THE CENTRAL BANK'S ABILITY TO CONTROL MONEY SUPPLY AND ITS IMPLICATION FOR THE EFFECTIVENESS OF MONETARY POLICY.

BY

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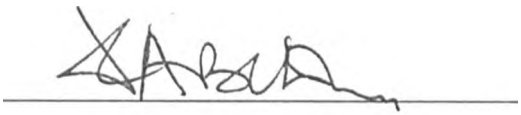
This research paper is my original work and has not been presented for a degree in another University.



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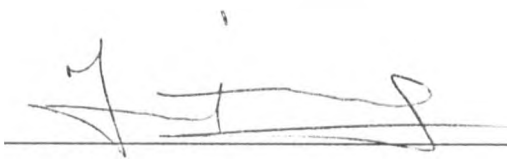

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Abstract

In this paper, the role of the money multiplier in the process of money supply control is explored. some hypotheses concerning the determinants of the behaviour of the non-bank public and the banking sector are discussed.

Empirical analysis based on a model of two equations that try to explain the behaviour of banks and the public is carried out. Annual secondary data for the period 1972-90 is used. Findings obtained indicate that to a certain extent, the behaviour of the non-bank public and the banking sector can be made. Results obtained also indicate that further research into the explanatory variables is still called for particularly as it relates to the indices used as proxies to represent such variables.

The paper is organised into five chapters. Chapter one deals with background and introductory remarks and includes the statement of the problem, objectives of the study and its justification. Chapter 2, surveys the literature related to the subject; chapter 3 gives the theoretical framework and the model specification. Chapter 4 analyses the results obtained in light of the hypotheses stated. And chapter 5 gives the summary, conclusion and policy implications.

CHAPTER I

1.1 Introduction

Economists now appear agreed that "Money matters" that is, money exerts a strong influence on important economic variables such as output, employment prices and so on[1]. One result of the volumes of research on this subject is the suggestion that monetary authorities could best achieve ultimate economic objectives such as full employment and stable prices, by controlling the growth rate of money stock[2]. There is, however, substantial disagreement as to the extent to which money matters (that is the size of the multiplier). On the one hand, economists of monetarist persuasion argue that changes in the stock of money are a primary determinant of changes in total spending, while on the other hand, non-monetarists though they may readily admit that money matters also regard changes in the various components of aggregate demand as having an important influence on the level of economic activity, they therefore place as much emphasis on fiscal policy as on monetary controls. Thus it would therefore appear that there is a spectrum of views ranging from "money matters little" to "money alone matters".[3]

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1 OJO, O. 1975 P. 19

2 BURGER, A-E, KALISH, L. and BABB, C.T. (1971) P. 6

3 PARK, Y.C (1972) P. 1

Many countries are concerned with economic stabilisation programmes and in pursuit of this objective it becomes imperative that the money stock is a policy variable that authorities should target. This is more so for developing countries where the keynesian transmission mechanism may not work due to the thinness of the financial markets. The importance of this variable cannot be overemphasised as can be noted from Laidler's (1978) assertion that, "..... it has been those countries which have paid most attention to the behaviour of money supplies that have suffered the least from instability in money income, and those which paid the least attention to monetary policy that have experienced the most instability in money income".

Countries therefore have come to accord great importance to monetary policy in their desire to achieve macroeconomic stabilisation. Monetary policy framework while basically the same in all countries however, is highly differentiated when money supply process is considered as it is dependent on a variety of factors. Some of these factors include the degree of openness of the economy, level of development of the financial markets, their degree of integration and so on.

For this reason, one would expect that the approach to monetary policy formulation would be varied for different economies depending on the nature of their financial systems.

To a large extent, the Central Monetary authority can influence the supply of the monetary base (or high-powered money). This is composed of currency held by non-bank members of the public and commercial bank reserves (liquid assets).

In general, the public has a preferred ratio of currency to deposits whereas banks have a desired ratio of reserves to deposits. In this regard, the total money stock that can be supported by a given monetary base can be calculated with the help of the money multiplier. The money multiplier may be defined as the ratio of the stock of money (money supply) to the stock of high-powered money.[4] The money stock may therefore be presented thus:

$M = m.B$

Where m = the money multiplier, and B = Stock of high-powered money or monetary base.

One way of controlling the money supply therefore is for Central Bank to specify its desired level of money stock, forecast the multiplier and adjust the monetary base accordingly. The Central Bank's control of the money supply, therefore requires accurate prediction of the multiplier (by estimating the behaviour of its currency, required reserve, and excess reserve components)

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[4] BORNBUSCH and FISHER (1988) P. 18

and control of the base.[5] However, economic variables do not behave in an exact manner. The behaviour of money supply reflects a complex, interaction of various sectors of the economy and can be fully analysed as an integrated part of the general economic system.

In this study we have focused on the money multiplier and its components. The multiplier framework goes along way in simplifying and explaining the interactions which help shape money's behaviour when used with due care and attention to the interactions of the various sectors.[6] Annual time series data covering the period 1972 - 1990 is used to analyse the behaviour of this component.

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5 COATS and KHATKHATE (1980) P. 18

6 COATS and KHATKHATE OP CIT P

The table below shows the annual growth rates for various components of money supply.

Year	Currency (%)	Total Deposits (%)	M_2 (%)
1971	6.2	9.3	7.6
1972	20.8	10.9	13.9
1973	9.8	28.6	24.7
1974	10.6	8.7	8.8
1975	13.6	17.9	17.1
1976	31.7	22.5	24.1
1977	34.3	46.8	46.8
1978	5.6	15.8	13.7
1979	16.0	13.0	16.1
1980	13.4	2.1	(1.2)
1981	17.7	12.0	13.3
1982	4.3	17.2	16.1
1983	9.6	5.7	4.9
1984	7.0	13.9	12.9
1985	15.3	11.0	6.7
1986	26.5	25.9	32.5
1987	20.7	8.5	11.2
1988	11.0	10.9	7.9
1989	13.1	20.8	12.9
1990	12.2	11.8	20.0

Source: Central Bank of Kenya: Quarterly Economic Reviews.

A glance at the table will note that, the behaviour of the components though it depicts a general growth trend, shows that the growth is erratic. In 1976/77 for example, there was a big swing in all the components indicating the important role played by variations in the external position of the economy i.e. movement in exports, imports and capital. In this case, the movement was due to exports arising from the coffee booms where the proceeds found their way into the domestic liquidity in form of either currency or deposits.

1.2 Statement of the problem

The stock of money or money supply is the outgrowth of the behaviour of the non-bank public, the banking sector as well as the actions of the Central Bank. In most less developed countries, a large part of the stock of money is held in the form of currency.[7] The interaction of the three units and the significance of each in the determination of money supply will vary depending on the state of the economy. In developed countries, the public's holding of currency relative to total money stock would be relatively insignificant. Our research problem is to understand the behaviour of the non-bank public and the banking sector in determination of the monetary base and hence the money supply. We therefore estimate equations which describe the behaviour of the two units.

1.3 Objectives of the Study

The study seeks to:

i) Specify a model delineating the factors that influence the money multiplier.

ii) Estimate the model specified in (i) determining the relative significance of the factors which influence the money multiplier.

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[7] PARK, Y. C. (1973) P. 399.

iii) On the basis of (i) and (ii) make appropriate suggestions on the conduct of monetary policy for Kenya.

1.4 Justification and Significance of the Study

Any policy action undertaken by the government be it fiscal or monetary should give predictable results. Even though economic variables do not behave in an exact manner, a policy maker should know the consequences of certain courses of action, other things being equal. In this regard, it is our contention that the money multiplier model specified and estimated would go along way in assisting the policy maker design appropriate monetary policy. Unless the behaviour of the variables that affect the money multiplier is explained, it is not possible to know why the changes in the money multiplier come about at all.[8] As noted in the introduction, the multiplier framework goes along way in simplifying and explaining the interactions which help shape money's behaviour.

In a developing economy like Kenya, where the financial market is too thin (underdeveloped) and authorities necessarily have to use various regulatory measures, it is even more desirable to be able to tell the consequences of any one policy instrument. Successful monetary policy management requires

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[8] KHATKHATE and VILLANUEVA (1972) P. 125.

effective "control" of money supply where "control" here is defined as the ability of the authorities to influence the level of money supply through deliberate manipulation of the relevant variables.

The specification and estimation of a money multiplier for Kenya could therefore be justified on the grounds stated above.

CHAPTER II

LITERATURE REVIEW

2.1 Literature Review

Ever since the problems of less developed countries came to the forefront in the period after the war, considerable attention has been focused on the importance of money and monetary policy in relation to economic development.[9] Despite the fact that a lot has been written on the subject of money and monetary policy, considerable amount of work done is still shrouded in controversy. A considerable divergence of opinion has existed as to the direction and shape of monetary policy that may be adopted to speed up development process. On the subject of money supply, some of the controversies emanate from the definition of money stock on the one hand, as an endogenous variable reflecting the behaviour of the banking sector and other economic units and on the other, as an autonomous variable controlled by the authorities as a stabilisation instrument.

Writings on the subject of money supply while acknowledging the important role of the money multiplier in determining money stock, seem agreed that the multiplier is non-constant. One of these writers is Jordan (1970) who stated

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9 KHATKHATE 91972) IMPF Staff papers Vol. 19 No.3

that the factors that cause changes in the money multiplier are the same factors that influence currency, time deposits, government deposits and the reserve ratios which are all behavioral parameters. He contends that lack of constancy of the monetary multiplier make the Central Bank's task of determining the money supply difficult. In this regard, the Central Bank must predict the value of the multiplier in order to know how much to increase the monetary base to achieve a desired level of the money stock. The article does not go into the techniques of predicting the money multiplier. He concludes that the degree of accuracy that can be achieved by the monetary authorities in controlling the money stock is a function of their ability to determine the monetary base, and to predict the net influence of the public's and bank's behaviour as summarised by the multiplier.

Burger et al (1971) carried out a study on the control of money stock and its implications for monetary policy. Its concern was with the implementation of policy decisions. The procedure they developed involved the estimation of changes in the source base (or some other reserve aggregate) required to achieve the policy determined growth path for money.

The procedure requires only that the Federal Reserve System (American Central Bank) has information about the previous three months' of the money multiplier and the effect of reserve requirement changes. The procedure involves

estimating the changes in the source base required to achieve the policy determined growth path for money. the federal reserve would then operate on a day-to-day basis to determine the growth of the source base.

The procedure used is developed from a multiplier - base framework, where money stock (M) is expressed as

$M = mB$

where B denotes the net source base and m represents the money multiplier. The following forecasting equation for the money multiplier is specified:

$$m_t = b_o + b_1 X_{1t} + b2 X 2_t + \sum_{i=1}^{11} bi + d_i + p^U t\text{-}1$$

where X_1 = three months moving average of past value of multiplier;

X_2 = Reserve adjustment magnitude (to capture the effects of reserve requirement changes). They are positive when average reserve requirements fall and are negative when reserve requirements rise.

di = dummy variables to account for seasonal factors.

P = Correlation coefficient of consecutive error terms in the equation during the sample period.

U_t-1 = lagged value of the error in the estimate of money multiplier.

The coefficients b_i were estimated using OLS technique using the previous 36 months' observations.

In the procedure the Federal reserve decides upon the desired growth rate of money, converts this growth rate into desired money stock levels for control periods.

The researchers themselves admit that the policy makers must have some means of comparing the effects of different control procedures on their ability to achieve their policy objectives in order to decide which procedure is best.

Khatkhate and Villanueva (1972) carried out a study of the behaviour of the money multiplier in the United States. Justifying their study by stating that a distinction is often drawn between changes in money supply arising from changes in the monetary base and those emanating from the variations in the value of the money multiplier, they assert that only the former are reasonably regulated by Central Bank but changes induced by the latter tend to vary considerably.

The model they employ is a general one with a series of equations estimated. One equation on excess reserves of banks is specified thus:

$R^e = a_o + a_1 r^s + U_1; a_1 < 0$

Where R^e denotes excess reserves, r^s is interest on short term Treasury bills, and U_1 is the error term.

Upon estimation, they obtained the following results:

$R^e = .675 - 0.0666r^s$

(16.367) (7.2154)

$R^2 = 0.88841$, D-W = 1.7376, SEE 0.0437184

Another relevant equation they estimated is that of currency outside banks specified thus:

$C = C_o + c_1 r^2 + c_2 r^t + C_3 Y + c_4 (\dot{P}/P) + U_3, C_1 < 0$

Where C denotes currency outside banks,

r^s = interest on short term Treasury bills

r^t = interest on time deposits

Y = permanent income

$(\dot{P}/P)$ = rate of inflation

they obtained the following results:

$C = 5.3154 - 0.181292r^s + 0.0443361Y$

(2.03806) (3.6082) (16.2919)

$R^{-2} = 0.9994$, D-W = 0.9416, SEE = 0.162102

In the two equations, the R^2s are acceptable, coefficients are of the correct signs. However, the D-W for the second equation is not good. They conclude that, if the authorities have confidence in the value of the multiplier derived from the model, they can adjust the magnitude of their open market operations to desired changes in money supply, or they can implement a more aggressive discount rate policy, supplemented by quantitative ceilings in order to discourage bank borrowing.

The authors themselves appear sceptical about its use for predicting change in money supply. Its usefulness will depend on the stability in the value of the money multiplier and accurate forecasts of exogenous variables such as expected incomes. The general applications of their model must therefore be seen in this light.

"In recent years growth in the monetary aggregates, particularly in narrowly defined money supply M_1, has come to play a prominent role in the formulation of monetary policy". This statement was made by Levin (1973) in a review of the money stock control model developed by Burger et al (already reviewed

here). However, his concern is to compare the performance of this model with those of three other models developed within the reserve system. He found that the model performed poorly in predicting the monthly growth rate in the money stock. However, the model provided reasonably accurate control over the growth in quarterly average money.

Overall, none of the four econometric models compared, did well in monthly prediction of growth rate of M_1, but all do well at predicting the quarterly growth rate of M_1. In this respect therefore, the models usefulness must be seen in light of the weakness stated.

Khan (1974) carried out a similar study on the Venezuelan economy. The study presented the results of a short term model constructed for forecasting the whole economy. The model therefore was for the whole economy. However, the portion dealing with money supply, he specified it basically as a behaviourial function of the monetary base. It is assumed that the supply of money in period t is a linear function of reserve money R in period t, period t-1, period t-2 etc, following the pattern.

$M_t = mo + m_1(R_t + aR_t\text{-}1 + a^2R_{t-2} + ...) + e$

Where $0 \leqslant a \leqslant 1$

The variable m_1 is the money multiplier and upon estimation

He obtained $m_1 = -1.807 + 2.313R_t + 0.375M_{t-1}$

(5.23) (14.27) (7.10)

$R^2 = 0.994$ SE = 0.305

However, Khan's model specifies a linear relationship between reserve money and money supply. This assures no change in the behaviour of the public or banks, that is the money multiplier is constant. In such a model therefore, it becomes difficult to analyse the effects on money supply of monetary policy instruments such as legal reserve requirements and/or interest rate relations.

On the same economy i.e. Venezuela, Khatkhate et al (1974) developed a money multiplier model for the economy taking into account the behaviour of the non-bank public and the banking sector hence improving on the Khan model. The focus was an attempt to analyse the determinants of the money multiplier process using data covering the period 1950-70.

They specified two equations explaining the behaviour of the public and the banking sector thus,

$\text{Log } C/TD = a_o + a_1 \log RVZ + a_2 \log GDP,\ a_1, a_2 < 0$

$\text{Log } R/TD = b_o + b_1 \log RVZ + b_2 \log RUS, b_1, b_2 < 0$

Where C = currency outside banks

R = excess reserves

TD = total private deposits

GDP = gross domestic product

RVZ = domestic interest rate

RUS = foreign interest rate

The results obtained were thus;

$$\text{Log } C/TD = 2.8637 - 0.98569 \log RVZ - 0.60524 \log GDP$$
$$(15.56) \quad (4.83) \quad (7.06)$$
$$R^{-2} = 0.9695 \quad D\text{-}W = 1.7328, \quad SEE = 0.076166$$

$$\text{Log } R/TD = 0.087166 - 0.57764 \log RVZ - 0.98705 \log RUS$$
$$(0.14) \quad (1.18) \quad (3.88)$$
$$R^{-2} = 0.8249; \quad D\text{-}W = 1.4304; \quad SEE = 0.20312$$

As can be seen from the results, the R^{2s} are good. The Durbin-Watson statistic in the first equation indicates the absence of first order serial correlation, whereas in the second, the test is inconclusive.

Black (1975) basing his analysis on Britain while acknowledging that major determinants of money supply include monetary base and currency ratio, sought to examine the tradition of the British liquidity school which emphasises that money should include the deposit liabilities of banks and non-bank financial institutions.

He ran tests of the various determinants of money supply and confirmed that the currency ratio is an important determinant. Further, he found that the choice of the definition of money is an important consideration for monetary authorities. However, notwithstanding the importance of the choice of definition the impact of the currency ratio and the monetary base cannot be ignored. Should the monetary authorities opt for M_3 definition (inclusion of currency and reserves held by non-bank financial institutions) the authorities must be concerned with off-setting destabilising movements in the non-bank ratio (i.e. the deposit ratio of non-bank financial institutions).

Another study, on a developing economy is that of Ojo (1975) in an attempt to forecast the money multiplier for Nigeria. He contends that there is nothing unique about the money multiplier but that it is dependent on the definition of the monetary base and of money supply itself.

Employing regression analysis the author used data for the period 1962-73 and used four money multipliers defined according to the definition of money supply. The estimating equations are:

$$M1_t = f\ (B_{1t}, M_{1t} - 1) \qquad (1)$$

$$M_{2t} = f\ (B_{1t}, M_{2t} - 1) \qquad (2)$$

$$M_{3t} = f\ (B_{2t}, M_{3t} - 1) \qquad (3)$$

$$M_{4t} = f\ (B_{2t}, M_{4t} - 1) \qquad (4)$$

Where the Mi's and Bi's are the money multiplier and monetary base respectively. Upon estimation using ordinary least squares the results obtained were:

$$M_{1t} = 0.142 + 0.00008B_{1t} + 0.734M_{1t-1}$$
$$(0.00004) \quad (0.106)$$
$$R^2 = 0.863, \quad D\text{-}W = 1.837$$

$$M_{2t} = 1.18 + 0.0005\ B_{1t} + 0.267\ M_{2t} - 1$$
$$(0.0001) \quad (0.092)$$
$$R^2 = 0.737, \quad D\text{-}W = 1.666$$

$$M_{3t} = 0.317 - 0.00001B_{2t} + 0.738\ M_{3t} - 1$$
$$(0.00001) \quad (0.095)$$
$$R^2 = .748, \quad D.W = 2.30$$

$$M_{4t} = 1.42 - 0.00002\ B_{2t} + 0.144\ M_{4t} - 1$$
$$(0.00001) \quad (0.063)$$
$$R^2 = 0.367, \quad D\text{-}2 = 1.08$$

The first equation used the narrow type (M_1) money supply. The second is based on the broad definition of (M_2) but with the definition of monetary base unchanged. The third money multiplier employed the narrow definition of money but with the monetary base defined to include treasury bills. The last multiplier used the broad definition of money and the monetary base defined broadly to include Treasury bills.

He found the fourth multiplier (M_4) to have the poorest predictive ability with or without seasonal dummy variables. M_2 followed M_4 which also had a low R^2. On the other hand, the first and the third multipliers predicted well indicating that the narrow definition of money supply (M1) is the most useful definition of money stock control for purposes of economic stabilisation.

Other researchers have made empirical studies by formulating multiplier model for controlling the money stock. Buttler et al (1979) using Switzerland's data started by making the standard definition of the multiplier as the ratio of the money stock to monetary base i.e.

$m = M/B$ which gives $M = mB$

Where M = money stock, m = money multiplier and B = monetary base. They further assumed that a specific stock target M^* is fixed for each month. If the multiplier can be correctly predicted, the monetary base (B^*) needed to achieve the money stock target is

$B^*_t = M^*_t/m^*_t$

Where m^* is the multiplier predicted and t signifies the time period. The researchers noted that under conditions of fixed exchange rates any expansion in the monetary base must in practice be due to an increase in foreign exchange reserves. Further, they found that introduction of flexible exchange

rate had not altered this significantly because Switzerland seldom employed open market operations. The results of their study indicate that the money multiplier can be reliably predicted. Further, they found that in the short run changing the monetary base has little impact on the money stock.

Another elaborate attempt at predicting the money multiplier was carried out by Johannes and Rasche (1979). The researchers used a component approach to forecasting the money multiplier. By this is meant the use of time series models of the individual money multiplier components i.e. the currency ratio, time deposit ratio, government deposits ratio and so on. They justified use of this approach in that, first it is possible that aspects of regulatory or institutional behaviour that affect individual components of the multiplier can be successfully modelled in this framework. Secondly, that it may be possible to explicitly account for the cross correlations in the errors of the components ratios and obtain a more efficient forecasting model.

Using this approach Johannes and Rasche concluded that the money stock could be predicted with considerable accuracy over several months given a knowledge of the path of the monetary base.

In Kenya, a number of studies on some aspects of the money multiplier have been done.

Ndua (1982) examined the behaviour of the currency-deposit ratio using monthly data between 1976 and 1980. He specified his model such that

$C = c\ (A, Y, i, \dot{P}/p, D_1, D_2, D_3, D_4)$

Where C = the currency ratio

A = degree of monetisation proxied by number of branches of commercial banks.

Y = income

$\dot{P}/p$ = rate of inflation

i = rate of interest proxied by the Treasury Bills rate

Di = dummy variables.

He found that, the level of income and the degree of monetisation of the economy were highly correlated. The results gave an $R^2 = 0.7406$, D-W = 0.61, DF = 122. When he dropped either A or Y he found the remaining variable to be a significant determinant. The other variables of rate of interest and the rate of inflation were not significant.

The work of Bolnick (1975) bears significant resemblance to our work. Bolnick framed his analysis on the stability and controllability of the important parameters affecting money aggregate in Kenya. In his analysis, he found that the monetary base fluctuated more than M_2 with the changes in the multiplier tending to dampen the instability. By looking at the currency ratio and its

change with respect to the multiplier, he concludes that cash and bank deposits "caused" or contributed little to the variation in the money multiplier while the behaviour of the banking system (liquidity ratio) had a significant contribution to the variation. In this regard therefore, he considered liquidity ratio (reserve requirement) as one factor that explains the instability of the relationship between the monetary base and money supply. To this extent therefore to control M_2, the authorities must be able to predict or control credit creation by commercial banks.

In assessing the significance of the factors that are thought to affect the reserve requirement, Bolnick tested for demand for credit (proxied by import demand), the changes in deposit structure, and lags in bank lending. His results showed that import and deposit structure had no significant effect on reserve ratio. Due to variations in the ratio of cash to bank deposits by the public and reserve requirement, Bolnick concludes that control of money stock could be an elusive goal.

Mwega's paper (1990) basically updated that of Bolnick using annual data over 1971-88. Like Bolnick he found that the liquidity ratio was more volatile than the currency ratio. In an attempt to explain the causes of changes in the liquidity ratio, he tried such determinants as cost of credit (lending rate), demand for credit, deposit structure, stance of monetary policy measured by

minimum liquidity ratio and growth in commercial banks liquidity measured by growth in monetary base.

Of all these factors he found that the growth of liquidity was the strongest. On the other hand, the variation in monetary base and money multiplier with the latter tending to counteract the former, he concluded that while the negative correlation between the multiplier and the monetary base stabilises money supply, it may frustrate monetary policy.

Mwega also tested M_3 i.e included the liquid assets of non-bank financial institutions (NBFI) in the definition of the monetary base. He found that the variable displayed the same pattern, but in the latter case, there was little correlation between the multiplier and the monetary base. This indicated that a broader definition of money may facilitate the formulation of monetary policy by providing a more direct linkage between the monetary base and money supply.

Our work has built on these studies. In particular, we estimate an equation which explains the behaviour of the non-bank public (currency ratio) and one relating to the behaviour of the banking sector. However, for the latter, we deem it more appropriate that the demand for excess reserves by commercial banks rather than just reserve requirement as used in both Bolnick's and

Mwega's studies best explains the behaviour of commercial banks. We also show the linkage of these behaviourial equations to the money multiplier.

2.2 Overview of Literature

The survey of literature on the subject of money supply in general and the money multiplier in particular has revealed that there are aspects of the subject still to be understood. There was no unanimity as to whether the money multiplier is predictable or not.

Secondly, it came out clearly that the money multiplier is dependent on the definition of the money stock used so that we would obtain different multipliers when M_1, M_2 etc is used as the definition of money stock.

Thirdly, the nature of the financial system i.e. the stage of development of the banking sector has a lot of influence on the functioning of the money supply process. The approach to monetary policy formulation in a developing economy like that of Kenya would differ from that of a developed economy.

We therefore will add to the existing wealth of knowledge on the subject through our analysis of the Kenyan data. However this does not mean that those who have researched on Kenya have not contributed to increased

understanding of the money supply process. Our approach however will be slightly different, and the variables tested will include new ones.

CHAPTER III

THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

3.1 Theoretical Framework

Pure theory teaches that changes in the supply of money may be determined by exogenous factors such as government borrowing to finance a war.[10] It may also be due to the demand for money. Further, both demand for and supply of money may be affected by the same factors.

When the money stock is narrowly defined as M_1, it is composed of the sum of currency held by the non-bank members of the public (C) and demand deposits CD. This may be represented thus;

$$M_1 = CD + C \qquad (1)$$

In Kenya the broader definition of money stock is that of M_2 which in addition to M_1 also includes time and savings deposits (Quasi money). This may be represented thus;

$$M_2 = M_1 + QD \qquad (2)$$

Where QD denotes - Quasi money.

If the distinction between demand deposits on the one hand and time and savings deposits on the other are ignored and considering the money supply

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10 HARRIS, L. Monetary theory. Mcgraw - Hill (1981)

process as if it was made up of a uniform class of deposits (D), then the money stock may simply be defined as:

$$M = C + D \qquad (3)$$

Where M represents M_2, C represents currency held by the public and D represents commercial bank deposits.

From equation (3) it can be seen that both the non-bank members of the public and the banking sector have an influence on the determination of the money supply. The former exert their influence through their demand for currency hence affecting the currency component (C) while the latter exert their influence through the holding of customer deposits - D. Besides these two actors (the public and banks), the actions of the Central Bank as another player also has significant influence on the money supply process. Respectively, the currency-deposit ratio, reserve-deposit ratio and the stock of high-powered money (monetary base) represent the behaviour of the public, banks and actions of the Central Bank.

63.1.1 The money multiplier

The money multiplier is the ratio of the stock of money to the stock of high-powered money[11]. In practice the money multiplier is larger than 1 since monetary base is only a fraction of the total money supply hence when divided into the money stock will yield a result which is greater than 1 unless required reserves is 100% in which case the multiplier will equal to 1.

From equation (3), the following can be written

$$M = C + D = (c + 1) D \qquad \text{(i)}$$

Where C has been substituted by cD, which denotes the non-bank public's desired ratio of currency to deposits (c). Equation (i) represents equilibrium between the money stock and the demand for money.

Secondly, equilibrium between the supply of and the demand for high-powered money which equals currency plus reserves implies that

$$B = C + R = (c + r) D \qquad \text{(ii)}$$

where B denotes high-powered money (monetary base); R denotes reserves. The demand for high-powered money has been expressed in terms of desired ratio of currency to deposits (c) and of bank's desired reserve ratio (r).

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11 DORNBUSCH and FISHER Macroeconomics Mcgraw - Hill (1988)

When (i) and (ii) both hold, there is a monetary equilibrium since the public hold the composition of their money balances in the preferred ratio and banks hold just the right ratio of reserves to deposits.

Dividing (ii) (the monetary base) by (i) (the money stock) yields the expression for the money multiplier:

$$\frac{M}{B} = m = \frac{(1+c)}{(c+r)} \qquad \text{(iii)}$$

As can be seen from the expression in equation (iii), the money multiplier depends on the c ratio and the r ratio. To obtain the money supply we multiply both sides by B so as to get

$$M = m.B \qquad \text{(iv)}$$

where m as we have shown is dependent on the currency-deposit preferences (behaviour of non-bank public) of the public and the reserve-deposits preference (behaviour of the banking sector) of banks.

A careful examination of (iii) shows that the multiplier is higher the smaller the reserve ratio (r) and the smaller the currency-deposit ratio (c).

3.2 Model Specification

From the discussion so far, we have established two important determinants for money supply namely the behaviour of the non-bank members of the public and the banking sector. We have also shown in the theoretical framework how the two are linked to the money multiplier. We also note that the money multiplier may be predicted in one of three ways: definitional method where the multiplier-base framework is treated as an accounting identity. Some of the ratios of the multiplier are forecast using information about the various components. Other elements of the ratios are treated as being equal to their previous values with some adjustment for trend or seasonal various;

Regression method - where the money multiplier is expressed as a function of variables that are known or are under the control of the Central Bank at the time the forecast is made; and behaviourial method- where each of the ratios of the multiplier is expressed as being dependent upon other variables such as policy instruments etc wherein these other variables are predicted.[12]

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12 BURGER Et al Money stock control and its implications for monetary policy. Federal Reserve bank of St. Louis Review at 1971.

Assuming that we prefer the last method, the money multiplier model may consist of three definitional equations and two behaviourial equations[13] expressed

$$B = C + R^q + R^e \quad (1)$$

$$M = C + TD \quad (2)$$

$$R^q = kTD \quad (3)$$

$$C/TD = f\ (TB, Y, DD) \quad (4)$$

$$R^e/TD = f\ (TB, AD, D, MB, LA, LR) \quad (5)$$

Where C = currency outside banks

M = money supply defined within the model

R^e = level of excess reserves

R^q = level of required reserves

TD = total private deposits

Y = income measured by Gross domestic product at current prices

B = monetary base*

TB = Treasury bill rate as a proxy for domestic interest rate

AD = Advances - deposit ratio taken to represent demand for credit

DD = ratio of demand to total private deposits

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13 KHATKHATE - El at Money multiplier model for a developing economy: The Venezuelan economy. IMF staff papers 1974.

D = total deposit liabilities

MB = growth in liquidity

LA = liquidity ratio

LR = commercial bank lending rate

Monetary base in this paper has been defined broadly to include currency in circulation plus commercial bank liquid assets. The latter forms the numerator of the required liquidity ratio.

Equation (1) is an identity which defines high-powered money in terms of its uses as the sum of currency outside banks and total commercial banks reserves (liquid assets).

Equation (2) is the money stock which in our case is assumed to be the M_2 variety. M_2 is preferred to M_1 because all bank deposits of the non-bank public are treated alike in Kenya when determining the required reserve ratio. This means that all deposit categories included in M_2 i.e demand, time and savings constitute the reserve base without differential treatment for each category of deposits. For this administratively simplified treatment of all bank deposits of the non-bank public, suggests that M_2 will be the better choice (Coats, 1980).

Equation (3) defines the level of required reserves. In our case this is defined to mean the same thing as the liquid assets ratio since currency outside banks merely explains the behaviour of non-bank members of the public and not banking sector whose behaviour we are interested in.

Equations (4) and (5) are behaviourial equations relating respectively to non-banking and the banking sectors of the economy. Equation (4) explains the movements in the currency - deposit ratio.

Equation (5) explains the ratio of excess reserves of banks and their total private deposit liabilities.

3.3 Methodology

Equations (1) through (5) explain the money multiplier. From equation (1), (2) and (3) the money multiplier can be solved thus:

From (1), $B = C + R^q + R^e$

substituting (3) into (1) we obtain

$$B = C + kTD + R^e \qquad (1_a)$$

Since C is assumed to be a ratio of total private deposits; (1_a) can be written

$$B = (C/TD + R^e/TD + k)\ TD \qquad (1b)$$

Likewise equation (2) can be expressed thus:

$$M = (C/TD + 1)TD \qquad (2a)$$

Recall that the money multiplier is the ratio of money stock to monetary base.

Therefore dividing (1b) by (2a) we obtain;

$$M/B = \frac{(C/TD + 1)\ TD}{(C/TD + R^e/TD + k)\ TD}$$

$$= \frac{C/TD + 1}{C/TD + R^e/TD + k} \qquad (6)$$

$$= m \quad \text{(Money multiplier)}$$

$$M = m.B \qquad (7)$$

From equation (6) the money multiplier is a function of the currency-deposit ratio, excess reserve ratio and the required reserve ratio. Equation (7) re-defines the money supply as the product of the monetary base and the money multiplier.

Estimates of equations (4) and (5) have been obtained using Ordinary Least Squares technique. Specifically, all regressions have been run on a computer using TSP version 6. The procedure enables us to obtain both the R^2 and the adjusted R^2. It also estimates the D-W statistic, the F-Statistics etc and is therefore considered appropriate for our work.

3.3.1 Data Sources and requirements

By the nature of our study and variables used, secondary data obtainable from Central Bank publications was utilised. The specific data used is given on the table on page 74 of this paper. We have used such variables as the level of income (as measured by GDP), rate of interest as measured by the Treasury Bill rate, the ratio of demand to total deposits, level of deposits, growth of liquidity, deposit mix as measured by Quasi-money and the reserve requirement ratio as measured by the liquidity ratio.

3.4 Variables and hypotheses

Currency (C) held by the public can be expressed as a proportion (k) of total deposits (D)[5] that is

$C = kD$

or

$k = C/D$

Clearly therefore changes in the level of "k - ratio" over time are influenced by such factors as income levels, time or savings deposit rate of interest, utilisation of credit cards, spread of banking facilities and habit, degree of

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[5] JORDAN J. L. Elements of money stock control. In issues in monetary theory and policy. AHM Publishing Cor.

monetisation of the economy and uncertainties regarding the general economic stability.

In our analysis however, we have used only three variables to estimate the currency-deposit ratio namely income levels, the rate of interest and ratio of demand to total deposits. The last variable has been chosen really as a composite variable - that is to represent such factors as spread of banking facilities and habit, degree of monetisation and even use of credit cards. The reason we have done this, is first, because we do not have data on the use of credit cards. Secondly, Ndua[6] (1982) found that the income level and the spread of banking facilities were highly correlated. Thirdly, there is no generally agreed index with which to measure degree of monetisation[7]. We believe however, that the absence of an index for measuring credit card holding and upto date bank branch network for the period 1977-90 would affect results obtained.

In case of the reserve-deposit equation, a missing variable is that of the general economic stability. Overall however, we do not think that our results would be rendered useless even in the absence of these variables.

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6 Ndua F. MA Thesis (1982)

7 Chandravarkar A.G. IMF Staff papers (1977).

3.4.1 Treasury Bill rate

The domestic rate of interest, in this regard deposit rates (saving and time deposit rates) is taken to represent the opportunity cost of holding currency instead of investing the same and earn interest. Therefore, for an individual holding cash, he foregoes the opportunity of earning interest had he deposited the amount in an interest earning account. However, such deposit rates would be very ideal if they were freely determined by market forces. For the period under review however, deposits rates in Kenya were administratively determined by the Central Bank of Kenya. For long periods of time such rates remained stagnant. To use such rates therefore would not reflect the true reaction of the public when making decisions as to their portfolio investments.

For this reason, we have chosen the Treasury Bill rate which is determined by tender and which did not remain stagnant for long periods as it reflected at least to a lesser degree the demand for the Treasury bills.

Because the rate represents an opportunity foregone of earning additional income, we expect that it will show a negative relationship with the desire to hold currency. We therefore make the following hypothesis:

Hypothesis 1: The publics' desire to hold currency (C/TD) is a decreasing function of the deposit rate of interest.

3.4.2 Level of income

One's level of income affects his decisions as to the amounts to apportion to currency and other forms of investment. Obviously without any income, there will be no currency held, other things being equal. We assume that individuals become more adept at managing their finances as the level of income rises. Other arrangements like use of Credit Cards (a trait associated with those whose incomes are high) obviates the need to hold large amounts of currency. For this reason, we expect that the ratio will be negatively related to income as individuals become more efficient in their fund management. Therefore our second hypothesis is:

Hypothesis 2: The publics' desire to hold currency is a decreasing function of the level of income.

3.4.3 Ratio of demand deposits

This variable is common to both equations (4) and (5). First, we analyse its behaviour with regard to the public's desire to hold currency. The dependent variable here has been expressed as a ratio of currency to total deposits.

The two variables therefore have a common denominator. For this reason, the two will tend to move together hence a positive correlation is expected. On a practical level, those who go for non-interest earning demand accounts are in general those who handle relatively large transaction payments quite often. This implies that, in general, they will also tend to carry more currency on average than those without demand accounts in order to satisfy their tastes and to maintain a certain level of standard of living. We therefore expect to see a positive correlation between currency ratio and the demand deposit ratio. For this reason we hypothesise that:

Hypothesis 3: The publics' desire to hold currency is an increasing function of the ratio of demand deposits.

Equation (5) which describes the behaviour of commercial banks in holding excess reserves also has the variable demand deposits as one of the explanatory variables. Demand deposits in general do not earn interest. Therefore, to commercial banks demand deposits are "cost-free" deposits. The

bigger the proportion of this ratio to total deposits is, the better for commercial banks. Banks earn the biggest portion of their income from lending their funds. Therefore, if the proportion of interest earning deposits to total deposits is high, banks will be motivated to limit excess reserves to a minimum. We therefore expect that demand deposits being "free deposits" will tend to encourage commercial banks to hold excess reserves. We therefore expect a positive correlation between the excess reserve ratio and the demand deposit ratio so that our hypothesis will be:

Hypothesis 4: The banks' holding of excess reserves is an increasing function of the demand deposits ratio.

3.4.4 Demand for credit

Banks are in the business of lending money. The source of their lending is public and private deposits with them. It would therefore appear that the limiting factor to more lending by banks is their level of deposits. However, banks cannot lend everything, Central Banks normally require them to hold a certain proportion as reserves. The size of this ratio is therefore the actual limiting factor. However, even if banks had unlimited funds to lend, they would still be limited by the demand for loans by customers.

The ratio of excess reserves is therefore expected to be negatively related to the domestic demand for credit (Loans). This is because if the demand for credit was very high, banks would try as much as possible to minimise excess reserves and channel the funds to profitable lending. Our fifth hypothesis will appear thus;

Hypothesis 5: The banks' holding of excess reserves is a decreasing function of the demand for credit.

3.4.5 Deposit levels

Excess reserves ratio is a ratio of total deposits. It is therefore expected that as the level of deposits rise, so too will the level of excess reserves, other things being equal. We therefore expect a positive correlation between this variable and the banks' desire to hold excess reserves. The total level of deposits has been included as a scale variable on the assumption that, as the size of the banking system increases, as measured by total deposits, the level of excess reserves will also increase. Our hypothesis therefore is:

HYPOTHESIS 6: The banks' holding of excess reserves is an increasing function of deposit levels.

3.4.6 Other variables

The other variables include the Treasury Bill rate, the liquidity (reserve) ratio and the growth of liquidity. The first two is expected to show a negative relationship with banks' desire to hold excess reserves while the last is expected to show a positive correlation. We therefore make the following hypotheses:

HYPOTHESIS 7: The bank's holding of excess reserves is a decreasing function of domestic rate of interest.

HYPOTHESIS 8: The banks' holding of excess reserves is a decreasing function of the reserve ratio.

HYPOTHESIS 9: The banks' holding of excess reserves in an increasing function of the growth of liquid assets.

CHAPTER IV

EMPIRICAL ANALYSIS

4.1 Introduction

The sample data used in this study is annual data running from 1972 - 90. Estimation of equations (4) and (5) herein reproduced were made:

$$C/TD = a_o + a_1 TB + a_2 Y + a_3 DD$$

$$a_1, a_2 < 0; a_3 > 0 \qquad (4)$$

$$R^e/TD = b_o + b_1 AD + b_2 D + b_3 DD + b_4 MB + b_5 LA$$

$$b_1, b_5 < 0; b_2, b_3, b_4 > 0 \qquad (5)$$

The equations were estimated using ordinary least squares. Initially, equation (4) was estimated with only two independent variables namely the level of income and the domestic rate of interest as measured by the short-term Treasury bill rate. The results obtained were poor with a very low R^2. This therefore indicated that some other important variables were left out. As stated elsewhere, important variables that determine the public's desire to hold currency relative to bank deposits include, the level of income, use of credit cards, uncertainty regarding general economic stability, degree of monetisation of the economy, spread of banking services etc. For reasons of lack of information either in the form required or in the time available, variables such as use of credit cards, degree of monetisation and spread of banking services could not be obtained. However, in place of this discrepancy, we introduced

the ratio of demand deposits to total deposits as a composite variable to take the place of spread of banking services, use of credit cards and degree of monetisation. This variable greatly improved the results. It turned out that the variable is significant at 1% level.

In addition, other variables were introduced which included the savings rate of interest and the rate of inflation. However, these two variables were highly correlated with the Treasury bill rate.

Further their explanatory power was not significant hence the two variables were dropped with only a slight adjustment downwards of the R^2.

Equation (5) on the commercial bank excess reserves function was also estimated with 8 explanatory variables. Three of these variables i.e the ratio of quasi-money to total deposits, commercial bank lending rate and the Treasury bill rate were dropped after estimation. The last two variables were justified in that they represent an opportunity cost foregone by banks by holding excess reserves. The variable of quasi-money represented the portfolio mix with which the public can hold their deposits. Savings and time deposits are interest earning and hence represent a cost to banks holding them. Therefore the higher the proportion of their component in the deposit portfolio of a bank the more the bank is under pressure to minimise if not eliminate

excess reserves. These three variables however exhibited a high-degree of correlation with the other variables in the equation. The Treasury bill rate and the commercial bank lending rate were highly correlated with each other and in addition, the commercial bank lending rate was highly correlated with the deposit level. The ratio of quasi-money was also highly correlated with the level of deposits. Besides, this high degree of inter correlation, their coefficients were not statistically significant. We therefore dropped these variables.

We have also tried to show the growth of money supply(both M_1 and M_2) over the sample period in chart 1a and 1b; the components of money supply on chart2 and the behaviour of the money multiplier when money stock is defined broadly (M2) and when it is defined narrowly (M1) on chart 3. The charts help to give a visual impression of what has been happening. For example in chart 3, the multiplier though unstable whether money stock is defined broadly or narrowly, the multiplier associated with (M1) appear to be less unstable than when the money stock is broadly defined suggesting that other things being equal, M1 may be the more appropriate policy variable for control purposes.

4.2 Regression analysis

Estimation results for equations (4) and (5) are given on tables 4.1 (a) 4.1(b), 4.2, and 4.3(a); 4.3(b) respectively.

For the currency/deposit function, it was found necessary to correct for serial correlation. This improved the D-W statistic significantly. All the variables exhibit the right signs except for the Treasury bill rate. Our assumption was that the domestic rate of interest (proxied by the Treasury bill rate) reflected the opportunity cost of holding currency.

In this regard therefore, the expected sign was a negative one in that the higher the rate of interest (to be earned on deposits) the less the public would be willing to hold funds in form of currency. Upon realisation of this unexpected sign, we ran a correlation matrix, and confirmed that indeed, the currency-deposit ratio is negatively correlated with the domestic rate of interest as measured by the Treasury bill rate. See table 4.1(b). It therefore implies that, the change of sign came in when it was regressed together with the other variables. Anyhow, the variables' explanatory power was not significant except at 30% level. Therefore, the variable is not an important determinant for currency holding by the public.

The role of the level of income in determining the value of currency/deposit ratio though of the correct sign was not significant. The two variables i.e. income and the Treasury bill rate were significantly intercorrelated.

It showed a correlation of 0.822 - see table 4.1(b), when one of the variables namely income was dropped, the results obtained are as shown on table 4.2. The adjusted R^2 dropped from 0.542 to 0.519.

The results with regard to the demand deposits ratio resulted in the correct sign and also it turned out to be a highly significant independent variable. It was significant at 1%.

The D - W statistic and the F - statistic for regression were good. The performance of the R^2 suggests that significant determining variables have been left out. This we have explained in the introduction to this chapter.

Furthermore, we believe with the benefit of hindsight the results may be improved if the data points were for shorter periods e.g quarterly or better still monthly rather than annual which fail to capture the role of seasonal factors like the desire to hold more currency during the month of December for purchases. Unfortunately this thought of using quarterly or monthly data has

come late in our study and we can only suggest that interested researchers may wish to pursue it.

The estimation results for equations (5) are given on table 4.3 (a) and 4.3 (b). All the coefficients exhibit the correct signs except the demand deposits variables. As explained in the previous chapter, this ratio was expected to show a positive correlation with the dependent variable in that,since demand deposits are in general interest-free, the higher this ratio is in relation to total deposits is, the more the commercial banks are willing to hold excess reserves. Like in the previous equation, the correlation between the excess reserve ratio and demand deposits ratio was indeed positive (see table 4.3 (b)). The negative sign therefore exhibited when the variable is regressed with the rest of the variables must have come about due to the influence of these other variables. Besides, the variable's explanatory power was not significally different from zero.

The other variables all had correct signs and were also significant determinants of excess reserves. Demand for credit and the level of deposits were significant at 5% while the growth of liquidity and the liquidity (reserve) ratio were significant at 10%.

The Durbin - Watson statistic indicate absence of serial correlation and the F - statistic was significant. Also, the R^2 was better than that for the public's desire for currency.

Table 4.1 (a): **The currency to deposit function:**

Equation (4)

$$C/TD = ao + a_1 Y + a_2 DD + a_3 TB$$

Variable	Coefficient	Std.Error	T.statistic
ao	11.2186	4.1452	2.7064
Y	-0.0002	0.0002	-0.7353
DD	0.2710	0.0738	3.6735*
TB	0.1731	0.1446	1.1966
MA(1)	0.6136	0.2601	2.3592

R^2 = 0.643

R^{-2} = 0.541

Durbin - Watson statistic = 2.1524

F - statistic = 6.3001

* Significant at 1%

Table 4.1(b) correlation coefficients between the currency ratio (C/TD); the level of income (Y); the ratio of demand to total deposits (DD); and the Treasury bill rate TB.

	C/TD	Y	DD	TB
C/TD	1.000			
Y	-0.2698	1.000		
DD	0.695	-0.474	1.000	
TB	-0.386	0.828	-0.681	1.000

Table 4.2: **The currency/deposit* function**:

$$C/TD = a_o + a_1 DD + a_2 TB$$

Variable	Coefficient	Std.Error	T.statistic
ao	11.8643	4.1051	2.8901
DD	0.2625	0.0735	3.5679***
TB	0.0854	0.0898	0.9508
MA(1)**	0.4906	0.2521	1.9465

$R^2 = 0.600$

$R^{-2} = 0.519$

Durbin - Watson statistic = 2.071

F - statistic = 7.497

---

* income and Treasury bill rate were intercorrelated with a value of 0.828.

** corrects for existence of serial correlation.

*** significant at 1%.

Table 4.3(a) **The excess reserve to deposits function. Equation (5)**

$$R^e/TD = b_o + b_1 AD + b_2 D + b_3 DD + b_4 MB + b_5 LA$$

Variable	Coefficient	Std.Error	T.statistic
bo	49.994	17.778	2.812
AD	-0.396	0.162	-2.450*
D	0.003	0.001	2.226*
DD	-0.089	0.116	-0.767
MB	0.071	0.038	1.855**
LA	-0.660	0.363	-1.816**

$R^2 = 0.727$

$R^{-2} = 0.623$

Durbin - Watson statistic = 2.057

F - statistic = 6.941

---

* significant at 5%

** significant at 10%

Table 4.3(b) correlation coefficients between excess reserve ratio R^e/TD; Demand for credit (AD); Deposit level (D); Demand deposit ratio (DD), Liquidity growth (MB); and Liquidity (reserve) ratio (LA).

	R^e/TD	AD	D	DD	MB	LA
R^e/TD	1.000					
AD	-0.651	1.000				
D	-0.007	0.499	1.000			
DD	0.107	-0.509	-0.486	1.000		
MB	0.730	-0.595	-0.024	0.044	1.000	
LA	-0.166	0.374	0.746	-0.452	0.004	1.000

4.3 Evaluation of hypotheses

We give below an evaluation of hypotheses stated.

4.3.1 hypothesis 1

Hypothesis one through three is in respect to the public's behaviourial habits with regard to currency holding. The first hypothesis was stated thus:

CHART 1

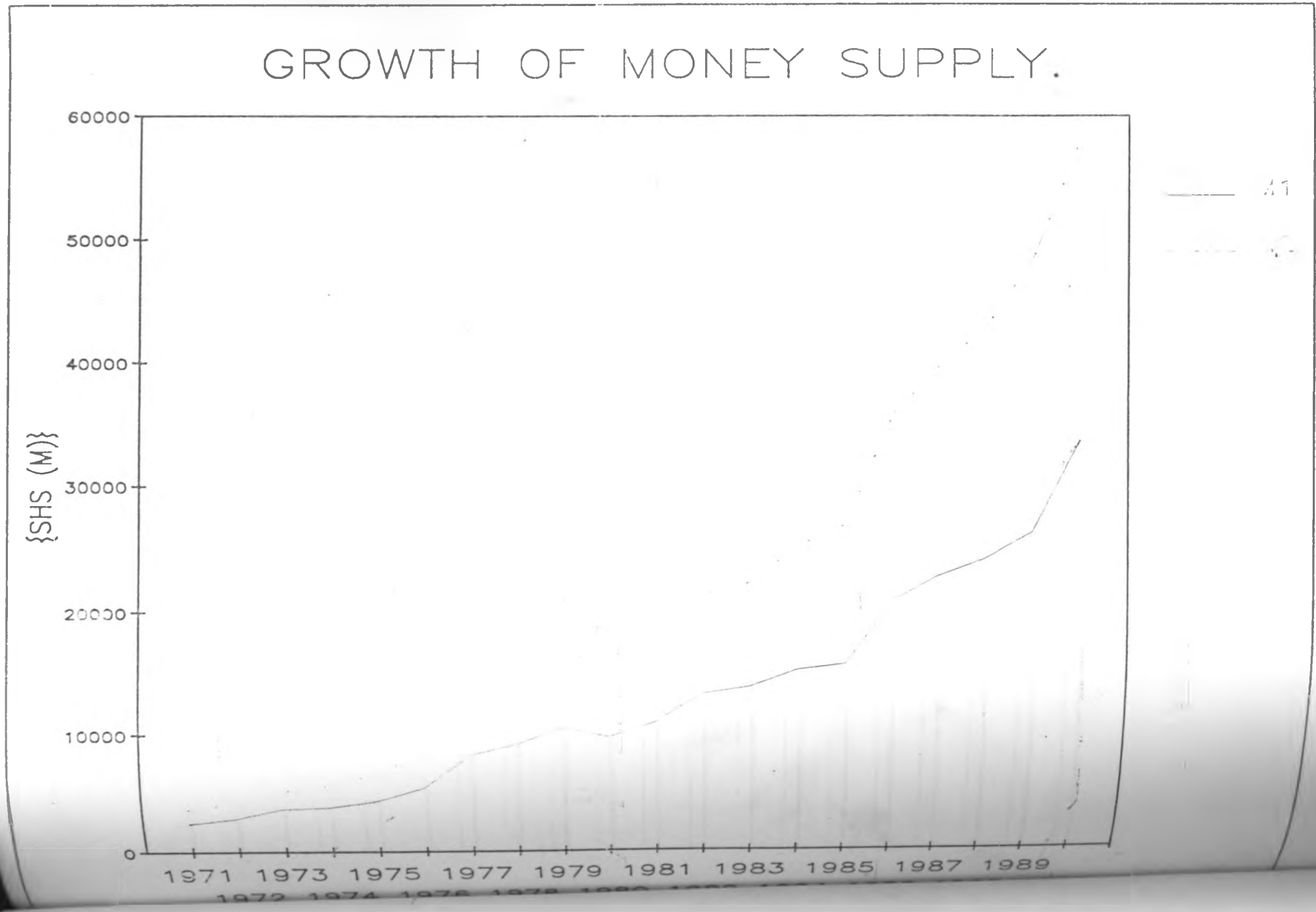

GROWTH OF MONEY SUPPLY.
60000
50000
40000
30000
20000
10000
0
{SHS (M)}
1971 1973 1975 1977 1979 1981 1983 1985 1987 1989

CHART 3

GROWTH OF MONEY SUPPLY.

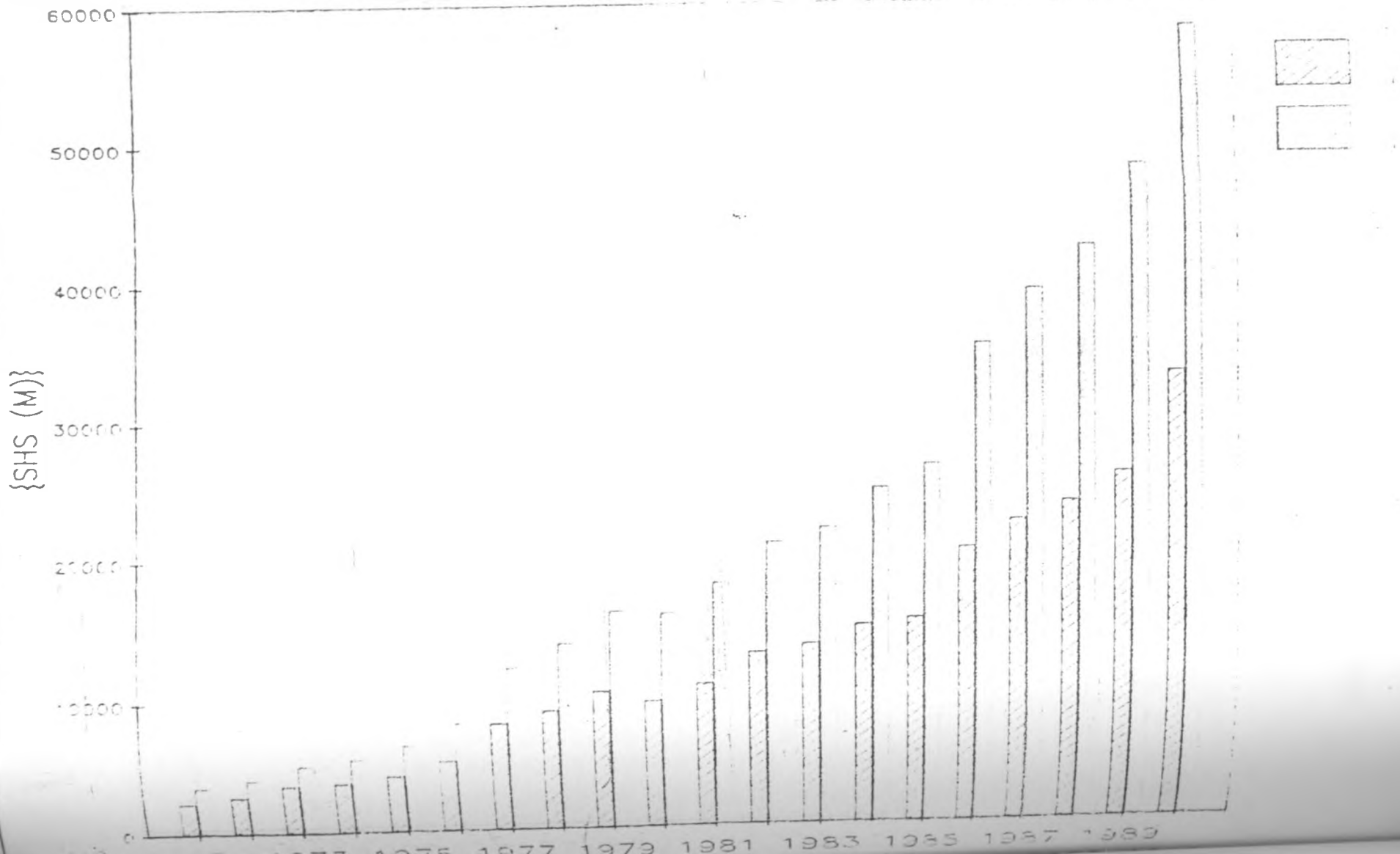
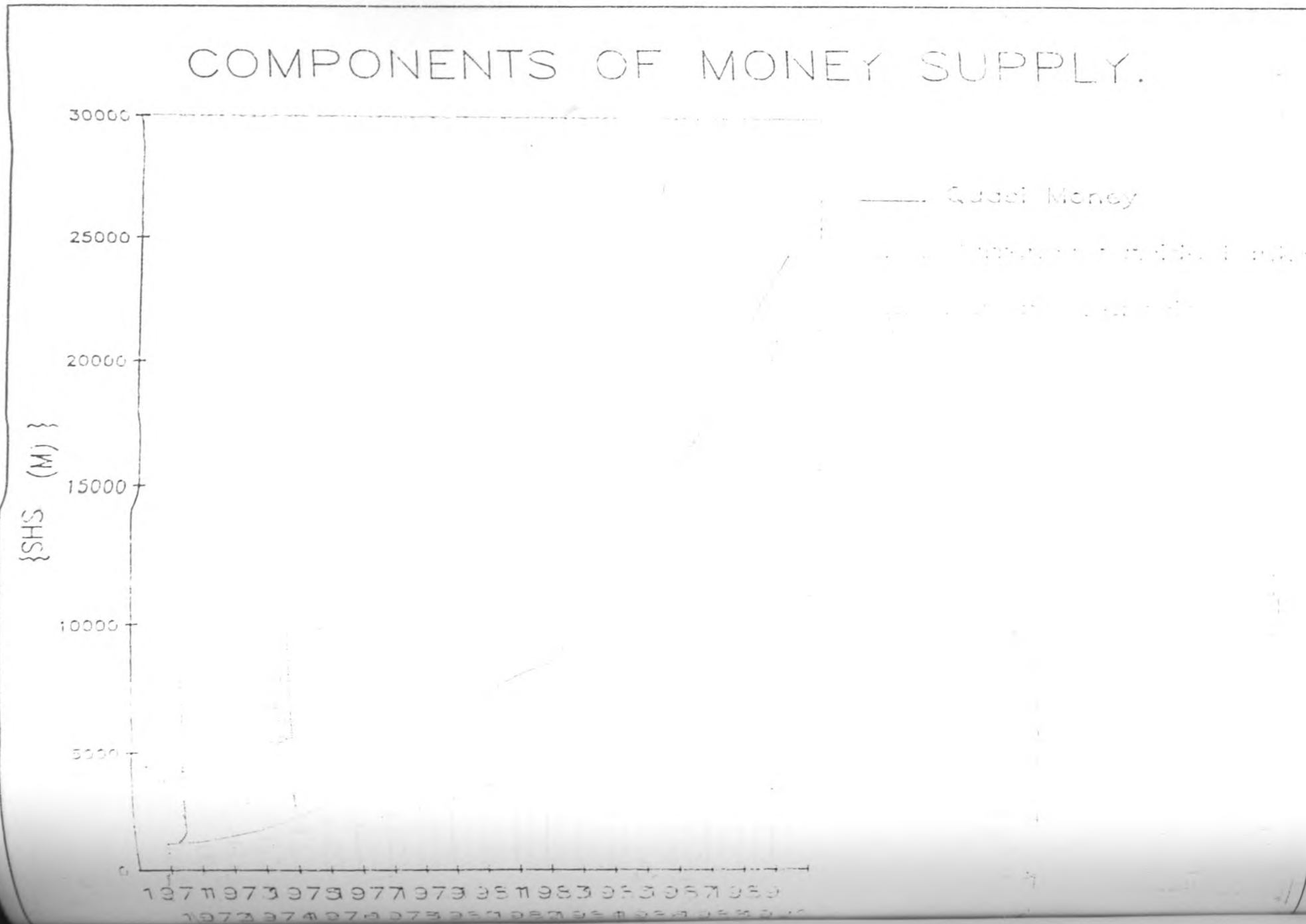
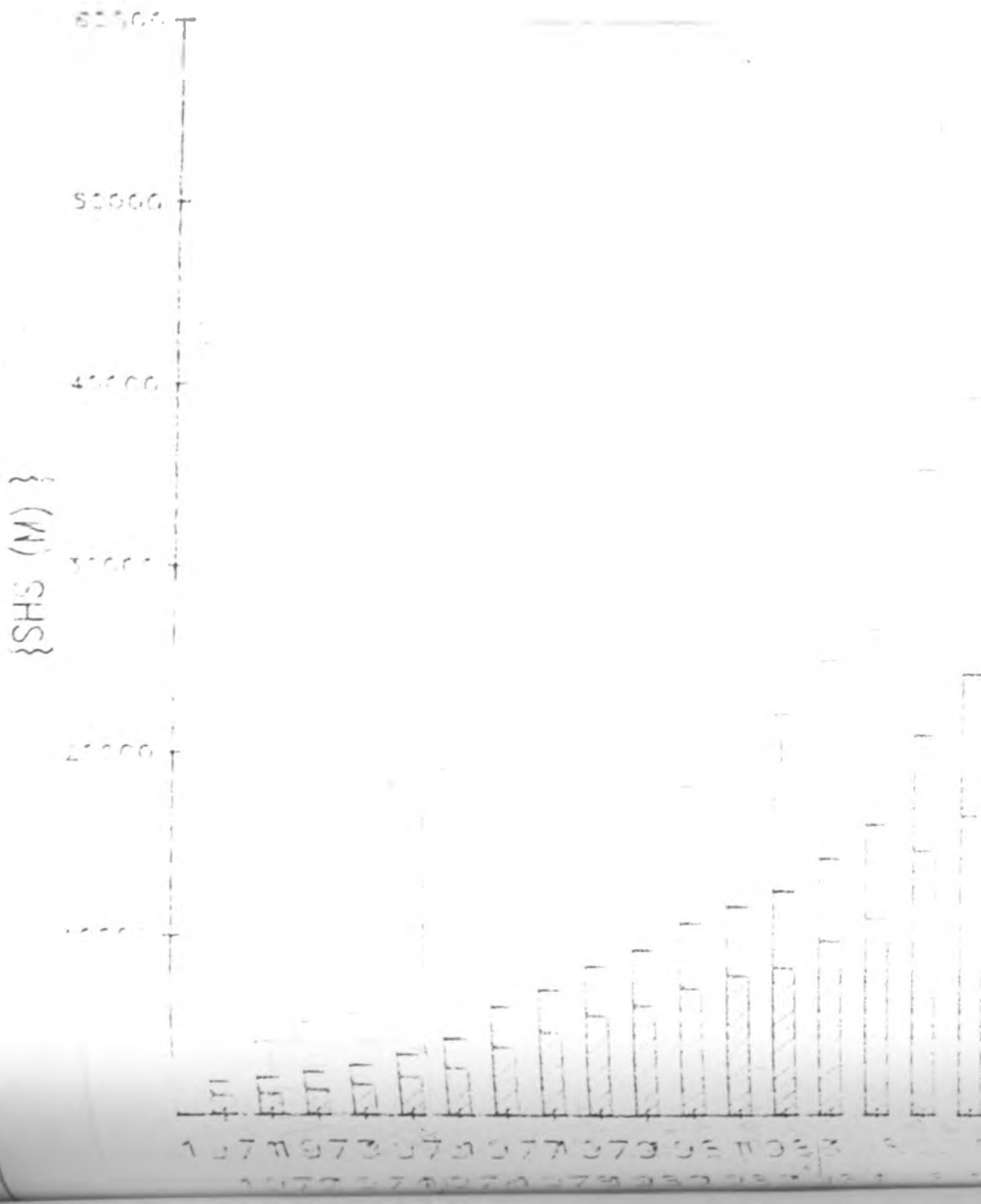


CHART 3


COMPONENTS OF MONEY SUPPLY.
30000
25000
20000
15000
10000
5000
0
{SHS (M) }
Liquid Money

COMPONENTS OF



MONEY SUPPLY.

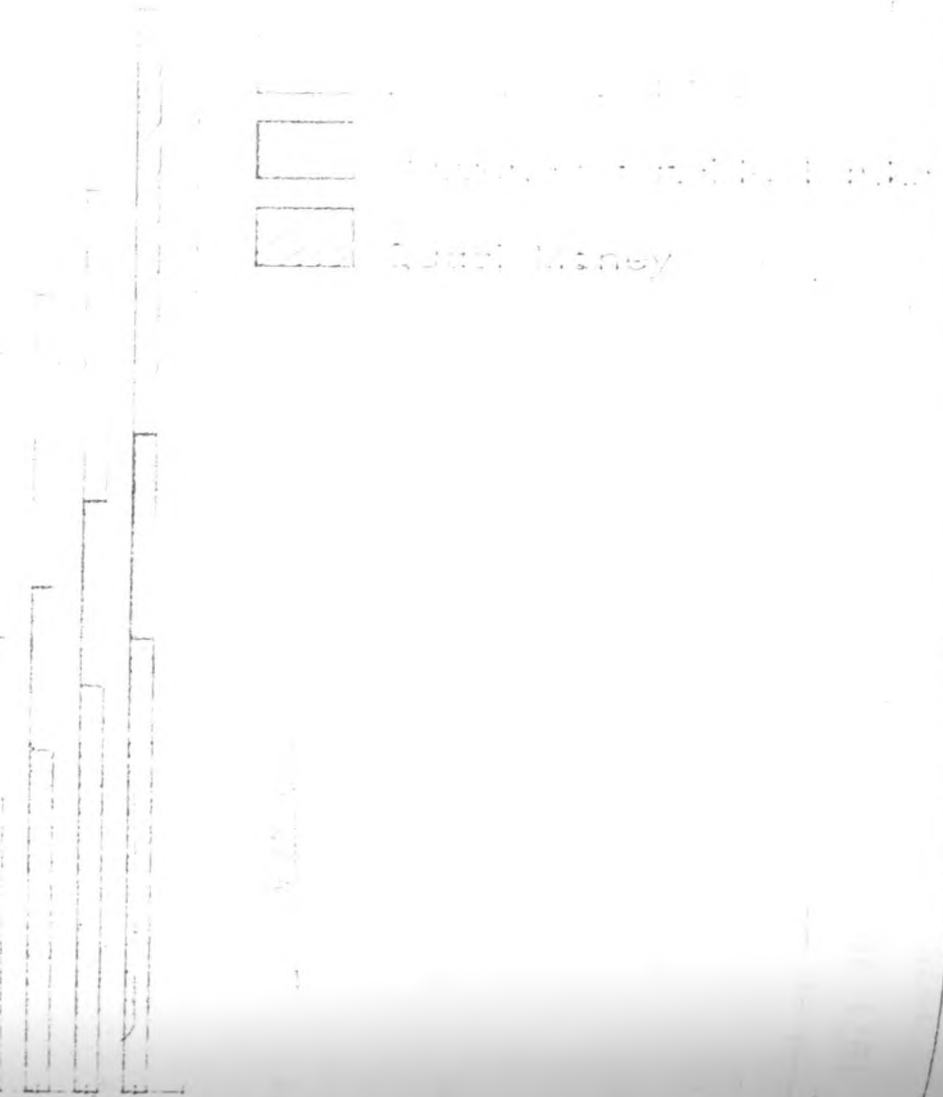
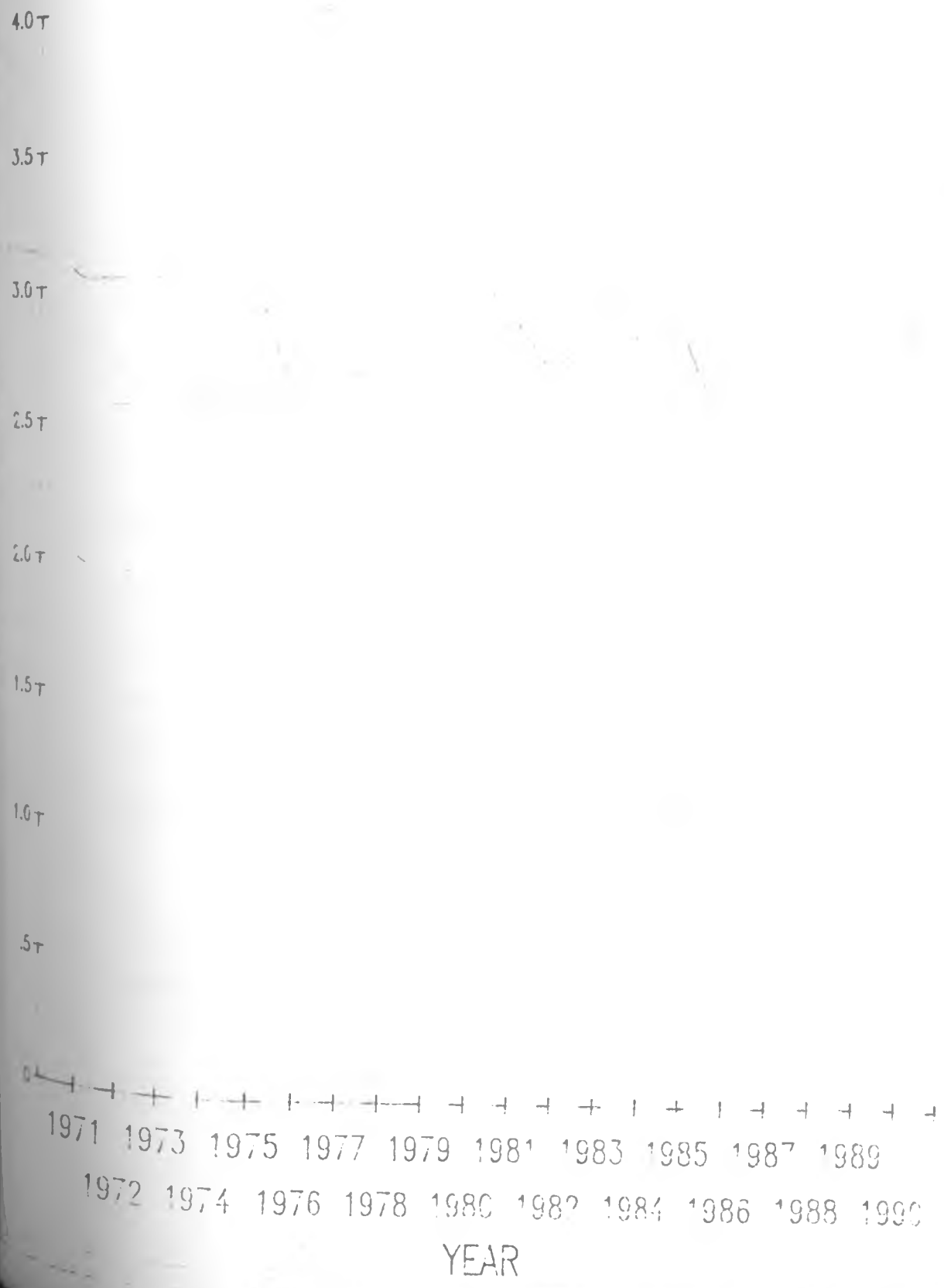


CHART 5

BEHAVIOUR OF MONEY MULTIPLIER WITH NARROW AND BROAD MONEY SUPPLY



HYPOTHESIS 1: The publics' desire to hold currency (C/TD) is a decreasing function of the deposit rate of interest.

As already stated in sub-section 4.2, our expectation was that the estimate would carry a negative sign. However, the regression results obtained gave a coefficient with a positive sign. This was rather puzzling as it would suggest that, the higher the Treasury bill rate (a proxy for deposit rate of interest), the more the public would prefer to hold currency instead of depositing the same in the bank to earn interest. This result, prompted us to run a correlation matrix for all the variables including the dependent variable. From this we confirmed that indeed, the desire to hold currency by the public is negatively correlated with the rate of interest. Therefore, the positive sign obtained when the variable is regressed with other independent variables, suggests that these other variables (level of income, the ratio of demand to total deposits) might have affected the sign of this coefficient. Be that as it may, the variable (Treasury bill rate) was not significantly different from zero. Based on these results therefore we have to reject our null hypothesis and accept that the public's desire to hold currency is not a decreasing function of the rate of interest as measured y the Treasury bill rate in Kenya.

What does this mean? Either the choice of the Treasury bill rate as a proxy for deposit rates of interest was not a good one or more probably, interest rates

whether savings or lending rates do not reflect the demand and supply forces. Whenever they have been adjusted by Central Bank the adjustment has been seen as inadequate due to the perceived high level of inflation and therefore has little effect on people's behaviour. It should also be noted that we also tried both the savings rate and the rate of inflation, which besides introducing problems of multicollinearity were even less significant than the Treasury bill rate, hence we dropped these two variables.

4.3.2 Hypothesis 2:

The second hypothesis was to do with income as an explanatory variable. In this we expected that the higher the incomes of the public are, the less the need to hold large amounts of currency on the assumption that individuals become more efficient in managing their funds. In this regard, we hypothesised that:

HYPOTHESIS 2: The publics' desire to hold currency is a decreasing function of the level of income.

From table 4.1 (a), the result was of the correct sign. However, the coefficient was not statistically significant. We therefore reject the null hypothesis and

accept that the desire to hold currency is not a decreasing function of income in Kenya.

Again, we ask what is the rationale for these results? Income is taken as a scale variable. Real gross domestic product (GDP) is the best measure of real income but not the best proxy for domestic expenditure.[1]

At this point however, it should be noted that we also tried the rate of inflation as an independent variable but was also found not to be statistically different from zero. We are inclined therefore to agree with the suggestion that in most less developed countries where the variety of available financial assets is limited, real assets tend to be close substitutes for real cash balances and hence the demand for real cash balances (currency) would be sensitive to the nominal rate of return on real assets.[2] Further research into an appropriate proxy for income is called for.

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1 COATS W. L and KHATKHATE D.R. (Eds) Money and monetary policy in less developed countries: Perganion Press (1980) p.p 14.

2 PARK Y.C. Role of money in stabilisation policy in developing countries" IMF Staff papers Vol.20 No.2 (July 1973).

4.3.3 Hypothesis 3:

Our third and last independent variable in the first of our two equations is the ratio of demand to total deposits. We hypothesised as follows:

HYPOTHESIS 3: The publics' desire to hold currency vis other deposits is an increasing function of the ratio of demand to total deposits.

The result obtained is of the correct sign and the coefficient is significant at 1% level. We therefore accept the null hypothesis that the public's desire to hold currency in place of bank deposits is indeed an increasing function of the ratio of demand to total deposits.

Demand deposits is attractive to depositors in that they make payments for transactions much easier. The widespread use of this facility would tend to indicate widespread banking services meaning that this variable could also act as a proxy for bank branches. However, demand deposit payments are effected through cheque system which is not universally accepted as a mode of payment.

There is therefore a tendency for those who operate cheque deposit accounts to at the same time carry more currency on average than those without such accounts. This enables them to meet their relatively more heavier transactions.

4.3.4 Hypothesis 4:

The first variable in the equation explaining the behaviour of commercial banks in deciding to hold excess reserves is the ratio of demand to total deposits. We had hypothesised as follows:

HYPOTHESIS 4: The banks' holding of excess reserves is an increasing function of the demand deposits ratio.

The coefficient obtained was of the wrong sing and its magnitude was statistically not different from zero. We had expected the sign of the coefficient to be positive since demand deposits to commercial banks do not attract interest rates hence are essentially "free deposits". In this regard, the higher this proportion is in terms of the total bank deposit portfolio, the less costly it is for banks and therefore tends to encourage them to hold excess reserves.

Because of the wrong sign and the insignificant explanatory power of the variable we have to reject the null hypothesis and accept that banks' desire to hold excess reserves is not an increasing function of the ratio of demand deposits. Just to confirm that our hypothesis was not entirely wrong in terms of the expected sign, we tried to see the correlation between excess reserves and demand deposits and the result was indeed a positive correlation. This implies that the negative sign obtained when all the variables in the equation are regressed, must have been affected by the behaviour of some of these independent variables.

4.3.5 Hypothesis 5

In economies where interest rates are determined by market forces, the opportunity cost of holding excess reserves would be an important determinant of amounts of excess reserves to be held. At this point it is in order to mention that neither the lending rate by commercial banks nor the proxy of the short-term Treasury bill rate were found to be significant determinants of excess reserves. Besides, the two including the other variable of growth in liquidity exhibited multicollinearity problems.

For this reason, we had to look for another important determinant and the demand for credit was thought a good determinant. Demand for credit was

chosen since banks are in the business of lending funds to those who need. Excess reserves therefore are held at the expense of earning income through loans. Hence we hypothesised as follows:

HYPOTHESIS 5: The banks' holding of excess reserves is a decreasing function of the demand for credit.

We have taken the ratio of advances (loans) to deposits to be a measure of the publics' demand for credit. Bolnick (1975) had used import demand as a measure of demand for credit and found the same to be significant while Mwega used the ratio of advances to deposits and found it to be insignificant. The result obtained is a coefficient with the correct sign and a magnitude that is significant. Therefore we accept the null hypothesis that excess reserves of banks decreases with increased demand for loans.

4.3.6 Hypothesis 6:

Commercial banks accept deposits from members of the public. It is from these deposits that they are able to extend credit to those who need. Growth in commercial bank deposits therefore would signify that more members of the public are having to deal with banks.

Alternatively, it would signify that more and more banking outlets are encouraging people to use these banking services. Either way, the size of deposits was taken as a scale variable on the assumption that as the size of the banking system increases as measured by total deposits, the level of excess reserves desired will also increase[3]. We therefore hypothesised that:

HYPOTHESIS 6: Commercial banks' excess reserve holding is an increasing function of total deposit levels.

Regression results obtained indicate that not only is the sign the expected one, but also that the coefficient is significant at 5%. We therefore accept the null hypothesis that banks' excess reserves increases with total deposits.

4.3.7 Hypothesis 7:

Central Banks in pursuit of their monetary policy objectives, usually require commercial banks to maintain a certain proportion of their deposits or deposit-like liabilities in vault cash and/or deposits with the Central Bank. In our case we have defined the reserve ratio more broadly to mean the liquidity ratio. Liquidity ratio is the ratio of commercial bank liquid assets to total deposits.

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[3] COATS W.L and KHATKHATE D.R. Oxford Bulletin of Economics and Statistics Vol. 40 No.2 (May, 1978).

Included in these liquid assets are government securities (Treasury bills) because they can usually be converted into reserves proper relatively quickly with minimal risk. However the ratio is defined, reserve requirements are "taxes" on the potential earnings of commercial banks. Looked at it this way, it is advisable to arrange transactions so as to avoid unnecessary reserves as much as possible. we envisaged that excess reserves can only increase with decreasing reserve ratio, hence

HYPOTHESIS 7: The commercial banks' holding of excess reserve is a decreasing function of the reserve ratio.

The estimation results confirm that the sign is the expected one and the magnitude is significant at 10% level. We therefore accept the hypothesis that commercial bank excess reserves is a decreasing function of the required reserve ratio.

4.3.8 **Hypothesis 8**:

Excess reserves is a ratio of required reserves. Liquidity is a measure of the ease with which commercial banks can meet their demand for withdrawals by their depositors and/or short-term creditors. This requires banks to maintain

adequate amount of cash and near cash assets. As stated elsewhere, we have defined our required reserve ratio broadly to mean the same thing as the required liquidity ratio. It therefore goes to say that as these assets grow in a bank's portfolio, the chances of increasing excess reserves rises. For this reason, we expect that, excess reserves held by commercial banks will move in the same direction as the size of liquid assets . Consequently we have hypothesised as follows:

HYPOTHESIS 8: Commercial banks' holding of excess reserves is an increasing function of the growth of liquid assets.

Our estimation results confirms that the expected sign of the coefficient is correct, and the magnitude is statistically significant. We therefore accept the hypothesis that indeed, commercial banks holding of excess reserves is an increasing function of liquid assets.

CHAPTER V

SUMMARY AND CONCLUSIONS

5.1 Summary

It has been the object of this study to focus on the behaviourial aspects of both the non-bank public and the banking sector. We have seen from the literature surveyed that there is substantial disagreement as to the extent to which money matters. While all are agreed that money is an important determinant of economic activity, agreement as to its control is not unanimous. Monetarists in general argue that monetary authorities can exercise effective control over the stock of money; others argue that the determination of the stock of money is part of a simultaneous solution for all variables in the financial and real sectors of the economy.[1]

Developing countries are having to accord increased attention to monetary policy formulation, in pursuit of their stabilisation programmes[2]. Our focus has been on the money multiplier, and we have sought to define the determining factors functionally so that we can estimate the same. We have justified this

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1 PARK Y.C The ability of monetary authorities to control the stock of money in less developed countries. IMF STAFF PAPERS VOL.20 NO.2 (1973)

2 LAIDLER, D" Money and money income. An essay on the transmission mechanism. Journal of Monetary economics.

approach in that the multiplier frame work simplifies the explanation of the interactions which help shape money's behaviour when used with due care and attention to the interactions of the various sectors[3].

Our research problem was to understand the behaviour (banking habits) of the non-bank public and the banking sector in determination of the monetary base and hence the money supply. Two equations relating to the two parties were specified and estimated using secondary annual data obtainable from the quarterly economic reviews of the Central Bank of Kenya. Estimation results obtained indicate that, the public's and banking sectors' behaviour can to a large extent be predicted provided all determinants are known. However, in our paper we have stated that factors which influence peoples' decisions to hold currency as opposed to bank deposits include the use of credit cards, uncertainty regarding the general economic stability among others. These two variables could not be tested for lack of appropriate indices (proxies) for them. This therefore may explain the rather low value of R^2 in the equation.

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[3] COATS, W.L and KHATKHATE D.R "Money and monetary policy in less developed countries. A survey of issues and evidence". pergamon press pp.19

The survey of the literature on money supply in general and the money multiplier in particular revealed like in many aspects of economics, that it is hard to come to unanimous agreement as to the behaviour of explanatory variables. There was for example, no unanimity as to whether the money multiplier was predictable or not. Secondly, it was clear that the value of the money multiplier is dependent on the definition of the money stock used so that we would expect to obtain different multipliers for M_1, M_2 etc as the case may be.

Thirdly, the role played by the nature of the financial system i.e. the development of the banking sector, would influence the functioning and result of the money supply process. For example, successful use of open market operations option depends on a well developed financial system with a wide range of financial assets. This therefore means that the approach to formulation of monetary policy in a developing economy would differ however slightly from that of a developed one, because of their differences in the financial system development. In the case of Kenya for example, throughout the period to which the study relates, interest rates were administratively determined by the Central Bank. Further, the Central Bank's option of using open market operation was not employed.

We have shown that the foundation of the multiplier framework is the monetary base. That the multiplier framework builds upon an identity which depicts the money (M) as some multiple (m) of the base money (B).

$$M = mB$$

The sources of the monetary base include Central Bank's credit to government (G), to commercial banks (BR) and net holdings of foreign assets (NFA). This implies that

$$B = G + BR + NFA + OAN$$

Where OAN is: other assets net. Changes in Central Bank's credit to government is dependent on budgetary operations of government in which case the Central Bank may have little influence. The NFA component is dependent primarily on variations in the external position of the economy i.e. movement in exports, imports and capital.

Quite obviously the Central Bank would have little direct control over this source of the monetary base. The commercial bank credit on the other hand can be controlled by the Central Bank directly and indirectly through the latter's discount rate.

If we assume a simple banking system so that the money stock is defined

$$M = C + D$$

Where C = currency with the non-bank public, and D is commercial bank deposits and to further assume simple behaviourial assumptions for currency and reserve demand that they are proportional to total deposits,

We have

$$C = cD$$

$$R^q = rD$$

$$R^e = eD$$

Then $M = C + D = (1 + c)\ D$

Therefore, $M = \underline{(1 + c)}\ (G + BR + NFA + OAN$

$(C+r+e)$

$= mB$

We estimated two equations using he OLS technique, with seven variables. Of the 7 variables we found 5 to have significant explanatory powers.

Overall, the results obtained while not being conclusive, give strong indications that, with refined data and variables, the public's and banking sectors' behaviour can be estimated and hence predicted. If this can be done, then we can say that the Central Bank can control the money stock to that extent.

5.2 Conclusion

The study has enabled us to make several conclusions. First, from the first equation here reproduced:

$$C/TD = a_o + a_1TB + a_2Y + a^3DD$$

$$a_1, a_2 < 0; a^3 > 0$$

Our estimation results show that, the variable of demand deposits (DD) is the only one with significant explanatory power. The rate of interest as measured by the Treasury Bill rate, and the level of income are non-significant variables. These results are consistent with Ndua's (1982). However, our results differ from that of Ndua in that our third variable - the ratio of demand to total deposit which we found to be highly significant was not tested by Ndua. For his part Ndua used bank branch network as a proxy for spread of banking services. This variable proved to be highly correlated with the level of income. When the two variables are used together in the equation neither of them was significant but when either one of them was dropped the remaining one was significant.

The second equation:

$$R^e/TD = b_o + b_1AD + b_2D + b_3DD + b_4MB + b_5LA$$

$$b_1, b_5 < 0; b_2, b_3, b_4 > 0$$

Of the five independent variables in the equation only one - the ratio of demand deposits to total deposits (DD) proved to be insignificant. To a great extent these results are consistent with those of Bolnick (1975) and Mwega (1990). However, for Bolnick the only variable he found significant was the growth of liquidity (MB). He used import demand as a proxy for demand for credit but found it to be insignificant. Mwega's variables which are common to our study, are demand for credit measured by advances to deposits ratio, growth in liquidity and the stance of Monetary policy as measured by the minimum liquidity ratio. All these variables he found to have influenced the reserve ratio at one time or another over the period 1971 to 1988. In our study, we have used excess reserves as the dependent variable as opposed to just the level of reserves as used in the Bolnick's and Mwega's studies. Our results are consistent with Mwega's with regard to variables - demand for credit, growth in liquidity and stance of monetary policy proxied by minimum liquidity ratio. However, though the variable of composition deposits (ratio of Quasi-money to total deposits) does not appear in our equation, we nevertheless tested it and found it to be insignificant contradicting Mwega's findings which he found to have been significant at one time or another. In addition, we had a new variable in our study namely level of deposits. This variable was introduced as a scale variable and it proved to be significant.

5.3 Policy Implications

We have seen how the money multiplier can vary depending on the definition of the money stock (see table 4.4.). Indeed the money multiplier is unstable. However, from our data it appeared less unstable when the money stock is defined as M_1 as opposed to when it is defined as M_2 (this comes out clearly on chart 4). On this aspect alone, it suggests that a narrower definition of money stock may facilitate easier control of money supply than the broader version of M_2. This conclusion would seem to contradict the one which states "M_2 will be most stable when all of the deposit categories included in it also constitute the reserve base - that is, when the reserve base consists of demand, time and savings deposits of the non-bank public. In this case government and interbank deposits should be excluded from the reserve requirement base[4]". The latter sentence gives the condition for making M_2 more stable. This is done in the case of Kenya i.e. Government deposits are excluded from reserve money. But the same article (Coats, 1980) clearly states that evidence as to which of the two (M_1 or M_2) is more stable and hence more appropriate to control is inconclusive and that the answer may well vary from country to country. Therefore our preference of M_2 over M_1 is our

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[4] COATS, W.L "The use of reserve requirements in developing countries" in money and monetary policy in less developed countries. A survey of issues and evidence. Pergamon press.

believe that the former reflects more on the country's economic activity than the latter. It is instructive at this point that Mwega also found M_3 (M_2 plus liquid assets of non-bank financial institutions) displayed the same pattern as M_2 and there was little correlation between the multiplier and the monetary base.

We have shown that one of the sources of the monetary base is net foreign assets. This is a variable that will tend to frustrate monetary authority's attempt to control money supply. This is more so when the domestic currency is pegged to external currencies. For policy formulation therefore, authorities would have to bear this mind. If the exchange rate was freely floating, its movement would stabilise excessive fluctuations of net foreign assets and hence stabilise money supply.

The rate of interest be it the savings rate, the treasury bill rate, or the commercial bank lending rate like in the studies conducted by Bolnick (1975) and Ndua (1982) were found to be insignificant variables for policy manipulation. Authorities would therefore stand little chance of success if they employed interest rates in formulation of monetary policy at least as long as the rates are administratively determined. As we have noted elsewhere however, interest rates have since been decontrolled and our conclusion cannot apply to such a situation. This apparent insensitivity on the part of the public to interest

rate changes, may be due to the relatively small range of financial assets available. Secondly, treasury bill rates are normally denominated in large amounts (a minimum of shs 100000) this would tend to be outside the range that can be afforded by most individuals. Thirdly treasury bills in Kenya also count as liquid assets, hence they are attractive to commercial banks because in addition to contributing to income they also count as liquid assets for liquidity purposes. With the freeing of interest rates therefore, these other issues; narrow range of financial assets, smaller denominations of Treasury bills would need to be addressed if policy designed and based on interest rates as a target variable is to succeed.

Secondly, policies designed to control money supply through incomes manipulation may fail as this variable was not significant. It has been said (see Park Y.C. 1973) that in developing countries due to the limited range of financial assets, real assets tend to be close substitutes for real cash balances and therefore the demand for real cash balances would be sensitive to the nominal rate of return on real assets. Further we mentioned that the GDP which we used as a measure of income though it may be the best measure for real income may not be the best proxy for domestic expenditure. Therefore based on our results authorities using income as a variable in assessing the behaviour of the public would do well to employ another variable or at the very least choose an index other than GDP.

Ratio of demand deposits, deposit mix (as measured by ratio of Quasi-money to total deposits) as well as the lending rate by commercial banks would also not yield good results for policy as all the of them displayed insignificant explanatory powers. Demand for credit and growth of liquidity were significant variables in explaining the banking sectors' holding of excess reserves. Policy designed to control money supply through these variables in Kenya is therefore bound to be effective.

We have mentioned that in the period after 1990, interest rates have been freed and the option of open market operations as a tool for money supply control has since June 1991* been implemented. We believe that with these two developments, the policy variables that influence the behaviour of both the banking system and non-bank public with regard to excess reserve holding and currency demand respectively, and their relative significance would have to change.

* This information is based on the researcher's knowledge of Central Bank. It will be published in the 1992 Central Bank annual report.

Table 4.4 The multiplier associated with narrow (M_1) and broad money stock (M_2).

YEAR	$M_{1/B}$	$M_{2/B}$
1972	1.88	2.67
1973	1.90	2.64
1974	2.05	2.97
1975	2.03	3.04
1976	1.71	2.55
1977	1.66	2.45
1978	1.93	2.93
1979	1.90	2.92
1980	1.89	3.10
1981	1.76	2.90
1982	1.67	2.67
1983	1.86	2.99
1984	1.70	2.80
1985	1.64	2.83
1986	1.42	2.43
1987	1.35	2.34
1988	1.50	2.65
1989	1.42	2.61
1990	1.43	2.47
Mean	1.72	2.73

Source: Central Bank of Kenya - Quarterly Economic Reviews.

Table 4.5 The currency ratio variously defined between 1972 - 1990

YEAR	C	C/TD	C/D	C/M_1	C/M_2
	K£(M)	(%)	(%)	(%)	(%)
1972	894.1	29.5	25.2	9.5	20.8
1973	982.0	25.1	21.5	25.4	18.3
1974	1085.7	25.9	21.9	27.0	18.7
1975	1234.5	25.1	21.1	27.2	18.1
1976	1625.1	27.3	22.7	28.6	19.2
1977	2182.4	24.5	20.8	25.9	17.6
1978	2305.0	22.4	19.0	24.8	16.3
1979	2673.3	23.0	19.5	25.1	16.3
1980	3031.5	24.9	21.6	30.6	18.7
1981	3568.7	26.6	22.8	32.1	19.4
1982	3724.1	23.0	20.2	27.9	17.5
1983	4083.0	23.3	21.0	29.3	18.3
1984	4370.2	22.1	19.7	28.6	17.3
1985	5037.6	22.3	20.5	32.0	18.7
1986	6371.1	22.3	20.6	30.5	17.9
1987	7687.6	24.8	22.9	33.6	19.4
1988	8536.2	28.7	22.9	35.2	19.9
1989	9654.6	24.0	21.4	36.7	20.0
1990	10829.4	23.8	21.5	32.3	18.7
Mean	**4203.9**	**24.7**	**21.4**	**29.6**	**18.5**

Source: Central Bank of Kenya Quarterly Economic Review.

What is apparent from the result of this study, is that control of money supply through the money multiplier approach is dependent on the interplay of many factors. It is therefore safe to say that control of money supply by the authorities through this approach would at best be a rough guide to formulation of policy. However, such a guide could be made more precise through use of more appropriate indices or proxies for those variables which cannot be measured directly. Secondly, it our considered view that short period data points e.g monthly or quarterly data may improve results as we can take care of seasonal factors.

DATA USED IN THE STUDY

YR	C/TD %	Y K£(M)	TB %	DD %	R/TD %	D K£(M)	AD %	MB %	LR %	QM %	SR %	LA %
1972	30	658.6	3.49	56.2	8.0	177.6	68.5	22.67	9.0	47.5	3.0	15.0
1973	26	747.0	2.12	56.0	11.0	228.0	70.8	26.0	9.0	38.9	3.0	15.2
1974	26	895.3	5.59	56.4	5.0	247.7	84.0	-3.56	10.0	43.8	5.0	16.1
1975	26	1052.6	5.70	52.8	4.0	292.0	80.2	14.43	10.0	47.0	5.0	15.0
1976	28	1296.1	6.23	52.4	8.0	357.9	74.3	47.83	10.0	47.5	5.0	18.0
1977	25	1680.0	1.41	51.1	12.0	525.3	68.8	53.27	10.0	45.5	5.0	18.0
1978	23	1788.4	6.67	47.7	5.0	606.7	76.5	-5.05	10.0	47.8	5.0	18.0
1979	24	1979.6	4.45	49.2	8.0	685.6	77.6	16.42	10.0	51.1	5.0	16.0
1980	25	2235.4	5.57	44.6	2.0	700.1	87.3	-6.68	11.0	52.8	6.0	16.0
1981	27	2582.0	9.99	43.3	5.0	784.3	84.1	20.86	14.0	55.0	10.0	15.0
1982	24	2944.6	13.35	40.4	11.0	919.6	76.9	26.86	16.0	51.1	12.5	15.0
1983	24	3310.9	15.0	42.8	1.0	972.5	83.5	-6.32	15.0	49.4	12.5	20.0
1984	23	3851.8	12.43	44.3	4.0	1108.0	82.5	20.48	14.0	51.9	11.0	20.0
1985	23	4418.7	14.14	41.3	1.0	1229.7	85.0	5.27	14.0	51.5	11.0	20.0
1986	23	5115.0	12.15	40.0	10.0	1547.8	79.3	54.72	14.0	53.6	11.0	20.0
1987	23	5648.2	13.0	37.1	11.0	1680.1	82.9	15.56	14.0	57.1	11.5	20.0
1988	26	6471.8	13.52	48.5	4.0	1863.5	84.6	-4.95	15.0	56.9	11.5	20.0
1989	26	7426.2	14.0	47.8	4.0	2252.0	82.7	14.8	18.0	60.0	13.5	20.0
1990	26	8633.6	15.93	49.6	10.0	2516.9	82.4	26.7	19.0	57.6	14.5	20.0

Key to variables used:

C/TD - Ratio of currency outside banks to total private deposits expressed as a percentage.

Y - GDP at current prices

TB - Short-term Treasury bill rate

DD - Ratio of demand deposits to total deposits

R^e/TD - Ratio of excess reserves (liquid assets) over required reserves ratio (liquidity ratio) expressed as a percentage.

D - Level of total deposits

AD - Demand for credit as measured by the ratio of total advances to total deposits

MB - Annual growth of liquid assets (liquidity ratio)

LR - Commercial bank lending rate

QM - Quasi-money ratio, i.e. ratio of savings and time deposits to total private deposits

SR - Savings rate of interest

LA - Required liquidity (reserve) ratio

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