). The greater than unity elasticity of income is a reflection of financial development and monetization of the Kenyan economy.

Table 3: The long run Money demand functions

Dependent variable	Ln_rm1	Ln_rm2	Ln_rm3
Ln_RGDP	1.610***	1.067***	1.011***
	(26.938)	(15.720)	(16.017)
Tb100	-1.289***	-0.037	-0.216
	(-4.998)	(-0.124)	(-0.964)
Ln_exc	--	--	-0.396***
			(-3.167)
R^2	0.94	0.84	0.91
Dw	1.56	0.54	0.86

*** significant at 1%, ** significant at 5%, * significant at 10%; (…) t-values and [..] critical values.

The estimated coefficient of interest rate is found to be negative in all specifications. In the case of the narrow definition of money, it is found to be negative and significant at 1 percent level of significance. However, in the estimations involving M2 and M3, the estimated coefficients are found to be negative but not statistically significant at the conventional levels of testing. Because the broad money supply includes the foreign exchange holding, it is therefore estimated with exchange rate as one of its explanatory variables. In this formulation, the coefficient of exchange rate is found to be negative, as expected, and significant at 1 percent level of testing. This finding suggests that movements in the exchange rate have a significant impact on the demand for broad money in Kenya. That is, currency depreciation increases the demand for money as foreign currency deposit liabilities increase in value of domestic currency. This valuation effect is likely to be compounded by the substitution effect, as local residents shift from local currency-denominated deposits to foreign currency denominated deposits with a weakening currency.

Table 3b: Tests for Cointegration

None	-3.465***	-2.309***	-2.581***
	[-2.580]	[-2.580]	[-2.581]
Intercept	-3.452***	-2.302	-2.667*
	[-3.472]	[-2.576]	[-2.577]
Trend and intercept	-12.592***	-3.235***	-4.465***
	[-4.016]	[-3.143]	[-4.022]

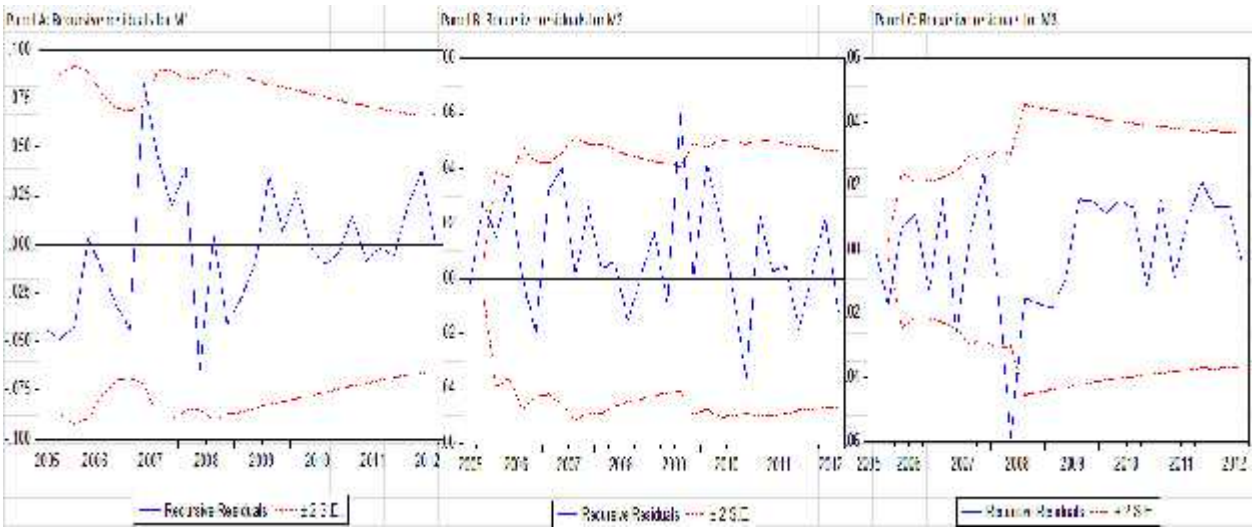
*** Significant at 1%, ** significant at 5%, * significant at 10%; (…) t-values and [..] critical values.

Table 3b shows the results of the cointegration test. The variables in the money demand functions are cointegrated. Therefore we proceed to estimate the error correction models for each of the long-run demand functions as shown on Table 4 and Table A1 and A2 in the appendix. A number of tests were conducted on the error correction models reported. Statistically the respective ECMs appear well specified; there is no evidence of serial correlation (AR test), autoregressive heteroscedasticity (ARCH test), non-normal errors (Normality test) and regression misspecification (RESET test). Based on the error correction models, it is found that in the case where the money demand is narrowly defined (M1), the error correction term is negative and significant at the conventional levels of testing. The estimated ECM is -0.369. In the case where money is defined as M2 and M3 the estimated ECM terms are found to be negative and also significant. However, the speed of adjustment appears to be low at -0.06 for M2 and -0.082 for M3.

Table 4: Error Correction Model for broad money demand

Panel C: Money demand – Dependent variable ln_rm3										
	0	1	2	3	4	5	6	7	8	9
D(ln_yr)							0.467 3.358	0.559 (3.447)	0.481 3.438	0.449 3.087
TB100			-0.767 (-3.669					0.545 2.365	0.417 1.706	
D(ln_exc)					-0.239 -2.189	-0.388 -3.557	-0.282 -2.621	-0.242 -2.031		
ECM_m3		-0.082 1.979								
R2= 0.65	DW=1.823									
Diagnostic tests: AR 1-3 test: F(3, 25) = 0.46719 [07078] ARCH 1-3 test: F(3, 22) = 0.25685 [0.8556] Normality test: chi^2 (2) = 0.02772 [0.9897] RESET test: F(1, 27) = 0.74305 [0.3963]										

Figure 7: Evidence of instability of money demand



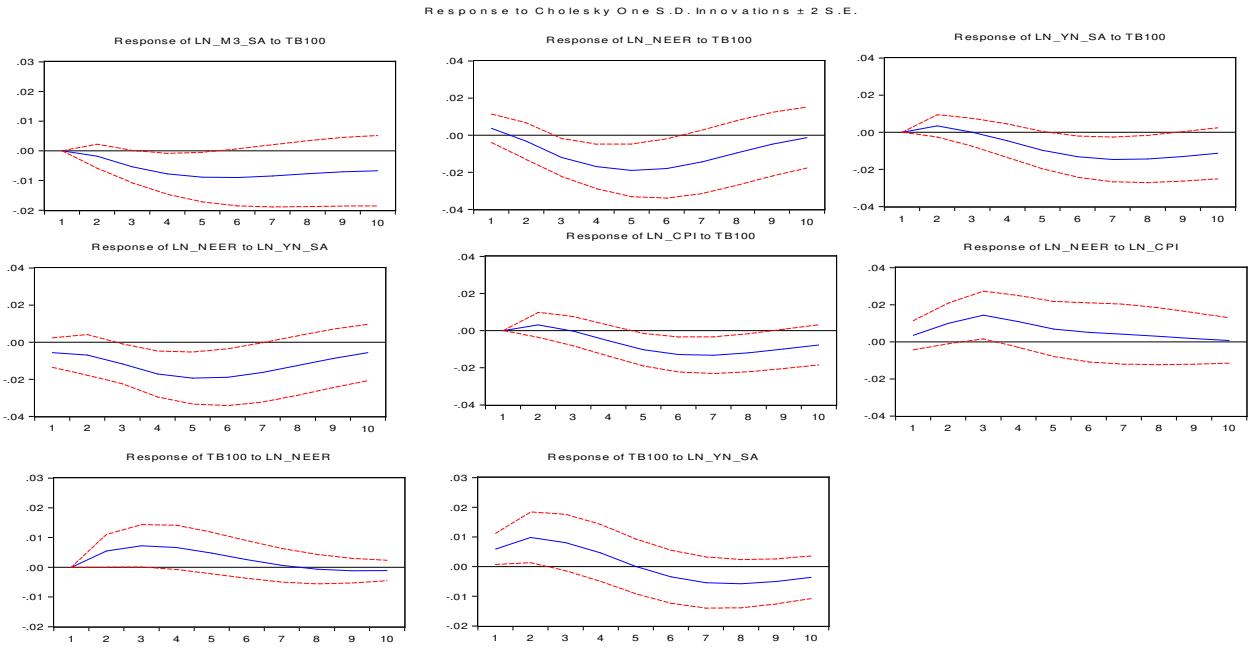
The period when the demand functions experienced instability also coincides with growth phase of mobile money in Kenya. Following the evidence adduced from the velocity of circulation and multiplier that these variables are not stable and further evidence that the money demand is not stable has far reaching consequences on the conduct of monetary policy in Kenya. The instability of the money demand function means that the current monetary policy framework, guided by the assumption of a stable demand for broad money is not reliable. The instability of the money demand function may reduce the ability of the central bank to fully control of the money supply process posing a challenge to the steering of the reserve money with a view to creating monetary conditions that are consistent with the objective of price stability.

(d) Financial innovations and monetary policy transmission

The previous section sought to show the implication of financial innovation on the conduct of monetary policy in Kenya. Earlier it was noted that the innovations which have been witnessed in Kenya in the 2000s have contributed immensely towards greater control of the central bank on the economy. During this time the currency outside banks has declined and also the financial access in Kenya has improved. With these pleasant effects of financial innovation we therefore expect the transmission of monetary policy to improve in Kenya. To investigate this we estimate a 5 variable VAR shown in Section 3. The findings in this study may be compared with earlier studies on transmission of monetary policy in Kenya. This will shed light as to whether or not the transmission of monetary policy has improved. A better approach would have been to partition the sample period into two non-overlapping periods of pre- and post-innovation periods and conduct separate VARs for each period and in so doing bring out differences in magnitude and speed of response of key macroeconomic variables. However, due to data limitation we simply conduct a VAR for the full sample period and compare our findings with those of previous studies on Kenya. Using the impulse response functions, the speed and effectiveness of monetary policy may be assessed as follows: Monetary policy signal in Kenya through the Central Bank Rate (CBR) which is expected to impact

other short term rates such as the REPO and interbank rates with relatively short lags. These short term rates are also expected to impact the 91 day Treasury bill rate, the rate that is used in this study.

Figure 7: Impulse response functions



From the impulse response functions, a 1 standard deviation shock originating from the interest rate will cause the money supply to decline. It takes a period of 2 quarters for the shock to become significant and it lasts for a period of 3 quarters thereafter. In addition, following the interest rate shock, the exchange rate appreciates- it takes a period of 2 quarters for the appreciation of the exchange rate to become significant and the effect lasts up the 7th quarter. This means that the monetary policy signals are effective in impacting on the intermediate target (M3) and also impact the exchange rate within a short span of time.

In terms of the effect of the interest rate shock on GDP, it is found that it takes up to 4 quarters for the effect of the shock to render meaningful effect on GDP. The effect of a decline in GDP arising from a rise in interest rate remains effective until the 9th quarter. The ultimate objective of monetary policy is to impact on the general price level. Here is found that a one standard deviation shock of interest rate is effective in fighting inflation. Such shock causes the price to decline within a period of 4 quarters. The effect remains for an extend period of up to 9 quarters. This therefore suggests that unlike past studies which did not find meaningful effect of monetary policy on the real sector, we find that the monetary policy is effective. However, the long period of time it takes for it to affect the GDP is an area of concern. This finding to a large extent conflicts with early studies: Mutoti and Antingi-Ego (2010) and Misati and Nyamongo (2012) found that the effect of monetary policy in influencing prices and output is quite faint- they found that a shock in the interest rate has no impact on output and inflation.

Other observations from the impulse response functions are as follows: a one standard deviation shock on GDP causes the exchange rate to appreciate within two quarters while the a price shock will cause a temporary depreciation of exchange rate with a lag of 2 quarters. In addition, a one

standard deviation shock arising from exchange rate will cause immediate interest rate (policy rate as well) rise to stem further depreciation of the currency while a GDP shock will occasion interest rate to rise as well to contain upward pressures on inflation.

Unlike past studies which established no effect of monetary policy on the real sector the current study establishes that the monetary policy has started to show evidence of effectiveness. What is of concern, however, is the speed at which the monetary policy impacts on the real sector. This current evidence may be on account of the recent financial developments and innovations expounded above.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to investigate the effect of financial innovation on monetary policy in Kenya during the period 1998-2012. During this period it is found that the financial sector has developed impressive and also a number of financial innovations have taken place in the country: the number of bank branches and Automated Teller Machines has increased; mobile money as well as agency banking innovation has been witnessed during this period. Following these developments the proportion of the population outside the banking system has declined substantially and also the currency outside banks has dwindled over time. The study results point to improved effectiveness of monetary policy. While earlier studies found no significant effect of monetary policy on the real sector, this analysis shows for instance that an interest rate shock impacts on GDP within 4 quarters and the effect remains effective until the 9^{th} quarter. This finding is in line with studies that show that innovations strengthen the interest rate channel.

However, these innovations have come at a cost. The velocity of money, the money multiplier and the money demand have become unstable. This has implications on the monetary targeting framework for Kenya. However, there are indications that these relationships are stabilizing in the very recent past. This shows there is need for keep a keen check on evolution these relationships so as to disentangle monetary evolutions that may reflect structural changes from those that may be short-run monetary developments. Such monitoring can, for instance, allow adjustments to be made to monetary aggregates in case of transitory shocks, in order to account for portfolio shifts which impact the demand for money without any incidence on future inflation. A permanent shift may, however, mean a change in the current monetary policy framework and adoption of more a flexible one. A possible candidate could be inflation targeting which is less restrictive.

Nevertheless, the financial innovations initiatives have had a positive effect in view of the improved efficiency of the monetary transmission mechanism and enhanced financial deepening and should be supported.

References

Al-Laham, M., Al-Tarawneh, H. & Abdallat, N. (2009). Development of electronic money and its impact on the central bank role and monetary policy. Issues in Informing Science and Information Technology, 6: 339-349.

Angeloni I., A. Kashyao and B. Mojon (ed) (2003), *Monetary Policy Transmission in the Euro Area, Cambridge university Press.*

Arrau, P. & De Gregorio, J. (1993). Financial innovation and money demand: Application to Chile and Mexico. The Review of Economics and Statistics, 75(3): 524-530.

Awad, I. (2010). Measuring the stability of the demand for money function in Egypt. Banks and Banking Systems, 5(1):71-75.

Bert, E. (1996). "Electronic Money And Monetary Policy: Separating Fact From Fiction", Cato Institute's Conference on The Future of Money in the Information Age,May 23, 1996

Cho, D & Miles, W. (2007). Financial innovation and the stability of money demand in Korea. Southwestern Economic Review, 34(1): 51-60.

Freedman, C., (2006) "Monetary Policy Implementation: Past, Present and Future: Will the Advent of Electronic Money Lead to the Demise of Central Banking?" Future of Monetary Policy and Banking Conference, Washington D.C, July, 11, 2000

Friedman, B. M. (1999): The future of Monetary Policy : The central Bank as an Army with only a single Corps? International Finance, 2 (3).

Gurley, J.G. & Shaw, E.S. (1960). Money in a Theory of Finance. Brookings Institution, Washington D.C.

Hasan, M. (2009). Financial innovations and the interest rate elasticity of money demand in the United Kingdom, 1963-2009. International Journal of Business and Economics, 8(3): 225-242.

Hughes, N. & Lonie, S. (2007). M-PESA: Mobile money for the "Unbanked" Turning cellphones into 24-hour tellers in Kenya. Journal of Innovations: Technology, Government, Globalization, 2(1-2): 63-81.

Kobrin, Stephen J. (1997), "Electronic Cash and the End of National Markets," Foreign Policy 107 (Summer), 65-77.

Khemraj, T. (2008). Excess liquidity, oligopolistic loan markets and monetary policy in LDCs. DESP Working Paper, 64

Kovanen, A. (2004), "Zimbabwe: A quest for a nominal anchor", IMF Working Paper, WP/04/130

Lungu, M., Simwaka, K & Chiumia, A. (2012). Money demand function for Malawi-implications for monetary policy conduct. Banks and Bank Systems. 7(1): 50-63.

McKinnon, R. (1973). Money and Capital in Economic Development. The Brookings Institution, Washington.

Misati, R. N. & Nyamongo, E. M. (2012). Asset prices and monetary policy in Kenya. Journal of Economic Studies, 39(4): 451-468.

Mwega, F.M. (1990). An Econometric study of monetary policy in Kenya. ODI working paper, 42.

Noyer, C, 2006. "Does money matter? A European perspective", at the 4th ECB Central Banking Conference "The role of money: money and monetary policy in the twenty-first century", Frankfurt am Main, 9 November 2006.

Noyer, C. 2007. "Financial Innovation, Monetary Policy and Financial Stability", Spring Conference of the Bank of France/Deutsche Bundesbank, Eltville, Germany, April 2007.

Saif S. Al-Sowaidi, S.S and A. F. Darrat. 2006. "Financial Innovations and the Stability of Longrun Money Demand: Implications for the Conduct of Monetary Policy in Three GCC Countries

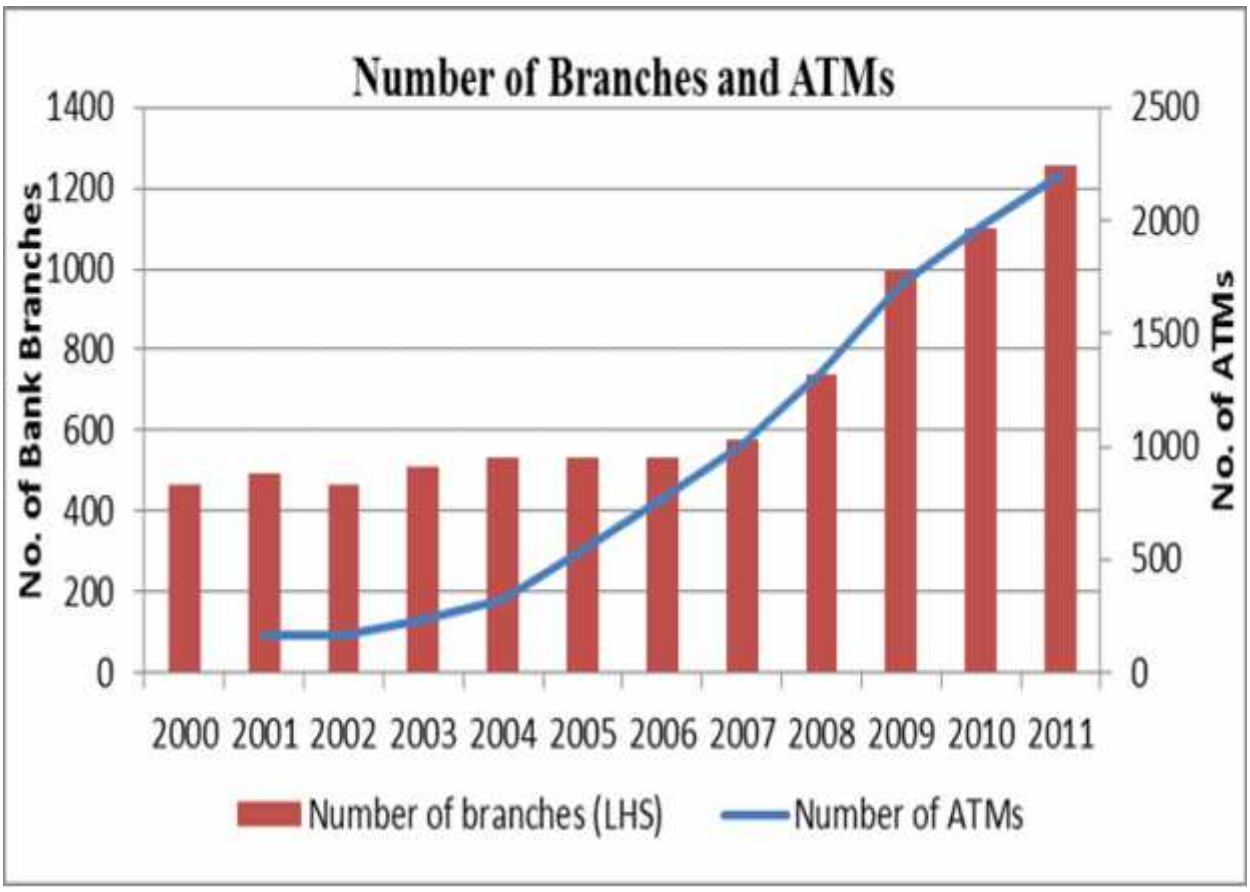
Sichei, M. & Kamau, A. (2012). Demand for money: Implications for the conduct of monetary policy in Kenya. International Journal of Economics and Finance, 4(8): 72-82.

Viren, M. (1992). Financial innovations and currency demand: Some new evidence. Empirical Economics, 17(4): 451-461.

Weil, D., Mbithi, I & Mwega, F. (2012). The implications of innovations in the financial sector on the conduct of monetary policy in East Africa. Report submitted to the International Growth Centre Tanzania Country Program.

Appendix 1

Figure A1: Evolution of bank branches and ATMs in Kenya: 2000-2011



Source: Central Bank of Kenya, Bank Supervision annual reports.

Appendix 2

Table A1: Error Correction Model: ln_rm1

	0	1	2	3	4	5	6	7	8	9
Panel A: Money demand – Dependent variable ln_rm1										
D(ln_rm1)		0.273 (2.021)		0.291 (2.241)			0.455 (3.005)	-0.376 (-2.765)		
D(ln_yr)	1.241 (4.640)	-0.376 (-2.554)			-1.375 (-4.648)		-0.435 (-2.973)			
TB100			-0.863 (-2.417)	1.380 (3.546)					0.903 (1.968)	
ECM_m1		-0.369 (-2.820)								
R^2= 0.71	DW = 2.3									
Diagnostic tests: AR 1-3 test: F(3, 26) = 1.0531[0.3859] ARCH 1-3 test: F(3, 23) = 0.31843 [0.8119] Normality test: chi^2 (2) = 3.0370 [0.2190] RESET test: F(1, 28) = 3.8830 [0.0587]										

Table A2: Error Correction Models: ln_rm2

	0	1	2	3	4	5	6	7	8	9
Panel B: Money demand – Dependent variable ln_rm2										
D(ln_rm2)		0.499 3.334					0.296 1.857	-0.357 -2.328		-0.259 -1.805
D(ln_yr)			-0.406 -2.907			-0.419 -3.162		-0.415 -2.876	-0.248 -1.743	
TB100				0.548 2.125	0.532 1.927					
ECM_m2										
R2=0.58	DW=1.9									
Diagnostic tests: AR 1-3 test: F(3, 26) = 0.23225[0.8731] ARCH 1-3 test: F(3, 23) = 0.11526 [0.9503] Normality test: chi^2 (2)= 0.82822 [0.6609] RESET test: F(1, 28) = 0.17411 [0.6797]										