

**EFFECTIVENESS OF MONETARY POLICY IN CONTROLLING  
INFLATION IN KENYA**

**BY  
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**A research paper presented to the School of Economics in partial fulfillment of the  
requirements of the degree of Masters of Arts in Economics**

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## **DECLARATION**

This research paper is my original work. I have not used any other than permitted reference sources or materials nor engaged in any plagiarism. All references and other sources used have been appropriately acknowledged in the work. The work has not been submitted for the purpose of academic examination, either in its original or similar form, anywhere else.

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## **DEDICATION**

To my family, may this paper be a symbol of the ripe fruits of your labor to provide me with an excellent foundation and support. May the Almighty bless you abundantly.

## **ACKNOWLEDGEMENT**

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

ATM	Automatic Teller Machine
ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
BSC	Bayesian Schwartz criterion
CBK	Central Bank of Kenya
CPI	Consumer Price Index
CBR	Central Bank Rate
FCD	Foreign Currency Deposit
GDP	Gross Domestic Product
KNBS	Kenya National Bureau of Statistics
NBFI	Non-Bank Financial Institution
OMO	Open Market Operation
REPO	Repurchase Agreements
VAR	Vector Autoregression

## **ABSTRACT**

This study determines the effectiveness of monetary policy in controlling inflation in Kenya. This study employs regression research design. It uses secondary data on inflation, exchange rate, Treasury bill rate, money supply, GDP growth, oil prices and world food prices. According to the study, the coefficient of money supply is positive but statistically insignificant at 5% level in controlling inflation rate in Kenya. The coefficient for GDP is negative and is also statistically insignificant at 5% level. However, the result indicated that nominal exchange rate is the major factor in controlling inflation in Kenya. The study recommended that policy makers should concentrate on nominal exchange rate. Instead of focusing on world food prices, the government should consider measures aimed at increasing food supply. This involves providing credit facilities to farmers, subsidized fertilizers and providing new technologies to farmers to increase food supply

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background to the Study

The Central Bank of Kenya (CBK) monetary policy focuses on achieving and maintaining stability in the general level of prices in the economy. The price stability objective is necessary for enhancing investment and supporting economic growth and employment creation. In this regard, the CBK formulates monetary policy to achieve the inflation target set by the Government (CBK 2012). In light of the above objective, the Central Bank of Kenya sets out the optimal path for both reserve money and money supply expansion consistent with Government inflation target and the expected economic growth.

Monetary policy is a stabilization tool adopted by countries to deal with different economic imbalances. Monetary policy covers the monetary aspect of the general economic policy which requires that a high level of co-ordination between monetary policy and other instruments of economic policy be maintained at all times (Akhtar, 2006).

The main target variables for monetary policy are usually inflation and output.

According to Keynes (1936), "inflation is the form of taxation which the public finds hardest to evade". According to Samuelson (1995), "Inflation denotes a rise in general level of prices".

According to Friedman (1963), “Inflation is always and everywhere a monetary phenomenon”. Inflation can be described as a decline in the real value of money—a loss of purchasing power in the medium of exchange. When the general price level rises, each unit of currency buys fewer goods and services. In simple terms, inflation is a situation where too much money chases too few goods.

Inflation and unemployment are major concerns in developing countries. Both Keynesian and Latin American structural economists suggest that low inflation could be good for economic growth in countries where there are wage and price rigidities.

Dornbusch and Fischer (1993) argues that both very high inflation and in particular hyperinflation destroy an economy and cause economic and political crises.

Friedman (1968b) argues that monetarists remain averse to inflation whether high or low. They believe that there is a ‘natural rate of unemployment’ which is determined by real factors. They hold that unemployment cannot be lowered below the natural rate without removing market imperfections, making real wages more flexible and keeping the rate of inflation low and steady.

Economic analysis shows that high inflation could be a source of unemployment. It creates uncertainties and lowers investment. In light of this proposition, price stability is considered

important in maintaining macroeconomic stability which creates an environment for productive investment and technological innovations. Monetarists do not find any positive role of inflation in relation to economic growth. Any stimulus that inflation gives to the economy is likely to be transitory and uncertain.

Among major causes of inflation are cost push inflation and demand pull inflation. Cost push inflation is when increases in costs are passed onto the consumer causing higher prices. Higher costs can arise from increases in the cost of labour (wages), rising interest rates or rising import prices (either through rising overseas costs or devaluation in the Kenya shilling).

Demand pull inflation occurs when the demand for goods and services exceeds the supply. In this instance, the excess demand leads to an increase in the price of the undersupplied goods and services, i.e. too much money is chasing too few goods. Structural causes are also important according to some economists.

### **1.1.1 Measuring inflation**

In Kenya, the consumer price index (CPI) is the most commonly used form of inflation measure. This index measures monthly price changes in a basket of goods and services that account for a high proportion of general household expenditure.

In Kenya, the Consumer Price Index (CPI) is based on expenditures of both urban and rural households. The most important categories in the CPI are as follows according to KNBS June 2014 monthly inflation report.

**Table 1: Composition of CPI June 2014. The CPI is generated by KNBS using data collected from 25 selected retail outlets in data collection zones and urban centers.**

<b>NO</b>	<b>EXPENDITURE CATEGORY</b>	<b>PERCENTAGE OF TOTAL WEIGHT</b>
1	Food and Non-Alcoholic beverages	36%
2	Housing, Water, Electricity, Gas and other Fuels	18.3%
3	Transport	8.7%
4	Clothing and Footwear	7.4%
5	Furnishings, Household Equipment and Routine Household Maintenance	6.2%
6	Restaurants and Hotels represent	4.5%
7	Miscellaneous Goods and Services	4.5%
8	Communication	3.8%
9	Health	3.1%
10	Education	3.1%
11	Recreation and Culture	2.3%
12	Alcoholic Beverages, Tobacco and Narcotics	2.1%

### 1.1.2 The effects of inflation

Generally rising price levels lead to uncertainty over future economic conditions; this has differing impacts on the economy, and differing impacts for businesses and individuals, borrowers and lenders.

Generally those that benefit from inflation are:

- Borrowers of funds as the real value of repayments falls over time, *ceteris Paribas*
- Holders of real assets such as property and land whose value can keep pace with the rising price level
- Workers who have market power through negotiating for wage increments and are able to increase their wages in line with the rising price level and so protect the purchasing power of their incomes.

Generally those that lose out in times of inflation are:

- Lenders of money who find that the repayments now have reduced purchasing power, in cases of fixed interest rates *ceteris paribus*.
- Individuals who have fixed interest investments will lose out as the real rate of return that they receiving are eroded by the rising price level.

- Similarly those individuals that hold cash investments will also lose out as cash does not increase in value as well as other assets. Money does not earn interest.
- Workers whose incomes do not keep pace with the rate of inflation, and hence the purchasing power of their income has fallen.

Inflation causes uncertainty about future prices. This affects decision on expenditure, savings and investment and distorts allocation of resources. It also allows substantial redistribution of income and wealth from savers to borrowers. From the point of view of policy makers, inflation hampers growth and development of an economy as it discourages savings and investment.

### **1.1.3 Overview of monetary policy after independence**

According to Killick and Mwega (1990), the Central Bank of Kenya (CBK) was created in 1966. Using the powers set out in the 1966 CBK Act and from subsequent practice, four main instruments of monetary policy can be identified.

First, the stipulation and variance of legal minimum reserve ratios observed by the commercial banks. Minimum liquidity ratios mainly comprise cash, inter-bank balances, Treasury Bills and bonds and has been in operation throughout. Minimum cash ratios, on the other hand, had been



laid down only rarely but were reintroduced in 1988 and showed signs of becoming more permanently and actively used.

Second, there was laying-down by the CBK of quantitative ceilings for the expansion of domestic credit by the commercial banks.

Third, there was control and variance of interest rates. As at mid-1989 minimum rates were specified for banks' time and savings deposits, and for their loans and advances. Similar controls were in force for 'non-bank' financial institutions (NBFIs), for building societies and the Post Office Savings Bank, among others.

Fourth, there was laying-down of guidelines by the CBK for the selective allocation of bank credit - a provision that was used to favour agricultural credit.

The deregulation of economic activities in early 1990s marked a major change in the conduct of monetary policy in Kenya in terms of objectives, instruments and institutional framework. The Central Bank of Kenya (CBK) Act was amended in 1996 to allow CBK greater operational autonomy in the conduct of monetary policy. The same Act stipulated the principal objective of the CBK as formulation and implementation of monetary policy directed to achieving and maintaining stability in the general level of prices. In addition, the Act provided for greater autonomy of the CBK in the conduct of monetary policy. Specifically, the Governor, the Deputy Governor and five other members of the Board of Directors are to be appointed by the President

for a four-year term (renewable once). The Governor can be removed in the course of his term under a tribunal constituted to investigate his conduct. The Permanent Secretary of the Ministry of Finance or his designated representative is an ex-officio member of the CBK Board of Directors.

Initially, for a greater part of 1990s, the conduct of monetary policy focused on the behavior of the broad monetary aggregate, M2, defined as currency in circulation and term and non-term domestic currency deposits with banks. The stability of the relation between M2 and nominal GDP came into question with increased openness of the economy. By 1998, the Bank had shifted to a much broader monetary aggregate, M3, defined as M2 plus foreign currency deposits (FCD) held by residents, as its intermediate target. The reserve money continued to be the operating target. In terms of instruments of monetary policy, the CBK initially managed monetary conditions in Kenya to obtain suitable growth in the money supply by engaging in primary auctions of government paper.

In addition, the reserve requirement and foreign exchange operations were actively used to influence monetary conditions. Later in the second half of 1990s, further refinement was made in the monetary policy instruments with CBK engaging in open market operation (OMO) through repurchase agreements (REPO) and less reliance on reserve requirement. Reserve ratio requirement that was actively used before mid-1990s was gradually lowered to the current level of 5.25percent from 20 percent in 1994 (CBK, 2012).

At the initial stages following liberalization, there was virtually no intervention by CBK in the foreign exchange market. As a result, Kenya was categorized among developing countries as a free floater. The stated exchange rate policy of the CBK has been and continues to be to pursue a market determined exchange rate, intervening only to smooth out erratic movement, service external obligations and achieve targeted level of foreign exchange reserves.

Nonetheless, there have been instances where intense lobbying from exporters for a depreciated exchange rate put pressure on the CBK to influence the market exchange rate in the short run. There were also instances where depreciation pressures emanating from speculative tendencies occasioned by fragile donor relations and large food importation to mitigate adverse effects of drought could have led CBK to intervene in the foreign exchange market to reduce pressures on domestic inflation (Rotich et al., 2007)

After economic liberalization in Kenya in the early 1990s and the subsequent review of the CBK Act in 1996, the control of inflation became a major focus of monetary policy. This was with the goal to rein in the consequences of relaxation of monetary policy that followed the run up to Kenya's first multiparty election in 1992 and increase in international oil prices occasioned by the first Gulf war. According to CBK (2006), annual changes in monetary aggregates, since early 1990s, decelerated to fairly low levels and were sustained at the low levels through 2000 before picking up slightly in the run up to the 2002 elections. These suggest a co-movement of interest

rates, monetary aggregates and inflation since liberalization in 1990s. This implies that CBK controlled inflation through high interest rates that reduced money supply.

CBK influences the target variables (inflation and output) 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. Monetary policy tools influence the price of liquidity and the quantity of money in the economy.

#### **1.1.4 A review of Kenya's recent monetary policy profile (2011/2012)**

CBK formulates monetary policy to achieve the inflation target set by the Minister for Finance. Central Bank of Kenya monetary policy for the fiscal year 2011/2012 focused on achieving and maintaining stability in the general level of prices in the economy. During the fiscal year 2011/12, the Monetary Policy Committee (MPC) adopted a tight monetary policy stance to rein in inflation and inflationary expectations and stabilize the exchange rate volatility. CBK Annual Report (2012) reported that inflation target for the fiscal year 2011/12 was 9% and that for the medium term was 5%. Inflation as measured by the GDP deflator was projected to increase from

6.7% in June 2011 to 13.4% in June 2012. The pick-up reflects the acceleration effects of inflation that had peaked at 19.7% by November 2011. The real GDP growth was projected at 4.5% for 2011 and 5.2% for 2012 with the average real GDP for the year to June 2012 at 4.8%.

Accordingly, the Central Bank of Kenya set out the optimal path for both reserve money and money supply expansion consistent with Government inflation target and the expected economic growth. Money supply, M3, and reserve money were targeted to grow by 18.7% and 14.2%, respectively, in the year to June 2012. Growth in broad money supply, M3, stabilized at 15.5% in the year to June 2012 compared with 15.2% growth in a corresponding period in 2011 and was within the respective target of 18.7% growth for the year to June 2012.

The Central Bank Rate (CBR) was the main instrument used to signal the direction of monetary policy. The rate was reviewed and announced at least every month beginning September 2011 as the Monetary Policy Committee (MPC) shifted from bi-monthly to monthly meeting when the inflation escalated to double digits and exchange rate instability persisted. The movement in the CBR guided the money market participants on the direction of short term interest rates. The monetary policy stance, as signaled by the movements in the CBR, was operationalised through open market operations and the CBK Standing Facility the CBK Overnight Discount Window (CBK, 2012).

This meant that the CBR was the lowest acceptable rate when CBK was injecting liquidity through the reverse Repo.

Similarly, whenever the Bank was withdrawing liquidity through a vertical repo, the CBR was the highest rate that the CBK would take on any bid received. Banks utilizing the CBK Overnight Window were charged the CBR plus a penalty of 6% points (reviewed from 3%age points in October 2011).

According to CBK, (2012), the MPC attributed the high inflation and exchange rate volatility to a number of factors including:

(a) Balance of payments pressures, with the current account share in GDP at 9.78% in 2011 and 11.43% by April 2012. This large exposure has the potential to weaken, and sustain volatility of the exchange rate;

(b) Turbulence in the global financial markets due to the Euro Zone sovereign debt crisis which has affected peripheral countries in the Euro, but has far reaching effects for bond markets and banks in the Euro zone. This has the potential to weaken the Ksh following flight to safer international currencies or flight to familiarity, especially the US Dollar and the concomitant strengthening of the US Dollar;

(c) Higher international prices for crude oil and imported oil as well as escalation of pump prices announced by the Energy Regulatory Commission. In addition, the high and rising commodities

prices for maize and sugar, supply shortfalls in domestic grain production due to adverse weather in 2011 and delayed long rains in 2012 combined to sustain inflation above single digit. However weather conditions in 2012 improved leading to enhanced food supply, especially for kales and other vegetables and thereby supporting deceleration in food inflation

(d) Credit growth to the private sector that peaked at 36.3% in September 2011 but declined thereafter consistently to 16.5% and within the respective target of 16.8% in June 2012. Domestic credit growth decelerated in the year to June 2012 compared to a similar period in 2011 due to strong reduction in credit to the private sector .The underlying demand pressures kept the non-food non-fuel inflation above the short term target of 9%.

CBK introduced various regulatory measures that included:

- Reduction of commercial banks' foreign exchange exposure limit from 20% of core capital to 10%;
- Restricted local currency borrowing by offshore banks to a tenor of one year; restricted forward contracts with offshore banks with Kenya shilling component to a minimum period of one year and all swaps and forwards involving local corporate and banks restricted to a minimum tenor of seven days.
- Required local banks to obtain supporting documents for all transactions in the Nostro Accounts of off-shore banks. Access to the CBK Discount Window by commercial banks was

also limited to twice a week with a view to restoring the lender of last resort characteristic of the Discount Window.

To rein in inflationary pressures and stabilize the exchange rate, the Monetary Policy Committee increased the Central Bank Rate (CBR) In September 2011 by 75 basis points to 7.00%. The CBR was increased further by 400 basis points in October 2011 to 11.00%, by 550 basis points to 16.5% in November and by 150 basis points to 18.00% in December 2011. In addition the cash reserve requirements (CRR) was raised by 50 basis points from 4.75% to 5.25% effective December 15, 2011 to reinforce the monetary policy stance.

To tame inflation expectations as well as stabilize the exchange, from January through June 2012, the MPC sustained the CBR at the December level of 18.00%.

In response to the increases in the CBR, the short-term rates trended upwards in the first half of fiscal year 2011/12.

According to CBK (2012), the average interbank rate increased from 8.61% in July 2011 to 28.90% in November 2011 and thereafter declined to 17.09% through June 2012. The easing of the average interbank rate during the second half reflected improved market liquidity supported by net redemptions of Government securities. A similar trend was shown by the 91-days and 182-days Treasury bill rate. The average commercial banks' lending rates rose from 14.14% in July 2011 to 20.41% in June 2012.



The average commercial banks' deposit rates rose from 3.85% in July 2011 to 7.88% in June 2012. The increase in the deposit rate was enhanced by strong competition for deposits among commercial banks.

The Kenya Shilling strengthened against major world trading currencies in the fiscal year 2011/12. The appreciation of the Shilling mainly reflects the tight monetary policy stance adopted by the Monetary Policy Committee. The Shilling recovered following a rapid depreciation in the third quarter of 2011.

#### **1.1.5 Intermediate targets of monetary policy**

Intermediate targets are economic variables whose value the central bank chooses to control in order to achieve its objectives. Their use arises from the fact that it may be difficult to understand all the interrelationships among economic variables sufficiently to aim the monetary policy instruments directly at its policy objectives. More importantly central banks do not have enough information on hand to make the best decisions to attain their goals directly due to imperfect information in monetary operations.

In the selection of intermediate targets, the central bank strives to have target variables that are consistent with the central bank goals. The variables must be measurable accurately and precisely. They should have available and timely information. Central banks require also being

able to control the magnitude of intermediate economic variables and achieve a target value for each selected intermediate target variable.

Interest rates and the quantity of money are key variables used as intermediate targets by central banks. Other economic variables that have been recently targeted by central banks include: nominal income, commodity prices and the spread between long and short term interest rates implied by the term structure of interest rates.

#### **1.1.6 Monetary Policy Instruments**

Monetary instruments affect money supply and the demand for money or cash holding of the general public. They change the flow of money from banks to the public and from the public to the banks. Monetary tools affect the capacity and flow of institutional credit by changing the quantity of money held by the people. This effect then spreads to the real variables.

Monetary instruments include: (i) Central Bank rate; (ii) Cash reserve and liquidity ratios; and (iii) Open market operations.

### **1.1.7 Statement of the Problem**

Monetary policy in Kenya should be effective in stabilizing inflation around the 5 percent target. This could be missed as a result of inappropriate monetary policy. Monetary policy has to be consistently evaluated to maintain the target inflation rate. The effect of monetary policy on inflation and other variables has been the subject of macroeconomic research and debates for quite a long time. Various studies have been done to address the problem but it still persists.

A review of literature on inflation in Kenya reveals a variety of conclusions, with most sets of variables having been analyzed using monetarist models, vector autoregression models and Granger non-causality tests. In spite of these studies there is no consensus on which theory is most adequate. With strong recurrent inflationary pressures, which to some extent are driven by supply side factors like increase in world food prices and oil prices, which are now seen to be persistent, there is need for continuous study on effectiveness of monetary policy in controlling inflation in Kenya.

### **1.1.8 Objectives of the study**

### **1.1.9 General objectives**

To determine the effectiveness of monetary policy in controlling inflation in Kenya

### **1.2.1 Specific objectives**

- a) To determine the effect of three months Treasury bill rate on inflation rates in Kenya.
- b) To determine the effect of exchange rates on inflation rates in Kenya.
- c) To determine the effect of money supply on inflation rates in Kenya.
- d) To determine the effect of GDP growth on inflation rates in Kenya.
- e) To determine the effect of oil prices on inflation rates in Kenya.
- f) To determine the effect of world food prices on inflation rates in Kenya.

### **1.2.2 Research questions**

- a) What is the effect of three month Treasury bill rate on inflation rates in Kenya?
- b) Does exchange rate affect inflation in Kenya?
- c) What is the effect of money supply on inflation rates in Kenya?
- d) How does GDP growth affect inflation rates in Kenya?
- e) Do oil price changes affect inflation rates in Kenya?
- f) What is the effect of world food prices on inflation rates in Kenya?

## **1.2 Significance of the study**

Establishing the effectiveness of monetary policy tools in controlling inflation in Kenya is of great importance as different economic environments have applied different monetary policy instruments. Killick and Mwege (1990) showed that the period 1966-1970, instruments used included: minimum reserve / liquidity ratios, quantity ceiling on domestic credit, control and variance of interest rates and selective allocation of bank credit that favoured agricultural sector.

In early 1990s, conduct of monetary policy focused on broad money M2 and later on M3. Sichei and Kamau (2012) argued that the shift to a floating exchange rate regime in 1991 and the liberalization of the capital account of the balance of payment in 1995 not only expanded the menu of assets available to economic agents in Kenya but also made exchange rate an indirect instrument of monetary policy, thus making the money supply process exogenous.

In 1996, the CBK was given more autonomy and monetary policy shifted and focused on Open Market Operations (OMO). The recent years are significant in Kenyan financial sector after transformation by financial innovations and developments that may have impacted on the monetary aggregates and the stability of money demand. Shocks like the post election violence, crowding in of private sector investment and global financial crises may affect money demand. In light of these developments and financial transformation, the study will establish the effectiveness of monetary policy in controlling inflation in the recent years.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

Inflation targeting has become a popular framework for monetary policy regimes in developed and developing countries. It can be described as a rule which does not define a fixed setting for policy parameters but allows them to adjust in response to developments in the economic system. This means that inflation targeting uses contingent rules based on forecast inflation relative to target point. In order to apply the inflation targeting concept, say the forecasted inflation rate exceeds the target relevant horizon given the present level of the policy rate, then the policy maker raises the interest rate to that level for which the forecasted inflation rate would return to the target over the appropriate horizon conditional on maintaining the new level of the policy interest rate.

Inflation targeting has the very considerable attraction that the central bank clearly has the ability to keep inflation at a permanently low average level, even if it cannot hit an inflation target precisely each quarter. The disadvantage is that inflation targeting eliminates the central bank's ability to smooth fluctuations in real output and employment. Indeed, in the case of an adverse supply shock which raises prices and reduces output, inflation targeting may lead the central bank to reduce the money supply at a time when the economy is already in a recession. Nonetheless, inflation targeting has become increasingly popular as a method by which central banks can emphasize their long – term commitment to price stability.

According to Kydland and Prescott (1977), the inability of policy makers to commit themselves to such a low inflation policy can give rise to excessive inflation despite the absence of a long run trade off. The basic observation by Kydland and Prescott is that if expected inflation is low, so that the marginal cost of additional inflation is low, policy makers will pursue expansionary policies to push output temporary above its nominal level.

## **2.2 Theoretical framework**

Although a number of studies on inflation in Kenya exist, there is no consensus on which theory is most appropriate.

Literature on monetary policy rule has focused on interest rate (Taylor rule) and monetary base (McCallum rule). The 1993 Taylor rule has been used by researchers to investigate the interest rate setting behavior of central banks in developed countries. Results from such studies indicate that central banks react mostly in a way to stabilize deviations either from a target level inflation or GDP growth, as predicted by the Taylor rule.

More recently, similar works have been undertaken in emerging economies following appropriate modifications of the standard Taylor specification to take into account the realities of underdeveloped financial markets and vulnerability to external shocks typical in these countries. While the results seem inconsistent, there is, nevertheless, evidence that the central banks in

these economies also follow some rule-like policy. Studies that have investigated interest setting behavior using the Taylor rule have focused on developed countries. According to Taylor, (1993) the model has been specified as follows:

$$I_t = b_0 + b_1 (\pi_t - \pi^*) + b_2 (y_t - y^*) \text{ ----- (1)}$$

Where  $I_t$  is the instrument rate in period  $t$ ,  $b_0$  is a constant,  $(\pi_t - \pi^*)$  is the “inflation gap”,  $\pi_t$  is the rate of inflation and  $\pi^* \geq 0$  is a given inflation target,  $(y_t - y^*)$  is the GDP gap, where  $y_t$  is log of output and  $y^*$  is log of potential output, and the coefficients  $b_1$  and  $b_2$  are positive.

The general finding using the simple Taylor rule (equation 1) is that the rule perform well in explaining central bank behavior in developed countries, and estimation are robust in the sense that results do not substantially change across different model settings. Furthermore, there is widely accepted agreement among researchers that no central banks adopts a simple rule as a formal policy rule in conducting monetary policy, although different modifications of the Taylor rule have been used as a guidelines in decision making process (Rotich et al., 2007).

Rotich et al. (2007) holds that researchers using McCallum rule have specified the instrument variable as the growth rate of monetary base expressed as follows:

$$\Delta b_t = \Delta x_t^* - \Delta v_t + 0.5(\Delta x_t^* - \Delta x_{t-1}) \text{ ----- (2)}$$



where  $\Delta b_t$  is rate of growth of the monetary base, in percent per year,  $\Delta x^*$  is the target rate of growth of nominal GDP, in percent per year,  $\Delta v_t$  rate of growth of base velocity, in percent per year, averaged over the previous four years, in the original McCallum estimation, and  $\Delta x$  is rate of growth of nominal GDP, in percent per year. In this rule, the target value of nominal GDP growth is calculated as the sum of the target inflation rate and the long-run average rate of growth of real GDP.

### 2.2.2 Quantity Theory of Money

The quantity theory of money gives the relation between money, prices, and output:

$$M \times V = P \times Y \text{-----} (3)$$

Equation (3) is the quantity equation, linking the price level and the level of output to the money stock. The quantity equation transformed to classical quantity theory of money when it was argued that both  $V$ , the income velocity of money, and  $Y$ , the level of output, were fixed. Real output was taken to be fixed because the economy was at full employment, and changes in velocity were assumed to be negligible. If both  $V$  and  $Y$  are fixed, it follows that the price level is proportional to the money stock. Thus the classical quantity theory was the theory of inflation.

The classical quantity theory is the proposition that the price level is proportional to the money stock. It can be viewed as a theory of price determination suggesting that the equilibrium price level is strictly proportional to the quantity of money.

Empirical studies of the quantity theory of money have been devoted on the relationship between the rate of change of the money stock and inflation. In monetary economics, the quantity theory of money is the theory that money supply has a direct, proportional relationship with the price level. The theory was challenged by Keynesian economics, but updated by the monetarist school of economics.

While mainstream economists agree that the quantity theory holds true in the long run, there is still disagreement about its applicability in the short run. Critics of the theory argue that money velocity is not stable and, in the short-run, prices are sticky, so that there is no direct relationship between money supply and price level.

### **2.2.3 Keynesian Liquidity Preference Theory**

Keynes (1936) developed the liquidity preference theory in his famous book, 'The general theory of Employment, Interest, and Money'. He studied both transaction and asset theories of money demand. Keynes distinguished three motives of holding money- a 'transaction motive', a 'precautionary motive' and a 'speculative motive'.

The speculative demand for money is Keynes's most important innovation. According to this theory, demand for money is negatively related to interest rate. Implication of the theory is that the demand for speculative money balances depends on both the observable market nominal interest rates and the people's expectation concerning that rate in the future.

Keynes describes some normal value that determines the decision of the people either to hold bonds or money. If interest rates are above the normal value, people will expect them to fall, bond prices to rise and capital gains to be realized. In such a case, people will hold wealth in terms of bonds and demand for money will fall. If the converse holds, bond prices fall and capital losses are realized. People will demand to hold wealth in terms of money causing high demand for money. At very low interest rate, the expectation will be that it will rise; demand for money in the aggregate will be perfectly elastic with respect to interest rate leading to a liquidity trap. Combining the three demands gives the Keynesian liquidity preference function that describes the total demand for money

$$M^d/P = \mu(R, Y) \quad \mu_1 < 0; \mu_2 > 0 \text{-----} \quad (4)$$

$\mu_i$  denotes partial derivative of  $\mu(\cdot)$  with respect to  $i$ th argument.

The function shows that the demand for real money balances is negatively related to the nominal interest rate,  $R$ , and positively related to real income,  $Y$ . In contrast to the quantity theory proposition that velocity is constant; the Keynesian liquidity preference theory implies that velocity is procyclical, since procyclical interest rate movements induce procyclical velocity movements.

#### 2.2.4 Friedman's Modern Quantity Theory

Friedman (1956) integrated an asset theory and a transactions theory of the demand for money within the context of neoclassical microeconomic theory of consumer and producer behavior. He

viewed monetary assets as durable goods yielding a flow of non-observable services proportional to the stock, which enter as arguments in utility and production functions. He also assumed that money competes with other assets such as bonds, stocks and physical goods for a place in individual's and business firm's portfolios. Friedman argued that the marginal utility of monetary services declines as the quantity of money held increases. The Friedman's modern quantity theory equation is expressed as follows:

$$M^d/P = \beta (Y_p; R_b; -R_m; R_e; \pi^e; \dots), \text{-----(5)}$$

Where:

$Y_p$  = real permanent income

$R_b$  = expected nominal rate of return on bonds

$R_m$  = expected nominal rate of return on money

$R_e$  = expected nominal rate of return on equities

$\pi^e$  = expected inflation rate

The dots in equation (5) represent other variables such as the ratio of human to non-human wealth that are regarded relevant but play no essential role in the Friedman's theory and have no important implications for monetary policy. In the equation it is assumed that the demand for real money balances is positively related to permanent income,  $Y_p$ , and negatively related to the yield on other assets. Friedman concluded that the demand for money is stable and insensitive to

interest rates. This has the implication that money velocity is predictable, leading to the quantity theory conclusion that money is the primary determinant of nominal aggregate spending.

### **2.2.5 Structuralist theory**

According to this theory, inflation is caused by structural imbalances such as imbalance between demand and supply of industrial inputs. Governments are forced to rely on deficit financing because of insufficient external borrowing, grants and aid. Other structural imbalances causing inflation include food scarcity, foreign exchange bottlenecks, and infrastructure bottlenecks, social and political constraints. Structuralist economists argue that inflation is a manifestation of structural rigidities in the system

### **2.3 Empirical Review**

Poole and Lieberman (1972) conducted a study to establish the technical feasibility of controlling inflation through money stock as opposed to use of interest rates. They established that due to use of monetary aggregates monetary control was not precise and tended to magnify fluctuations in both interest rates and income. They found that interest rate control was relatively easy compared to control of monetary stock. This phenomenon was attributed to the significant lag on availability of money stock data and the frequent and substantial revisions of the same.

Ryan and Milne (1994) demonstrates an approach to modeling inflation rate in developing countries through the use of the annualized monthly inflation rate in an attempt to distinguish

between once-and-for-all increases in the price level and a generally rising price level. Their empirical results show that this approach is useful in allowing both monetary and institutional variables to play a role in determining the inflation rate.

Ball (1999) states that given the nature of markets in developing countries, the policy instrument could be not only short-term interest rate, but also the monetary base or some other monetary aggregate. In his analysis, he stresses the importance of exchange rates in monetary policy rule setting in developing countries and argues that the inclusion of the exchange rate in the central bank reaction function does not contradict the objectives of central banks, since in emerging economies sometimes exchange rate stabilization is a precondition for output stabilization and bringing down inflation to a targeted level.

Durevall and Ndung'u (2001) analyses the dynamics of inflation in Kenya during 1974 –1996, a period characterized by external shocks and internal disequilibria. By developing a parsimonious and empirically constant model, they find that the exchange rate, foreign prices, and terms of trade have long-run effects on inflation, while money supply and interest rate only have short run effects. They also argue that, inflation is also influenced by changes in maize-grain prices, indicating a non-negligible role for agricultural supply constraints in the inflation process.

Taylor (2001) argued that policymakers in developing countries are more concerned with exchange rate stabilization because of the problem of exchange rate pass-through to prices. The application of both rules in developing countries raises the issue of what modification is required

to take into account the realities in these economies, including the underdeveloped financial markets and vulnerability to external shocks, among others.

Taylor (2001) argues that the effect of monetary policy on real variables through the financial markets, though limited, due to the less developed nature of these markets, could have significant impacts through changes in wages and property prices. Hence from this argument, a predictable behavior of central banks in developing economies significantly improves the transmission and effectiveness of monetary policy.

Mohanty and Klau (2003) main conclusion of their study is that, in emerging economies, central banks, most of the time, change short-term interest rate in response to deviations in inflation and exchange rate movements from their targets.

Rasche (2005) in the study on the effectiveness of monetary policy concludes that it is not clear what will happen to low and stable inflation if “bad shocks” are realized and the “going gets tough.” “Good luck” in the form of a decade or two of relatively mild “shocks” cannot be ruled out as a significant environmental factor during the inflation targeting period. According to the study, the case for consistently effective short-run monetary stabilization policies is problematic – there are just too many dimensions to uncertainty in the environment in which central banks operate.

Adam (2009) studied the conduct of monetary policy in Uganda. He concluded that Uganda has been amongst the most consistently successful countries in Africa in controlling inflation since the early 1990s. However this has come at a high fiscal cost and that the conduct of monetary policy has stifled rather than encouraged the development of the financial sector. He pointed a growing feeling that the reserve money framework is proving less successful in delivering low and stable inflation as the capital account has become more open.

Kiptui (2009) focuses on the exchange rate and oil prices using a generalized Phillips curve. The results show that both variables drive inflation in the short run, but that the exchange rate is by far the most important variable. Aggregate demand, measured by the deviation of GDP from trend, has a positive, small and barely significant, effect.

Mishra et al. (2010) holds that high inflation is a monetary phenomenon related to excess money supply. The main driving forces are seigniorage to finance budget deficit, expansion of money supply to stimulate aggregate demand, or expectations of higher inflation force the authorities to accommodate historical price increases. However, in many Sub-Saharan countries it is challenging for monetary authorities to control inflation even if there is a political will, due to weak institutional frameworks, thin financial markets and imperfect competition among banks. In such an environment, central banks might lack effective tools to control money supply.



Durevall and Sjö (2012) conducted an assessment of the of the main drivers of inflation in Ethiopia and Kenya by developing single-equation error correction models for the Consumer Price Index in each country. The key conclusion was that there is no nominal anchor for inflation in either country in the form of a clear and well-functioning monetary or exchange rate policy.

Misati et al. (2012) estimated a VAR model that included GDP, money supply, fiscal expenditure and exchange and interest rates. Using innovation accounting they found that broad money supply, M3 was the main driver of inflation in Kenya.

### **2.3.1 Monetary Policy Tools**

Economists are of the view that monetary policy, to a great extent, is the management of expectations. Monetary policy deals with the relationship between the rates of interest in an economy, that is, the price at which money can be borrowed, and the total supply of money. Monetary policy uses a variety of tools to control one or both of these, to influence outcomes like economic growth, inflation, exchange rates with other currencies and unemployment. Where there is a regulated system of issuing currency through banks which are controlled by a central bank, the monetary authority has the ability to alter the money supply and thus influence the interest rate to achieve policy goals.

Several monetary policy tools available to achieve these ends include: increasing interest rates; reducing the monetary base; and increasing reserve requirements. All have the effect of contracting the money supply; and, if reversed, expand the money supply. The set of tools available to monetary authorities may differ from one country to another, according to differences in political systems, economic structures, statutory and institutional procedures, development of money and capital markets and other considerations.

### **2.3.2 Open Market operations (OMO)**

This is the primary tool of monetary policy. It involves controlling the quantity of money in circulation through the buying and selling of various financial instruments, such as treasury bills, company bonds, or foreign currencies. All of these purchases or sales result in more or less base currency entering or leaving market circulation.

Wallace (1981) argues that central banks in most industrial countries conduct monetary policy mainly via open market operations, where money is supplied in exchange for securities discounted with a short run nominal interest rate. The Central Bank buys or sells on behalf of the Fiscal Authorities securities to the banking and non-banking public. When the Central Bank sells securities, it reduces the supply of reserves and when it buys securities by redeeming them it increases the supply of reserves to the banking sector, thus affecting the supply of money.

### **2.3.3 Interest Rates**

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.

Keith and Howells (2000) hold that equity and asset prices will respond to changes in interest rates. In the event that Central Bank raises the interest rates, for instance, the rate available on the risk-free assets goes up and if more can be earned on risk-free assets, the holders of risky shares will want a higher return as well. The share prices will also fall if the equity market as a whole becomes more risk averse and demand a higher premium for any level of risk.

Central bank sets short term official rate of interest, referred as the Central Bank rate (CBR) which indicates the price at which it will make liquidity available to the banking system as a lender of last resort. 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 later (Gichuki et al., 2012).

#### **2.3.4 Repo Rate**

In repurchase agreement, the central bank buys securities from a dealer and the dealer agrees to repurchase the securities at a specified date and price. This effectively is a loan by central bank to the dealer. Interest rate is set by auction. In reverse repo, the central bank buys securities from a dealer. This is used to inject liquidity in the market. Vertical repo is used to reduce liquidity in the economy. These are usually short term contracts.

Repos are important to central banks both as a monetary policy instrument and as a source of information on market expectations on short term interest rates. Repos carry a low credit risk while serving as a flexible instrument for liquidity management.

Brunetti et al. (2009) argue that a key distinguishing feature of repos is that they can be used either to obtain funds or to obtain securities. This latter feature is valuable to market participants because it allows them to obtain the securities they need to meet other contractual obligations, such as to make delivery for a futures contract.

### **2.3.5 Money Supply**

The three main monetary aggregates include: M1, M2, and M3

Deposit liabilities are defined in narrower and broader senses as follows: narrow money (M1); broad money (M2); and extended broad money (M3).

M1= Currency outside banking system (in circulation) + demand deposits

M2 =M1 + time and savings deposits + certificates of deposits

M3= M2 + residents' foreign currency deposits

In the conduct of monetary policy, Central Bank of Kenya has been targeting M3. The monetary policy action concern is to increase or decrease of the monetary aggregate.

### **2.3.6 Exchange rates**

In economies with developed capital markets, foreign exchange rate is an important determinant of the financial position.

Mishkin (2000) argues that stock exchange market serves as a channel through which surplus funds are moved from Lender-Savers to Borrower-Spenders who have shortages of funds.

Mishra (2004) argues that there is no theoretical consensus on the interaction between stock prices and exchange rate. More importantly, it shows that there is no consensus on the influence of foreign exchange volatility on stock market.

## **2.4 Overview of literature**

From the discussion, there is no consensus in literature on the use of monetary policy instruments to attain the targeted inflation levels. Inflation targeting has become a popular phenomenon in the world although we cannot say that it is a universal practice. There is need to establish a clear monetary policy framework to address inflation in Kenya. Several scholars have used different approaches to study the relationship of monetary policy instruments and control of inflation.

The effectiveness of monetary policy has to be continuously reviewed due to the dynamic nature of inflation. Currently there is uncertainty in future prices of crude oil, which have a pass-through effect to pump prices and cost of energy. There are also changing and continuously increasing world food prices, widening current account deficit, and persistent instability in the Eurozone that affect the exchange rate.

This discussion shows that only limited studies have been conducted on the effectiveness of monetary policy tools in countering inflation in Kenya. This study therefore seeks to fill this research gap by investigating the effectiveness of monetary policy in controlling inflation in Kenya.

The approach adopted takes into account potential sources of inflation in addition to monetary sources. Empirical identification of sources of inflation will help policy makers in formulating short term and long term policies to contain inflation. This paper attempts to improve upon past studies in that apart from including non-monetary sources of inflation in Kenya, sample data used will include data up to year 2013. This covers a period of financial innovation, world financial crisis and post-election violence and drought in Kenya which has not been addressed. Most studies have concentrated on the period between 1980 – 2005.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter develops the procedures and methodologies that were undertaken to develop the relationship between the monetary policy and inflation rates in Kenya. Specifically, the chapter covers: research design; data collection, model specification and data analysis.

#### **3.2 Research Design**

This study employed regression research design. The study also used time series empirical data on the variables to examine the effectiveness of monetary policy tools in controlling inflation in Kenya by establishing impact coefficients between the inflation and the monetary policy tools.

#### **3.3 Data Collection**

This study used secondary data on inflation, exchange rate, treasury bill rate, money supply, GDP growth, oil prices and world food prices . The data was sourced from Kenya National Bureau of Statistics (KNBS) economic surveys as well as World Bank, IMF and CBK publications. Exchange rate data in this study focuses on the US dollar rate as it is the most commonly used bench mark by CBK. The period of study for which data was obtained focuses on the period between 1980 and 2013. The study also made use of annual data.



### 3.4 Model Specification

The effectiveness of monetary policy instruments in control of inflation in Kenya can be analyzed by the use of the quantity theory of money. This theory gives the relation between money, prices and output. It believes that price level is positively related to money supply. This is presented by the use of the quantity equation ( $MV=PY$ ) where:

M is stock of money in circulation,

V is the velocity of money circulation,

P is the general price level,

Y is the level of output.

The variables of the study comprises of Inflation as the dependent variable. Exchange rate, three months Treasury bill rate, money supply, GDP growth, oil prices and world food prices comprise the independent variables. It has been observed by researchers like Durevall and Ndung'u (2001), Kiptui (2009), Mishra et al,(2010), Durevall and Sjö (2012) and Misati et al,(2012) that inflation in Kenya is affected by the above variables .The multivariate model presents inflation as a function of the stated variables as follows:

First a general model was estimated, and the general-to-specific modeling strategy used to obtain an empirically constant parsimonious model. The general model is stated as:

$$Y=f(X_1, X_2, X_3, X_4, X_5, X_6)$$

The specific regression equation appeared as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

Where;

Y = Inflation;

X1= Exchange rate (US dollar);

X2= 91-days Treasury bill rate;

X3= Money Supply (M3);

X4= GDP growth,

X5= Oil prices;

X6= World food prices

$\varepsilon$  = Random term.

The three months Treasury bill rate was measured by applying the average yearly rate at which the government borrows from the public. The exchange rate was measured by taking the average applicable exchange figures for the United States Dollar. GDP growth, oil prices and world food price; the study applied figures available from the Central bank of Kenya, IMF, World Bank and KNBS for the period 1980-2013.

Money Supply (M3) data in this study will take into consideration the money supply figures by the Central bank of Kenya. The random term represents the effect of other factors other than monetary policy tools on inflation and helps in stabilizing the model.

### **3.5 Diagnostic Tests**

Before analysis of data, various diagnostic tests were conducted on the data series to ensure that time series properties are not violated. Since the study employs time series data and economic literature suggests that casual inspection of most time series data reveal that these series are non-stationary. If a series is non-stationary, regression of the two such series variables would lead to a spurious result. Spurious regression arises in a case where truly unrelated series are seen to be related because of the fact they share a common time trend. In this situation there appears to be a statistically significant relationship between variables, when in real sense the variables are not related.

The main reason for the spurious result is because the Gauss-Markov Theorem would not hold since a random walk does not have a finite variance. This results into inconsistent estimates from the OLS regression since this method of estimation is only applied where observations are independent.

Quite often, economic theory suggests that certain pairs or groups of macroeconomic variables are linked by a long run equilibrium relationship. If economic series are non-stationary but their linear combination is stationary, then such series are said to be cointegrated. Cointegration implies that the variables may drift from each other in the short run but should not diverge from each other in the long run.

Cointegration is an econometric concept which mimics the existence of long-run equilibrium relationships among economic time series. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then they are said to be cointegrated (Wei, 2006).

Cointegration does not require the long run equilibrium relationship to be generated by market forces but may be causal, behavioral or a reduced form relationship among similarly trending variables (Engle-Granger, 1987). Before testing for causal relationship between time series, it is important to ensure that the variables used are either stationary individually or non-stationary individually. Detection of Cointegration is very important prior to estimation since fundamentally different conclusions are made between spurious regression and cointegration. In order to overcome problems associated with non-stationarity, causality and relational dynamics, conducting the following tests on the variables is necessary.

### 3.6 Testing for Unit Roots

Unit root testing is done to determine whether a series is stationary or non-stationary and establish their order of integration. The need for this is because the non-stationary series is seen to be time dependent in its mean and variance which makes it move away from the mean. Non-stationarity in a time series occurs when there is no constant mean, no constant variance or both of these properties. This may originate from various sources but most important one is unit root.

Differencing removes the effect of non-stationarity; however it leads to loss of long-run information. A stationary series is independent of time, has a constant mean, with finite variance.

The first step is to test the variables for unit roots to establish their order of integration. To test the level of integration of the variables that will be employed in this study, Augmented Dickey-Fuller test (ADF) will be applied. The aim is to determine whether the variables follow a non-stationary trend and are of the order 1 denoted as  $I(1)$  or whether the series are stationary, that is, of the order of 0 denoted as  $I(0)$ . ADF test is based on the estimate of the following regression:

$$\Delta x_t = a_0 + a_1 t + \beta x_{t-1} + \sum_{j=1}^p \delta_j \Delta x_{t-j} + \varepsilon_t \quad (7)$$

Where  $a_0$  is a drift term;  $t$  represents a time trend; and  $p$  is a large enough lag length to ensure that  $\varepsilon_t$  is a white noise process.

The null hypothesis that the variable  $x$  is non-stationary ( $H_0 : \beta = 0$ ) is rejected if  $\beta$  is significantly negative, when compared with the Augmented Dickey-Fuller (1979), critical values. If the series are non-stationary, the use of classical methods of estimation such as OLS could lead to a spurious relationship thus rendering the results meaningless.

The traditional suggestion to deal with series that are non-stationary around their means is to difference the series. However, first differencing is not an appropriate solution to the above problem and has a major disadvantage: it prevents detection of the long-run relationship that may be present in the data, that is, the long-run information is lost (Emilio and Smith, 2001). With the ADF test is sensitive to lag lengths, Akaike Information Criterion (AIC) and Bayesian Schwartz Criterion (BSC) are used to determine the optimal lag length.

### **3.7 Data Analysis**

This study employed computer software Stata Version 12 to analyze the data. The multivariate model was also used in multiple regression analysis technique to establish the relationship between the inflation the monetary policy tools and other variables in the model. The analysis entailed the use of regression analysis of the model to determine the effectiveness of monetary policy tools in controlling inflation in Kenya.

## **CHAPTER FOUR**

### **DATA ANALYSIS AND FINDINGS**

#### **4.1 Introduction**

We discuss our research findings and analysis in this section. Time series data estimation techniques were used to determine out the effectiveness of monetary policy in controlling inflation.

#### **4.2 Estimation procedure**

The study used the OLS method in the regression of data. Normality and stationarity tests were carried out to ensure accuracy of the data before analysis.

#### **4.3 Descriptive Statistics**

A descriptive analysis of the data was conducted and the result presented in table below.

**Table 2: Summary Statistics**

<b>Variable</b>	<b>Obs</b>	<b>Mean</b>	<b>Std.Dev.</b>	<b>Min</b>	<b>Max</b>
INF	34	13.31915	9.432101	1.55	45.98
TB	34	13.58882	6.33898	2.8	23.6
M3	34	1.56E+10	8.75E+09	7.83E+08	3.90E+10
GDP	34	3.576015	2.159015	-0.7995	7.18
OIP	34	106.6466	31.19569	69.57578	188.0652
WFP	34	113.3066	22.60141	89.28827	169.9291
NER	34	119.7644	18.80883	90.491	193.39

Source: Own STATA computation

Kenya has experienced high levels of inflation in the study period as indicated by a maximum overall annual inflation rate of 45.98 percent with an average of 13.319 percent. 91day Treasury bill rate recorded an average of 13.5889 percent with a maximum rate of 23.6 percent. During the study period money supply (M3) had a mean of Ksh.15.6 billion with a maximum money supply reaching Ksh. 39 billion. The country recorded mixed economic performance during the study period with a peak GDP growth rate of 7.8 percent and -0.7995 percent as the bottom. On average, nominal exchange rate was 119.7644 with a maximum of 169.9291 in the study period. Oil price reached a maximum of Ksh. 188.0652 with an average price recorded at Ksh. 106.6466. During the study period the world food price index averaged at 113.3066 with a maximum index of 169.9291.



#### 4.4 Normality test

The study used Shapiro–Wilk test to test for the normality of the variables used in the study. The null-hypothesis of this test is that the population is normally distributed. Thus if the p-value is less than the chosen alpha level, then the null hypothesis is rejected and there is evidence that the data tested are not from a normally distributed population. In other words, the data are not normal. On the contrary, if the p-value is greater than the chosen alpha level, then the null hypothesis that the data came from a normally distributed population cannot be rejected. To correct the problem of non-normality, non-normal variables were transformed by taking logarithm of sample values.

**Table 3: Normality test**

<b>Variable</b>	<b>Obs</b>	<b>W</b>	<b>V</b>	<b>z</b>	<b>Prob&gt;z</b>	<b>Normality</b>
INF	34	0.8488	5.28	3.467	0.00026	Not normal
TB	34	0.9427	2.001	1.445	0.07423	Not normal
M3	34	0.97087	1.017	0.035	0.48595	Normal
GDP	34	0.96233	1.315	0.571	0.28398	Normal
OIP	34	0.88017	4.184	2.982	0.00143	Not normal
WFP	34	0.79701	7.088	4.081	0.00002	Not normal
NER	34	0.86982	4.546	3.155	0.0008	Not normal

Source: Own STATA computation

## 4.5 Correlation Matrix

To establish whether there exists multicollinearity among the variables used in the regression, a Correlation matrix is obtained (Table 4.2.1). Most of the variables do not depict significant relationships. The second column shows the relationship between dependent variable and the explanatory variables. Treasury bills rate is positively related to inflation rate (0.1135) which implies that an increase in treasury bills rate will increase the rate of inflation. Money supply is positively related to inflation rate (0.2764). An increase in money supply will increase the level of inflation rate. From the correlation matrix table below, GDP is negatively (-0.3841) related to the inflation rate.

Very high correlation ( $R=0.9093$ ) was reported between world food prices and oil price because the connection between food and oil is systemic, and the prices of both food and fuel have risen and fallen more or less in tandem in recent years. Modern agriculture uses oil products to fuel farm machinery, to transport other inputs to the farm, and to transport farm output to the ultimate consumer. Oil is often also used as input in agricultural chemicals. Oil price increases therefore put pressure on all these aspects of commercial food systems.

**Table 4: Correlation matrix**

	INF	TB	M3	GDP	OIP	WFP	Nominal Exch
INF	1.0000						
TB	0.1135	1.0000					
M3	0.308	0.1268	1.0000				
GDP	-0.3841	-0.2473	-0.0735	1.0000			
OIP	-0.0884	-0.3302	0.1164	0.3193	1.0000		
WFP	-0.0301	-0.2757	0.2422	0.3623	0.9093	1.0000	
NER	0.63	0.4049	0.2825	-0.3625	-0.3838	-0.3291	1.0000

Both oil price and exchange rate are also positively related to inflation while world food price is negatively related to inflation.

#### 4.6 Unit root result

The result below is from Dickey-Fuller test to examine unit root. The null hypothesis that the variable  $x$  is non-stationary ( $H_0 : \beta = 0$ ) is rejected if  $\beta$  is significantly negative, when compared with the Augmented Dickey-Fuller (1979), critical values. Variables with p values (z-scores) less than 0.005 are stationary while variables with p values greater than 0.005 are non-stationary.

**Table 5: Unit root result**

<b>Variable</b>	<b>test statistics</b>	<b>5% critical value</b>	<b>P value z=(t)</b>	<b>Stationarity</b>
<b>INF</b>	-3.19	-2.978	0.0206	<b>Stationary</b>
<b>TB</b>	-2.318	-2.978	0.1663	<b>Non Stationary</b>
<b>M3</b>	-3.759	-2.978	0.0034	<b>Stationary</b>
<b>GDP</b>	-3.269	-2.978	0.0163	<b>Stationary</b>
<b>OIP</b>	-1.879	-2.978	0.3419	<b>Non Stationary</b>
<b>WFP</b>	-0.859	-2.978	0.8011	<b>Non Stationary</b>
<b>NER</b>	-2.830	-2.978	0.0541	<b>Non Stationary</b>

Treasury bill rates, oil price, world food prices and real exchange rates being non-stationary variables were transformed by differencing to become stationary. Differencing helped in solving the problem of non-stationarity. Since the dependent variable (Inflation) is of integrated of order zero (I(0)) and the non stationary independent variables are of integrated order one (I(1)), there was no need to conduct cointegration test. Cointegration test is only done if dependent and independent variable are integrated of order one (I(1)).

## 4.7 Regression Result

**Table 6: Regression result**

```
. reg D1lnCPI D1ln91TB D1lnM3 D1lnGDP D1lnOIP D1lnWFP D1lnNER
```

Source	SS	df	MS			
Model	1491.16913	6	248.528189	Number of obs =	34	
Residual	1444.66002	27	53.5059267	F( 6, 27) =	4.64	
Total	2935.82916	33	88.9645199	Prob > F =	0.0023	
				R-squared =	0.5079	
				Adj R-squared =	0.3986	
				Root MSE =	7.3148	

  

D1lnCPI	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
D1ln91TB	-.2589896	.2297677	-1.13	0.270	-.7304341	.2124549
D1lnM3	-.4661574	1.923862	-0.24	0.810	-4.413597	3.481282
D1lnGDP	-1.207797	.668615	-1.81	0.082	-2.579682	.1640879
D1lnOIP	-.0384523	.102513	-0.38	0.711	-.2487915	.1718869
D1lnWFP	.1562419	.1449317	1.08	0.291	-.1411333	.4536172
D1lnNER	.3430181	.0858855	3.99	0.000	.1667956	.5192407
_cons	-22.68392	40.45843	-0.56	0.580	-105.6978	60.32993

Source: Own STATA Computation

The regression result gives R-squared of 50.79%% which implies that 50.79% of the total variation in inflation is attributed to the changes in the independent variables (Money supply, growth rate, treasury bills, world food price and nominal exchange rate). The estimated model becomes:

$$\Delta \ln \text{CPI} = -22.683 - 0.25898 \Delta \ln \text{TB} - 0.46615 \Delta \ln \text{M3} - 1.2078 \Delta \ln \text{GDP} - 0.03845 \Delta \ln \text{OIP} + 0.1562 \Delta \ln \text{WFP} + 0.343 \Delta \ln \text{NER}$$

From the regression result above, it is evident that treasury bills rates, money supply, gross domestic product rate, oil price, world food price are not statistically significant in controlling consumer price index.

However, nominal exchange rate is an important factor in controlling inflation in Kenya. At 5% level of significance, nominal exchange rate is significant factor in controlling inflation and 1% increase in nominal exchange rate will led 0.3430181% increase in consumer price index

#### 4.8 Post Regression Analysis

**Table 7: Regression Result Analysis**

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.002291	Prob. F(6,27)	0.4442
Obs*R-squared	6.193400	Prob. Chi-Square(6)	0.4019
Scaled explained SS	2.453779	Prob. Chi-Square(6)	0.8736

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	15.71518	Prob. F(1,26)	0.0005
Obs*R-squared	12.80868	Prob. Chi-Square(1)	0.0003

Testing for Multicollinearity

Variable	Coefficient Variance	Centered VIF
D1LN91_TB	0.052793	1.308365
D1LNGDP	0.447046	1.285215
D1LNM3	0.701246	1.357429
D1LNNER	0.007376	1.609442
TD1LNOIP	0.010509	1.307522
D1LNWFP	0.021005	1.617744

**Source own STATA computation**

Table 4.7 above shows the post regression analysis tests for serial-correlation, multicollinearity and heteroskedasticity. The above result for heteroskedasticity at 1%, 5% and 10% level of significance indicates the presence of heteroskedasticity as shown by the p-values. This represents a weakness in the model. From the above table, it is evident that the residuals of the model have no serial correlation as shown by the p-value, at 1% and 5% level of significance. Using the variance factor, VIF, and a threshold of 10, the results show that the variables are not collinear and this can be seen in the coefficient variance, all of which are greater than 0.1.

# CHAPTER FIVE

## SUMMARY, CONCLUSION AND RECOMMENDATION

### 5.1 Summary

The main objective of the study was to determine the effectiveness of monetary policy in controlling inflation in Kenya while the specific objective was to determine the effect of three months Treasury bill rate, exchange rates, money supply, GDP growth, oil prices and world food prices on inflation rates in Kenya. The result from chapter four indicated that 91 treasury bill rate recorded an average of 13.5889 percent with a maximum rate of 23.6 percent while supply (M3) during the study period had a mean of Ksh.15.6 billion with a maximum money supply reaching Ksh. 39 billion. GDP growth rate recorded a high growth rate of 7.18 percent. The coefficient for nominal exchange rate is positive and is statistically significant at 5% level of significance in determining inflation.

### 5.2 Conclusion

Money supply is an important instrument for controlling inflation by the central bank of Kenya. However, the study result indicates that money supply is not significant in controlling inflation. The result contradicts Mishra et al (2010) who contends that high inflation is a monetary phenomenon related to excess money supply.

According to the study findings Economic growth is not significant in controlling inflation. However, the result has established that economic growth negatively impact on the rate of inflation. This implies that an increase in economic growth reduces the level of inflation. The research findings further indicate that nominal exchange rate is statistically significant in



controlling inflation. Positive relationship has been established between nominal exchange rate and inflation. This illustrates that an increase in nominal exchange rate will result to an increase in the consumer price index.

### **5.3 Recommendation**

According to this study, policy makers should concentrate on nominal exchange rate. Instead of focusing on world food prices, the government should consider measures aimed at increasing food supply. This involves providing credit facilities to farmers, subsidized fertilizers and providing new technologies to farmers to increase food supply. There is also need to move from rain fed agriculture and invest in irrigation systems to counter drought effects that have effects on inflation.

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## APPENDICES

### Appendix I

Year	INF	91 TB	M3	GDP	OIP	WFP	Nominal Exchange rate
1980	13.86	18.6	782663605	5.59	75.8	97.3	97.08
1981	11.6	15.2	1.326E+10	3.77	80.8	95.8	93.86
1982	20.67	7.6	1.693E+10	1.51	96.5	101.1	110.19
1983	11.4	15.2	4.942E+09	1.31	85.6	98.4	110.86
1984	10.28	20.8	1.279E+10	1.76	83.3	103.0	122.65
1985	13.01	23.5	6.346E+09	4.3	112.6	116.6	126.87
1986	2.53	21.3	3.27E+10	7.18	108.7	137.9	130.01
1987	8.64	19.5	1.113E+10	5.94	106.2	110.7	129.15
1988	12.26	12.3	8.039E+09	6.2	99.4	98.3	125.58
1989	13.79	13.5	1.292E+10	4.69	85.8	89.3	126.28
1990	17.78	10	2.006E+10	4.19	69.6	100.4	134.47
1991	20.08	19.8	1.957E+10	1.44	75.1	98.7	132.9
1992	27.33	20.1	3.902E+10	0.8	79.8	101.1	136.92
1993	45.98	23.6	2.803E+10	0.35	80.2	97.1	193.39
1994	28.81	12.5	2.318E+10	2.63	106.8	101.3	145.86
1995	1.55	17.6	2.9E+10	4.41	108.1	105.3	112.03
1996	8.86	20.7	2.533E+10	4.15	98.6	113.7	120.24
1997	11.36	22.4	2.019E+10	0.47	106.0	111.3	115.64
1998	6.72	23.3	2.931E+09	3.29	130.5	105.6	112.97
1999	5.74	13.2	6.488E+09	2.31	94.2	92.6	123.03
2000	9.98	12.1	4.908E+09	0.6	70.4	92.4	131.03
2001	5.74	12.7	5.64E+09	3.78	71.7	101.0	123.34
2002	1.96	8.9	9.889E+09	0.55	93.9	96.2	119.58
2003	9.82	3.6	1.179E+10	2.93	101.0	98.1	122.26
2004	11.62	2.8	1.347E+10	5.1	104.4	105.0	123.41
2005	10.31	8.4	9.908E+09	5.91	92.9	106.8	110.56
2006	14.45	6.8	1.697E+10	6.32	99.9	112.7	106.63
2007	9.76	6.7	2.042E+10	7.01	143.4	134.6	97.9
2008	16.23	7.7	1.555E+10	1.55	175.6	155.7	108.28
2009	9.23	7.42	1.646E+10	2.59	126.6	132.8	91.85
2010	3.961	3.6	2.236E+10	5.75	158.3	150.7	90.491
2011	8.36	8.8	1.915E+10	5.8	188.1	169.9	103.74
2012	7.67	12.9	1.439E+10	4.4	169.0	161.0	112.93
2013	5.78	8.9	1.566E+10	4.6	147.1	159.9	130.01

**Source: World data bank, KBS, CBK**