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Monetary Policy Reaction Function for Kenya

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Abstract

The objective of this study was to estimate a monetary policy reaction function (MRF) for Kenya. It sought to understand whether the Central Bank of Kenya (CBK) in its reaction to macroeconomic changes and/or disturbances, reacted consistently and in a systematic way or randomly. Quarterly data from 1966, when the CBK was established, to 2003 was used in a structural vector auto-regression model including a vector error correction to analyse this phenomenon. Results indicate that the reaction of monetary policy to changes in inflation were contrary to expectations during the period 1966-1990/91 when the CBK used domestic credit as the monetary policy instrument. This reflects inconsistency in the implementation of monetary policy as it contradicts policy expectations. Further, the results show that the reaction of monetary policy to changes in the output gap were insignificant, implying that monetary policy did not take into account output stabilisation. These results imply that over the entire period of study, monetary policy has not been counter-cyclical. Results from impulse response and variance decomposition analysis reveal that over the period, monetary policy behaviour was dominated by fiscal pressures and changes in net foreign assets (NFA). This points to the need for better coordination between fiscal and monetary policy as monetary policy driven by fiscal pressures may not effectively achieve its primary objectives. Results also show that monetary policy reaction to shocks or movements in the exchange rates has not been systematic. The results further indicate that monetary policy reacts more to changes in NFAs than other macroeconomic variables.

Abbreviations and Acronyms

CBK	-	Central Bank of Kenya
EACB	-	East African Currency Board
ESAF	-	Enhanced Structural Adjustment Facility
FFR	-	Federal funds rate
GDP	-	Gross Domestic Product
MRF	-	Monetary policy reaction function
NBFIs	-	Non-bank financial institutions
NFA	-	Net Foreign Assets
OMO	-	Open Market Operations
TBs	-	Treasury bills

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1. Introduction

1.1 Monetary policy in Kenya

Monetary policy is a cornerstone of macroeconomic management in market economies worldwide. It captures the behaviour of monetary authorities as they react to and/or try to influence changes in an economy's macroeconomic environment. The role of monetary authorities in general, is to conduct monetary policy with the objective of achieving price stability, attaining sustainable economic growth and establishing a stable financial system. In Kenya, monetary policy has evolved over the years. The implementing agency of monetary policy, the Central Bank of Kenya (CBK), was established in 1966 under an Act of Parliament – the CBK Act (Cap 491) of 1966. The Act has, however, been amended several times with substantial amendments undertaken in 1996 to extend CBK's authority to manage monetary policy. The latter amendment defined more precisely the Bank's mission, mandating it to formulate and implement monetary policy directed principally at "maintaining price stability and fostering liquidity, solvency and proper functioning of a stable market-based financial system."[1]

The CBK, like any other monetary authority, has over the years continued to refine its monetary policy formulation and implementation processes in order to enhance effectiveness and efficiency in the delivery of its broad goals in an ever-changing economic and financial environment. To analyse how this has evolved since CBK's inception, this study distinguishes two distinct periods: the period between 1966 and 1990/91, before liberalisation, and from 1991/92 to 2003, a period characterised by liberalisation of the exchange rate regime. The latter period is also characterised by wide ranging reforms in the financial sector, including

1. See Monetary Policy Statement, June 2003, p. (ii) for "Principal Objects of the Bank" at http://www.centralbank.go.ke/cbk/objectives.html.

interest rate liberalisation and a move towards the use of indirect monetary policy instruments in the conduct of monetary policy. Appendix 2 outlines episodes of monetary policy in Kenya through the two broad periods of the use of direct and indirect instruments.

This study addresses the following key questions: How has monetary policy evolved or the monetary authorities reacted to different macroeconomic environments in the conduct of monetary policy since 1966? To what extent were monetary policy actions consistent with monetary policy objectives taking into account other constraints?

Monetary policy, 1966-1992

Prior to the establishment of the CBK in 1966, the East African Currency Board (EACB), established in December 1919, served Kenya, Tanzania and Uganda (then British protectorates in East Africa), Zanzibar, Pemba, British Somaliland and Aden Protectorate. The EACB addressed issues pertaining to monetary policy management; for example, the provision of a medium of exchange.[2] The Board played a purely passive role in monetary policy. The EACB collapsed after the break-up of the East Africa Protectorate in 1966, which was precipitated by the desire of the countries that formed the British East African Protectorate for independent monetary and financial policies. This brought about the birth of the Central Banks of Kenya, Uganda and Tanzania.

The CBK Act assigned the Central Bank of Kenya statutory objectives: "to assist in the development and maintenance of a sound monetary, credit and banking system in Kenya, conducive to the orderly and balanced economic development of the country and the external stability of the currency." It was also mandated to maintain a level of foreign exchange equivalent to at least four months of import cover averaged

2. The EACB issued the first East African Shilling on 1st May 1920. See Symes (2004), "The East African Currency Board in Aden," at http://www.pjsymes.com.au/articles/EACBarticle.htm

over the last three years. During the first decade after independence, the CBK pursued a rather passive monetary policy. Brough and Curtin (1981, p.40), in analysing the conduct of monetary policy during this period, failed to find "...any thread of coherent monetary policy attempts to control events rather than be controlled by them." This may be attributed to two main reasons: first, the Bank had to contend with a skeleton staff that had not gathered sufficient experience in monetary policy management and thus had to deal first with capacity-building issues. Secondly, and most important, the economy was growing at about 8 percent per year and inflation at below 2 percent during the 1960s (Kinyua, 2001), with no serious macroeconomic imbalances to deal with. In addition, no major external shock was experienced to warrant an active monetary policy.

In the second decade after independence, major macroeconomic imbalances emerged mainly arising from the oil crisis of 1973 that led to severe constraints in balance of payments. Economic growth slowed, inflation rose to 7 percent and after successive surpluses over the period 1967-1970, there was a balance of payments deficit of Ksh 362 million in 1971 (Kinyua, 2001). The unfavourable developments were exacerbated by excessive expansion in domestic credit occurring in the previous two years resulting in a larger volume of imports in 1970/71. There was also a decrease in net capital inflows that had weakened balance of payments position during the same period. To contend with these shocks, the CBK sought to restrict credit expansion to help curb imports. It raised the minimum liquidity ratio to 12.5 percent in 1969 and imposed a cash ratio of 5 percent on commercial banks. A tight monetary policy stance was thus put in place.

Following the coffee boom of 1976/77, Kenya's terms of trade improved substantially with balance of payments registering surpluses. Recognising the potential danger from credit expansion on domestic

prices, minimum liquidity ratio was raised to 18 percent in 1976 and further to 20 percent in 1978. By 1985, however, the government recognised that the economic difficulties faced were structural and needed structural reforms to address. The CBK continued to rely on direct instruments of monetary control, namely: cash reserve requirements on commercial banks, a liquid assets ratio applied on both commercial banks and non-bank financial institutions (NBFIs), a rediscount and advances facility at CBK, and a system of credit ceilings. The CBK applied these instruments, especially the first three, at low levels of stringency. Credit ceilings dominated in monetary control and were adjusted from time to time. However, the enforcement of this instrument remained loose. In 1991, new measures were introduced to make monetary policy more effective. The significant ones included: a relatively more flexible management of exchange rates; liberalisation of interest rates; and, introduction of open market operations (OMO).

Therefore, with the introduction of indirect instruments of monetary policy in 1991/92, a new era in the conduct of monetary policy was unveiled. These two episodes in the conduct of monetary policy define the distinctions used in this study. In general, as noted above, during the first period of this review, i.e., 1966-1990, monetary policy was not effectively implemented.

Monetary policy, 1993-2003

From 1993, persistent balance of payments problems and structural constraints called for massive economic reforms. These reforms were supported under the IMF's Enhanced Structural Adjustment Facility (ESAF). High double digit inflation, partly arising from excessive monetary expansion used to finance the first multiparty elections of 1992, and the CBK's excessive accommodation of troubled banks placed the shilling on the verge of collapse since a managed floating exchange rate regime had been adopted. It became necessary to bolster CBK's

authority/independence in the management of monetary policy. This was achieved with the 1996 CBK Amendment Act. The use of indirect instruments thus begun under circumstances of extreme instability and uncertainty. The periodic auctions of Treasury bills (TBs) to redress the macroeconomic imbalances (explained as mopping-up operations) propelled the market-clearing rates for TBs to historic levels. Lack of a vibrant secondary market in the private sector to trade the liberalised TBs kept the rates high throughout the 1990s.[3] In addition, the authorities dominated the 'market', controlling not just the primary issue of the large volumes of bills on auction, but also their secondary trading through the available rediscounting facilities for government paper at the CBK.

After the 1996 amendment, there was a shift from targeting broad money M3[4] (used until 1998) to broader money M3X[5] as the principal concept of money stock (Kinyua, 2001). In order to achieve and maintain price stability, the CBK targets inflation at below 5 percent. CBK's series of monetary policy statements to date indicate the target at 3.5-5 percent and in addition link the policy to the support of economic growth targets. Although not explicitly emphasised in the series issued to date, the exchange rate is an important indicator of the secondary objective of monetary policy, i.e., exchange rate stability.

Although published analytical work on Kenya's monetary policy and impact is limited, in terms of inflation performance, actual year on year underlying inflation rates during the period 1997-2003 ranged between

3. In late 1993, the rediscount rate reached levels in excess of 80 percent.

4. M3 is the currency outside banking institutions plus the term and non-term deposits of both the private and other public sectors with the banking institutions and non-bank financial institutions.

5. M3X consists of M3 and foreign currency holdings by residents.

2.3 percent (in 2003) and 8.3 percent (in 1997) with a mean and median of 5.2 and 5.5 percent, respectively. However, the key concern with the current monetary policy stance is whether it has the scope to influence, in complementarity with other policies, some important aspects of economic strategy such as economic recovery, growth and poverty reduction.

1.2 A monetary policy reaction function (MRF) perspective

A monetary policy reaction function (MRF) for a country ascertains goals that have been determining its monetary authority's actions. The potential of monetary policy in maintaining price stability and managing the business cycle has spurred many countries to empirically assess the behaviour of their monetary authorities through the estimation of MRFs. Because the function captures important information on policy effectiveness, it can generate new information on macroeconomic options that would strengthen desired responses from the Central Bank. Thus, empirical evidence yielded could help determine and improve the mode of monetary authority's reactions to key economic developments in the country. Estimation of MRFs is, therefore, justified by the need to establish robust reaction functions to improve the response of monetary policy to key macroeconomic changes in a country. For a developing country like Kenya, it is critical that an MRF be established to help understand the appropriateness of monetary policy responses to various macroeconomic changes.

The study's main goal, therefore, is to establish how the Central Bank of Kenya reacts to macroeconomic changes in the economy and whether any new considerations are warranted to strengthen the effectiveness of monetary policy. By estimating Kenya's MRF, evidence is adduced to test whether the monetary policy decisions have been systematic (if it

exists), or random (if it does not) in terms of effecting changes in the policy instrument to attain the desired macroeconomic objectives, subject to existing constraints.

This paper is organised as follows. Section One provides a brief overview of the practice of monetary policy in Kenya since independence. It distinguishes between two distinct periods, between 1966 and 1990/91 (before liberalisation of the exchange rate regime and direct monetary policy instruments predominated policy), and between 1991/92 and 2003 (when a floating exchange rate regime and indirect policy instruments became dominant). Section Two explores some of the literature on MRFs and their theoretical expositions. Section Three specifies Kenya's MRFs and empirically discusses and analyses them in Section Four upon which policy implications are drawn. Section Five comprises conclusion and policy recommendations.

2. Brief Review of Literature on MRFs

Empirical work on estimating MRFs increased especially in the 1990s both for developing countries (Clarida *et al*, 1998; Hsing, 2000; Brouwer and Gilbert, 2003) and developed countries (Huang and Shen, 2002; Selthare, 2000; Sa'nchez-Fung, 2002, etc.). Most of these works have been inspired by Taylor (1993) and have basically sought to extend work on monetary policy rules with modifications to suit the specific economic circumstances. The basic difference in the estimated MRFs for different countries is the stance of monetary policy for which available literature has never been conclusive. An exposition of some of the literature is provided below.

The original specification of monetary policy rules is due to Taylor (1993) who observed the US federal funds rate (FFR) as the major monetary policy instrument, and that the output and inflation gaps consistently moved in line. In his calibrations, the coefficients of both the output and inflation gaps were set at 0.5, implying that the Central Bank pays equal attention to both output and inflation stabilisation. It also implies that if actual real GDP is higher than potential GDP by a percentage point, FFR will increase by 0.5 percent; and if actual inflation rate is higher than the inflation target of 2 percent by a percentage point, FFR increases by 0.5 percent.

Hsing (2002) extended the Taylor rule and applied the VAR model to estimate the MRF for Canada. The monetary policy instrument used was the overnight rate. Results showed that the overnight rate responds directly to a shock in the output gap, inflation gap, exchange rate and the lagged overnight rate in some quarters. The implication is that the Taylor rule can be extended to Canada's monetary policy by an addition of the exchange rate and lagged overnight rate variables.

Huang and Shen (2002) estimated Taiwan's MRF using a binary choice model using a novel monetary indicator constructed by the narrative-

based approach. The monetary indicator takes the value of 1 for an expansionary monetary policy and 0 for a contractionary monetary policy. The use of the discrete monetary index is advantageous because it avoids the problems of endogeneity and inconsistency. However, it fails to consider the properties of time series data; for example, serial dependence of the error terms. Adopting an expansionary or contractionary monetary policy is assumed to be influenced by macroeconomic variables such as rate of inflation and growth rate. The empirical results showed that the monetary authority adopts counter-cyclical policies, responding asymmetrically to macroeconomic conditions. For instance, a tight monetary policy action is considered when the rate of inflation is higher than a given threshold, but no corresponding easy policy is considered when the rate of inflation is below the threshold. Further results showed positive serial correlation of the error terms implying that monetary policy tends to be persistent suggesting also that estimating a binary choice model with time series data and failing to consider serial dependence is inappropriate.

In estimating Turkey's MRF, Olcay *et al* (2000) estimated offset and sterilisation coefficients using monthly data in two different periods, 1990-93 and 1995-99, to determine the scope and stance of monetary policy. The results showed that in the first period—i.e., 1990-93, a low degree of sterilisation, offset and neutralisation coefficients suggested a relatively accommodative monetary policy to fiscal policy by the Central Bank increasing domestic credit so as to finance budget deficit. In the second period (1995-99), however, a more active monetary policy was implemented by the central bank sterilising most of the increases in foreign assets and neutralising increased government credit. This is reflected in high sterilisation, offset and neutralisation coefficients. Besides, in the second period, the Central Bank prioritised to obtain stability in the financial markets by injecting domestic currency and/or foreign exchange whenever needed.

Sa'nchez-Fung (2002) estimated a hypothetical monetary policy rule using high-powered money as the monetary policy instrument with target variables being output gap, inflation gap and the difference between nominal market and nominal official exchange rate for the Dominican Republic, for the period 1969-2000. Results showed that the monetary authorities were biased towards targeting the parallel and official exchange rate gap. The finding was in line with the authorities' long-standing endorsement of a multiple exchange rate regime. The findings imply some learning for the authorities given that they operate apparently in a rule-like decision making process reflected in their choice of exchange rate policy.

Brouwer and Gilbert (2003) built their MRF for Australia along applied formulations of the Bryant-Hooper-Mann rule, on backward-looking and forward-looking reactions in assessing the stability and consistency of interest-rate setting in post-float period. They wanted to find out whether the monetary authority acted as if following a rule and whether it did so consistently. They concluded that the Central Bank had not followed a single simple rule in the post-float period. The results were consistent with the fact that the Bank had operated three monetary policy regimes over the period: a monetary targeting policy until 1985, the checklist approach between 1986 and 1990, and an inflation-targeting regime from 1991 onwards. The latter represents the boldest breakaway from the way the Bank has run monetary policy. Nevertheless, they would not determine from the results whether the Bank's preferences contained in its objectives had changed or it was the economy's structure and processes that had changed.

3. Theoretical Framework

3.1 MRF specifications

As discussed in Section Two, research already conducted on monetary reaction functions (MRFs) for most countries, both developing and developed,[6] requires the determination of variables that represent the stance of monetary policy and how it relates to macroeconomic goals of monetary policy, such as price stability, low inflation, stable currency value and economic growth. A study of a MRF, therefore, begins by first establishing a variable that represents, as closely as possible, the stance of monetary policy (i.e., the instrument of policy) in a country, which becomes the endogenous variable in an MRF specification. It then proceeds to determine variables that serve as policy targets and which are reflective of the state of the economy. These are used in the MRF as exogenous variables. There are other variables that influence monetary policy because of their ability to impact on policy target variables and are also considered and inputted into the MRF as independent variables.

From this categorisation of variables, most empirical work on MRFs has specified the model generally as follows:

$$Y_t = \beta + aY_{t-1} + \sum \alpha_i X_{it} + \varepsilon_i \quad \text{.....1}$$

where:

Y_t is the indicator of monetary policy, or major instrument used

X_{it} are the exogenous variables for $i = 1, 2, \ldots, n$

ε_i is the disturbance term

6. See, for example, Clarida *et al* (1998), Taylor (1999), Hsing (2002), Brouwer and Gilbert (2003), etc., for the latter, and Huang and Shen (2002), Setlhare (2000), Sa'nchez-Fung (2002), etc., for the former.

β, a, and α are the parameter coefficients to be estimated for $i = 1, 2, .., n$ and t is the time period.

For Kenya, this general equation used to estimate MRFs is adapted to reflect its monetary policy stance as has been practised over the years. Two distinct time periods are captured; between 1966 and 1990, and the period after 1991 to 2003 when Kenya adopted a flexible exchange rate regime.[7] However, as Brough and Curtin (1981) show, it is rather problematic to pinpoint a clear monetary policy stance, particularly in the first period. Nonetheless, still in keeping with its mandate, the Central Bank of Kenya (CBK) effected its monetary policy by controlling interest rates and credit expansion by banking institutions. Over the first period, the Bank relied more on domestic credit ceilings in the conduct of monetary policy, thus this variable is used as the instrument variable over the period.

In the second period (from 1991), persistent balance of payments problems and structural constraints called for massive economic reforms also supported by the Breton Woods institutions. The reforms, which encompassed monetary policy reforms as well, brought a shift from the use of broad money M3, used until 1998 as the intermediate monetary target, to broader money M3X. The Bank uses reserve money or monetary base, which it regulates and controls in the pursuit of its monetary policy goals. This study therefore adopts reserve money as the instrument of policy for the second period and it becomes the endogenous variable.

Regarding target variables, one key variable is inflation. The attainment of low inflation, in fact at single digit,[8] has been a primary monetary

7. See Appendix 2 for monetary policy evolution in Kenya.
8. For example, monetary policy adopted for the year 2003 aimed at containing inflation within single digit and below the 5 percent level (Government of Kenya, 2004), p.19.

policy goal of the CBK (Central Bank of Kenya, 2003). Its realisation also implies that the principal objective of monetary policy, i.e. price stability, as stated in the CBK Act and also repeatedly stated by the government in several government publications, is achieved. This goal is carefully monitored so that when undesired rates seem to emerge, the CBK, using domestic credit or reserve money, as the case may be, reacts to contain it at the desired levels. It is anticipated that with high inflation rates, CBK curtails increases in domestic credit or reserve money and even acts to reduce it (them) to return inflation to its desired level. The envisaged relationship between the variables is, therefore, indirect. Inflation is defined as a gap, that is the deviation of the actual rate π from a single digit π^* as targeted by CBK, i.e., Inflation Gap - (IG) $=\pi - \pi^*$.

Another target variable considered is the rate on short-term government paper, mainly Treasury bills, and especially the 91-day Treasury bills frequently used to mop up excess liquidity in the economy and, therefore, stabilise prices and curtail high inflation rates. It is obvious that excess liquidity is a recipe for high inflation and must also be continually watched and controlled.

The study also considers movements in nominal exchange rates as another target variable. In early 1990s, the government embarked on liberalisation of the exchange rate regime. Currently, the exchange rate remains largely market-determined with the Central Bank of Kenya intervening occasionally to ensure stability. A weakening of the shilling generates automatic rise in the local currency value of debt service and import bill. Depending on the magnitude, this may elicit policy reactions. Between 1966 and 1992, the government pursued a pegged exchange rate regime.

The fourth target variable considered is the output gap. Although containing inflation at low levels and consequently maintaining price

stability is the main goal of monetary policy, observing output gap is also important since it measures whether the economy is above or below its potential, consequently generating either inflationary or deflationary pressures. The Output Gap (OG) is estimated as the difference between actual output (GDP) and potential output (GDP*), i.e., OG = GDP – GDP*. The output gap is measured as actual minus potential GDP or, alternatively, as a ratio of (GDP – GDP*) to actual GDP. In this study, annual real GDP is interpolated to yield quarterly series. Potential GDP (GDP*) is generated through the Hodrick Prescott filter process.

In the actual specification of the MRF for Kenya, it is assumed that the CBK has been consistently pursuing price stabilisation, which is its primary goal. Accordingly, the CBK manipulates the policy instrument until the target variable (i.e., inflation), is restored to its target. With this supposition, the MRF can be specified as follows:

$$D_t = D_t(IG_t, Tbr_t, \Delta NEr_t, OG_t, \Delta M3X_t, NFA_t, DD_t, \varepsilon_t) \quad \text{.....2}$$

where

D_t = reserve money or domestic credit, dependent on period under consideration

IG_t= inflation gap

Tbr_t= the 91-day Treasury bill rates

NEr_t= movements in the nominal exchange rates

OG_t= output gap

$\Delta M3X_t$=currency, demand deposits plus short-term time deposits in real terms

NFA_t= changes in net foreign assets

DD_t = domestic debt

ε_t= random variable and t is the time period

3.2 Data sources and collection

The different data sources include: the Central Bank of Kenya, World Bank Africa database 2005 CD ROM, US Federal Reserve Bank at *http://www/st.frb.org* and the IFS CD ROM - December 2004. Quarterly time series data has been assembled for the variables discussed above. Where quarterly data was not available, especially for GDP, annual time series was interpolated into quarterly series. All the variables are in their logs.

To simulate the dynamic response of monetary policy instruments due to changes in the target variables a structural vector auto-regressions (SVAR) model is used in the estimations. The estimation of a reaction function for Kenya requires that we estimate output gap and inflation gap. Output gap represents transitory movements from the potential output. Potential output represents the maximum output that can be sustained by the level of economic activity in a country without raising inflation. The approaches commonly used in estimating potential output include: Hodrick-Prescott (HP) filter method, and production function approach, among others. The Hodrick Prescott (HP) method was used for two reasons: one, because it requires considerably less data compared to the other methods, and two, because estimates of potential output using the different methods do not show great divergences (Njuguna et al, 2003). To get the output gap, the difference between the potential output and the actual output is generated.

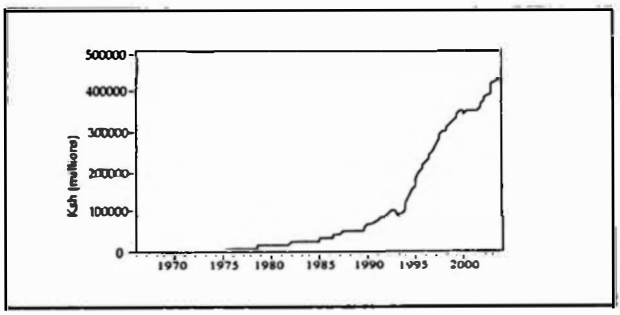
4. Emprical Work

4.1 Data properties

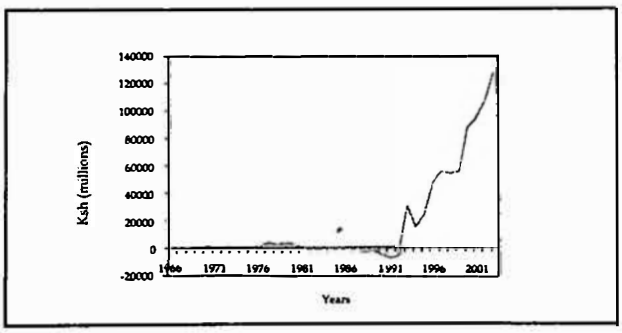
Before estimations, the series are tested for stationarity. Plots of the model variables at their levels indicate that the variables may be exhibiting non-constant means and variances (Figure 4.1).

Figure 4.1: Movement of variables at levels

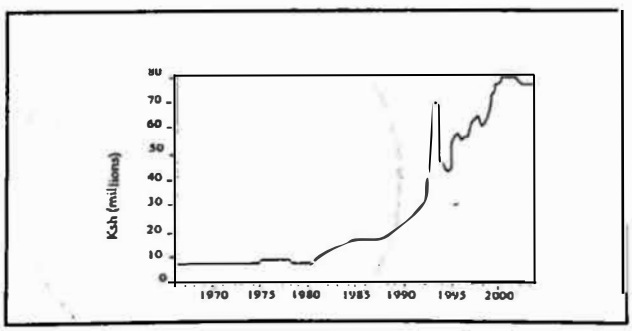
(a) Domestic credit



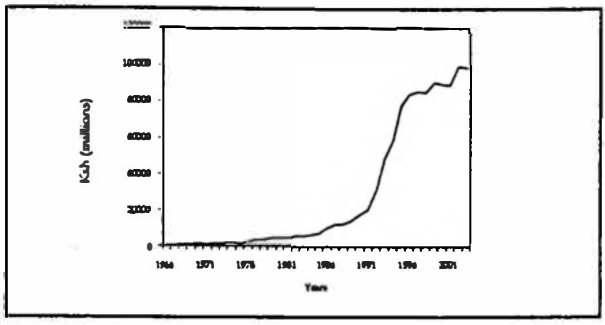
(b) Net foreign assets



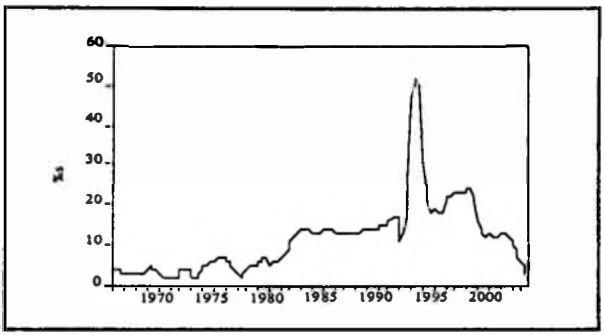
(c) Nominal exchange rate



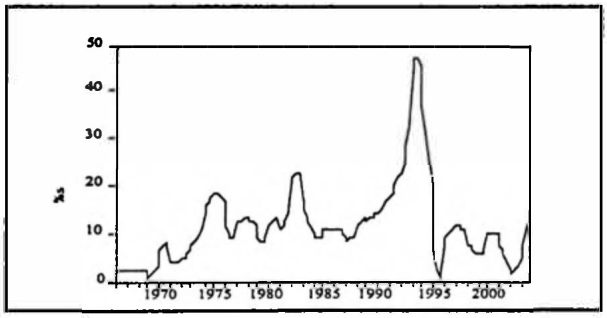
(d) Reserve money



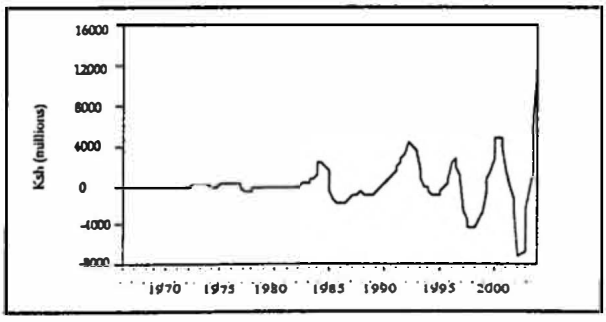
(e) 91-day Treasury bill rates



(f) Inflation



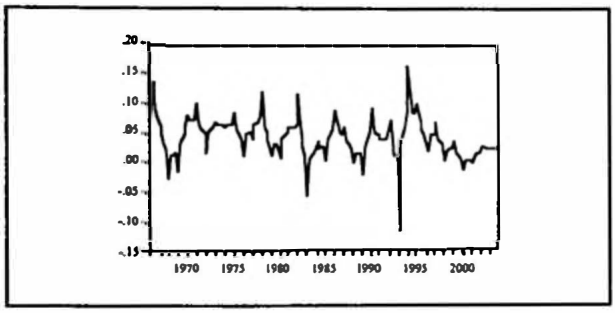
(g) GDP gap



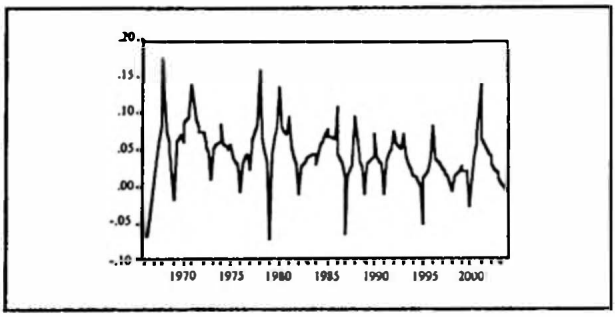
When plotted at their first differences, the variables seem to exhibit constant means and variances as shown in Figure 4.2.

Figure 4.2: Movement of variables at first differences

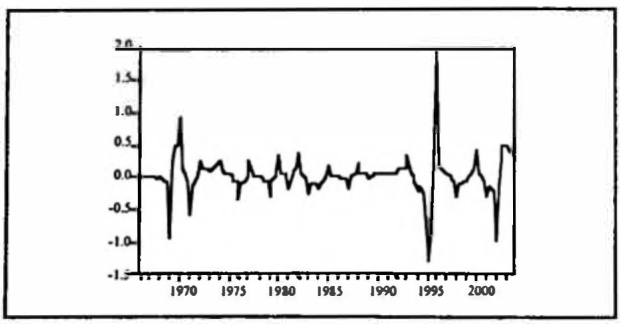
(a) Change in domestic credit



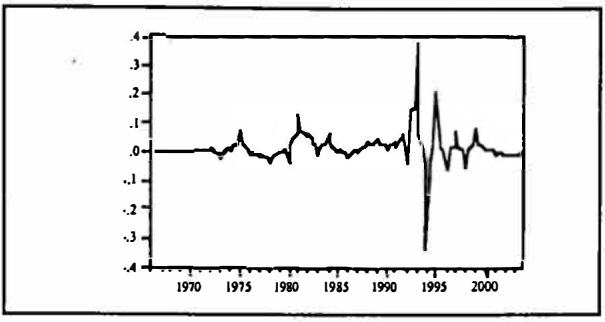
(b) Change in domestic debt



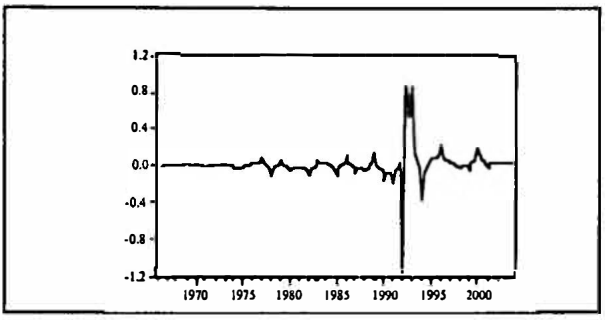
(c) Inflationary changes



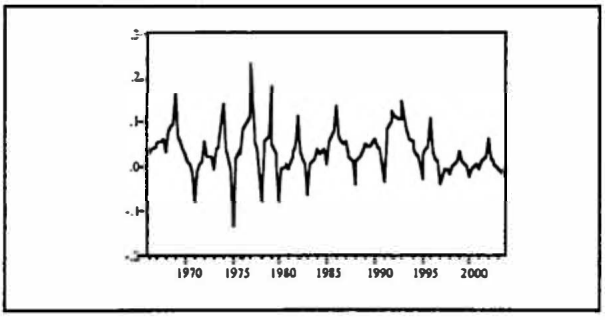
(d) Change in the nominal exchange rates



(e) Change in the net foreign assets



(f) Change in reserve money



(g) Change in Treasury bill rates

A test of the unit roots of the variables at their levels show that some variables are non-stationary (Table 4.1).

Table 4.1: Unit root test results

	ADF t-statistic	Prob.	Philip-Perron	Prob.	Kwiatkowski-Phillips-Schmidt-Shin test
Domestic credit	0.759208	0.9997	0.671942	0.9996	0.349374
Domestic debt	0.760028	0.9997	0.814013	0.9998	0.33112
GDP gap	-5.65652	0.000	-5.857739	0.0000	0.028904
Inflation	-2.85312	0.1811	-2.935720	0.1607	0.153379
Nominal exchange rates	-1.47224	0.8348	-1.722922	0.7364	0.344337
Net foreign assets	1.59003	1.0000	0.531435	0.9993	0.323523
Reserve money	-1.47304	0.8346	-1.401418	0.8569	0.336138
T bill rates	-0.85248	0.9574	-1.921425	0.6384	0.162716

Notes: Critical values for the ADF test are 3.45 at 5 percent. For Kwiatkowski-Phillips-Schmidt-Shin test, the values are 0.216000 at 1 percent level, 0.146000 at 5 percent level and 0.119000 at 10 percent level. The Kwiatkowski-Phillips-Schmidt-Shin model tests the null hypothesis of stationarity against the alternative of non-stationarity. The PP and ADF, on the other hand, test the null hypothesis of non-stationarity against the alternative of stationarity.

The results from the unit root tests indicate that the series are non-stationary at levels. All the series, however, become stationary after differencing once implying that they are integrated of order one. A test of a linear movement of the non-stationarity variables (cointegration) was then done using the Johansen's cointegration test. The Trace test and max-eigenvalues both indicate 2 cointegrating equations at the 0.05 level of significance (Table 4.2).

Table 4.2: Johansen cointegration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesised		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical value	Prob.**
None *	0.317103	169.1950	125.6154	0.0000
At most 1 *	0.274294	112.7460	95.75366	0.0020
At most 2	0.149719	65.29567	69.81889	0.1088
At most 3	0.109982	41.29179	47.85613	0.1796
At most 4	0.096348	24.04784	29.79707	0.1984
At most 5	0.059155	9.053785	15.49471	0.3604
At most 6	0.000198	0.029267	3.841466	0.8641
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* Denotes rejection of the hypothesis at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesised		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.317103	56.44895	46.23142	0.0030
At most 1 *	0.274294	47.45036	40.07757	0.0062
At most 2	0.149719	24.00388	33.87687	0.4553
At most 3	0.109982	17.24395	27.58434	0.5591
At most 4	0.096348	14.99406	21.13162	0.2893
At most 5	0.059155	9.024518	14.26460	0.2841
At most 6	0.000198	0.029267	3.841466	0.8641
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
* Denotes rejection of the hypothesis at the 0.05 level				

After testing for cointegrating restrictions, it was found that only one of the cointegrating equations satisfied the theoretical assumptions of the study model.

The cointegration test results show that the linear combination of the non-stationary series is stationary, implying that there exists a long-run relationship among the variables. The study proceeds to estimate the

Table 4.3: Test of cointegrating restrictions

Tests of cointegration restrictions:				
Hypothesised No. of CE(s)	Restricted Log-likehood	LR Statistic	Degrees of Freedom	Probability
1	1127.264	5.132545	1	0.023481
2	1153.555	NA	NA	NA
3	1165.557	NA	NA	NA
4	1174.179	NA	NA	NA
5	1181.676	NA	NA	NA
6	1186.188	NA	NA	NA

NA indicates restriction not binding.
1 Cointegrating equation(s): Convergence achieved after 102 iterations.

Restricted cointegrating coefficients (standard error in parentheses)

LRMNOY	LGDPGP	LINFL	LNFA	LTBILLS	LNER	LDDEBT
1.000000	-0.514715	-0.410029	-1.591418	-0.874075	-0.340600	-0.034159
(0.00000)	(0.37153)	(0.17456)	(0.24456)	(0.26801)	(0.37405)	(0.16301)

vector error correction (VEC) model without the fear of losing the long-run properties of the data. Restrictions are imposed to recover the structural dynamics of the model and estimate the VEC model to correct for the short-run adjustments to the long run in the VAR and compare results of the VEC with the results from the structural VAR. The findings from the two estimations show that the impulse responses from the two estimations are not significantly different. Therefore, the study concentrates on the interpretation of the SVAR results.

The main purpose for using a SVAR is to obtain non-recursive orthogonalisation of the error terms for the impulse response analysis. This alternative to the recursive Cholesky decomposition requires the user to impose enough restrictions to identify the orthogonal (structural)

components of the error terms. The following restrictions are imposed in the AB matrices (Giannini, 1992; see Appendix 1)

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & \lambda_{27} \\ 0 & \lambda_{32} & 1 & 0 & 0 & 0 & \lambda_{37} \\ 0 & \lambda_{42} & \lambda_{43} & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & \lambda_{57} \\ 0 & 0 & \lambda_{63} & \lambda_{64} & \lambda_{65} & 1 & \lambda_{67} \\ \lambda_{71} & \lambda_{72} & \lambda_{73} & \lambda_{74} & \lambda_{75} & \lambda_{76} & 1 \end{bmatrix} \begin{bmatrix} e_{debt} \\ e_{gdpgap} \\ e_{inflation} \\ e_{Tbills} \\ e_{NFA} \\ e_{NER} \\ e_{D} \end{bmatrix} = \begin{bmatrix} \beta_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \beta_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{77} \end{bmatrix} \begin{bmatrix} \varepsilon_{debt} \\ \varepsilon_{gdpgap} \\ \varepsilon_{inflation} \\ \varepsilon_{Tbills} \\ \varepsilon_{dNFA} \\ \varepsilon_{NER} \\ \varepsilon_{D} \end{bmatrix}$$

..... (3)

Identification of this model would require at least

$$2n^2 - \frac{n(n+1)}{2} = 2 \times 7^2 - \frac{7(7+1)}{2} = 70$$

restrictions (including the 1s along the leading diagonal in the A matrix; n - the number of variables in the model). If it has 70 restrictions, then the model is exactly identified. Seventy-five (75) restrictions are imposed in this model implying that it is overidentified with 23 parameters to be estimated. This means, therefore, that no identification problems are envisaged. The diagonal elements in the B matrix are used to scale the structural errors so as to achieve orthonormality; i.e., its covariance matrix is an identity matrix.

The zeros in the matrix show that the variable with zero coefficients does not enter in the relevant equation contemporaneously. The above formulation nests various assumptions on the monetary policy operating procedures of the CBK. The first row shows the domestic debt equation, which is taken as exogenous in this model and is determined outside the model. The second equation states that changes in the GDP gap are affected contemporaneously with the changes in money supply. In the third row, changes in inflation are only influenced contemporaneously by the changes in domestic credit and GDP gap. The fourth equation

can be used to describe the Taylor-type feedback rule (reaction function) of the monetary authorities. It is assumed that the monetary authorities will change the Treasury bill rates in response to changes in GDP gap and inflation gap. Treasury bill rates in this case are used as a monetary policy reaction tool. The fifth row shows that changes in the net foreign assets are only contemporaneously related to the changes in domestic credit. Changes in the nominal exchange rates in the sixth equation are influenced by the changes in money supply (domestic credit), price levels (inflation), changes in the country net foreign assets position, the GDP gap and changes in the Treasury bill rates as interest differential changes attract capital inflows (outflows).

The last row, therefore, assumes that monetary policy changes (changes in the levels of domestic credit) will be influenced by the changes in all the model variables. It is expected that increases in domestic public debt "crowding out" credit to the private sector. In this case, we expect a negative relationship between private sector credit and public domestic debt. A significant relationship between public domestic debt and the policy variable of the CBK may reflect the role of fiscal pressures in driving monetary policy in Kenya. An increase in the gap between potential GDP and the actual GDP would imply less than "full employment" of resources. This would call for the monetary authority to increase money supply in the economy in order to create demand for increased production. In this case, the expectation is that changes in the GDP gap are directly related to the changes in the levels in domestic credit. The relationship between the nominal exchange rates and money supply can be traced to the quantity theory of money. If an economy is experiencing depreciated exchange rates and would like to use monetary policy to appreciate the rates, then the country has the option of restricting its monetary policy to achieve this end. Restricting money supply, for instance by constraining the level of domestic credit in the economy, has the effects of increasing domestic interest rates and

increasing interest rate differentials. This triggers capital inflows thereby appreciating the exchange rate. In this case, the expected coefficient of the nominal exchange rate variable is positive. In other words, to appreciate the exchange rate, the monetary authorities must restrict money supply (monetary policy) and to depreciate the currency the reaction of the Central Bank would be expansionary. Domestic credit freeze would be expected as inflation rises; freezing domestic credit is equivalent to restricting money supply in order to mitigate inflationary pressures in the economy. The expected coefficient of inflation is, therefore, positive. To balance the balance sheets of the monetary authorities, decreases in net foreign assets will be sterilised by increases in domestic credit.

The other monetary policy reaction equation has reserve money as the endogenous variable with the same theoretical underpinnings as above.

4.2 Major observations from the SVAR estimations results

The impulse responses from the estimation of the SVAR are reported in Figure 4.3. In this sub-section, an analysis is made of the impact of changes in the macroeconomic variables, particularly inflation, exchange rates and output gap on monetary policy.

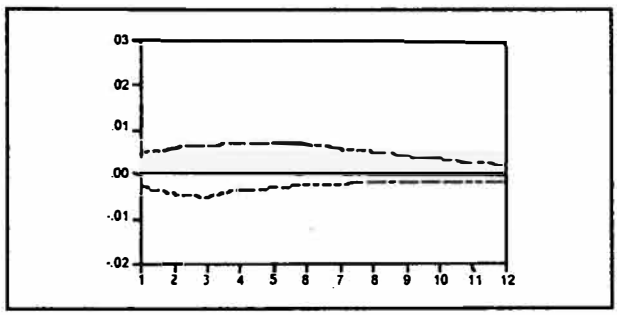
The impulse response graphs in Figure 4.3 indicate how monetary policy reacted to different shocks over time. Domestic credit is used as the monetary policy tool using the sample from 1966 to 2003. Graph (c) gives the relationship between inflation and domestic credit. It shows that the reaction of monetary policy to changes in inflation, assuming the CBK used domestic credit as the instrument of policy, has been inverse. This means that when inflation has been rising, domestic credit has not fallen to mitigate the impacts of the rising inflation; domestic credit has been rising instead. Figure 4.4, which represents the sub-sample 1966-1990, confirms this apparent inconsistency in policy reaction. The figure also

uses domestic credit as the monetary policy tool with the sample 1966-1990. Graph (c) (Figure 4.4) also shows the reaction of monetary policy when domestic credit is used as the instrument of policy due to inflationary changes.

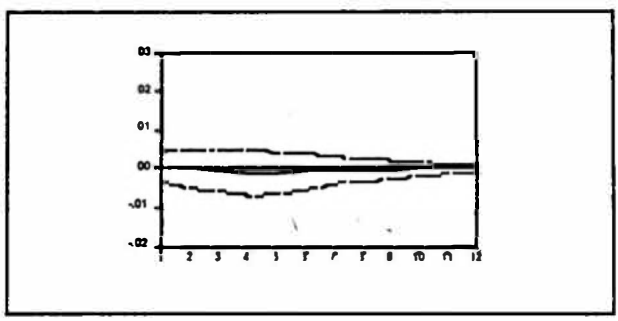
Figure 4.3: Response of domestic credit as the monetary policy tool to the various shocks, 1966-2003

Response to structural one s.d. innovations ± 2 s.e.

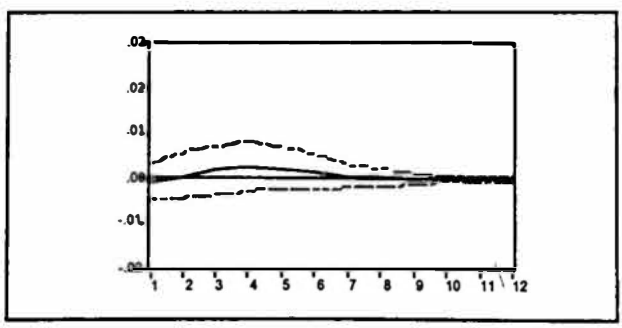
(a) Response of domestic credit to domestic debt



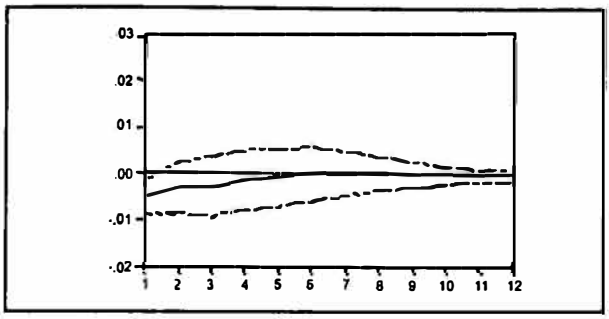
(b) Response of domestic credit to GDP gap



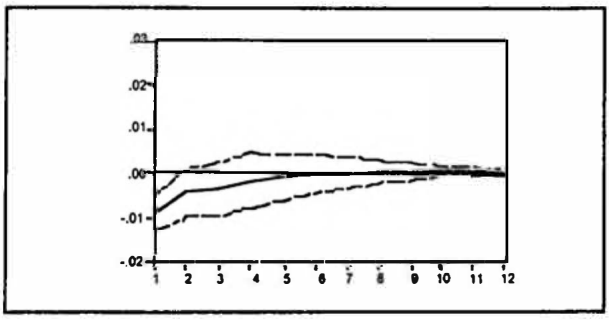
(c) Response of domestic credit to inflation



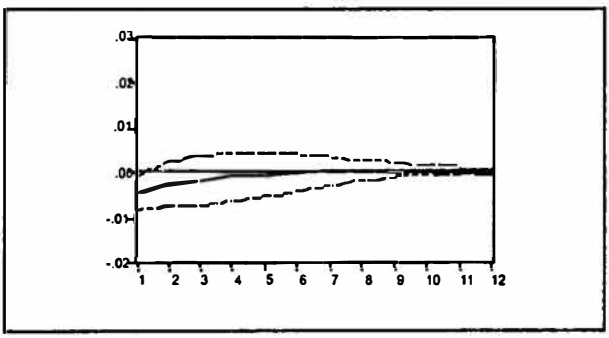
(d) Response of domestic credit to Tbills



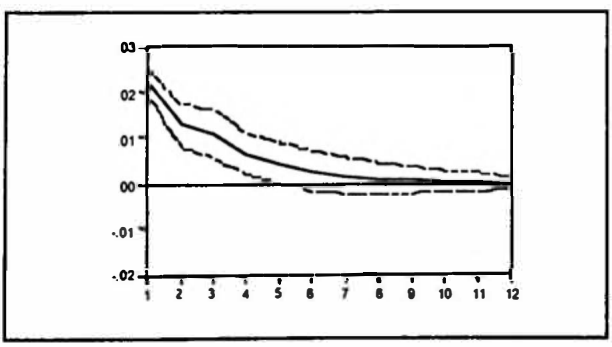
(e) Response of domestic credit to net foreign assets



(f) Response of domestic credit to exchange rates



(g) Response of domestic credit to domestic credit

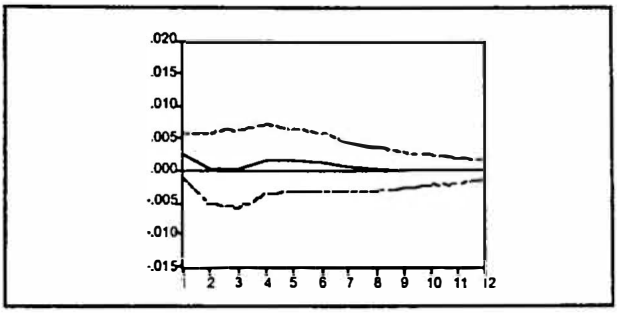


Graph (b) in Figure 4.3 shows the reaction of monetary policy to changes in the output gap. The graph shows that monetary policy reaction to the changes in output gap, assuming the CBK used domestic credit to minimize deviations in the gap, was not significant. This is seen from the fact that the impulse line in the graph runs around the zero line for most of the quarters. This shows that monetary policy in this period did not react to the changes in the GDP gap.

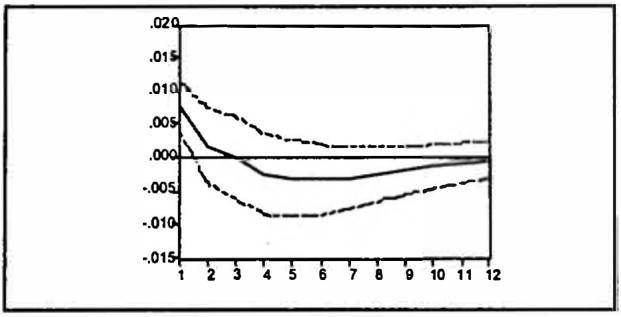
Figure 4.4: Using domestic credit as the monetary policy tool with the sample 1966-1990

Response to structural one s.d. innovations ± 2 s.e.

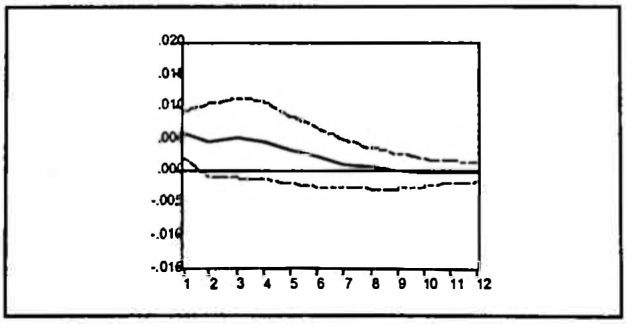
(a) Response of domestic credit to domestic debt



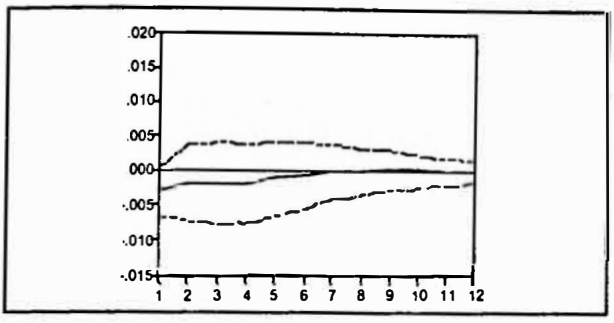
(b) Response of domestic credit to GDP gap



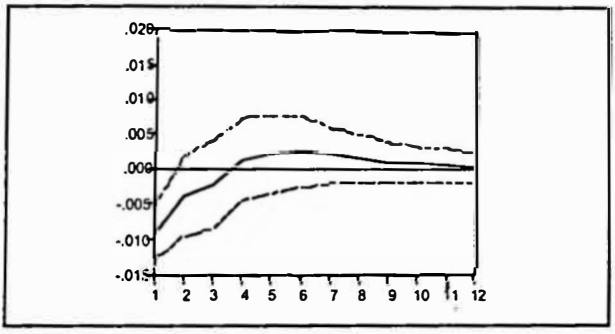
(c) Response of domestic credit to inflation



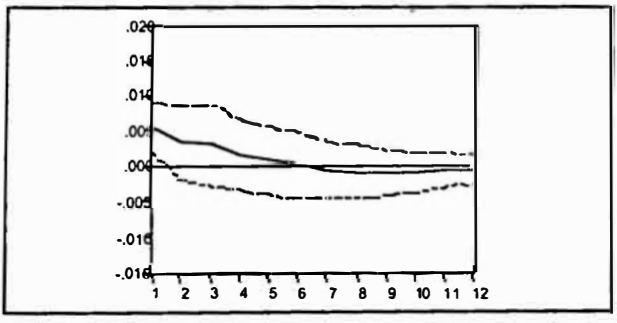
(d) Response of domestic credit to T bills



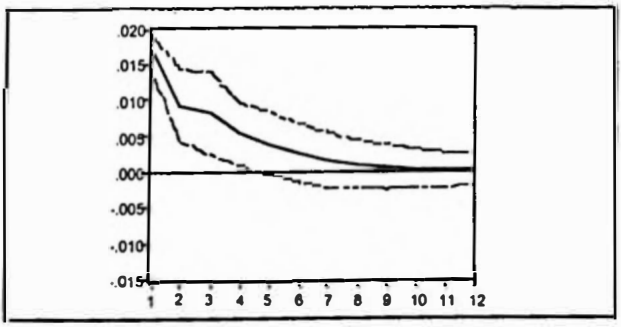
(e) Response of domestic credit to net foreign assets



(f) Response of domestic credit to exchange rates



(g) Response of domestic credit to domestic credit



For the period 1966-1990, monetary policy reaction to the changes in the gap was in most of the period contractionary as the gap widened (Figure 4.4, Graph (b)). This is seen from the impulse in the graph, which is contrary to expected reaction when the gap is widening. A widening GDP gap shows potential for expansionary monetary policy as potential output is greater than the actual output.

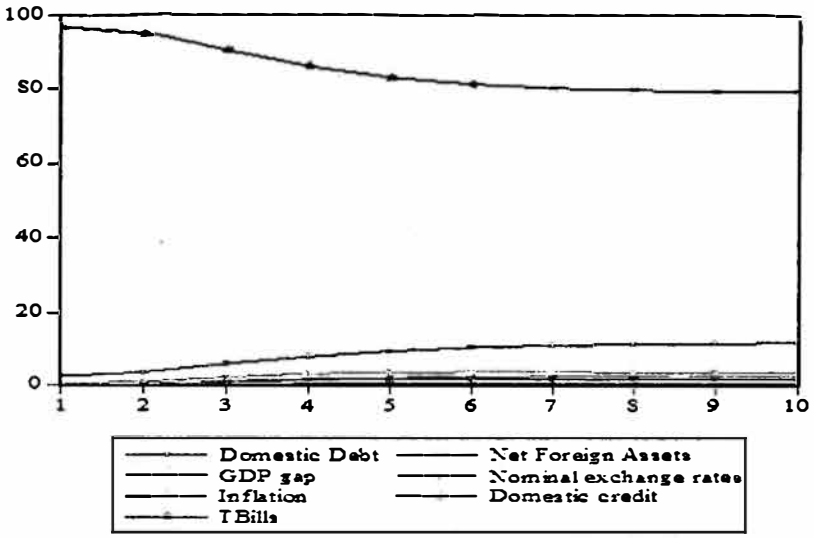
One major objective of the CBK is price stability. To ensure stability in prices, monetary expansion (contraction) should be programmed in line with the inflationary gap. On the other hand, if the CBK aims at stabilising output, it will react to the output gap. If the actual output is below the potential output (the output gap is negative), then this means that there are still resources in the economy that can be exploited by expansionary monetary policy without fears of inflationary pressures. It is expected, therefore, that the monetary authority will react with expansionary policies when the gap is negative. This gives a direct relationship between the gap and monetary policy (domestic credit or reserve money). If the gap is negative then the scope for monetary expansion is limited.

For the two periods (Figures 4.3 and 4.4) the responses of monetary policy to positive changes in the exchange rates are inconsistent. In Figure 4.3, the response is negative (contractionary for a depreciating currency) while the response is expansionary for a depreciating currency (Figure 4.4). This shows that monetary policy reaction to exchange rate changes has not been systematic but random over time.

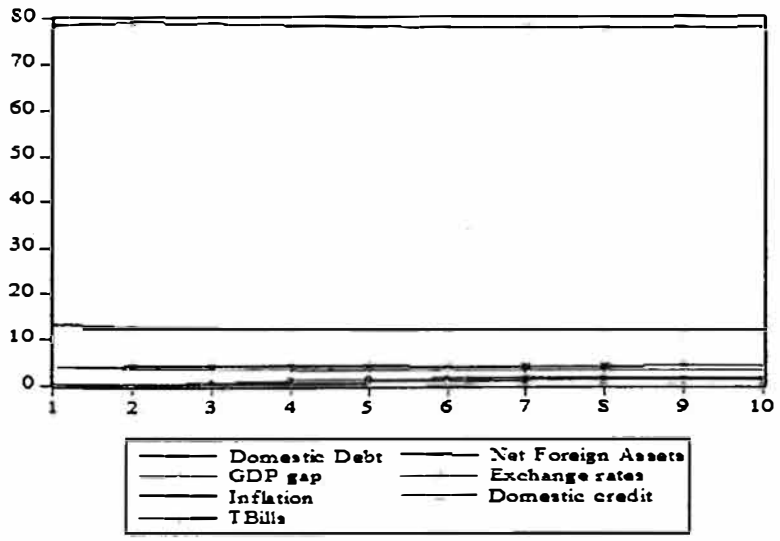
The variance decomposition of the shocks on the variables helps to determine the proportion of the variance in a series that is due to its own shock, the policy shock and other identified shocks. It does so by allocating weights to each identified shock in the system at every forecast horizon for a particular variable. The sources of the variance in the Treasury bill rates and on domestic credit are analysed in Figure 4.5. Using domestic credit as the instrument of monetary policy, the sources

Figure 4.5: Variance decomposition of the changes in domestic credit with the sample, 1966-2003

(a) Variance decomposition of Tbill rates



(b) Variance decomposition of domestic credit



of monetary policy change during the period are established. The variance decomposition graphs for both the samples show that the variations in the Treasury bill rates are dominated by the shocks from domestic debt with the greatest contribution of the variations. The second largest major shock comes from the GDP gap, followed by domestic credit and inflation. The other variables only contribute modestly to the variations in the Treasury bill rates. The inference here is that changes in monetary policy (assuming that the CBK uses the Treasury bill rates to influence the direction of monetary policy) majorly depend on the activities in the domestic debt market, which on the other hand are driven by the fiscal policies in place. This reflects the importance of the fiscal pressures on monetary policy in Kenya.

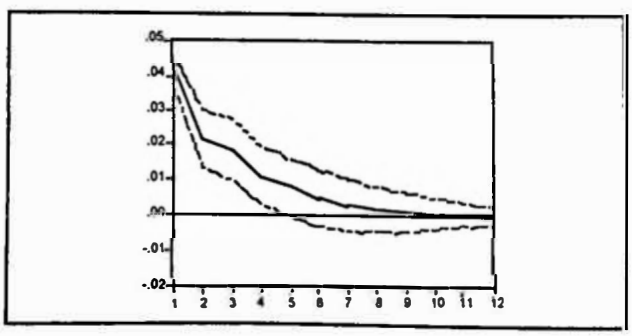
The variance decomposition of domestic credit shows that the variations in domestic credit mainly come as a result of changes in the net foreign assets followed by Treasury bill rates and exchange rates (Figure 4.5). Accordingly, changes in NFA are viewed by monetary authorities as being more important than changes in other variables including inflation, GDP gap and domestic credit.

Using reserve money as the instrument of policy gives the impulses as shown in Figure 4.6.

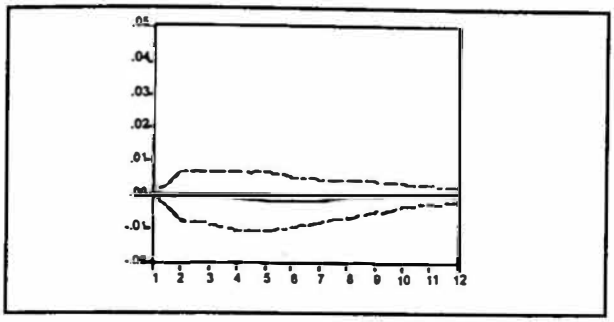
Figure 4.6: Using reserve money as the monetary policy tool (1966-2003)

Response to structural one s.d. innovations ± 2 s.e.

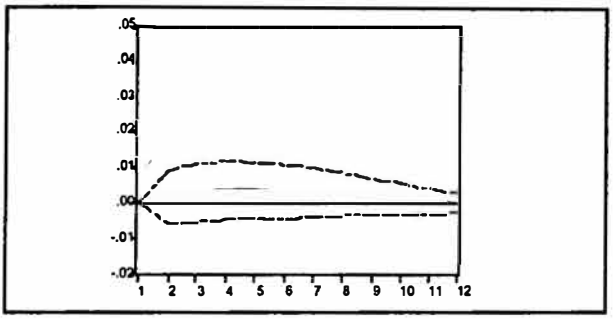
(a) Response of reserve money to shocks from reserve money



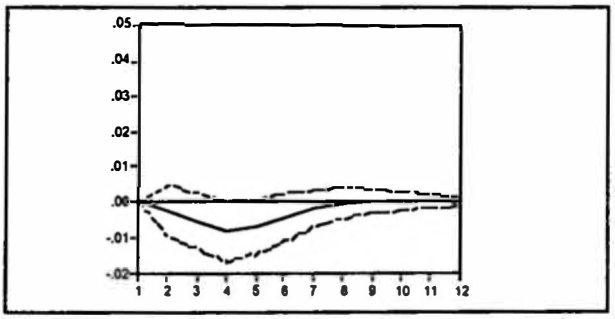
(b) Response of reserve money to shocks from GDP gap



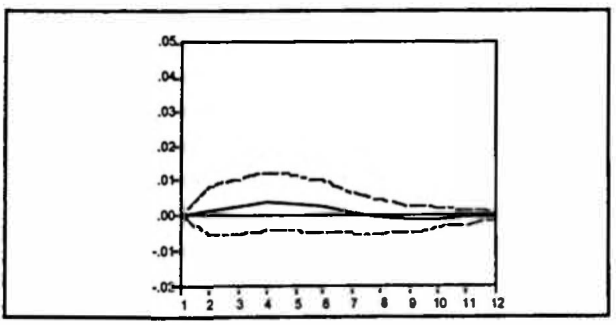
(c) Response of reserve money to shocks from domestic debt



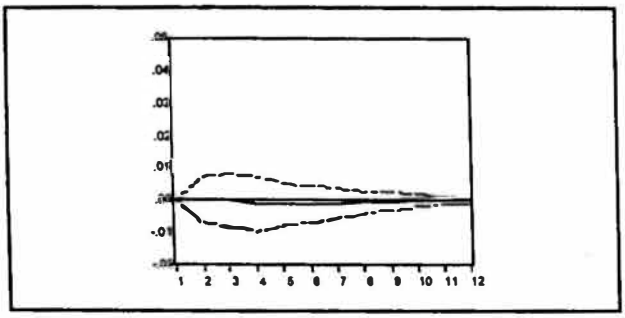
(d) Response of reserve money to shocks from inflation



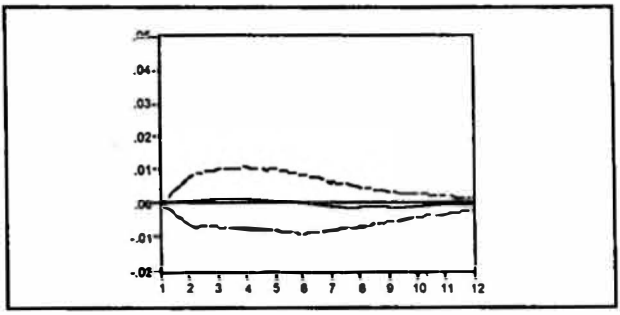
(e) Response of reserve money to shocks from exchange rate



(f) Response of reserve money to shocks from net foreign assets



(g) Response of reserve money to shocks from T bills

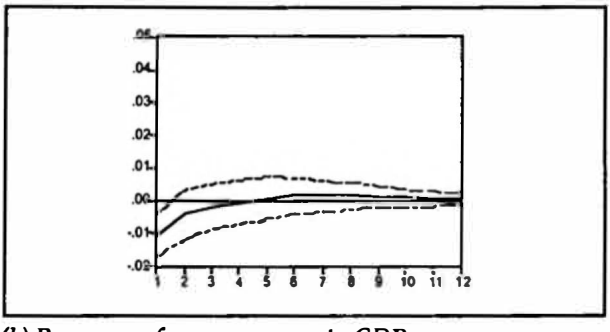


The results show that monetary authority reacted by restricting reserve money when output gap increased (Graph (b)). It reveals the lack of emphasis on output stabilisation.

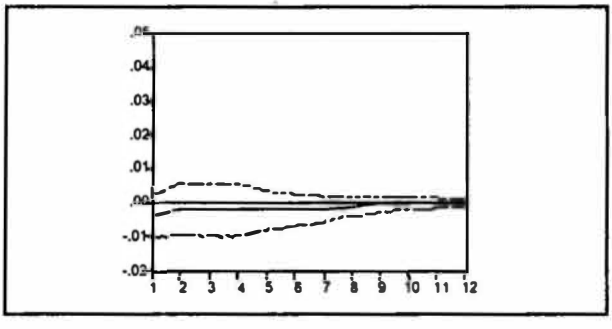
Graph (d) in Figure 4.6 and Graph (c) in Figure 4.7 both give the impulse response of monetary policy to the changes in inflation when reserve money is used as the policy instrument for the periods 1966-2003 and 1990-2003, respectively. The two graphs show that monetary policy has been contractionary as inflation rises. This is consistent with expectations. However, Graph (c) in Figure 4.7 indicates that monetary policy only reacts after two quarters of the change in inflation. It is not instant, therefore indicating policy lags.

Figure 4.7: Using reserve money as the monetary policy tool with the sample, 1990-2003
Response to structural one s.d. innovations ± 2 s.e.

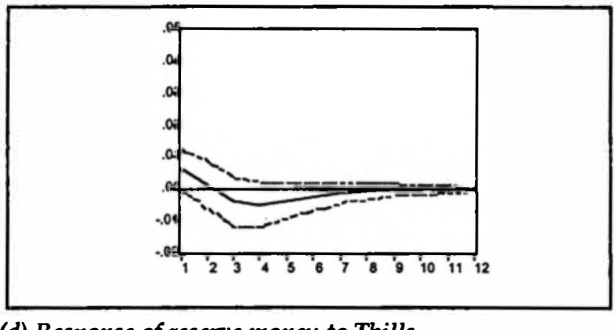
(a) Response of reserve money to domestic debt



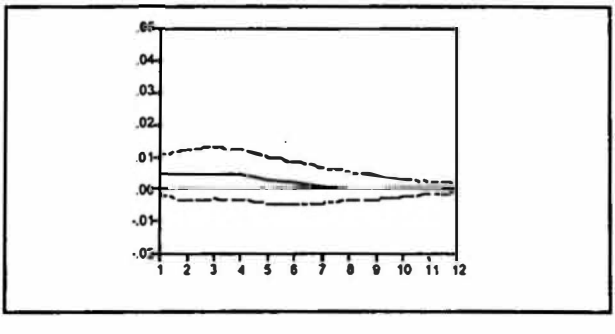
(b) Response of reserve money to GDP gap



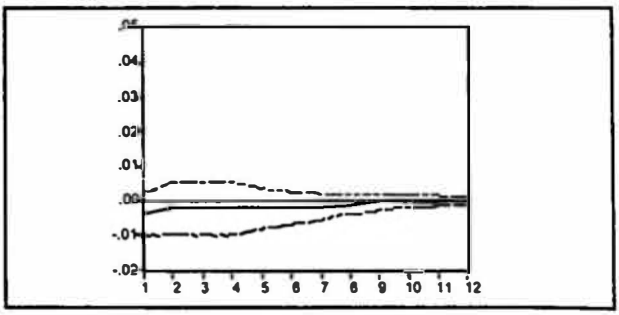
(c) Response of reserve money to inflation



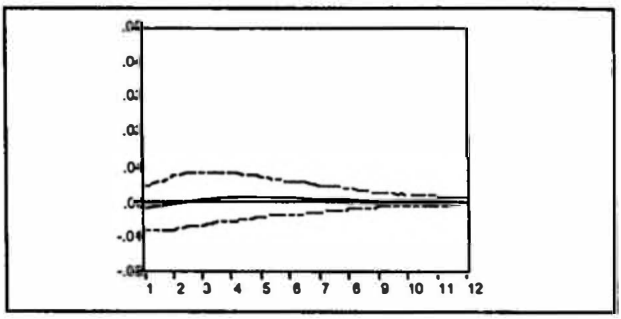
(d) Response of reserve money to Tbills



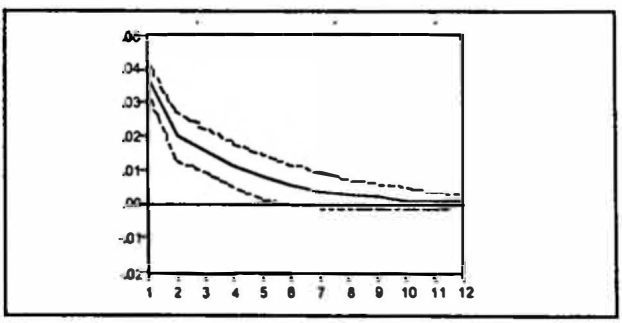
(e) Response of reserve money to net foreign assets



(f) Response of reserve money to exchange rates



(g) Response of reserve money to reserve money



Graph (e) in Figure 4.6 and Graph (f) in Figure 4.7 both give the response of monetary policy to the changes in the exchange rates when reserve money is used as the policy instrument for the periods 1966-2003 and 1990-2003, respectively. The impulses show that monetary policy reaction to depreciations in the exchange rate (positive shocks on the exchange

rate) has been expansionary. It is expected that the CBK would increase money supply to mitigate the effects of a depreciating currency. This reaction is, therefore, consistent with expectations.

The results from this analysis also show the prominence of fiscal pressures on the monetary policy operations and that there is a lagged response of monetary policy due to inflationary pressures. The response of monetary policy due to the changes in the GDP gap is inconsistent with the expectations. The response of monetary policy to the positive changes in the Treasury bill rates are expansionary, giving further evidence of fiscal pressures on monetary policy.

5. Conclusion and Policy Recommendations

5.1 Conclusion

This study set to estimate the monetary policy reaction functions (MRF) for Kenya in order to establish how the monetary authority has reacted to different macroeconomic changes over time. The objective was to establish whether CBK has reacted consistently in a systematic way or whether its reactions have only been random with no clear policy directions. Quarterly data from 1966 to 2003 was used in the vector error correction model and structural vector autoregressions to analyse CBK's MRF. Results indicate that the reaction of monetary policy to changes in inflation, assuming the CBK used domestic credit as the instrument of policy, has been inverse. This implies that when inflation has been rising, domestic credit has not fallen to mitigate the impacts of the rising inflation.

Further, the results have shown that the reaction of monetary policy to changes in the output gap using domestic credit as the monetary policy instrument to stabilise output, was not significant. Monetary policy over this period did not react to changes in the output gap. For the period 1966-1990, monetary policy reactions to the changes in the output gap was, in most of the period, contractionary as the gap widened. A widening GDP gap shows potential for expansionary monetary policy, as potential output is greater than the actual output. The analysis shows that if CBK was using domestic credit as the instrument of policy, the reaction of monetary policy was inconsistent with expectations.

Analysing the sources of the shocks in the Treasury bill rates and on domestic credit with a view to establishing why monetary policy changed during the period, the variance decomposition analysis showed that the variations in the Treasury bill rates are dominated by the shocks from domestic debt. The other variables contributed modestly to the variations in the Treasury bill rates. The inference here is that changes in monetary

policy (assuming that the CBK uses the Treasury bill rates to influence the direction of monetary policy) majorly depend on the activities in the domestic debt market, which on the other hand are driven by fiscal policy. This implies that fiscal pressures have a major impact on monetary policy in Kenya. There is need for the CBK to delink its operations from the fiscal operations because monetary policy, driven by the fiscal policy, cannot be able to achieve its primary objectives.

The results also show that monetary policy was not consistent in its reaction to shocks in the exchange rates in different periods. In one period, the response is negative (contractionary for a depreciating currency) while the response is expansionary for a depreciating currency in another period. This shows that monetary policy reaction to exchange rate changes has not been systematic but random over time.

The results also indicate that changes in monetary policy are dominated by changes in NFA. This could be interpreted to mean that the CBK considers changes in NFA more important than the changes in the other macroeconomic variables.

5.2 Policy recommendations

1. The CBK should design monetary policy to take into account the growth potential of the economy.
2. A better coordination between fiscal and monetary policy is important if fiscal operations are not to undermine monetary policy operations.
3. The unsystematic response of monetary policy to changes in exchange rate calls for further investigations on the importance of exchange rate in realising monetary policy objectives.
4. That changes in monetary policy are dominated by changes in NFA calls for a study to establish the strength of current monetary policy

against external influence, especially the adjustment to interest rate differentials, which might influence capital inflows. Due to increased integration between domestic and international financial markets, there exists increased possibility of substitutability between domestic and foreign assets with inherent potential to weaken monetary policy. Knowledge about this will be important for monetary policy effectiveness.

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Appendix

Appendix 1: Structuralisation methods in the AB model

A, B are (nxn) invertible matrices

$$BA(L)y_t = B\varepsilon_t$$

$$B\varepsilon_t = Ae_t$$

$$B(\varepsilon_t\varepsilon_t')B' = A(e_te_t')A$$

The structural innovations are assumed to be orthonormal, i.e., its covariance matrix is an identity matrix

$$E(\varepsilon_t\varepsilon_t') = I_n$$

The assumption of orthonormal innovations imposes the following identifying restrictions on A and B.

$$A\sum A' = BB', \text{ where } \sum = E(e_te_t')$$

This imposes a set of $2n^2 - \left(\frac{n(n+1)}{2}\right)$ non-linear restrictions on the parameters of the A and B matrices. This leaves $\frac{n(n+1)}{2}$ free parameters to be estimated.

Source: Giannini, C. (1992)

Appendix 2: Evolution of Monetary Policy in Kenya

Period	Macroeconomic Environment	Monetary policy framework	Intermediate targets	Monetary policy instruments
1966-70	No serious macroeconomic problems, save for balance of payments deficit experienced in 1967 and 1969: - Growth averaged 8% - Inflation was low at 2% government budget was in surplus	Domestic credit control under a fixed exchange rate regime	Domestic credit	Minimum liquidity ratio fixed at 12.5% of commercial banks deposit liabilities
1971-75	- Balance of payments difficulties experienced, especially after the first oil crisis in 1973/74 - Inflation pressures emerge, reaching 15.5% in 1975	Domestic credit control under a fixed exchange rate regime	Domestic credit	-Required reserve (cash ratio) imposed at 5% but later removed in 1972. -Liquidity ratio raised to 15% -Devaluation of the shilling exchange rate -Moral suasion: Commercial banks instructed to reduce lending to import sector and foreign controlled firms and, instead, increase lending to agriculture, export trade, tourism, and agro-based manufacturing
1976-77	-Balance of payments surpluses due to commodity boom brought about by high coffee and tea prices	Domestic credit control under a fixed exchange rate regime	Domestic credit	- Minimum liquidity ratio raised to 18% - Interest rates control imposed with maximum lending rate fixed at 10%

	-Incipient inflationary pressures arising from commodity boom			
1978-84	- Spillover of liquidity arising from commodity boom of 1976/77 threatens a balance of payments deficit and inflationary pressures - GDP growth started to slow down towards the end of this period - Government budget deficit reached 8% of GDP	Domestic credit control under a fixed exchange rate regime	Domestic credit	Initially, to stem excess liquidity, minimum liquidity ratio was adjusted to 20% and required reserve ratio re-imposed at 4%. -Discount rate increased to 7.5% from 6% -Later, towards the end of the period when liquidity eased, liquidity and required ratio requirements were reduced to 16% and 3%, respectively
1985-92	Continued weak budgetary position puts pressure on balance of payments and inflation	Domestic credit control under a flexible exchange rate regime	Domestic credit and money supply (M2)	-Open-Market Operation through Treasury bond of one, two and five year maturities -Required reserve ratio was raised to current level at 10% -Interest rate deregulated in 1991
1993 to date	-Persistent balance of payments problems and structural constraints necessitated economic and financial deregulation -Excess liquidity injected in the run-up to multi-party democracy in 1992	Base-money targeting under a floating exchange rate system	Broader monetary aggregates: Initially M3, and later M3X	-Required reserve ratio raised to the statutory limit of 20% by 1995 -Active Open Market Operation – Primary and secondary operations -Use of rediscount facilities at the CBK -Foreign exchange interventions

Source: Kinyua (2001)