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THE CHOICE OF OPTIMAL MONETARY POLICY INSTRUMENT FOR KENYA

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ABSTRACT

The Central Bank of Kenya (CBK) has over the years used monetary policy to stabilize both inflation and output using two instruments; interest rates and reserve money simultaneously. However, literature suggests that the two instruments used simultaneously will not be effective in hitting the monetary policy targets. In fact, the CBK has over the years missed its inflation target, a fact that could in part be explained by the use of the two instruments simultaneously. The CBK therefore must make a choice between the two instruments. Literature suggests that the choice depends on the economic environment of the country in question. Furthermore, some literature argues that a combination policy which is a mix of these two instruments may work better than either of the two used independently. Using data for the period 1994 to 2010 and an error correction model (ECM), this study establishes that the interest rates result in minimum losses in output compared to the reserve money instrument. Furthermore, a combination instrument minimizes losses from equilibrium output better than the other two instruments taken independently. There is therefore need for the CBK to adopt a pure interest rate instrument policy strategy if it desires to use one isolated instrument. Better still; there is need for the CBK to construct a monetary policy conditions index which would help in the implementation of a combination instrument policy.

CHAPTER I

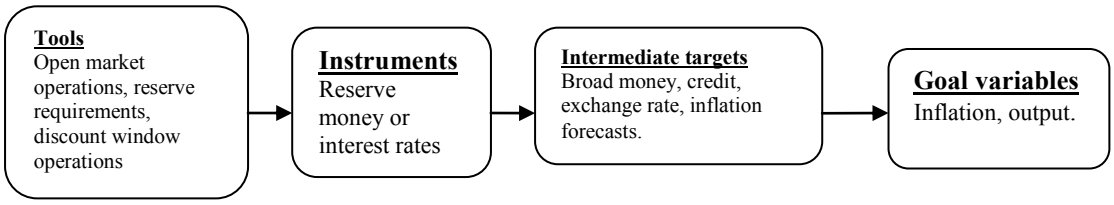
INTRODUCTION

1.1 Background of the Problem

The Central Bank of Kenya (CBK)'s principal objective is formulation and implementation of monetary policy directed at achieving and maintaining stability in the general level of prices (CBK 2010). The aim is to achieve stable prices – that is low inflation-and to sustain the value of the Kenya shilling. CBK formulates and conducts monetary policy with the aim of keeping overall inflation at the Government target of 5 percent (CBK 2010). Achieving and maintaining a low and stable inflation rate together with adequate liquidity in the market facilitates higher levels of domestic savings and private investment and therefore leads to improved economic growth, higher real incomes and increased employment opportunities. CBK's monetary policy is therefore designed to support the Government's desired economic activity and growth as well as employment creation through achieving and maintaining a low and stable inflation (CBK 2010).

The main target variables therefore for monetary policy are inflation and output. However, the CBK cannot influence its target variables (inflation and output) directly. It influences them indirectly using mainly two monetary policy instruments; interest rates which is the price of liquidity and reserve money which is the quantity of liquidity. To influence the instruments, the Central Bank uses a number of monetary policy tools. The monetary policy tools include the open market operations (OMO), Central Bank Rate (CBR), standing facilities (as a lender of the last resort), required reserves, foreign market operations, licensing and supervision of commercial banks and communication of bank decisions. Some of the tools like changes in the reserve requirements and participation in the foreign exchange market are meant to specifically change reserve money and quantity of money available in the economy (commercial bank interest rates like lending rates will change as a result) while other tools like changes in the CBR are meant to change the cost of the money (this will only change the commercial bank interest rates but will not change the amount of liquidity held by the commercial

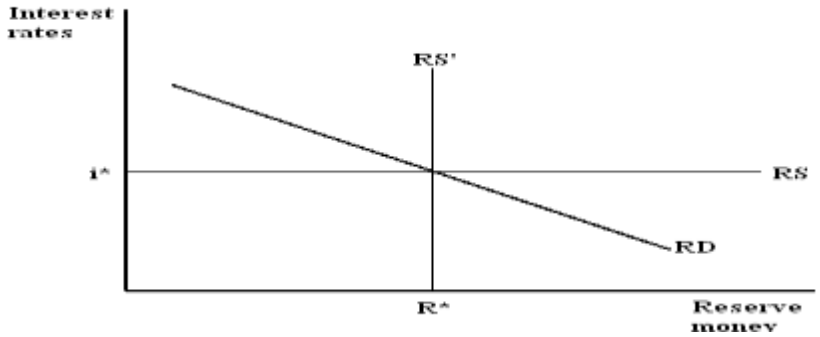
banks). Therefore, these tools are basically used to influence either interest rates which is the price of liquidity or money stock, which is the quantity of money in the economy. Interest rates and money stock are therefore the instruments of monetary policy (they are different from tools of monetary policy. However total liquidity in the economy may change if the commercial banks are not able to advance loans due to the high cost of money). Interest rates and money stock will influence the target variables through other intermediate targets including credit (loans), exchange rates and inflation forecasts. The direction of influence of monetary policy changes is as given in the schematic relationship below:



To hit its target of low and stable inflation, Central banks always have to decide whether to use interest rate as the instrument or reserve money as the instrument. A choice on the monetary policy tools to be used to influence the chosen instrument can then be made.

While majority of empirical literature (see Kydland and Prescott 1977, Taylor 1983, and McCallum1995) suggest the use of discretion in the choice of the instrument to be used to stabilize inflation and output, there is consensus that interest rates and reserve money will not be effective in achieving monetary policy goals of low and stable inflation when used simultaneously (see Dornbusch and Fischer, 1990 and Turnovsky, 1975). Turnovsky (1975) for instance, notes that there exists an inverse relationship between interest rates and money supply and due to this relationship, monetary authorities are unable to simultaneously use money supply and interest rates as policy instruments but are instead forced to choose between them. According to Dornbusch and Fischer (1990), the Central Bank cannot simultaneously set both the interest rate and the stock of money at any given target levels that it may choose. They argue that if the Central Bank chooses to fix the interest rates, it loses control over money supply. Furthermore, if the Central Bank wishes to set a certain target for the interest rates then it has to supply the amount of money demanded at that interest rate. On the other hand, if it chose to set a certain money supply target, it has to allow the interest rates to adjust to equate to the demand for money. This can be demonstrated as follows;

Figure 1.1: Reserve Money and Short-Term Interest Rates as Instrument Targets

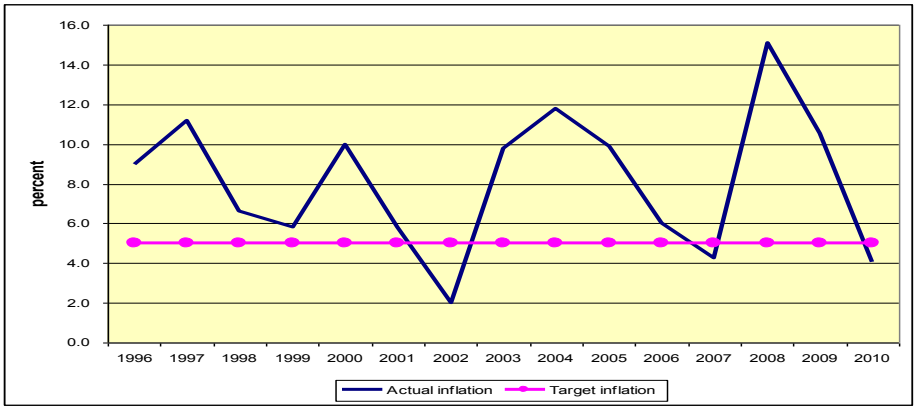


From figure 1.1 above, it can be seen that for a given demand for reserve money **RD**, in order to use nominal interest rates ***i**** as the instrument, the supply of reserve money must be perfectly elastic **RS** thus causing the quantity of reserve money to be demand determined. On the other hand, if reserve money is to be used as the instrumental target **R***, the supply of reserves will be perfectly inelastic and the level of interest rates will be demand determined. As can be seen from figure 1.1 above, it is clear that the Central Bank can never be able to set both ***i**** and **R*** simultaneously and effectively control money supply**.**

Even with this consensus in the literature that using both interest rates and reserve money will lead to sub-optimal outcomes of monetary policy goals, the Central Bank of Kenya still uses both the interest rates and reserve money to influence the direction of monetary policy. This simultaneous use of the two instruments could likely cause the CBK to miss its inflation targets. As Dornbusch and Fischer (1990) notes, the Federal Reserve Bank could not hit its money growth targets not for technical reasons but because it set both interest rate targets

and money stock targets at the same time. As mentioned earlier, the CBK's main goal is to achieve an inflation rate of 5 percent (CBK 2010). But this has consistently been missed as shown in the figure below:

Figure 1.2: Actual Vs Target Inflation



Source: CBK website at http://www.centralbank.go.ke/Publications/default.asp accessed on 30th June 2011

From figure 1.2, monetary policy in Kenya does not seem to be effective in stabilizing inflation around the 5 percent target. This could be as a result of the use of the two instruments simultaneously. The CBK therefore need to make a choice on which of the instruments is optimal (leads to the minimum loss between its target and actual inflation). Unfortunately, even with the agreement that a choice between the two instruments must be made, literature is divided on which of the instruments is superior. While Gordon (1979) finds that interest rates were the superior instrument for monetary policy in Canada, Sergeant and Wallace (1975) writes that interest rates may not be a good instrument since equilibrium indeterminacy gives it a natural disadvantage over reserve money as an instrument. Niemann, *et al* (2010) concludes that the welfare maximizing choice of instruments depends on the economic environment under consideration. The knowledge gap is therefore clear, that while there is consensus in the literature that the two instruments cannot be used simultaneously and therefore CBK has to choose between the instruments, literature is divided on which would be superior. At best literature suggests that it all depends on the economic environment. Other studies have pointed out that a combination policy would in fact be superior that the two instruments used independently. A combination policy involves a mix of the two instruments with certain weights in what could be called a monetary policy conditions index. According to Poole (1970), Woglom (1979), Benavie and Froyen (1983), Butter (1983) and Phongthiengtham (undated), monetary authorities can have a combination instrument which lies between the interests rate and monetary aggregates which could be preferable to either the interest rate or the monetary aggregate control used in isolation. To Poole (1970), and Woglom (1979), a combination instrument amounts to a deterministic relationship between the money stock and the interest rate.

1.2 Interest Rate Monetary Policy Strategy

Interest rate is the rate of return on investment and the cost of borrowing funds. It is determined by the supply and demand for money. Long-term interest rates are paid to a borrower of flawless solvency for a loan of indefinite duration. In Kenya, these are reflected by interest rates for long-term bonds. Short-term interest rates on the other hand are indicated by the treasury bills. The short-term rates are averaged lower than long-term rates but have higher fluctuations.

According to Darryl (1969), interest rates are a price for the use of funds and if rapid monetary expansion contributes to excessive demand and inflation, it also contributes to rising interest rates. Central Bank's role under the interest rate instrument is to set a short-term official rate of interest, which indicates the price at which it will make liquidity available to the banking system as a lender of last resort**.** In Kenya, this rate is called the Central Bank Rate. This rate is reflected in the CBK overdraft rates. Inflation stabilization can be implemented through a 'Taylor rule' in which interest rates are adjusted in response to output and inflation. In using interest rates, first the Central Bank sets a target inflation rate and then interest rates are steered to move inflation to its intended levels. In this case, interest rates are increased when the inflation rate is above the target rate, and reduced when inflation is below the target rate. A reduction in the official rate for instance, encourages the commercial banks to borrow money from the Central Bank, thereby increasing money supply in the economy**.** This increases consumption and output towards the desired output target. However, this action increases the inflation rates. This introduces the paradox of monetary policy that is; excessively low interest rates now will only lead to much higher interest rates latter.

Using the is IS-LM framework, Poole (1970) showed that interest rates are best suited as a policy instrument when there are variations in the LM function i.e. if the money demand is randomly shocked since fixing a money target only serves to increase the variation in output. Among the strengths attributed to the interest rate instrument are that it is observable with accurate data available, it is controllable, and it is key in influencing investment and spending behavior making it key in the transmission mechanism through which monetary policy affects the economy. The long and short of the interest rate instrument is to allow interest rates to rise gradually when it is necessary to slow the economy's rate of expansion and to let rates fall when stimulation is needed.

1.3 Reserve Money Monetary Policy Strategy

Reserve money or base money refers to liabilities of the Central Bank in the form of notes and bank reserves. It contains the decisive means of payment, which carry no credit risk and through it, the banking system intermediates between the central bank and the rest of the economy in obtaining the required liquidity. Reserve money is created when the central bank acquires assets and pays for these assets by creating liabilities i.e. the currency and the deposits of banks and NBFIs. Its strengths are, it is a narrow measure of money, controllable, accurately measurable without delay and data about it is obtained frequently and without delay. Furthermore, even though the money base is the actual instrument, the Central Bank can very well behave as if the market nominal interest rate is its instrument where it adjusts the base to attain some target value of the nominal interest rate. This is a case of an interest rate target procedure.

Under reserve money control CBK's role is to set targets for money growth and leave the private and banking sector the task of generating the interest rates and the exchange rates consistent with money growth. This strategy has its strengths in that, it is more direct and has an efficient control mechanism. Its control, acts more from the supply side and is more suitable where productivity in the real goods sector is not predictable but the money market is more predictable. Poole (1970) used IS-LM framework to show that where the real goods sector is randomly shocked and the demand for money function stable, it is better to control monetary policy using the reserve money since use of interest rates only serves to increase the variations in output and inflation.

The Central Bank often changes the stock of reserve money through the open market operation where it either carries out a purchase or a sale. When Central Bank purchases securities at the open market, this increases its assets and at the same time increases its liabilities (reserve money) with the same amount of purchase. When the central bank carries out a sale, this reduces the amount of high powered money since the CBK reduces its assets which now go to the public (buyers) and it then decreases its liabilities (a reduction in the volume of cash in the economy) by the amount of its sale of securities. However, it is important to note that given the stock of high powered money, the supply of money increases with the money multiplier. The multiplier increases with the level of market interest rates and decreases with the discount rate, the required reserve ratio and the currency deposit ratio. The Central Bank cannot control the money stock exactly since the multiplier is never constant.

According to Maturu (2006), Kenya uses the reserve money as the monetary aggregate in targeting policy operating framework. Reserve money is in use as the operating target while broad money supply M3X is the intermediate target in targeting low and stable inflation at 5%. In the use of reserve money as an instrument, money supply growth is not determined by the demand by the general public but by the Central Bank. The market determines the interest rate, which is now out of central banks control. The interest rates are abandoned as a signaling device in this policy strategy or maintained only for emergencies at central banks discretion. Lagged reserve settlements are left ushering in a simultaneous settlement period. The practice is for the Central Bank to put a uniform reserve requirement against all deposits entering the definition of money and a zero reserve requirement against all other deposits.

For growth in monetary aggregate to act as a useful indicator of inflation, there needs to be a predictable relationship between money growth and future inflation. Central Bank must have predictable control over money growth while operating its monetary instrument. Sharp increases in money supply initially affect real output and employment but in the long-run only prices will be affected, all other variables held constant. These conclusions arise from the quantity theory of money identity which is used as a basis for monetary targeting. It is represented as; $Mv = PY$

Where M represents money supply, P is the general price level, Y the real income, (PY is the GDP at current prices), and V represents the rate at which money changes hands in the economy. M is determined by central bank (exogenous). Money supply is balanced by the demand for money from households and firms represented by this identity. This theory shows that the value of money is determined not only by the amount of money in circulation but also on the rate at which it changes hands and by the output of goods and services. Monetarists argue that though V may change due to introduction and spread of new financial practices and techniques of

debt settlement, such as the credit card, it will not change in response to changes in M or if it does the induced changes will often reinforce the inflationary or deflationary impact of monetary fluctuations rather than offset them.

The main disadvantage of using monetary base is the long and variable lags between monetary policy and its effects on the economy which make it difficult for CBK to conduct countercyclical policy.

1.4 Kenya's Monetary Policy Profile

The first decade after independence can be characterized as passive in the conduct of monetary policy in Kenya, mainly because no intervention was necessary in an environment of 8% GDP growth and below 2% inflation rate, Kinyua (2001). The first major macroeconomic imbalance arose in the second decade in the form of 1973 oil crisis and the coffee boom of 1977/78. This came at a time when the fixed exchange rate system had just collapsed with the Britton Woods System in 1971. In these first two decades, monetary policy was conducted through direct tools which were cash reserve ratio, liquidity ratio, credit ceilings for commercial banks, and interest rate controls.

The 1990s brought about the liberalization of the economy where interest rate controls were removed and exchange rate made flexible, ushering in a new era in monetary policy where open market operations (OMO) was the main tool. This was a period characterized by high interest rates and widening interest spread, which inhibited the benefits of flexible interest rate policy such as increasing financial savings and reducing cost of capital. Competing against double digit inflation rate spurred on by excessive money supply and accommodation of troubled banks, CBK used indirect tools to tame inflation in an atmosphere of instability and extreme uncertainty. In 1996, the CBK Act was amended and this allowed the CBK to shift from targeting broad money M3 to targeting broader money M3x as the principal concept of money stock, Kinyua (2001).

The CBK operates under a monetary policy programming framework that includes monetary aggregates (liquidity and credit) targets that are consistent with a given level of inflation and economic growth, KIPPRA (2006). For instance, the banks objective for the fiscal year 2005/2006 was to achieve inflation rate below 5% using quarterly reserve targets. To this end, the CBK set a ceiling for reserve money and a floor for the net foreign assets (NFA). This was the mainstay of monetary policy at least until the introduction of the Central Bank rate CBR. The use of monetary targeting as currently used by the CBK has also been criticized. Monetary aggregate targeting policy is more effective where there exists a stable demand for money relationship dependent on overall economic activity and price level, but this may not be the case in Kenya which has a financial sector which is at a period of growth, making demand for money unstable according to KIPPRA (2006).

1.5 Statement of the Problem

The Central Bank of Kenya's key objective is formulation and implementation of monetary policy towards achieving and maintaining stability in the general level of prices in order to achieve desired growth rates. But because it cannot influence inflation directly, the CBK uses short term interest rate and reserve money as instruments or tools to achieve its goals. The CBK has used these two instruments simultaneously to influence the direction of monetary policy. However, there is consensus in literature that for monetary policy actions to be effective, reserve money or money supply generally and interest rates cannot be used simultaneously to influence the direction of monetary policy in the economy. Dornbusch and Fischer (1990), document that the Federal Reserve Bank could not hit its money growth targets not for technical reasons, but because it set both interest rate targets and money stock targets at the same time. Money (reserve money) represents the quantity while interest rate is the price of money. From microeconomic theory, it is not possible to manipulate both the quantity and price at the same time in a free market. You either determine quantity leaving the price to be determined by the market, or determine price and leave quantity to be determined by the market. The CBK's main goal is to achieve an inflation rate of 5 percent (CBK, 2010). But this, as shown in figure 1.2, has been consistently missed with actual inflation consistently above the target inflation. Monetary policy in Kenya therefore does not seem to be effective in stabilizing inflation around the 5 percent target. This could be as a result of the use of the two instruments simultaneously. The CBK therefore needs to make a choice on which of the instruments is optimal. Unfortunately, literature is divided on which of the instruments is superior. While Gordon (1979) finds that interest rates were the superior instrument for monetary policy in Canada, Sergeant and Wallace (1975) prefers reserve money as the instrument and maintains that interest rates may not be a good instrument since equilibrium indeterminacy gives it a natural disadvantage over reserve money as an instrument. Niemann et al (2010) summarizes the divide and concludes that the welfare maximizing choice of instruments depends on the economic environment under consideration. Poole (1970), Woglom (1979), Benavie and Froyen (1983), Butter (1983) and Phongthiengtham (undated) further argue that monetary authorities can even have an

optimal combination instrument which lies between the interests rate and monetary aggregates which could be superior to either of the instruments used independently.

The gaps that this study is filling are therefore clear. First is the policy gap; that the CBK currently uses both interest rates and reserve money as instruments but available literature contends that the two instruments used simultaneously will not be effective. CBK therefore has to make a choice between the two or an optimal combination of the two. The second is the knowledge gap; that while there is consensus in the literature (see Dornbusch and Fischer,1990 and Turnovsky, 1975) that the two instruments cannot be used simultaneously and therefore CBK has to choose between the instruments, literature is divided on which of the instruments would be superior. At best, literature suggests that it all depends on the economic environment. It is therefore interesting to find out which one is optimal in the Kenyan economic environment.

1.6 Research Questions

a) Which instrument between interest rates and reserve money is optimal in influencing the direction of monetary policy in Kenya?
b) Is a combination policy using a mix of interest rates and reserve money better than using either of the instruments independently?

1.7 Objectives of the Study

1.7.1 General Objectives

In line with the research questions, the general objective of this study is to determine the optimal instrument of monetary policy in Kenya.

1.7.2 Specific Objectives

a) To determine which instrument between interest rates and reserve money is optimal (superior) in influencing the direction of monetary policy in Kenya.
b) To determine whether a combination policy using a mix of both instruments could be a better policy than using either of the instruments independently.

1.8 Significance of the Study

Establishing the appropriate instrument of monetary policy by the CBK is important since it will ensure the effectiveness of its policy interventions in stabilizing inflation and achieving desired growth targets. As noted by Dornbusch and Fischer (1990), monetary authorities may not be able to hit their monetary targets not for any technical reasons but because they set both interest rate targets and money stock targets at the same time. It therefore becomes difficult for the CBK to hit its target goals of inflation and desired growth if it does not hit its money growth target. Furthermore, since available literature is divided between reserve money and interest rate instruments and also suggests that the instrument choice depends on the economic environment, it is interesting to find out which instrument befits the Kenyan environment.

1.9 Scope and Limitation of the Study

This study recognizes that there are a number of other policy instruments that the CBK can possibly use to influence the direction of monetary policy. However, it will restrict itself to the analysis of the effectives of reserve money and interest rates. In addition, the study makes several assumptions. One main assumption is that the demand for money is stable in the economy. The study will not explore the consequences of unstable money demand on the results even though it recognizes that money demand function may be unstable in Kenya. In addition, the study assumes perfect transmission of monetary policy to the real economy and does not envisage a situation where the results of this study may change because of lack of efficient transmission of monetary policy changes. We also ignore the fact that Kenya is a small open economy. All foreign trade account balances and exchange rates are excluded.

1.10 Organization of the Study

The remaining part of this study is organized as follows; chapter two provides a review of both theoretical and empirical literature on the use of interest rates and reserve money as monetary policy instruments while chapter three develops the methodology of the study, chapter four is the data analysis and interpretation as chapter five closes with the summary, conclusion and policy recommendations.

Chapter II

LITERATURE REVIEW

2.0 Introduction

This chapter reviews both the theoretical literature on the choice of a monetary policy instrument between interest rates and reserve money and empirical literature on choice between the two as monetary policy instruments.

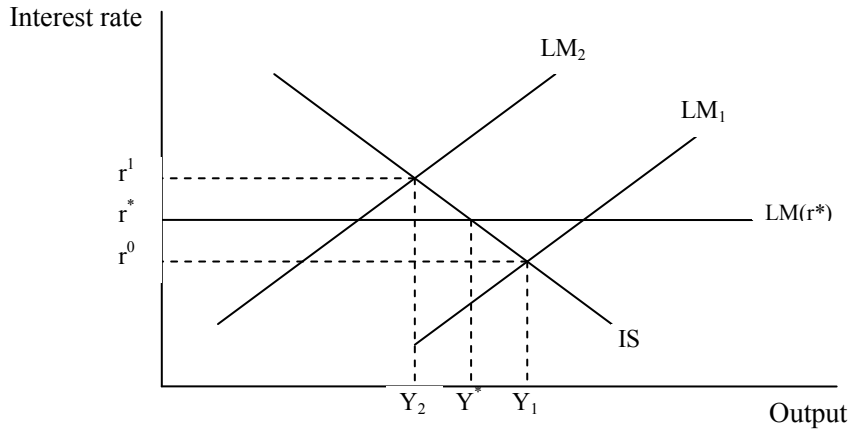
2.1 Theoretical Literature Review

Theoretically, a choice between instruments involves assessing whether the risks to the economy arising from possible, unprovoked interest rate movements over the short run, given reserve money control are greater than the dangers of a slightly slower policy response to unexpected inflationary shocks given interest rate control. The choice is a question of whether a given target level of money stock is tenable more accurately by holding interest rates fixed or by fixing reserve money. White (1979), notes that in attempting to achieve its monetary growth targets the Central Bank could rely principally on the characteristics of either the demand curve with interest rates as instrument, or the supply curve with the money base as instrument, or some optimal combination of the two.

2.1.1 Interest Rate as a Monetary Policy Instrument

Poole (1970), using the IS-LM approach demonstrated that if output deviates from its equilibrium mainly due to demand for money function shifting, Central Bank should operate monetary policy by fixing the interest rates and not the money supply. This way, it neutralizes automatically the effect of shifts in money demand using interest rate targets. If the **IS** function is stable and money demand function is random, the instrument choice problem can be illustrated as shown in the diagram below;

Figure 2.1: Choosing a Monetary Policy Instrument with Monetary Shocks



Source: Quarterly Journal of Economics, vol. 84 No. 2

In the diagram above, the real goods sector is assumed to be stable and thus uncertainty in monetary policy arises from shifts in money demand represented by the LM functions. Central bank still has control of the money supply and the **LM** curve shifts since the money demand shifts. Central bank does not know what the interest rate will be when it sets the money stock. Assume that the **LM** curves are either LM_1 or LM_2. If central bank fixes the interest rate at r^*, this would ensure that the level of output is Y^*. If money stock is fixed, output will lie between $\mathbf{Y_1}$ and $\mathbf{Y_2}$. A positive shock in money demand shifts the LM function to the left from $\mathbf{LM_1}$ to $\mathbf{LM_2}$ raising the interest rates to $\mathbf{r^1}$ and reducing investment and hence output to $\mathbf{Y_2}$ away from the target output **Y***. A negative shock would reduce interest rates to $\mathbf{r^1}$ and increase investment hence output to $\mathbf{Y_1}$ away from **Y***. This means that if output deviates from equilibrium since money demand shifts, then central bank should fix the interest rates. This neutralizes the effects of money demand shifts. In this case the interest rates are the proper instrument.

According to Poole (1970), the choice of instrument, more generally, depends on the relative importance of real versus monetary disturbances and therefore the choice of the instrument depends on the relative importance of

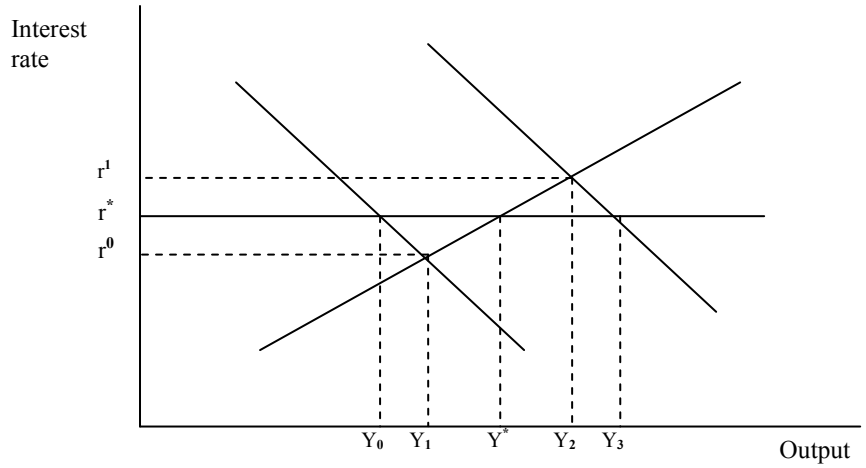
the random disturbances and on the slopes of the **IS** and **LM** functions that is on the structural parameters of the system.

2.1.2 Money Supply as a Monetary Policy Instrument

Several studies have advocated for the use of money supply as the appropriate instrument in several contexts. Friedman (1960), advocated for the use of a money supply rule (k-percent rule) in which money supply grew at a given rate in order to provide secure price stability irrespective of the business cycles. Proponents of the constant growth rule found it desirable when authorities don't have information or capacity to know when or by how much to stimulate the economy. This rate would be equated to the rate of growth of real gross domestic product.

Poole (1970), using the IS-LM approach demonstrated that if output deviates from its equilibrium level mainly because the IS curve shifts, then output is stabilized by manipulating money stock and not interest rates. This relationship can be seen in the diagram below;

Figure 2.2: Choosing a Monetary Policy Instrument with Real Shocks



Source: Quarterly Journal of Economics, vol. 84 No. 2

In the diagram above the IS function unpredictably shifts between IS_1 and IS_2. The central bank can't be certain which **IS** curve it will obtain. **LM(m*)** represents the **LM** curve when the central bank fixes the money stock**.** **LM(r*)** describes the money market equilibrium when the central bank fixes the interest rate. It's horizontal at the chosen level of the interest rate ***r****. The aim of monetary policy is to make output come as close as possible to the target, **Y***. This occurs when the **LM** curve is **LM(m*)** in which case output will lie between $\mathbf{Y_1}$ and $\mathbf{Y_2}$ (closer to **Y***). This is because if the **IS** shifts to the right (positive shock) and the **LM(m*)** curve applies, then the interest rate rises to r^1 reducing the investment demand and thus moderating the effect of the shift on output. Note that the opposite is also true that a negative shock would reduce the interest rates to r0 and thus moderate the effect of the shift in output. If the monetary policy chooses to fix the interest rates at **LM(r*)**, this would bring about output farther away from the target output **Y*** represented by region between $\mathbf{Y_0}$ and $\mathbf{Y_3}$. This deviation is larger since the interest rates are fixed at r* and as a result cant rise or fall to moderate the effects of the IS curve shocks. Consequently, if disturbances originate primarily from the **IS** function that summarizes the real sector of the economy (in consumption and investment behavior and in government spending and taxation) the money stock is the proper instrument of control and not interest rates.

Taylor (1993) demonstrated that the Taylor rule, with short-term interest rate as the policy instrument, responded to movements in inflation and output gap, and closely followed the observed path of the Federal Funds Rate in the United States in the late 80s and early 90s. Indeed, Taylor rule did not foresee the Central Bank using both the monetary stock and the interest rates in directing monetary policy but solely the interest rates as the solitary instrument to set the direction of monetary policy.

Gavin et al (2005), develops a dynamic stochastic general equilibrium framework, examined the effects of alternative monetary policy rules on inflation persistence, the information content of monetary data, and real variables. They showed that inflation persistence and the variability of inflation relative to money growth depended on whether the central bank followed a money growth rule or an interest rate rule. With a money growth rule, inflation was not persistent and the price level was much more volatile than the money supply. Those counterfactual implications however were eliminated by the use of interest rate rules regardless of whether prices were sticky or not. Central Bank's use of interest rate rules, however, obscured the information content of monetary aggregates and also led to subtle problems for econometricians trying to estimate money demand functions or to identify shocks to the trend and cycle components of the money stock

2.2 Empirical Literature Review

Poole and Lieberman (1972), sought to determine the technical feasibility of controlling inflation through the money stock as opposed to interest rates and found out that imprecision in monetary control by the use of monetary aggregates tended to magnify fluctuations in both income and interest rates. They pointed out that while interest rate control was relatively easy, control of monetary stock was not since money stock data are only available after significant lag and are subject to frequent and substantial revisions.

Burger (1972) and Levin (1973), suggests that a simple empirical criterion in optimal instrument choice is to compare how well monetary aggregates can be predicted using either demand for money functions or supply of money functions relating monetary growth to estimated money multipliers, changes in measures of the cash base, and other relevant factors such as short-term interest rates.

Sergeant and Wallace (1975), criticized the interest rate instrument saying that equilibrium indeterminacy gives interest rates a natural disadvantage over money growth targets.

Gordon (1979) Canada, using Mundels model of stabilization policy under flexible exchange rates found out that interest rates were the better instrument for monetary policy control since they insulate income from disturbances in the money market which would otherwise be expected to be large over periods as short as a month or less. He found that there was no simpler multiplier relationship between reserves and money supply. Control through monetary aggregate would reduce effects on income of unpredictable fluctuations in aggregate demand and balance of payments but would permit money market to stabilize income particularly in the case in which capital flows are highly interest inelastic.

Fair (1987) USA, used stochastic simulation to choose between interest rates and reserve money using the variances, covariance, and parameters of the model on GNP. The study found out that interest rate directly affected plant, equipment and investment in the model, thus increasing the sensitivity of real GNP to the interest rate and this favored the interest rate policy over the money supply policy. The exchange rate was exogenous in the model but if it was endogenous and was influenced by the interest rate, then its variance is likely to be greater for the money supply policy. The results also showed that the contribution of the error terms in the demand for money equations to the variance of real GNP is not very great even when the money supply is the policy instrument.

Staundiger (2001) used an augmented Phillips curve in a simple dynamic equilibrium analysis and found out that the higher the degree of persistence of a supply shock, the stronger is the reaction of the interest rate, whereas the opposite holds for a demand shock. The study found that the reaction on demand disturbances is independent of weight given to output stabilization by the Central Bank; in the case of a supply shock the reaction of the interest rate depends on this weight.

Atkeson et al (2007) applied the Phillips curve linking inflation and output growth to a Euler equation in determining the choice between an interest rate instrument, monetary growth instrument and the exchange rates in controlling inflation. Basing his choice on tightness and transparency, he found out that interest rates which are endogenously determined have a natural advantage over the exchange rate and monetary growth instruments respectively.

Bhattacharya and Singh (2007), using an overlapping generation's model with limited communication and stochastic relocation creating an endogenous transactions role for fiat money, investigated the issue of a policy instrument choice in an economy with real and nominal shocks. They found that when the shocks are real, welfare is higher under money growth targeting. When the shocks are nominal and not large, welfare is higher under interest rate targeting. While under interest rate instrument, it is always optimal to pursue an expansionary policy, it is never optimal to do so under money growth targeting.

Niemann et al (2010) using an optimal discretionary fiscal and monetary policy cast as a dynamic game between the Central Bank, the fiscal authority and the private sector, found out that as long as there is a conflict of interest between the two policy-makers, the central bank's monetary instrument choice critically affects the Markov-perfect Nash equilibrium of this game. Focusing on a scenario where the fiscal authority is impatient relative to the monetary authority, they showed that the equilibrium allocation is typically characterized by a public spending bias if the Central Bank uses the nominal money supply as its instrument. If it instead uses the nominal interest rate, the Central Bank can prevent distortions due to fiscal impatience and implement the same equilibrium allocation that would obtain under cooperation of two benevolent policy authorities. Despite this property, the welfare maximizing choice of instrument depends on the economic environment under consideration. In particular, the money growth instrument is preferred whenever fiscal impatience has positive welfare effects, which is easily possible under lack of commitment.

Phongthiengtham (undated) used the IS-LM framework with vector error correction model (VECM) empirical estimation technique to compare the interest rate instrument to the monetary base instrument and found the interest rate instrument superior to monetary base. Taking the comparison further to include the optimal combination of interest rates and monetary base, an optimal combination proved even better than either of the sole instruments.

2.3 Overview of Literature

From the preceding discussion, there is consensus in literature that there is a cost to pay when the Central Bank tries to simultaneously set both the interest rates and monetary aggregate to achieve its inflation and economic growth targets. The Central Bank does therefore have to make a choice between the instruments.

It is also clear from the review that literature is divided on which of the instruments is superior. While Gordon (1979) finds that interest rates were the superior instrument for monetary policy, Sergeant and Wallace (1975) prefer reserve money as the instrument. Niemann et al (2010) concludes that the welfare maximizing choice of instruments depends on the economic environment under consideration. Poole (1970), Woglom (1979), Benavie and Froyen (1983), Butter (1983) and Phongthiengtham (undated) on the other hand argues that monetary authorities can even have an optimal combination instrument which lies between the interests rate and monetary instruments. It is therefore not clear from the literature which instrument the CBK should choose. This is the gap that this study attempts to fill in the Kenyan case. Furthermore, no study has been done in Kenya to determine the optimal instrument of monetary policy.

Chapter III

RESEARCH METHODOLOGY

3.0 Introduction

This section develops the methodology for determining the choice instrument for monetary policy in Kenya. The heart of it is to develop the methodology to determine which instrument between the reserve money and interest rates is appropriate for the conduct of monetary policy in Kenya.

3.1 Theoretical Model

Borrowing from Poole (1970), it was assumed that there are two markets, the goods market and the money markets and start with a nonstochastic linear version of the Hicksian IS-LM model given as:

$$Y = \alpha_0 + \alpha_1 r \quad \text{(Goods market)} \qquad (3.1)$$

$$M = \beta_0 + \beta_1 Y + \beta_2 r \quad \text{(Money market)} \qquad (3.2)$$

Where Y was national income, M was money supply or the monetary aggregate used as the policy instrument and r the interest rate. Equation (3.l), the IS function, was obtained by combining linear consumption and investment equations with the equilibrium condition *Y=C+I.* In equation (3.2), the LM-function, the left-hand side was the stock of money and the right-hand side was the demand for money. The parameters were not necessarily constant all the time; they were assumed to change as a result of fiscal policy measures and other factors. What was assumed was that the parameters were known period by period. The model had two equations and three variables, Y, M, and r. The monetary authority (Central Bank) therefore would select either M or r as the policy instrument so that there were two endogenous variables and one exogenous variable.

Adding stochastic terms to the deterministic model above we had;

$$Y = a_0 + a_1 r + u \qquad (3.3)$$

$$M = b_0 + b_1 Y + b_2 r + v \qquad (3.4)$$

Where *u* and *v* were disturbance terms with;

$E(u) = 0, E(v) = 0, E(u^2) = \sigma_u^2, E(v^2) = \sigma_v^2, E(uv) = \sigma_{uv}$. Output is now random.

Poole (1970) argues the selection of the instrument should depend on which instrument minimized the expected loss from failure of the actual income to equal the desired income. The policy maker therefore wants to stabilize output around full employment (desired) output denoted by Y^*. Assuming a quadratic loss function, the expected deviation of the actual output from the desired level was given by a quadratic loss function as;

$$L = E\left[(Y - Y^*)^2\right] \qquad (3.5)$$

The goal was to find the optimal setting for r under an interest rate instrument and M under a money stock instrument that minimized this loss function.

3.1.1 Minimum Expected Loss under Interest Rates Instrument

To get the minimum expected loss under the interest rate instrument, the first step was to get the structural models given in equations (3.3) and (3.4) into reduced form. That would express the endogenous variables as a function of exogenous variables. The reduced form equations would therefore depend on the choice instrument. Equation (3.3) given as $Y = a_0 + a_1 r + u$ already expressed output in reduced form for the interest rate instrument.

Poole (1970) showed that if the interest rate was the instrument, then the minimum expected loss was obtained when $r = r^*$. Hence, we substituted equation (3.3) into the loss function, equation (3.5) and considering that $r = r^*$ at the point of expected minim loss. Then chose r that minimized the modified loss function:

$$\underset{r}{Min}\, E\left\{\left[\left(a_0 + a_1 r^* + u\right) - Y^*\right]^2\right\} \tag{3.6}$$

Setting the derivative equal to zero would yield:

$$E\left[2a_1\left(\left(a_0 + a_1 r^* + u\right) - Y^*\right)\right] = 0 \tag{3.7}$$

Dividing through by $2a_1$ and taking expectations of the resulting expression would yield:

$$r^* = a_1^{-1}\left(Y^* - a_0\right) \tag{3.8}$$

This was the optimal value of $r*$ under the interest rate instrument. Remembering that the minimum expected loss was to be obtained when $r = r*$ and substituting equation (3.8) into the reduced form equation (3.3) we had;

$$\begin{aligned} &Y = a_0 + a_1 a_1^{-1}\left(Y* - a_0\right) + u \\ &\Rightarrow Y = a_0 + Y* - a_0 + u \\ &\Rightarrow Y = Y* + u \end{aligned} \tag{3.9}$$

By substituting equation (3.9) into the loss function equation (3.5), we had

$$\begin{aligned} &L_r = E\left[\left(\left(Y* + u\right) - Y^*\right)^2\right] \\ &L_r = E\left[\left(Y^* - Y^* + u\right)^2\right] = E\left[u^2\right] = \sigma_u^2 \\ &L_r = \sigma_u^2 \end{aligned} \tag{3.10}$$

The expected minimum loss under the interest rate instrument would therefore equal the variance of the IS function (σ_u^2).

3.1.2 Minimum Expected Loss under Reserve Money Instrument

Under this policy regime, reserve money was chosen by the central bank making reserve money exogenous in the model. The reduced form for the reserve money instrument was therefore given as;

$$Y = \left(a_1 b_1 + b_2\right)^{-1}\left[a_0 b_2 + a_1\left(M - b_0\right) + b_2 u - a_1 v\right] \tag{3.11}$$

This equation was obtained by setting Y in equation (3.4) as a function of both r and M using both equations (3.3) and (3.4). Next, substitute the reduced form equation into the loss function and eliminate Y in the loss function. Then the monetary authorities faced the following minimization problem when using reserve money as the instrument:

$$\underset{M}{Min}\, E\left\{\left[\left(\frac{a_0 b_2 + b_2 u - a_1 v + a_1 (M - b_0)}{a_1 b_1 + b_2} - Y^*\right)\right]^2\right\} \tag{3.12}$$

Again, taking the derivative and setting it equal to zero, we obtained:

$$E\left[\frac{2a_1}{a_1 b_1 + b_2}\left(\frac{a_0 b_2 + b_2 u - a_1 v + a_1 (M - b_0)}{a_1 b_1 + b_2} - Y^*\right)\right] = 0 \tag{3.13}$$

Taking expectations and solving for M yielded:

$$M^* = \frac{Y^*(a_1b_1 + b_2) - a_0b_2 + a_1b_0}{a_1} \tag{3.14}$$

This was the optimal value of $M*$ under the reserve money instrument. Again, following Poole (1970) who shows that if reserve money is the instrument, the minimum expected loss was obtained when $M = M*$, we substituted the optimal money stock equation (3.14) into the reduced form equations (3.3) and (3.4) and substituted the resulting functions into the loss function (3.5) to get:

$$\begin{aligned} L_M = \left[\left(Y_r - Y^*\right)^2\right] &= E\left[\left(\frac{b_2u - a_1v}{a_1b_1 + b_2}\right)^2\right] \\ &= (a_1b_1 + b_2)^{-2} E\left[b_2^2u^2 + a_1^2v^2 - 2a_1b_2uv\right] \\ &= (a_1b_1 + b_2)^{-2}\left[b_2^2\sigma_u^2 + a_1^2\sigma_v^2 - 2a_1b_2\sigma_{uv}\right] \end{aligned} \tag{3.15}$$

This was the minimum loss obtained when using reserve money as the instrument.

3.1.3 Combination Policy

Combination policy was the policy that lied between the interest rates and the monetary base instruments**.** Monetary base was a function of the interest rates prevalent in the market such that when the interest rates were zero it was a pure monetary base targeting rule. As the interest rate approached infinity then this became a purely interest rate targeting instrument. Poole (1970) demonstrated this by defining combination policy in terms of setting the values for c_1 and c_2 in a money supply equation given by $M = c_1' + c_2'r$. However because the denominators of the optimal c_1' and c_2' vanish for certain parameter values, it was convenient to define the money supply function by the equation (3.16) below where c_0 was set to equal the common denominator of the optimal c_1' and c_2'.

$$c_0M_t = c_1 + c_2r_t \tag{3.16}$$

When the equation above was added to the model consisting of equations (3.3) and (3.4), there were three equations and three unknowns- Y, r and M - and the expected loss was minimized by setting the partial derivatives of the loss with respect to c_1 and c_2 equal to zero. The policy instruments were then be said to be the values of c_1 and c_2. Poole (1970) showed that the optimal policy would be given by;

$$c_0M = c^*_1 + c_2r^*$$

Where $c_0 = b_1\sigma_u^2 + \sigma_{uv}$

$$\begin{aligned} c_1^* &= c_0(b_0 + b_1Y^*) + (Y^* - a_0)(\sigma_v^2 + b_1\sigma_{uv}) \\ c_2^* &= c_0b_2 - a_1(\sigma_v^2 + b_1\sigma_{uv}) \end{aligned} \tag{3.17}$$

Under this combination policy the stochastic term in the reduced form equation for income was affected so that the minimum expected loss L_c was found to be;

$$\mathrm{L_c} = \frac{\sigma_u^2\sigma_v^2(1 - \rho_{uv}{}^2)}{\sigma_v + 2\rho_{uv}b_1\sigma_u\sigma_v + b_1^2\sigma_u^2} \tag{3.18}$$

In equation (3.18) it to be seen that the combination policy became a pure interest rate policy when c_1=0 and became pure monetary aggregate policy when c_2=0.

3.1.4 Deciding which Policy Instrument was Optimal

Even though the values for the interest rate and money stock in equations (3.8) and (3.14) respectively were to be the best under a given instrument policy, we would not yet have determined what the optimal policy was. This was to be done by comparing the loss implied by the two instruments. The loss under the interest rate target

was given by equation (3.10) as $L_r = \sigma_u^2$. The loss under reserve money instrument was given by equation (3.15) $L_m = (a_1 b_1 + b_2)^{-2} E\left[b_2^2 \sigma_u^2 + a_1^2 \sigma_v^2 - 2a_1 b_2 \sigma_{uv}\right]$ while the loss under a combination policy was given by $\mathrm{L_c} = \dfrac{\sigma_u^2 \sigma_v^2 (1 - \rho_{uv}{}^2)}{\sigma_v + 2\rho_{uv} b_1 \sigma_u \sigma_v + b_1^2 \sigma_u^2}$.

First, comparison of the losses under interest rate instrument and reserve money instrument were to be taken by taking the ratio of L_M to L_r:

$$\frac{L_M}{L_r} = (a_1 b_1 + b_2)^{-2} \left[b_2^2 + a_1^2 \frac{\sigma_v^2}{\sigma_u^2} - 2a_1 b_2 \frac{\sigma_{uv}}{\sigma_u^2} \right] \qquad (3.19)$$

If the ratio was greater than 1, then an interest rate policy was optimal; if the ratio was less than 1, then a money stock instrument was optimal. To evaluate whether the combination policy was optimal, the loss under combination policy L_c was compared with the loss under the two instruments independently that is L_m and L_r.

3.2 Empirical Model

3.2.0 Introduction

To achieve the objectives of this study, Error Correction Model (ECM) was used. Since the ECM model ensured that it captured both the short-run and long-run effects and that any deviation from equilibrium would be adjusted.

3.2.1 Empirical Model

The empirical model used in the course of this study was the error correction model. Expanding equations 3.3 and 3.4 into the error correction models we obtained;

$$\Delta Y_t = a_0 + a_1 \Delta r_t + a_2 u_{t-1} + u_t \qquad (3.19)$$

$$\Delta M_t = b_0 + b_1 \Delta Y_t + b_2 \Delta r_t + b_3 v_{t-1} + v_t \qquad (3.20)$$

These equations were estimated where;

Y was the real National Income, M was the real Money Stock, r was the real Interest Rate, u_{t-1} and v_{t-1} were the error correction terms where $E(u) = 0, E(u^2) = \sigma_u^2$ and $E(v) = 0, E(v^2) = \sigma_v^2$ and $E(uv) = \sigma_{u,v} = \rho_{uv} \sigma_u \sigma_v$.

After estimating the equations (3.19) and (3.20), we obtained the value of the parameters $a_0, a_1, a_2, a_3, b_0, b_1, b_2,$ and b_3. In addition the estimation provided the residual terms, the variance and covariance of residual terms, $\sigma_u^2, \sigma_v^2, \sigma_{uv}$.

3.2.2 Evaluating which Policy was Optimal from Empirical Results

We substituted the parameters and variance / covariance in the loss functions (3.10), (3.15) and (3.18) to determine between interest rate policy, money stock policy and combination policy, which one was optimal. If the loss from an interest rate policy was less than the loss from a money stock policy, it was to be concluded that interest rate policy is optimal and should be used instead of money stock policy and vice versa. The value of loss from the combination policy L_c would then be compared with the values of L_r and L_M to determine whether a combination policy was better than both of the instruments used independently. This conclusion would be reached if L_c was less than both L_r and L_M

3.2.3 Definition and Measurement of Variables

Y- was the Gross Domestic Product (GDP) at constant prices and was be in logarithm terms.

M- For this study M3 was used. It was defined as the component of money comprising of currency in circulation, demand deposits, time and savings deposits, certificate of deposits liabilities of non-bank financial institutions.

R- was the CBK overdraft rates which were be converted to real terms by subtracting inflation.
The estimation had all the variables in logarithms.

3.2.4 Data Types and Sources

This study used Kenyan quarterly data from 1994 to 2010. The data for national income (Y) was sourced from Kenya National Bureau of Statistics (KNBS) economic surveys, and CBK publications. Quarterly GDP data were not available, and was obtained by interpolation from annual GDP data. Overdraft interest rate data was sourced from Central Bank of Kenya. It was the interest rate R which CBK could easily influence. The data for monetary base (M3) was sourced from KNBS.

3.2.5 Diagnostic Tests

Before analysis of data, various diagnostic tests were conducted on the data series to ensure that time series properties were not violated. After estimation of the model, all the relevant diagnostic tests to ascertain the econometric validity of the estimated model were be carried out and presented. Unit root and cointegration tests were performed before estimating the error correction model.

3.2.6 Data Analysis

The study addressed two objectives. The two objectives were achieved by obtaining the value of the parameters, fitting them into their respective loss functions and comparing the values of losses. The same was done with the combination instrument and the loss obtained was compared with the losses of the other two instruments. Form these losses, a decision was made on the optimal instrument.

Chapter IV

DATA ANALYSIS AND INTERPRETATION

4.1 Introduction
In this section, data analysis and interpretation is presented.

4.2 Unit Root Tests
The unit root results revealed that the raw data were non-stationary at levels as shown in the table below;

Table 4.1: Unit Root Tests at Levels

Variable	ADF test statistic	ADF critical values	Phillip Peron statistic	PP critical values	Conclusion
Log GDP	-2.633334	1%= -3.5328 5%= -2.9062 10%= -2.5903	-2.973354	1%= -3. 5297 5%= -2. 9048 10%= -2. 5896	NOT STATIONARY
Log Overdraft rate	-1.547115	1%= -3.5328 5%= -2.9062 10%= -2.5903	-1.461067	1%=-3. 5297 5%=-2.9048 10%=-2. 5896	NOT STATIONARY
Log (M3)	0.733491	1%= -3.5328 5%= -2.9062 10%= -2.5903	0.891994	1% = -3. 5297 5%=-2.9048 10%=-2. 5896	NOT STATIONARY

All variables are found to be nonstationary at levels hence the need to determine the order of integration of the variables since regressing then in their current state would have brought inappropriate coefficient standard errors.

Table 4.2: Unit Root Tests at First Difference

Variable	ADF test statistic	ADF critical values	Phillip Peron statistic	PP critical values	Conclusion
Log GDP	-3.564109	1% -4.1059 5% -3.4801 10% -2.5903	-3.460837	1% -3.5312 5% -2.9055 10% -2.5899	STATIONARY
Log Overdraft rate	-7.731487	1% -3.5328 5% -2.9062 10% -2.5903	-5.148907	1% -3.5312 5% -2.9055 10% -2.5899	STATIONARY
Log M3	-6.527113	1% -3.5345 5% -2.9062 10% -2.5907	-5.324168	1% -4.1013 5% -3.4779 10% -3.1663	STATIONARY

All the variables were stationary at first difference as shown in the table above. This meant that the variables are integrated of order I (1). This further meant that these variables as expected of many financial variables were I(1).

4.3 Cointegration Tests
Having conducted the unit root tests, cointegration tests were done to determine whether there existed long run relationships between the non-stationary variables. First, it was sought to establish whether there was any long-run relationship between the GDP and the overdraft rates which were the interest rate instrument variables. This was done by comparing the trace and maximum Eigenvalues and comparing them to the critical values as shown below;

Table 4.3.1: Trace Cointegration Test Results for Interest Rate Instrument Variables

Test assumption: Linear deterministic trend in the data **Series: LNGDP RATE_OVERD**				
	Likelihood	5 Percent	1 Percent	Hypothesized
Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
0.108884	13.97163	15.41	20.04	None
0.094861	6.478362	3.76	6.65	At most 1 *

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. rejects any cointegration at 5% significance level.

The results as shown above revealed that there existed at most one cointegrating relation between the GDP and the overdraft rates. This cointegrating relation meant that there existed a long-run relationship between the GDP and the overdraft rates. The existence of a long-run relationship meant that the variables converged to certain long-term values and where they no longer changed. This long-run relationship necessitated the use of an error correction model to correct for any disequilibrium that existed during the previous period. Next, the cointegration test for the monetary aggregate instrument variables was conducted. This was represented by the results of cointegration test between the monetary aggregate (M3), national income (GDP) and overdraft rates as shown in the table below;

Table 4.3.2: Cointegration Test Results for Monetary Aggregate instrument variables

Test Assumption: Linear Deterministic Trend in the Data **Series: LNM LNGDP RATE_OVERD**				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.312627	32.54536	29.68	35.65	None *
0.111856	8.178279	15.41	20.04	At most 1
0.007172	0.467887	3.76	6.65	At most 2

*(**) denotes rejection of the hypothesis at 5% (1%) significance level

L.R. test indicates the existence of at most one cointegrating relation at 5% significance level.

These results revealed that there exist at least one cointegrating relationship at 5% level of significance between the monetary aggregates, GDP, overdraft rates. The existence of this long-run relationship meant that the variables converged to a certain value in the long-run where they no longer changed. This thus called for the use of an error correction model to correct for any disequilibrium which existed in the previous period. This would help isolate the long-run effects into the error correction term so that the coefficients generated would only capture the short-run effects. The error correction model was constructed using the Engel Granger two step method by first estimating the respective instrument equations obtain the long-run residuals. The residuals generated in these estimations (lagged once) were then used to generate the error correction term. The error correction term was then regressed along with the lagged variables in the respective equations to get the short-run coefficient estimates and the speed of convergence as the coefficient of the error correction term.

4.4 Estimates for the Interest Rate Instrument

4.4.1 Long-Run Model for the Interest Rate Instrument

The model under estimation for the long-run interest rate instrument was;

$$\ln gdp = a_1 + a_2 LNR + e \quad \text{.....(4.1)}$$

The table 4.5(a) below shows the result of this long-run estimation;

Table 4.4.1: Long-Run Estimates for the Interest Rate Instrument

Dependent Variable: LNGDP **LNGDP=C(1)+C(2)*LNR**				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	16.94945	0.193832	87.44385	0.0000
C(2)	-1.121730	0.065829	-17.03998	0.0000
R-squared	0.814795	Mean dependent var		13.66796
Adjusted R-squared	0.811988	S.D. dependent var		0.419081
S.E. of regression	0.181715	Akaike info criterion		-0.543786
Sum squared resid	2.179338	Schwarz criterion		-0.478506
Log likelihood	20.48872	Durbin-Watson stat		0.188639

Substituted Coefficients:
LNGDP=16.94944878-1.12172956*LNR (4.2)

4.4.2 Short-Run Model for the Interest Rate Instrument
The short-run model under estimation for the interest rate instrument was;

$$\Delta LNGDP_t = a_1 + a_2 \Delta LNR_t + a_3 u_{t-1} + u_t \quad (4.3)$$

Where LNGDP represented the natural log of the GDP, LNR represented the natural log of the overdraft rates. The result for this estimate was as shown in table 4.6(a) below;

Table 4.4.2: Short-Run Estimates for the Interest Rate Instrument

Dependent Variable: D(LNGDP) **D(LNGDP)=C(1)+C(2)*D(LNR)+C(3)*ECTR**				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.021751	0.001628	13.35807	0.0000
C(2)	-0.014554	0.023769	-0.612295	0.5425
C(3)	-0.022697	0.009125	-2.487258	0.0155
R-squared	0.088302	Mean dependent var		0.022005
Adjusted R-squared	0.059812	S.D. dependent var		0.013487
S.E. of regression	0.013078	Akaike info criterion		-5.792100
Sum squared resid	0.010945	Schwarz criterion		-5.693382
Log likelihood	197.0353	Durbin-Watson stat		0.226283

Substituted Coefficients:
D(LNGDP)=0.02175111955-0.01455369972*D(LNR)-0.02269654003*ECTR (4.4)
The loss of the interest rate instrument was given by;

$$L_r = \sigma_u^2$$

This represented the variance obtained from the standard deviation of the residuals from the estimation of the short-run interest rate instrument. The standard deviation for this estimation was 0.012878 and thus the variance 0.000165842. The covariance was 0.0163.

4.5 Estimates for the Monetary Aggregate Instrument

4.5.1 Long-Run Model for Monetary Aggregate Instrument

The model under estimation for the long-run monetary aggregate instrument was;

$$LNM_t = b_1 + b_2 LNGDP_t + b_3 LNR_t + v_t \quad (4.5)$$

The results for this estimation were as shown in the table 4.7 below;

Table 4.5.1: Long-Run Estimates for the Monetary Aggregate Instrument

Dependent Variable: LNM3 **LNM3=C(1)+C(2)*LNGDP+C(3)*LNR**				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-4.443436	2.070038	-2.146548	0.0356
C(2)	1.307777	0.121606	10.75418	0.0000
C(3)	0.222002	0.151120	1.469047	0.1466
R-squared	0.881194	Mean dependent var		14.08066
Adjusted R-squared	0.877538	S.D. dependent var		0.513002
S.E. of regression	0.179522	Akaike info criterion		-0.553918
Sum squared resid	2.094840	Schwarz criterion		-0.455999
Log likelihood	21.83321	Durbin-Watson stat		0.031358

Substituted Coefficients:

LNM3=-4.443435993+1.307777402*LNGDP+0.2220016229*LNR (4.5)

The standard deviation (σ_v) of the regression is 0.176823 thus the variance is 0.031266373. The covariance for this estimation is 0.0308064755479.

4.5.2 Short-Run Model for the Monetary Aggregate Instrument

The model under estimation for the long-run monetary aggregate instrument was;

$$\Delta LNM_t = b_1 + b_2 \Delta LNGDP_t + b_3 \Delta LNR_t + b_4 v_{t-1} + v_t \quad (4.6)$$

The estimation results for this instrument were as shown in the table below;

Table 4.5.2: Short-Run Estimates for the Monetary Aggregate Instrument

Dependent Variable: D(LNM3) **D(LNM3)=C(1)+C(2)*D(LNGDP)+C(3)*D(LNR)+C(4)*ECTM**				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.030390	0.004716	6.444101	0.0000
C(2)	-0.023881	0.182490	-0.130863	0.8963
C(3)	-0.021664	0.036220	-0.598114	0.5519
C(4)	0.048896	0.014748	3.315538	0.0015
R-squared	0.148609	Mean dependent var		0.029833
Adjusted R-squared	0.108066	S.D. dependent var		0.021141
S.E. of regression	0.019966	Akaike info criterion		-4.931760
Sum squared resid	0.025114	Schwarz criterion		-4.800136
Log likelihood	169.2139	Durbin-Watson stat		1.468924

Estimation Equation:

D(LNM3)=C(1)+C(2)*D(LNGDP)+C(3)*D(LNR)+C(4)*ECTM +e_t (4.7)

Substituted Coefficients:

D(LNM3)=0.03039006295-0.02388113135*D(LNGDP)-0.02166398028*D(LNR) (4.8)
+0.04889591913*ECTM

The standard deviation for this estimation is 0.019507 and thus the variance of the estimation 0.000381. The covariance of the estimation is 0.000375.

$$\sigma_{uv} = 0.0000153$$

4.6 Determination of Optimal Monetary Instrument

The loss for the monetary aggregate instrument was given by;

$$L_m = (a_1 b_1 + b_2)^{-2}\left(b_2^2\sigma_u^2 + a_1^2\sigma_v^2 - 2a_1 b_2 \sigma_{uv}\right)$$

From the estimation above and using the coefficients as obtained from the estimations we obtain;

$$\Delta LNGDP_t = a_1 + a_2 \Delta LNR_t + a_3 u_{t-1} + u_t$$

\

$$\Delta LNM_t = b_1 + b_2 \Delta LNGDP_t + b_3 \Delta LNR_t + b_4 v_{t-1} + v_t$$

D(LNGDP)=0.02175111955-0.01455369972*D(LNR)-0.02269654003*ECTR

D(LNM3)=0.03039006295-0.02388113135*D(LNGDP)-0.02166398028*D(LNR) +0.04889591913*ECTM

$$a_1 = \text{-}0.0146, \mathrm{b}_1 = \text{-}0.0239, \mathrm{b}_2 = \text{-}0.0217, \sigma_{\mathrm{u}}^2 = 0.000166, \sigma_{\mathrm{v}}^2 = 0.000381, \sigma_{u,v} = 0.0000153$$

$$L_m = (a_1 b_1 + b_2)^{-2}\left[b_2^2\sigma_u^2 + a_1^2\sigma_v^2 - 2a_1 b_2 \sigma_{uv}\right]$$

$$= (0.000349 - 0.0217)^{-2}\left[0.000000078 + 0.000000081 - 0.000000009\right]$$

$$= 2193.6309(0.000000149)$$

$$= \mathbf{0.000326}$$

$$L_r = 0.000166 \text{ and } \mathrm{L_m} = 0.000326$$

To evaluate between the two instruments which has the greater loss we have;

$$\frac{L_r}{L_m} = \frac{0.000166}{0.000326} = 0.50920$$

$L_m > L_r$, implying that the interest rate instrument is preferred over the interest rate instrument in the short-run.

4.7 Estimating the Combination Instrument

The loss of the combination instrument was stated according to equation (3.16) as

$$\mathrm{L_c} = \frac{\sigma_u^2\sigma_v^2(1-\rho_{uv}{}^2)}{\sigma_v + 2\rho_{uv}b_1\sigma_u\sigma_v + b_1^2\sigma_u^2}$$

Using the short-run estimates of the data generated by the two models above we have;

$$a_1 = \text{-}0.0146, \mathrm{b}_1 = \text{-}0.0239, \mathrm{b}_2 = \text{-}0.0217, \sigma_{\mathrm{u}}^2 = 0.000166, \sigma_{\mathrm{v}}^2 = 0.000381, \sigma_{uv} = 0.0000153,$$

$$\sigma_v = 0.019507\ , \sigma_u = 0.012878$$

$$\sigma_{uv} = \rho_{uv}\sigma_u\sigma_v$$

$$\rho_{uv} = \frac{\sigma_{uv}}{\sigma_u\sigma_v} = \frac{0.0000153}{0.00025121114} = 0.060904942$$

Thus the loss for the combination instrument becomes;

$$L_c = \frac{0.000166 * 0.000381(1 - 0.003709411)}{0.019507 + 2 * 0.060904942 * 0.0002512 + 0.000000078}$$

$$L_c = \frac{0.0000000639(0.996290589)}{0.019537676}$$

$$= \frac{0.000000063}{0.019537676}$$

$$= 0.000000325$$

This is the loss of the combination instrument for monetary policy.

The lesser of he two between interest rate and monetary aggregate instrument was the interest rate instrument which had a loss $(L_r) = 0.000166$

We compare the combination instrument and the interest instrument as follows

$$\frac{L_r}{L_c} = \frac{0.000166}{0.000000325} = 510.7692$$

$L_c < L_r$, and as a result the combination instrument performs better than both the interest rate instrument and the monetary aggregate in the short-run.

4.8 Discussion of the Results

This research sought to determine which instrument between interest rates and reserve money was optimal in influencing the direction of monetary policy in Kenya and determines whether a combination policy using a mix of both instruments was a better policy than using either of the instruments independently.

The results of this research showed that between the interest rate instrument and the reserve money instrument, the interest rate instrument was better than the reserve money instrument in meeting Kenya's monetary policy objectives. This was because the interest rate instrument led to a lower loss in income compared to the reserve money instrument.

On the second objective of whether the combination instrument performs better than the interest rate and reserve money instruments used independently, this research finds that the combination policy performs better than these two instruments. This is since the combination instrument posts the lowest loss compared to either the interest rates instrument or the reserve money instrument.

In keeping with the findings of this paper therefore CBK stands a better chance of effecting monetary policy by using a combination instrument. However, should the CBK wish to choose one of the instruments between reserve money and interest rates, then it would best affect its policy by using the interest rates rather than the reserve money.

The findings of this paper are in agreement with those of other papers particularly those of Poole (1970), Gordon (1979) Benavie and Froyen (1983), Butter (1983) and Phongthiengtham (undated) who all found a combination instrument better than either the interest rate instrument or the monetary aggregate instruments.

On the first objective of the choice between the interest rate and the reserve money, this paper is in agreement with the findings of Poole(1970), Gordon (1979), Butter (1983), Fair (1987), Staundiger (2001), and Atkeson et al (2007) who found that the interest rate instrument was superior to the monetary aggregates in influencing the direction of monetary policy.

Chapter V

SUMMARY CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter comprises of the summary, conclusions and policy recommendations arising out of the section on data analysis.

5.2 Summary and Conclusions

This study sought to establish the optimal instrument for monetary policy in Kenya between the interest rate, reserve money and whether an optimal combination of the two instruments is better than either of the two taken independently. The instrument problem was investigated in a stochastic IS-LM model with real parameter values for the Kenya. It was observed that there exists a long-run relationship between the overdraft interest rates and the GDP meaning that lower interest rates tend to relate to changes in the GDP in the long-term. It was further observed that there exists of a long-run relationship between the monetary aggregate, GDP and the interest rates meaning that changes in the monetary aggregate tracked the changes in the GDP and the overdraft rates in the long-run. The existence of these long-run relationships called for the use of the error correction method (ECM) to cater for both the long-run and short-run effects and then ensure that any deviations from the equilibrium were adjusted.

Using data between 1994 and 2010 and an error correction model (ECM), the results of this analysis showed that, the interest rate instrument leads to a lower loss in the monetary policy objective (minimization of the output gap) than the monetary aggregate instrument. These results appear somewhat contrary to intuition, especially in case of a direct money transmission in the IS-curve. One would expect this mechanism to be favorable for a monetary aggregate policy, but indeed in this case it favors the interest rate policy. Moreover, a combination policy of the instruments leads to a lower loss in the monetary policy objective than both the interest rate and monetary aggregate instrument. This result confirms the expectations from theory that it performs better. This means that the combination instrument is best suited to steer monetary policy in Kenya.

5.3 Policy Recommendations

In keeping with the findings of other studies similar to this study, the following are the policy recommendations arising from this study:

- The finding that the interest rate instrument minimized losses in monetary policy compared to the reserve money instrument should inform the Central Bank of Kenya to rely exclusively on the interest rate instrument as a pure instrument policy rather than using the two instruments at the same time. This will help steer monetary policy instrument policy in the right direction while solving the problem of the simultaneous use of the instruments.
- The finding that the combination policy performs better than both the interest rate and the monetary aggregate instrument means that the Central Bank of Kenya needs to construct a Monetary Policy Conditions Index as the monetary policy instrument to optimize the effects of monetary policy actions on the target variables (output and inflation).

5.4 Suggestions for Further Research

This study was limited to the choice of the monetary policy instrument between the interest rates, monetary aggregates and combination instrument, aimed at minimizing the losses that would be incurred in the form of output deviations from its equilibrium. This leaves room for further research especially on the determination of which instrument is best placed to guide monetary policy towards minimizing losses arising from inflation. The model used for this paper could also be expanded to accommodate more realistic features in the economy like the exchange rate and foreign trade, the government sector and consumption behavior.

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