MONEY SUPPLY DETERMINATION IN KENYA:
A MACROECONOMETRIC ANALYSIS

BY

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Research paper submitted to the Department of Economics, in partial fulfillment of the requirements for the degree of Master of Arts in Economics.


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Money supply determination in
This research paper is my original work and has not been presented for a degree in any other university

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This research paper has been submitted for examination with our approval as university supervisors

DR. G.M. MWABU

DR J. F. MWEGA
Acknowledgement

I am greatly indebted to Dr. Mwabu for laying a good econometric foundation which formed the basis for the analysis of this study. I benefited greatly from his patient, and from his insightful comments.

I owe special thanks to my brothers, David Korir and Joseph Birir, who inspired me to take up postgraduate studies and for their generous financial assistance which facilitated my study at Kenyatta University. I also owe a debt of gratitude to the African Economic Research Consortium and to International Health Policy Program for the financial support.

I thank all my classmates, Chepkurgor, Mwangi and Kaboro who assisted me in several ways in this study. Thanks also go to lecturers at the Department of Economics, Kenyatta University and staff of the Central Bank of Kenya for their assistance.

My sincere gratitude goes to my family for the patience and encouragement I received from them throughout my course.

Julius Kipkemoi Korir
July, 1992
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Abstract

Monetary policy plays an ever-increasing role as an economy develops. Understanding of money supply determination is important in formulating correct monetary policy measures. This study investigated the impact of high powered money and the basic ratios of money multiplier on money supply.

Time series data used for estimation were obtained from published documents from the Central Bank of Kenya. The only artificial variable constructed is quarterly data for income.

The results show that high powered money and the various deposit and reserve ratios are all significant in the determination of money supply in Kenya. On the basis of empirical results, it is recommended that:

(a) greater stability be sought on the balance of payments to increase predictability of the high powered money as it was found to be the most important determinant of money supply.

(b) The government budget gap be narrowed to reduce government domestic credit so as to enable the Central Bank to have some grip over high powered money. Budget deficit in Kenya have been shown to exert a powerful impact on trends in domestic credit and money, and this applies to deficits financed by borrowing from the banking sector and of deficits financed externally.

(c) Effective ways of controlling bank credit be designed and implemented in response to changes in their liquidity. This can involve use of banks reserve base which requires raising of liquidity ratios until they affect credit creation by the banks.
CHAPTER 1 INTRODUCTION

1.1 Background

In a modern economy, money is something more than a technical device, serving as a standard of value, a medium of exchange, a store of value, or a standard of deferred payments. Money exerts important dynamic influences on economic affairs in a modern economy. The change in the quantity of money, and in its velocity is known to affect the behavior of such aggregate economic variables as level of output, employment and inflation rate.[Friedman, 1956 and others].

There are several aggregate variables that may be targets of monetary policy. According to Beecham (1986), money supply, credit, interest rates and expenditure may be such targets. However, in the case of Kenya, as is evident in the Development Plans, money supply or money stock has been the major target of monetary policy. A survey of empirical studies in many countries shows that money supply is preferred as a target variable by monetary authorities (Ajayi, 1981). The money stock is often chosen to serve this purpose because it is under the control of Central Banks. This is by no means tantamount to saying that the stock of money is determined unequivocally by the Central Bank. Money stock determination is a process which results from a complex interaction of behavior of various economic agents, and such an interaction poses questions of controllability of money supply. Controllability of money supply
is important because when money stock is out of control, the consequence of that may be serious economic as well social upheavals (Chung, 1976).

Ease or otherwise of controllability of money supply also depends on which definition of money is assumed as target variable. For example, there are two commonly used concepts of money: M1 and M2. M1 is defined as currency outside banks plus demand deposits; M2 is the sum of M1 and quasi-money, where quasi-money consists of savings and time deposits. In this study, M2 is the point of concern because M2 is the target for monetary policy in Kenya (Republic of Kenya, 1984).

To appreciate the basic issues in the control of money stock, it is necessary to examine the behavior of various agents in determination of money stock and the institutional setting within which this behavior occurs.

1.2 The Financial Sector in Kenya

The Kenyan economy, when compared with other developing countries, is well monetized relative to its stage of development (Republic of Kenya, 1986). By the close of 1985, total financial assets which included currency outside banks, the deposits of the banking system and government securities were 67 per cent of gross national product.

Between 1967 and 1985, the banking system deposits grew at an annual average rate of 16 per cent, while deposits in non-bank financial institutions (NBFIs) recorded a higher growth
of 26 per cent. These growths in deposits essentially reflected diversification of the financial wealth by the public. It should however be noted that deposits play an important role in credit creation which in turn affects money stock in the economy.

The banking sector plays an important role in money stock determination in the process of credit creation (Bolnick, 1975; Hamdani, 1976; Cuthbertson, 1985). Kenya's financial system is composed of the Central Bank of Kenya, 26 Commercial Banks with 236 full branches, 87 sub-branches, 41 agencies and 127 mobile units; 52 non-bank financial institutions with 103 branches; and 17 building societies. Other financial intermediaries include 2 development financial companies, the Post Office Savings Bank, 39 insurance companies and numerous Cooperative savings and credit societies (Republic of Kenya, 1991). This large number of financial agents shows the potential of the banking sector in money supply determination.

The growth in money supply in Kenya has been on the average steady. Between 1967 and 1985, the growth in M2 averaged 15.8 per cent per year, reflecting, in part, continued expansion and diversification of the financial system. The most rapid expansion in money supply, since the Coffee Boom of 1977, was in 1982. This growth caused a record inflation of about 22.3 per cent (Republic of Kenya, 1986). After 1982, the growth in money supply was reduced to a manageable level, through ceilings on overall credit expansion. Between December, 1982 and December, 1985, the average annual growth rate in money stock was around
8 per cent. This low rate of growth helped to curb inflation.

Much of the expansion in the money stock was due to the upward trend in quasi-money. This component of money supply grew at a yearly rate of 18 per cent, up to 1985. M1 however, grew at a moderate rate of 12.6 per cent. The high growth of the quasi-money can be viewed as evidence of a shift of financial portfolio, a factor in the determination of money supply.

High growth rate in money supply after 1982 occurred in 1986 and in 1990, reaching 33 per cent and 20 per cent respectively. This high growth in money stock in 1986 was due to the 1986 mini-coffee boom while that of 1990 can be traced back to total domestic credit which grew by 27 per cent in the year. The expansion in 1990 was supported by increased domestic credit as the foreign assets declined.

Although the aim of Monetary Authorities in Kenya is to control money stock, and hence real macroeconomic aggregates, the instances of 1982, 1986, and 1990, whereby money growth was out of hand, cast doubts on the ability of Monetary Authorities to manipulate money stock. Serious attention therefore needs to be given to the process of money supply determination in Kenya so as to understand the extent to which Monetary Authorities can have control over money supply. Since this process influences real economic aggregates such as output and employment levels, its understanding would, to the extent that it informs in formulation of monetary policy contribute to national development.
Figure 1 below displays the trends in the money stock (M2) and high powered money. There is evidence of relatively stable and rising trends in both the money stock and high powered money. It can be shown that the gap between the two variables shows a widening trend.

Figure 1: Trends in Money (M2) and High Powered Money (HR)
Figure 2 shows the trend in the money multiplier. The trend indicates that the money multiplier exhibited dramatic fluctuations.

Figure 2: Trend in Money Multiplier (mm)
1.3 The Research Problem

The objectives of Monetary Authorities in Kenya include the growth in income, balance of payments equilibrium, and control of inflation. These objectives are to be achieved through manipulation of money supply. In order to achieve these macroeconomic objectives the monetary authorities should measure and predict stock of money at any particular time. The authorities can be in a strong position to control money stock if they are in a position to regulate monetary base given that money multiplier is relatively predictable. But according to Bolnick (1975) and Mwega (1990) both the multiplier and monetary base have been shown to vary more than money stock in Kenya. In the short-run money multiplier has been shown to exhibit more dramatic variations than the monetary base. However, it is noteworthy that the money supply, broadly defined, in Kenya has experienced, on average, steady growth. But this cannot affirm our confidence in the ability of the authorities to control money supply. This is because there are cases when money supply was excessive causing inflationary pressure among other instabilities.

The basic issue that arises is whether the monetary Authorities in Kenya are in a position to control money supply. This issue can be understood and addressed to through an analysis of money supply determination.
1.4 **The Research Objectives**

(i) To specify and estimate money supply function for Kenya.

(ii) To estimate the determinants of the money multiplier.

(iii) To specify and estimate the reaction function of the Central Bank of Kenya.

(iv) To deduce policy implications based on research findings.

1.5 **The Significance of the Study**

Monetary policy plays an ever increasing role in macroeconomic stabilization as an economy grows. Therefore, study provides an empirical foundation on which continued formulation and conduct of monetary policy in Kenya can be based. This involves understanding the process of money supply determination as money is known to play a very important role in the economy through its influence on real economic variables. This study by providing such an understanding therefore generates and enhances the ability of Monetary Authorities to manipulate money supply for the purpose of controlling it.

1.6 **Outline of the Remaining Chapters.**

Chapter two outlines briefly the related literature. The studies cited touched on both developed and developing countries. Most of these studies focused on the components of money supply, especially the money multiplier components.

In chapter three, the money supply determination is
modelled, taking into account the Central bank, the Commercial banks and the non-public behaviors in money supply. This modelling gave the theoretical framework. The research hypotheses tested on the following chapter were stated in this chapter.

In chapter four, data collection and analysis are given briefly. Empirical results are presented and discussed. The discussion of these results on the control of money supply is highlighted.

Chapter 5 gives the summary of major findings, conclusions and policy implications.
2.1 Theoretical Literature

Ajayi (1981) explains that money supply is determined by the behavior of three economic agents: The behavior of the banks concerning the amount of reserves that they decide to keep at any point in time; the behavior of the non-bank public in dividing their money assets between currency and demand deposits. The larger the non-bank public's marginal currency-deposit ratio, the smaller will be the expansion of deposits and the money supply resulting from an increase in the monetary base; the monetary authorities in their decision to change the size of monetary base and also the right of the authorities to set the legal reserve ratio. The behavior of the banks and non-bank public are embodied in the money multiplier and that of the authorities embodied in monetary base. It should be noted that factors that determine money multiplier positively (negatively) will, by extension, determine money supply positively (negatively). Evidence in support of this view can be found in for example Iman (1970) Bolnick (1975) Scadding (1977), Mangla et. al (1978).

Dornbusch (1984) discusses the factors that determine reserve-deposit ratio. This ratio is determined by the monetary authorities through minimum reserve requirement, the cost is of borrowing from the Central Bank when the commercial banks run short of reserves, the interest forgone by holding reserves, and, the variability of cash flow to the banks. He gave the
following functional form of reserve deposit ratio:

\[ r = r(i, i_D, r_R, \delta). \]

When market rate of interest \( i \) on earnings assets increase, the reserve ratio decreases, since it becomes costly to hold reserves. An increase in the discount rate increases the ratio, since it raises the cost of running short of reserve. An increase in the required reserve ratio increases the actual reserve ratio. The forgoing discussion suggests that the supply of money itself may also be a function of market rate of interest rates.

According to Furness (1975) reserve requirement and discount rate are important tools of monetary control in developing countries where financial markets are not well developed.

2.2 Empirical Literature

Studies pertaining to money supply process have been done in many countries. Ajayi (1974) estimated parameters of determinants of money supply in Nigeria using a portfolio model. He stated the demand for currency as a function of current income, rate of interest on treasury bills and seasonal dummies. All these variables were found significant except for the rate of interest on treasury bills, although of the right sign. The demand for demand deposits was made a function of the same variables as in the case of currency, but instead of current income, he found permanent income performing better in
terms of statistical significance. He also found that permanent income performed better than current income in terms of statistical significance with regard to time deposits and savings deposits. With exception of savings deposits, the rate of return on treasury bills was of the right sign. Savings were found not be sensitive to their own rate of return. The reason given for this result is that savings deposits at commercial banks were held, not due primarily to interest rates, but to services offered by the banks. A similar conclusion was reached using Canadian data by Salyzyn (1966).

In a structural model of Pakistan's monetary sector, Iman's (1970), demands for currency and demand deposits were made a function of income and weighted average rate of interest on financial assets. Likewise private demand for time deposits was hypothesized to be a function of the same variables. The reasons for using only current income here was on the basis of Adenkule's (1968) work suggesting that in a low income region current income is a very adequate approximation to permanent income. With regard to demand for currency, demand deposits and the time deposits, the weighted average rate of interest was statistically significant. However, although of the right sign, the current income was statistically insignificant.

In an econometric analysis of money supply and money demand in Canada, for the period 1955-65, Courchene et. al (1970) found the demand for currency was related more closely to permanent income as permanent income was statistically significant at the
5 per cent level. The lag response was also found significant at the same level. The coefficient of the expected price on the demand for currency was also found to be statistically significant. The importance of this coefficient arises from the fact that when the public expects the price to rise less, currency is demanded. In the case of demand deposits model, current income was used as an explanatory variable to reflect the transactions purpose for which deposits are held. To capture the portfolio rationale of holding demand deposits, the average maturity term of publicly held government debt was included in the model. An additional variable was the turnover ratio of demand deposits defined as the ratio of cheques cashed to an average level of deposits. This ratio was used as a proxy for technological factors influencing demand deposits. All the variables in the function for the demand deposit were found to be statistically significant at the 5 per cent level. The results showed a rather quick adjustment to equilibrium, in the sense that 55 per cent of the desired change in deposits occurred in the first quarter.

With regard to demand for savings deposits, Courchene et al. (1970) found out that savings were held for wealth purposes rather than for transactions purposes, as evidenced by highly statistical significance of permanent income. Also included in their model, was a long-term bond rate, to represent the opportunity cost of tying up the funds in personal savings deposits. Average maturity rate of the public debts was an
additional variable in the model. These two variables were statistically significant at the 5 per cent level.

Thomson et. al (1971) formulated and estimated a monthly money market model for the U.S for the period 1960 to 1968. Currency was hypothesized to be a function of wealth, retail sale and seasonal factors. All the variables were statistically significant at 5 per cent level. The authors tested currency holding for interest rate sensitivity but none was found. Their results showed that wealth was significant in determination of time and savings deposits.

The banking sector plays an important role in money supply determination. The determination of portfolio behavior of the banks has been empirically studied. Ajayi (1974) desegregated the demand for liquid assets by the banks into two components, Cash and Treasury bills. Treasury bills were made a function of total deposits, the loans, their rate of return and their first lag. All the variables, except own rate of interest, were statistically significant at the 5 per cent level. He also found out that treasury bills were held as buffer stocks in anticipation of seasonal credit demands.

Imam (1975) formulated a model in which excess reserves function indicated that commercial banks excess reserves are influenced by changes in commercial loans portfolio, changes in the stock of high powered money and changes in the weighted average rate of interest. Excess reserves is a very important variable with which the banking sector affects money supply.
through credit creation. Galbraith et. al (1970) contend that variations in observed values for cash reserve ratios in the banking system have traditionally been taken to reflect changes in the preferences of banks for reserves. Devel (1963) explained that the capacity of a bank to extend credit is determined by its reserve positions. According to Crouch (1967), from the individual bank’s point of view, the demand for cash reserves is a function of its deposits.

The importance of Central banks in determination of money stock cannot be overemphasized. The behavior of the Central Bank is explicit in the Bank’s manipulation of the high-powered money. The supply of high-powered money is influenced by monetary policy objectives and by the constraints faced by the Central Bank in the external sector. Scadding (1974) notes the importance of Central bank’s control of money supply. He asserted that the Central bank should be able to forecast the behavior of the real variables in the supply of money quite a long time ahead.

The behavior of Central bank with regard to money supply can be analyzed using a function called the reaction function. Ajayi (1974) formulated a reaction function for the Central Bank of Nigeria in which the dependent variable was the rate of return on treasury bills; the explanatory variables were U.K. rate of return on treasury bills, levels of foreign exchange reserves and trade account balance. The U.K. rate and own lag were found to be statistically significant at the 5 per cent
level. The coefficient of foreign exchange variable was of wrong sign although insignificant.

In a reaction function of the Central Bank of Canada, Courchene et. al. (1970) investigated the extent to which the monetary base responded systematically to various stimuli from the private sector. Monetary base rather than bank reserves was used as the dependent variables in the reaction function. The explanatory variables included currency, lagged monetary base, U.S interest rate, and price changes. All these variables were found out to be statistically significant at the 5 per cent level.

Frost (1977) found out that increase in high powered money in the U.S, accounted for 91 per cent of the secular growth in money supply from 1875 to 1955. After adjusting for the trend, he found that currency ratio accounted for 46 per cent of cyclical fluctuations of the rate of growth in money supply; high-powered money accounted for 27 per cent and reserve ratio 27 per cent.

Frost (1977) shows that short-run fluctuations in the monetary multiplier played an important role in determining year to year fluctuations in the growth in money supply. Movements in the currency ratio and the ratios of certificates of deposits to demand deposits were the major contributions to fluctuations in the money multiplier.

In a trade and money market model, Laffer (1970) assumed that, since demand deposits and currency earn zero rate of
return, the short-term rates of interest, are in fact, a good proxy for the opportunity cost of holding demand deposits and currency. His results yielded that real money supply and real money demand were sensitive to short-term interest rates prevailing in the market.

Ajayi (1981) gives regression analysis of the relationship between money supply and monetary base in Nigeria. Quarterly data for the period 1960(2) to 1974(4). Linear functional forms were utilized, with M1, M2 and M2 as dependent variables. The explanatory variables were monetary base lagged one year. For M1, the coefficients of both explanatory variables were statistically significant at 5 per cent level. The $R^2$ was 0.94. For the other definitions the significance of lagged monetary declined with definition. He tested the log-linear in which the dependent variable was M1 and current monetary base the only explanatory variable. The coefficient of current monetary was very highly statistically significant. This results showed that 96 percent of the variation in money supply was explained by monetary base. Ajayi also used a distributed lag form of equation, where M1 was made a linear function of current monetary base and monetary base for the last three periods. The results showed that current monetary base was more statistically significant than the others of subsequent period. $R^2$ was about 0.97.
Another study was done on Nigerian economy by Akinnifesi and Philips (1978), using the data for the period 1962-75. Money supply was specified as a behavioral function of monetary base. They utilized a function in which money supply was a log-linear distributed lag function of the monetary base with geometrically declining weights as follows:

$$\ln m_t = \delta (1-k) + \delta \ln H_t + k \ln m_{t-1} + u_t$$

The results showed good fit with about 97 percent of the variations in money supply, narrowly defined, explained by the independent variables. Both current monetary base and money supply lagged one year were statistically significant at 5 percent level. War dummy for the Nigerian civil war was statistically insignificant.

Black (1975) analyzed the determinants of money supply in Britain. He used the broad definition of money supply M3, which includes the deposit liabilities of non-bank financial institutions. The study covered the data for the period 1960-1970. The explanatory variables included and currency ratio. He found that currency ratio was the most significant determinant of money supply.

Khan (1974) specified and estimated a monetary model for the Venezuelan economy. He specified money supply to be a behavioral function of the monetary base. The coefficient of the monetary base was highly statistically significant, with monetary base explaining 99 percent of variations in money supply. The argument he gave for the use of monetary base only
for explanatory variable was that Venezuela being an open economy, money supply was no longer determinable by policy.

Most studies on money supply have concerned themselves mainly with the components of money supply. Buttler et. al (1979) analyzed the importance of multiplier and monetary base in determining money supply. They found out that in the short-run money multiplier plays an important role in variations in money supply and that change in monetary base has small effect on money supply. Jordan (1970) contends that factors that cause changes in the money-multiplier are the same factors that determine currency, time deposits and the reserve. By extension, this suggests that also the same factors affect money supply.

Khatkhate and Villanueva (1972) studied the behavior of money multiplier in the united states. They concluded that if the authorities are confident in the value of money multiplier they can adjust the size of the open market operations to the desired changes in money supply; or they can implement a more aggressive discount rate policy, supplemented by quantitative ceilings in order to discourage bank borrowings. But it should be noted that effectiveness of open market operations is small in a developing country like Kenya. Discount rate can be a very effective tool where commercial banks on central bank for borrowing.

Johannes and Rasche (1978) attempted a study aimed at predicting the money multiplier, using the data for the period 1955-1978. They concluded that the stock of money could be
predicted with considerable accuracy over several months given a knowledge of the path of the monetary base. But knowing the path of the monetary base may require that it is more closely controlled by the authorities. For Kenya, we are skeptical about the grip of monetary authorities over the monetary base given that in 1977 and 1986, the economy was not insulated against the excess inflow of foreign assets that affected the money base causing excess supply of money.

Khatkhate et al (1977) developed and estimated a money multiplier model for Venezuela. They found out that domestic interest rates and income significantly explained the behavior of currency-deposit ratio. Therefore we can hypothesize that interest rates affect money supply.

Rakissoon (1990) estimated determinants of money supply in Trinidad and Tobago using base-multiplier model. He used the data for the period 1969 to 1988. Currency was made a function of time deposit rate, demand deposit to total deposit lagged one period and currency lagged one period. All these variables were statistically significant. Excess liquidity ratio responded significant to deposit variability and credit to total deposit ratio. Credit made out by the banks was made a function required liquidity to excess liquidity and total deposit ratio. These variables were highly significant statistically, with the two variables explaining 99 percent of the credit supply. The quasi-policy variable i.e required liquidity to excess liquidity ratio being statistically significant confirms that the relationship
between required and excess liquidity is crucial in determining whether a particular liquidity ratio will be effective in influencing credit supply. He concluded that liquidity ratio was very important instrument since when it was increased, it exerted substantial downward pressure on the money multiplier and the money supply. This conclusion was based on the simulation results.

Mangla et al. (1978) estimated money supply functions. These functions utilized the functions derived by Brunner and Meltzer, and that by Gibson. In the first function, the stock of money was made a function of the basic ratios determining the multiplier and monetary base. The Gibson model consists of money supply being made as a function of total reserves of the banks, interest rate on bank loan and discount interest rate. They found that for the first function, the Brunner-Meltzer linear money supply model, fits the Pakistani data very well. All the coefficients except that of excess reserve ratio had the expected sign and in most cases were highly significant. The seasonal dummy was not significant. The Brunner-Meltzer linear money supply model with adjusted base, rather than monetary base itself, produced money stock predictions inferior to those produced by the estimates of the function with unadjusted monetary base. The explanatory variables for the former explain 99 per cent of variations in money supply. The Durbin-Watson statistics showed no serial autocorrelation.
For the Gibson model, the model when adjusted for serial autocorrelation gave better predictions. The estimates of reserves and interest rate variables were statistically different from zero, although the estimated coefficient of discount rate had incorrect sign.

Mangla et al. (1978) concluded that Brunner-Meltzer linear money supply model provided the best short-term predictions of the Pakistani money stock. This model will be utilized in our study.

2.3 Literature Specific to Kenya

Bolnick (1975) analyzed the proximate determinants of money supply in Kenya. His aim was to determine the degree of controllability of the stock of money by the monetary Authorities. The study used data for the period, 1967-IV to 1973-IV. He found that monetary base fluctuating more than M2 with the change in the multiplier tends to dampen the instability. He found that changes in currency-deposit ration contributed little to the variation in the money multiplier. But the variation in the reserve ratio was one major factor explaining instability between the monetary base and money supply. The implication of this is that for Authorities to control money supply, they should predict and/or control credit creation by the commercial banks. The most important monetary instrument here is the required reserve ratio.
Mwega (1990) updated Bolnick's study and found out that liquidity ratio was the most significant factors causing variation in money multiplier. He tried to explain the causes of changes in multiplier using factors as cost of credit, demand for credit, composition of deposits, stance of monetary policy measured by minimum liquidity ratio and growth in commercial banks' liquidity measured by growth in monetary base. He found out the growth in liquidity was the strongest determinant. Using M3 i.e. including the liquid assets of NBFFs in the definition of the monetary base. The results displayed the same pattern as for M2, but there was little correlation between the money multiplier and the monetary base.

Ndele (1991) estimated the components of money stock in Kenya. The explanatory variables were real income, rate of interest on financial asset and expected inflation. For the demand deposits function; the coefficients of real income and inflation were statistically significant at 5 per cent level. This results were for long-run demand equation. For a short run demand function including the demand deposits of NBFFs, the coefficients of real income, inflation, interest rate and currency lagged one year were statistically significant at the one per cent level. Currency demand for both long run and short run demand functions showed that interest rate and inflation rate were statistically significant at 5 per cent level. Time and savings deposits combined responded statistically significant to all the explanatory variables, with inflation being the
most statistically significant variable.

Ndua (1982) examined the factors influencing the currency-deposit ratio in Kenya. This ratio was made a function of real income, treasury bills rate, rate of inflation, degree of monetization, proxied by the number of commercial banks branches, and seasonal dummies. Income, the degree of monetization, and seasonal dummies were found to be the most important in influencing the currency-deposit ratio.
3.1 The Money Multiplier-Monetary Base Model

The model constructed takes account of behavior of three economic sectors, namely, the non-bank public, the commercial banks, and the Government.

The approach used is organized around the concept of demand for and supply of high-powered money.

Let \( M = Cc + Dd + Ds + Dt \) \hspace{1cm} (1)

Where \( M = M2 \)

\( Cc \) = Currency

\( Dd \) = Demand deposits

\( Ds \) = Savings deposits

\( Dt \) = Time deposits

The monetary base, \( H \), is the sum of total reserves, \( R \), plus currency in circulation.

\( H = Cc + R \) \hspace{1cm} (2)

We can express the components of \( M \) as fractions of demand deposits.
\[
\begin{align*}
C &= \frac{c}{D_d} \quad \text{(3)} \\
S &= \frac{s}{D_d} \quad \text{(4)} \\
T &= \frac{t}{D_d} \quad \text{(5)}
\end{align*}
\]

Where, \( c, s, t \), are respectively, the ratios of currency, personal savings deposits, and time deposits. In addition, let \( r \) represent the actual reserve-deposit ratio of the banking system.

\[
R = \frac{r}{T_D} \quad \text{(6)}
\]

Where \( T_D \) is the total deposit liabilities.

Substitution of (3 - 6) into (1) and (2) yields

\[
M = D_d \left(1 + c + s + t\right) \quad \text{(7)}
\]

\[
H = D_d \left(r + c + rs + rt\right) \quad \text{(8)}
\]

Combining (7) and (8), we get;

\[
\frac{(r + c + rs + rt)}{(1 + c + s + t)} = \frac{H}{M} \quad \text{(9)}
\]

or

\[
\frac{(1 + c + s + t)}{(r + c + rs + rt)} = \frac{M}{H} \quad \text{(10)}
\]

Using concepts developed by Dornbusch et. al. (1982), equation (9) yields the demand for high-powered money. The slope
of this line is positive but less than one because, in practice, banks hold assets other than reserves in their portfolios; in addition all the ratios in the equation are positive. Equation (9) reflects the portfolio preferences of the public and the banks. The way in which the public divides its financial asset portfolio between currency and different categories of deposits, and the preferences of the banks between cash reserves and other assets, determine \( c, s, t \) and \( r \). The high-powered money is determined by the Central Bank and is denoted by \( H \). Equating the supply of and demand for high powered money, we find:

\[
H = H^d = \frac{(r + c + rs + rt)}{(1 + c + s + t)} \cdot M
\]

(11)

The interaction of these two sides is depicted in figure 1.

**Figure 3: Money Stock Determination**

![Diagram of Money Stock Determination](Image)

From figure 3 it can be seen that demand and supply curves intersect at \( E \), giving equilibrium money stock, \( M_0 \).

The figures below demonstrate that changes in high-powered money and the multiplier, affect money stock.
From figure 4, it is evident that the Central Bank can affect money supply through manipulation of the monetary base.

From figure 5, the change in slope from \( H^i \) to \( H'^i \), i.e., change in the size of money multiplier, reflecting portfolio shifts on the part of general public and or banks, causes change in money stock from \( M_0 \) to \( M_{11} \).

We can conclude from this discussion that variability in high-powered money and in the money multiplier causes movements of the money stock. An appreciation of the predictability of the
movement of the money stock, and hence its control, calls for critical analysis of the process underlying the shifts in money multiplier and changes in high powered money.

In the above model of money stock determination, the desired holdings of the monetary wealth are assumed to be linearly related to the level of demand deposits. This is unlikely to be the case in reality. In order to make the model more realistic, it is necessary to express the ratios making up the multiplier as functions of other variables. To start with, let the multiplier now depend on basic ratios as shown below.

\[ M = mH, \]

\[ \frac{(1 + c + s + t)}{(r + c + rs + rt)} \]

Where, \[ M = \frac{\text{----------------------}}{\text{-------------}} \] (12)

\[ M = m (r, c, s, t) H \]

Therefore money supply function can be given as:

\[ M = f(m,H) = f(r,c,s,t,H) \] (13)

But the currency-deposit ratio \( c \), is determined by a set of interest rates \( i \), and other variables \( Z \), such as banking habits, and income. Therefore:

\[ C = g(i, z) \] (14)

The reserve ratio of the banks is determined by a set of interest rates \( l_x \), the variability of cash flow to banks \( \delta \), any imposed minimum reserve \( AR \), and the rediscount rate of the authorities \( l_s \), therefore:
\[ R/Td = r = r(i_x, i_o, RR, \delta) \] (15)

Where \( i_x \) is the rate paid on reserve assets (which could be zero), \( i_o \) is the rate of return on alternative assets.

Equations (13), (14), (15) will be estimated.

Since the money supply determination is a function of the interaction of the three sectors already mentioned, we now turn to the modelling of the processes generating the portfolio behavior of these sectors.

### 3.2 Risk Aversion Model

Given the amount of high-powered money, money supply is determined by the size and variations in the money multiplier. The money multiplier summarizes the portfolio preferences of the banking sector and the general public.

The behavior of these entities can be explained by a model of portfolio choice in which a risk averting agent would choose to hold different types of financial assets.

Let,

- \( \pi^e = \) expected return from whole portfolio
- \( \sigma^2 = \) variances of portfolio returns
- \( r_i = \) return on risk free asset \( i, i=1,2,... \)
- \( R_i = \) return on risky asset \( i \)
- \( R^e_i = \) expected return on risky asset \( i \)
\( \mathbf{g}_i^e \) = expected capital gain on risky asset \( i \)

\( \mathbf{g}_i^e \) = expected capital gain on risky asset \( i \)

\( \mathbf{A}_i \) = amount of asset \( i \) in the portfolio

\( \sigma_i \) = standard deviation on \( i \) asset

\( \sigma_{ij} \) = degree of correlation on returns on assets \( i \) and \( j \)

\( \mathbf{W} \) = total wealth

In allocating wealth among a portfolio of assets, an entity is assumed to be rational and to seek to maximize net returns from the portfolio. The utility function of such an agent or entity can be expressed as:

\[
\begin{align*}
\text{Max} \ (A_1, A_4, \lambda) \\
\mathbb{E}[u(W)] = u(\pi^e, \sigma^2): \ u^1_{\pi^e} > 0, u^2_{\sigma^2} < 0 \\
\text{s.t} \\
\sum_{i=1}^{n} A_i = W, i=1,2,3,\ldots,n.
\end{align*}
\]

Assuming a specific form of the utility function commonly used (see, Cuthbertson, 1985) and letting \( i = 1,2 \), the
optimization problem becomes:

$$\text{Max } (A_1, A_{21}, \lambda)$$

$$E[U(W)] = \pi^e - c/2\sigma^2\pi$$

s.t.

$$A_1 + A_2 = W$$

(18)

Where, $c$ is a coefficient of absolute risk aversion.

But

$$\pi = A_1 R_1 + A_2 R_2$$

$$\pi^e = A_1 R_1^e + A_2 R_2^e$$

$$R_i = r_i + g_i$$

$$R_i^e = r_i^e + g_i^e$$

$$\sigma^2 = \text{E}[\pi - \pi^e]^2 = A_1^2 \sigma_1^2 + A_2^2 \sigma_2^2 + 2A_1 A_2 \sigma_{12}$$

The resultant Lagrangian function

$$L = \pi^e - c/2\sigma^2 + \lambda [A_1 + A_2 - W]$$

$$= A_1 R_1 + A_2 R_2 - c/2 (A_1^2 \sigma_1^2 + A_2^2 \sigma_2^2 + 2A_1 A_2 \sigma_{12} + \lambda [A_1 + A_2 - W]$$

(19)

where, $\lambda$ = Marginal utility of wealth.

The first-order conditions for a maximum are:

$$\frac{\delta L}{\delta A_1} = R_1^e - c(A_1 \sigma_1^2 + A_2 \sigma_{12}) + \lambda = 0$$

(20)

$$\frac{\delta L}{\delta A_2} = R_2^e - c(A_2 \sigma_2^2 + A_1 \sigma_{12}) + \lambda = 0$$

(21)
Equating (19) and (20) and substituting for $A$ from the wealth constraint and rearranging we obtain:

$$A_1 = \frac{R^e_1 - R^e_2}{c(\sigma^2_1 + \sigma^2_2 - 2\sigma_{12})} + \frac{(\sigma^2_2 - \sigma_{12})W}{\sigma^2_1 + \sigma^2_2 - 2\sigma_{12}}$$

Where $K_1$ and $K_2$ are constants, when variances, covariance and the coefficient of absolute risk aversion are constant. Using the budget constraint and equation (22) we find:

$$A_2 = K_1(R^e_2 - R^e_1) + (1 - K_2)W$$

Assuming that the choice is between a risk free asset $A_2$ e.g. currency, demand deposit, saving deposits and risky asset, asset $A_1$ as bond, then

$$R^e = \sigma_2(g^e_2 = 0), \sigma^2_2 = \sigma^2_{12} = 0$$

and therefore

$$A_1 = \frac{R^e_1 - r_2}{c\sigma^2_1}, \quad A_2 = W + \frac{1}{c\sigma^2_1}(r_2 - R^e_1)$$

In summary, the demand for assets depends on a set of expected yields, wealth and the variability of asset prices. The 'own' relative rate has a positive effect, $(K_1 > 0)$ provided $\sigma^2_1 + \sigma^2_2 > 2\sigma_{12}$. The latter will always hold for $\sigma_{12} > 0$.
3.3 Working Hypotheses

(a) Permanent income has no effect on the basic ratios that make up the multiplier.

(b) The basic ratios of the multiplier have strong effect on the movement of money supply in the short-run.

(c) Own prices of financial assets have positive effect on their supply.

(d) The reserve ratio has the strongest effect on the money multiplier.

(e) Ultimate monetary policy objectives determine the changes in monetary base.

3.4 Specification of the Empirical Model.

The models above give general forms of equations estimated. In this section the general equations are put in estimable forms. Both linear and log-linear functions will be estimated. Specializing with linear functional forms as examples, the complete model maybe summarized as follows:

1a. Linear Money Supply Function:

\[ M^s = \hat{a}_0 + \hat{a}_1 c_t + \hat{a}_2 r_t + \hat{a}_3 q_t + \hat{a}_4 H_t + \hat{a}_5 M^s_{t-1} + \hat{a}_6 S_t + \varepsilon_t \]

1b. Money Multiplier Function:

\[ MM_t = \hat{a}_0 + \hat{a}_1 c_t + \hat{a}_2 r_t + \hat{a}_3 q_t + \hat{a}_4 S_t + \varepsilon_t \]
2. Currency Ratio Function:
\[ c_t = 60 + 61 Y_t + 62 i_t + 63 r_t + 64 d_{t-1} + 65 S_i + 66 c_{t-1} + \varepsilon_2 \]

3. Reserve Ratio Function:
\[ r_t = a0 + a1 i_t + a2 i_d + a3 R + a4 Y_t + a5 S_i + a6 r_{t-1} + \varepsilon_3 \]

4. Quasi deposit Ratio Function:
\[ q_t = b0 + b1 i_t + b2 Y_t + b3 r_t + b4 Y_{t-1} + b5 S_t + b6 q_{t-1} + \varepsilon_4 \]

5. High Powered Money Function i.e Reaction Function:
\[ H_t = v0 + v1 Y_t + v2 FER_t + v3 d_{t-1} + v4 r + v5 G + v6 S_i + \varepsilon_5 \]

6. Treasury Bills Function:
\[ TB_t = g0 + g1 T + g2 r_t + g3 d_t + g4 TB_{t-1} + g5 S_i + \varepsilon_8 \]

List of Variables in the Model
- \( c \) = Currency deposit ratio
- \( FER \) = Foreign exchange reserves
- \( iB \) = Interest of government bond
- \( it \) = vector of interest rates
- \( GD \) = Government deficit
- \( H \) = Monetary base i.e High-powered money
- \( MS \) = Money supply
\text{mm} = \text{Money multiplier} \\
\text{p} = \text{Change in price} \\
\text{rtn} = \text{Treasury bill rate} \\
\text{r}^t = \text{Time deposit rate} \\
\text{r} = \text{Reserve deposit ratio} \\
\text{r}^s = \text{Savings deposit rate} \\
\text{TB} = \text{Treasury bill holdings of banks} \\
\text{Q} = \text{Quasi money (savings plus time deposits)} \\
\text{q} = \text{Quasi money deposit ratio.} \\
\text{Y} = \text{Current income} \\
\text{TD} = \text{Total deposit liabilities} \\
\hat{\alpha}_i, \hat{B}_i, \hat{a}_i, \text{etc} = \text{parameters to be estimated.} \\
\text{Si} = \text{Quarterly seasonal dummies.}
CHAPTER 4 DATA COLLECTION AND ANALYSIS

4.1 Data Collection

Secondary data were used to accomplish the objectives of the study. Time series data on the relevant variables were collected from various publications and unpublished document.

The following sources of data were used:

(a) Central Bank of Kenya
   (i) Economic Report
   (ii) Quarterly Economic Reviews
   (iii) Other unpublished Reports

(b) Government Sources
   (i) Development Plans
   (ii) Economic Surveys
   (iii) Statistical Abstracts

(c) International Sources
   (i) International Financial Statistics by IMF
   (iii) World Tables by World Bank.

The above materials were obtained from the following sources:

(a) Central Bank of Kenya library (Nairobi)
(b) Central Bureau of Statistics
(c) The Treasury
(d) World Bank Library (Nairobi)
(e) Kenyatta University library
The data for money supply, currency, demand deposit, quasi deposit, and reserves were collected from various publications of quarterly economic reviews of the Central Bank of Kenya. The currency ratio and quasi deposit ratio were obtained by dividing, respectively, currency and quasi deposits by demand deposits. The reserve ratio was derived from division of reserves by total net deposits. High powered money is the sum of currency outside banks and reserves. The change in price variable was obtained by computing percent changes in the GDP deflator. The data were refined by deflating the raw data using GDP deflator to get real values. The only artificial variable used is income. This variable was generated into quarterly data by method used by Galdafo (1981).

4.2 ECONOMETRIC RESULTS AND DISCUSSION

4.2.1 Money supply Function

Econometric Results

To predict the effects of a change in any of the determinants on the level of money supply, econometric analysis of the major factors influencing money supply was carried out by estimating various forms of the model presented in chapter 3. The reported results were evaluated on the basis of economic and statistical criteria. The results to be presented are for the linear and log-linear functions which were selected.
Presented below is the correlation matrix of the linear money supply function estimated.

Table 1: Correlation Matrix for linear Money Supply

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>Q</th>
<th>R</th>
<th>H</th>
<th>LM</th>
<th>X8</th>
<th>X9</th>
<th>X10</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>0.852</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0.069</td>
<td>0.069</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>0.736</td>
<td>0.805</td>
<td>0.3714</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM</td>
<td>0.555</td>
<td>0.818</td>
<td>-0.0437</td>
<td>0.8160</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X8</td>
<td>0.185</td>
<td>-0.008</td>
<td>-0.0798</td>
<td>0.0787</td>
<td>-0.0703</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X9</td>
<td>-0.070</td>
<td>0.042</td>
<td>0.0167</td>
<td>-0.0117</td>
<td>0.0010</td>
<td>-0.3397</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>X10</td>
<td>-0.140</td>
<td>0.011</td>
<td>-0.0899</td>
<td>-0.1324</td>
<td>0.0421</td>
<td>-0.3396</td>
<td>-0.3269</td>
<td>1.000</td>
</tr>
</tbody>
</table>

The correlation matrix assist in checking for multicollinearity between the regressors. One of the assumption of least squares method is that the explanatory variables should not be strongly collinear. Where this assumption is violated, the efficiency of the estimated parameters is impaired.

From the correlation coefficients in table 2, we can suspect existence of multicollinearity in the equation, with the source being the inclusion of currency-deposit ratio, and quasi-deposit ratio, high powered money and lagged money supply.

The procedure explained in Koutsoyiannis (1977) was used to detect the presence and severity of multicollinearity. The procedure is to regress the dependent variable on each one of
the explanatory variables separately. Then the results obtained are assessed on the basis of a priori and statistical criteria. We then choose the elementary regression which appears to give the most plausible results, on both a priori and statistical criteria. Then we gradually insert additional variables and examine their effects on the individual coefficients, on their standard errors, and on the overall $R^2$. The procedure then proceeds as follows:

(a) If a new variable improves $R^2$ without rendering the individual coefficients unacceptable on a priori considerations, the variable is considered useful and is retained as an explanatory variable.

(b) If the new variable does not improve $R^2$ and does not affect any considerable extent the values of the individual coefficients, it is considered superfluous and is rejected.

(c) If the new variable affects considerably the signs or the values of the coefficient, it is considered as detrimental and is rejected.

When this procedure was applied to the money supply functions, the regression of money supply on high powered money was taken as the elementary regressions. Then additional variables were added gradually, and all the variables were accepted as explanatory variables.

The table below shows the regression results of both the linear and log-linear functional forms of money supply estimated.
Table 3, shows the results for the linear money supply equation. The currency deposit ratio, the quasi deposit ratio, reserve-deposit ratio, high-powered money, lagged money supply and seasonal dummies are used as explanatory variables.

Table 3, which shows the results after correction for serial correlation, displays that all the explanatory variables, except the lagged money stock and seasonal dummies, are statistically significant in determination of money stock.

The coefficient of currency deposit ratio is -248.6. This coefficient has the expected sign and is statistically significant. The negative relationship between the ratio and money stock is expected because the higher the currency deposit
ratio, the higher the fraction of money balances the public wants to hold in the form of currency, and the lower the fraction to be held in other forms of deposits. Furthermore, the larger the multiplier, the lower are the currency deposit ratio and reserve deposit ratio. It should be noted that the higher the value of multiplier, the higher is the resultant value of money stock for a given amount of high powered money. The higher the value of the currency ratio the lower are the level of the reserves the commercial banks have and those that they need. An increase in currency-deposit ratio increases the demand for high powered money at any given level of money stock, and therefore cause the demand curve for high powered money, $H^d$, to rotate up to the left and reduce the equilibrium money stock.

Coefficient of -248.6 for the currency-deposit ratio means that when currency-deposit ratio increases by one shilling, the stock of money reduces by 248.6 shillings.

Another very important determinant of money is the reserve-deposit ratio. This regressor has a coefficient of -0.1698. This coefficient has the right sign and is statistically significant. This value shows that a shilling change in reserve-deposit ratio causes -0.1698 shilling change in money supply. The inverse relationship between money stock and reserve-deposit is expected as in the case of currency-deposit ratio. Both currency and reserves make up high-powered money. It follows that when reserve-deposit ratio increases, the demand for high-powered money also increases for
a given level of money stock. This results in an upward rotation of demand for the stock of high-powered money as shown on the table above. Further, it should be noted that the larger the value of money multiplier, the lower are currency-deposit ratio and the reserve-deposit ratio. Realistically, the higher the amount of reserves the commercial banks wishes to hold the less is the actual credit created.

The quasi-deposit ratio is another important factor in money supply determination. Its coefficient has a value of 48.37 and is also statistically significant. For a unit increase in quasi-deposit ratio, there is a corresponding increase in money stock of 48.37 units. The positive effect of this ratio on money stock can be explained by the fact that in recent years in Kenya, the major component of money stock that has contributed more to the growth of money has been the quasi deposits. This deposits comprise the savings and time deposits.

High powered money is the single most important determinant of money stock in any economy. The coefficient of this explanatory variable is 2.8. This coefficient has the expected positive sign and is statistically significant. It is evident that this variable was the most significant of all the explanatory variables. The coefficient of 2.8 means that a shilling increase in high-powered money results in 2.8 shillings increase in money supply.

The quarterly dummies did not cause significant effects on the money supply as their coefficients are not statistically
significant at the 10 percent level. There is lack of adjustment as the coefficient of lagged money stock is not statistically significant. The dummy variables are used to smooth out seasonal movements in the stock of money while the lagged value is meant to act as a continuity variable.

The results of the log-linear money supply equation are shown on table 4. The results show a very high value of coefficient of multiple determination of 98.5. However, this value is less than that of the linear form by one percent.

Unlike the linear form, the results obtained from the log-linear equation displayed serious serial correlation with a Durbin-Watson statistic of 0.87. However, this problem of autocorrelation was corrected using Cochrane-Orcutt method which gave a D-W statistic for the transformed residuals as 2.2. The results shown on table 4 were obtained after correcting for serial correlation.

All the explanatory variables have coefficient with the expected signs. The reported coefficients are money supply elasticities with respect to various explanatory variables. The significant coefficients are those for currency-deposit ratio, quasi deposit ratio, reserve ratio, high-powered money. The seasonal dummies and lagged stock of money are not statistically significant.

Except for the money supply elasticity with respect to high-powered money, other elasticities are less than one. These small elasticities mean that money supply is not very responsive
to changes in these variables. The high-powered money elasticity of money supply displays a value of about unity. This means that for a unit proportionate change in high-powered money, there is an equal proportionate change in money supply. This value of about unity suggests that money stock is responsive to changes in the stock of high-powered money.

The four significant explanatory variables whose effect on money supply determination were significant, were made functions of other variables and these functions were estimated to ascertain the effects of these second order variables.

First, we analyze estimation results for high powered money function.
### Table 4: Regression Results for high powered Money:

**Quarterly Data, 1972-IV - 1989-IV**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2279.9655</td>
<td>-1.7660</td>
</tr>
<tr>
<td>NFA</td>
<td>0.2078</td>
<td>3.3881</td>
</tr>
<tr>
<td>P</td>
<td>-8826.1359</td>
<td>-1.1259</td>
</tr>
<tr>
<td>Y</td>
<td>0.3695</td>
<td>8.7961</td>
</tr>
<tr>
<td>GD</td>
<td>-0.0167</td>
<td>-0.3059</td>
</tr>
<tr>
<td>Dummy 4</td>
<td>79.4431</td>
<td>0.4920</td>
</tr>
<tr>
<td>Dummy 3</td>
<td>-241.4473</td>
<td>-1.2830</td>
</tr>
<tr>
<td>Dummy 2</td>
<td>-604.5559</td>
<td>-3.7806</td>
</tr>
</tbody>
</table>

**R-squared** 0.9032

Table 5 shows that current real income (Y), net foreign assets (NFA), changes in price level (P), government deficit (GD), and quarterly seasonal dummies were used as explanatory variables in the determination of high powered money.

Firstly, the net foreign assets have a coefficient of 0.2078. This coefficient is statistically significant at 1 percent level. This coefficient of 0.2078 means that when net foreign assets increase by one unit, high powered money
increases by 0.2078 unit. The positive relationship between NFA and it is expected since increase in NFA leads to increase in high-powered money. When the foreign assets increase, the pressure on the central bank over capital outflow is reduced.

Income is another significant variable in the determination of high powered money. Its coefficient is statistically significant at the 5 percent level. This variable is included as an economic trend variable. The sign of the coefficient of this variable is positive showing a unit increase in income leads to 0.369 unit increase in high powered money.

The coefficient of government deficit is not significant at the 5 percent level, but it is surprising that it has a negative sign. A positive relationship is expected since the central bank usually monetize a portion of deficit. The monetization of deficit results in increased high powered money. In Kenya, credit to the government is mostly extended by the Central Bank in forms that increase high powered money base and which is expansionary (Mwega, et. al 1990).

The quarterly seasonal dummy variables are included to smooth seasonal movements in the seasonally unadjusted monetary base. Using a high powered money data series not seasonally adjusted, complemented by quarterly seasonal dummy variables, avoids estimating biases that may occur with seasonally adjusted data (Lovell, 1963). Only the coefficient of the dummy for the second quarter is statistically significant. This dummy shows that in the second quarter, a negative effect is exerted on the
4.2.3 **Currency-Deposit and Quasi-Deposit Equations**

Both linear and log-linear functions were utilized for estimation. The log-linear function gave better results in terms of coefficient of multiple determination and Durbin-Watson statistic. Therefore, we are going to utilize the log-linear equation for the analysis of the determination of currency-deposit ratio and quasi-deposit ratio.

Below are regression results for the log-linear currency-deposit equation and quasi-deposit equation.

<table>
<thead>
<tr>
<th></th>
<th>Coef</th>
<th>Std. Err.</th>
<th>t</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>0.087</td>
<td>0.105</td>
<td>0.833</td>
<td>0.429</td>
</tr>
<tr>
<td>D2</td>
<td>0.007</td>
<td>0.006</td>
<td>1.165</td>
<td>0.255</td>
</tr>
<tr>
<td>D3</td>
<td>0.005</td>
<td>0.006</td>
<td>0.808</td>
<td>0.421</td>
</tr>
<tr>
<td>D4</td>
<td>0.004</td>
<td>0.006</td>
<td>0.668</td>
<td>0.507</td>
</tr>
<tr>
<td>D5</td>
<td>0.003</td>
<td>0.005</td>
<td>0.677</td>
<td>0.502</td>
</tr>
<tr>
<td>D6</td>
<td>-0.002</td>
<td>0.005</td>
<td>-0.459</td>
<td>0.651</td>
</tr>
<tr>
<td>R2</td>
<td>0.704</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-W</td>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-statistic</td>
<td>74.000</td>
<td>11.700</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5: Regression Results: Quarterly Data, 1972-IV-1989-IV

<table>
<thead>
<tr>
<th>Variable</th>
<th>Currency Function</th>
<th>Quasi Deposit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-6.971</td>
<td>-9.514</td>
</tr>
<tr>
<td></td>
<td>(-2.699)</td>
<td>(-5.126)</td>
</tr>
<tr>
<td>LogY</td>
<td>0.555</td>
<td>0.904</td>
</tr>
<tr>
<td></td>
<td>(2.098)</td>
<td>(4.776)</td>
</tr>
<tr>
<td>LogRTN</td>
<td>0.019</td>
<td>0.034</td>
</tr>
<tr>
<td></td>
<td>(0.698)</td>
<td>(1.523)</td>
</tr>
<tr>
<td>LogRS</td>
<td>0.132</td>
<td>0.052</td>
</tr>
<tr>
<td></td>
<td>(1.196)</td>
<td>(0.684)</td>
</tr>
<tr>
<td>Lagged Log c</td>
<td>-0.116</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.340)</td>
<td></td>
</tr>
<tr>
<td>Lagged Log q</td>
<td></td>
<td>0.037</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.332)</td>
</tr>
<tr>
<td>Dummy4</td>
<td>0.001</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>(3.270)</td>
<td>(1.361)</td>
</tr>
<tr>
<td>Dummy3</td>
<td>-0.052</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>(-2.918)</td>
<td>(1.652)</td>
</tr>
<tr>
<td>Dummy2</td>
<td>-0.064</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(-3.721)</td>
<td>(0.863)</td>
</tr>
</tbody>
</table>

R2  | 0.703 | 0.934 |
D-W | 2.300 | 2.100 |
F-statistic | 24.00 | 139.00 |

T-ratios are shown in brackets below coefficients
4.2.4 Currency-Deposit Ratio

The explanatory variables that became statistically significant are income and quarterly seasonal dummies. The rate of returns on alternative assets were found to be statistically insignificant in the determination of currency-deposit ratio.

The coefficient of income is 0.555. This coefficient is statistically significant at better than 5 percent level. This coefficient is the elasticity of currency deposit ratio with respect to income. The positive relationship between currency ratio and income is the expected. Currency is used for transactions purposes. This is true for a developing country like Kenya, where currency is the single most important means of effecting transactions. The higher the income, the more is the fraction of it kept in currency for transactions purposes.

All the three quarterly seasonal dummies were statistically significant at the one percent level. These seasonal dummy variables were used to smooth out seasonal movements in the currency-deposit ratio as this ratio was not seasonally adjusted. As expected, the influences of these dummies on the dependent variables are expected to increase as the quarters increases.

The rates of return on treasury bills, and savings deposits were used as the measures of returns on other assets. As such the expected signs of their coefficients should be negative. But the regression results produced coefficient for these variables which are of the wrong signs although they are
statistically insignificant. Ajayi (1974) obtained similar results in estimation of currency determination in Nigeria, with respect to treasury bills rate.

4.2.5 Quasi Deposit Equation

Table 6, equation 2 show the results for the quasi-deposit equation. The only significant explanatory is income. The positive relationship between income and quasi-deposit ratio obtains from the fact that as income increase, some of it is held in the financial assets for the portfolio diversification.

A very interesting result from our work is that we find that quasi-deposit ratio is not sensitive to their own rate. The rates of return on savings and time deposits are very insignificant, although they are of the right signs. The insensitivity of the ratio to own rate suggests that quasi-deposits at commercial banks were therefore not due primarily to interest rates. This insensitivity can be explained by the fact interest rates were not market determined but institutionally controlled. The rate of return on Treasury bills is of wrong sign.

The quarterly seasonal dummies meant to smooth seasonal movements on the ratio are very statistically significant. The seasonal dummy variable for the third quarter is statistically significant at the 10 percent level and has a positive effect on the ratio. The lagged value is not statistically significant.
### Table 6: Regression Results for Reserve Ratio: Quarterly Data, 1972-IV - 1989-IV

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.3541</td>
<td>1.006</td>
</tr>
<tr>
<td>Y</td>
<td>0.0002</td>
<td>0.735</td>
</tr>
<tr>
<td>RS</td>
<td>0.6840</td>
<td>0.764</td>
</tr>
<tr>
<td>RLR</td>
<td>1.0430</td>
<td>58.660</td>
</tr>
<tr>
<td>RTN</td>
<td>-0.9983</td>
<td>-2.673</td>
</tr>
<tr>
<td>Lagged R</td>
<td>0.0011</td>
<td>0.127</td>
</tr>
<tr>
<td>RT</td>
<td>-0.1199</td>
<td>-0.185</td>
</tr>
<tr>
<td>Dummy4</td>
<td>-1.1682</td>
<td>-1.399</td>
</tr>
<tr>
<td>Dummy3</td>
<td>0.0506</td>
<td>0.054</td>
</tr>
<tr>
<td>Dummy2</td>
<td>-1.8080</td>
<td>-2.216</td>
</tr>
<tr>
<td>R2</td>
<td>0.9930</td>
<td></td>
</tr>
<tr>
<td>D-W</td>
<td>2.0900</td>
<td></td>
</tr>
<tr>
<td>F-statistic</td>
<td>1025</td>
<td></td>
</tr>
</tbody>
</table>

This function has explanatory variables as income (Y), rates of return on quasi deposits (RS), rate of return on Treasury bills (RTN), required liquidity ratio (RLR), lagged reserve ratio and quarterly seasonal dummy variables.

Among the explanatory variables used, required liquidity
ratio, rate of return on Treasury bills and dummy variable for the second quarter are the only significant variables.

The required liquidity ratio is the most significant variable. It has a coefficient of 1.04 which is statistically significant at better than 1 percent level. This coefficient can be interpreted to mean that when the required liquidity increases by a unit, the reserve-deposit ratio increases by 1.04 units. The relationship between this regressor and the regressand is positive and it is as expected. This positive relationship derives from the fact that when the required liquidity is increased, the commercial banks are forced to retain a higher proportion of their deposit liabilities as reserves. It should borne in mind that this variable is policy determined and is very instrumental in controlling the liquidity of the banks.

The other significant explanatory variable in the determination of reserve ratio is the rate of return on Treasury bills. The quarterly dummy variable for the second quarter is statistically significant at 3 percent level and the effect of this quarter on the ratio is negative.

4.2.7 Money Multiplier Function

The table below shows the results of the money multiplier function.
Table 7: Regression Results: Quarterly Data 1973.1-1989.4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>6.2053</td>
<td>67.3260</td>
</tr>
<tr>
<td>Currency ratio</td>
<td>-5.212</td>
<td>-12.7408</td>
</tr>
<tr>
<td>Quasi deposit ratio</td>
<td>1.1521</td>
<td>8.5816</td>
</tr>
<tr>
<td>Reserve ratio</td>
<td>-11.4905</td>
<td>-32.3779</td>
</tr>
<tr>
<td>Dummy4</td>
<td>0.0166</td>
<td>0.7693</td>
</tr>
<tr>
<td>Dummy3</td>
<td>-0.0060</td>
<td>-0.2545</td>
</tr>
<tr>
<td>dummy2</td>
<td>0.01161</td>
<td>0.7196</td>
</tr>
</tbody>
</table>

Adjusted R-squared     | 0.9721      |
D-W                    | 1.6758      |
F-statistic            | 298.589     |

The coefficients of currency ratio, quasi deposit ratio; reserve ratio are statistically significant and have the expected signs significant. The reserve ratio is seen to be the most statistically significant of all the variables.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>17491.146</td>
<td>17429.85</td>
<td>17520.99</td>
</tr>
<tr>
<td></td>
<td>(19.922)</td>
<td>(20.55)</td>
<td>(21.07)</td>
</tr>
<tr>
<td>Currency ratio</td>
<td>-40673.233</td>
<td>-40674.74</td>
<td>-40238.57</td>
</tr>
<tr>
<td></td>
<td>(-12.236)</td>
<td>(-12.37)</td>
<td>(-12.56)</td>
</tr>
<tr>
<td>Quasi deposit ratio</td>
<td>9500.235</td>
<td>9469.37</td>
<td>9155.64</td>
</tr>
<tr>
<td></td>
<td>(6.814)</td>
<td>(6.96)</td>
<td>(6.85)</td>
</tr>
<tr>
<td>Reserve ratio</td>
<td>-73809.017</td>
<td>-73970.71</td>
<td>-74390.49</td>
</tr>
<tr>
<td></td>
<td>(-18.503)</td>
<td>(-18.48)</td>
<td>(-19.12)</td>
</tr>
<tr>
<td>High powered money</td>
<td>3.650</td>
<td>3.66</td>
<td>3.67</td>
</tr>
<tr>
<td></td>
<td>(26.078)</td>
<td>(26.76)</td>
<td>(27.75)</td>
</tr>
<tr>
<td>Dm1</td>
<td>0.008</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.152)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dm2</td>
<td></td>
<td>-0.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.25)</td>
<td></td>
</tr>
<tr>
<td>Dm3</td>
<td></td>
<td></td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.86)</td>
</tr>
<tr>
<td>Dummy4</td>
<td>63.464</td>
<td>124.95</td>
<td>113.74</td>
</tr>
<tr>
<td></td>
<td>(0.158)</td>
<td>(0.93)</td>
<td>(0.87)</td>
</tr>
<tr>
<td>Dummy3</td>
<td>-115.040</td>
<td>-11.35</td>
<td>-104.13</td>
</tr>
<tr>
<td></td>
<td>(-0.707)</td>
<td>(-0.03)</td>
<td>(-0.71)</td>
</tr>
<tr>
<td>Dummy2</td>
<td>-108.794</td>
<td>-102.10</td>
<td>-878.10</td>
</tr>
<tr>
<td></td>
<td>(-0.707)</td>
<td>(-0.67)</td>
<td>(-2.00)</td>
</tr>
</tbody>
</table>

R-squared                      | 0.995           | 0.995           | 0.995           |
D-W                            | 1.910           | 1.910           | 1.94            |
F-statistic                    | 1175            | 1175            | 1245            |

The table above shows the regression results for money supply where the explanatory variables include variables...
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>47820.24</td>
<td>17176.36</td>
<td>34631.24</td>
</tr>
<tr>
<td></td>
<td>(0.299)</td>
<td>(20.31)</td>
<td>(0.89)</td>
</tr>
<tr>
<td>Currency ratio</td>
<td>-31400.04</td>
<td>-40131.56</td>
<td>-31742.44</td>
</tr>
<tr>
<td></td>
<td>(-8.344)</td>
<td>(-12.37)</td>
<td>(-8.45)</td>
</tr>
<tr>
<td>Quasi ratio</td>
<td>3968.87</td>
<td>9408.72</td>
<td>4289.16</td>
</tr>
<tr>
<td></td>
<td>(2.111)</td>
<td>(7.03)</td>
<td>(2.30)</td>
</tr>
<tr>
<td>Reserve ratio</td>
<td>-53888.02</td>
<td>-72430.12</td>
<td>-57155.25</td>
</tr>
<tr>
<td></td>
<td>(-8.657)</td>
<td>(-17.88)</td>
<td>(-10.00)</td>
</tr>
<tr>
<td>High powered money</td>
<td>2.799</td>
<td>3.65</td>
<td>2.86</td>
</tr>
<tr>
<td></td>
<td>(11.61)</td>
<td>(27.44)</td>
<td>(12.26)</td>
</tr>
<tr>
<td>Dm4</td>
<td>-4436.18</td>
<td></td>
<td>(-1.008)</td>
</tr>
<tr>
<td>Dm5</td>
<td></td>
<td>-4908.25</td>
<td>(-1.36)</td>
</tr>
<tr>
<td>Dm6</td>
<td></td>
<td>2457.13</td>
<td>(0.99)</td>
</tr>
<tr>
<td>Dm4</td>
<td>585.75</td>
<td>134.96</td>
<td>140.00</td>
</tr>
<tr>
<td></td>
<td>(1.307)</td>
<td>(1.02)</td>
<td>(1.23)</td>
</tr>
<tr>
<td>Dummy4</td>
<td>-101.94</td>
<td>388.81</td>
<td>-111.72</td>
</tr>
<tr>
<td></td>
<td>(-0.793)</td>
<td>(0.98)</td>
<td>(-0.87)</td>
</tr>
<tr>
<td>Dummy3</td>
<td>-197.85</td>
<td>-79.60</td>
<td>-440.57</td>
</tr>
<tr>
<td></td>
<td>(-1.508)</td>
<td>(-0.56)</td>
<td>(-1.56)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.995</td>
<td>0.995</td>
<td>0.995</td>
</tr>
<tr>
<td>D-W</td>
<td>2.01</td>
<td>2.01</td>
<td>2.07</td>
</tr>
<tr>
<td>F-statistic</td>
<td>1242</td>
<td>1212</td>
<td>1241</td>
</tr>
</tbody>
</table>
The variables Dm4, Dm5 and Dm6 were obtained from interaction of reserve ratio and the seasonal dummies for the fourth, third and second quarters respectively. The results show that the coefficient of Dm4, Dm5 and Dm6 are not statistically significant. This means that money supply responds the same way to the changes in the reserve ratio over the quarters. Therefore, the coefficient of this ratio is stable.

These stability tests suggest that money supply function estimated is a stable function and fits the data well.

4.2.8 **Treasury Bills Function**

The variables used as explanatory included total deposits, Treasury bills rate, rates of return on savings deposits, changes in loans, and lagged Treasury bills. The regression results are shown below.
Table 10: Regression Results: Annual Data, 1972-1989

<table>
<thead>
<tr>
<th>Variable</th>
<th>1. Coefficient T-ratio</th>
<th>2. Coefficient T-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-6.4290 (-18.356)</td>
<td>-6.395 (-39.070)</td>
</tr>
<tr>
<td>LogTD</td>
<td>1.3892 (69.927)</td>
<td>1.392 (82.504)</td>
</tr>
<tr>
<td>LogRTN</td>
<td>0.2837 (0.812)</td>
<td>0.2853 (3.504)</td>
</tr>
<tr>
<td>LogDL</td>
<td>0.0046 (0.291)</td>
<td></td>
</tr>
<tr>
<td>LogRS</td>
<td>0.0179 (0.045)</td>
<td></td>
</tr>
<tr>
<td>LLogTBB</td>
<td>-0.0406 (-1.359)</td>
<td>-0.024 (-2.757)</td>
</tr>
<tr>
<td>R²</td>
<td>0.997</td>
<td>0.995</td>
</tr>
<tr>
<td>D-W</td>
<td>2.16</td>
<td>2.130</td>
</tr>
<tr>
<td>F</td>
<td>1343</td>
<td>2560</td>
</tr>
</tbody>
</table>

Equation 2 gives better results. In equation 1, the only explanatory that is statistically significant is the total deposits. Therefore, the discussion that follows is with respect to equation 2.

The statistically significant coefficients are for total deposit and rate of Treasury bills. The lagged value of the log of Treasury bills is statistically significant implying the existence of continuous adjustment with about 43 percent of the desired changes being obtained in the first quarter.
4.2.9 Discussion of Analytical Results as They Apply to the Control of Money Supply.

The significant factors in the determination of money supply in Kenya are high-powered money, currency-deposit ratio, quasi-deposit ratio, and reserve-deposit ratio.

The most significant factor of all these explanatory variables is high-powered money. Alone, this variable accounts for over 80 percent of variations in money supply. Given the importance of this variable, the Monetary Authorities in Kenya should be able to influence and regulate this variable in order to control money supply. But to understand the extent to which the Central Bank has control over this variable, we need to decompose it into its components. Important components include net foreign assets and government credit. The degree of Monetary Authorities over the net foreign assets is little. This is because assets as a result of balance of payments such as terms of trade, export volumes, long-term capital flows, etc, are beyond the control of the Monetary Authorities in Kenya. The Authorities can increase its control over balance of payments variables by the use of exchange rate policy, but given the flexible exchange rate prevails in Kenya the Central Bank has less to say.

The other component of high powered money that need to be controlled by the Central Bank is the domestic credit to the government. Mwega et. al (1990) found out that government financial needs exert a powerful influence on the overall
monetary situation in Kenya. The control of this component, in
Kenya, by the Central Bank is little because of the heavy
presence in the government expenditures of wage bill to the
civil service and the cost of servicing the public debt and the
political reluctance to use tax weapon. Therefore, this
discussion highlights the weak position of the Monetary
Authorities in Kenya to control high-powered money. Lack of
control over this variable reduces the ability of the Central
Bank to control money supply.

The money multiplier is the other component of money stock
that requires stability and/or predictability for a better
management of the growth of money supply. Of the
currency-deposit ratio, quasi-deposit ratio and reserve-deposit
ratio, reserve-deposit ratio is the most statistically
significant in the determination of money supply. This is
consistent with the findings of Bolnick (1975) and Mwega and
Killick (1990). They found out the reserve-deposit ratio to be
more unstable and to have a more powerful effect on the money
multiplier in Kenya. The reason they gave for this is that banks
were slow to adjust their lending to changes in their liquidity.
The currency-deposit ratio and quasi-deposit ratio are not
sensitive to changes in interest rates. This means that the
Central Bank may not control these ratios as the only
significant determinant of them is the income. As the major
source of variation in multiplier is the reserve-deposit ratio,
there is need on the part of the Central Bank to have close
control over the commercial banks' liquidity.

Mwega and Killick (1990) explains that Kenya has never experienced a prolonged period of grossly excessive credit creation. According to Kanga (1985), bank lending in Kenya was not responsive to the changes in the liquidity ratios. Therefore, control of bank liquidity may not provide much control of credit creation. This arises from the definition of the liquidity ratios used in Kenya. Kanga went on and found out that bank lending was sensitive to banks' narrow reserve base, i.e., cash, interbank deposits, etc. Consistent with this is our definition for the reserve-deposit ratio. We used the narrow definition. We found out the narrow reserve-deposit ratio is highly responsive to changes in the required liquidity ratio. This is perhaps the most important tool the Central bank can use to control lending by the banks.
5.1 Summary

This study was meant to analyze money supply determination in Kenya in order to understand the ability of the Monetary Authorities to control money supply. The determinants of money supply as high powered money and the basic ratios of the money multiplier were used in estimation of money supply function. Other functions that are important in the control of money supply were also considered and estimated.

The results showed that high powered money as the most statistically significant variable. Of the ratios of money multiplier, the reserve ratio was found out to be the most statistically significant.

Estimation of high powered money was done and it was found that the net foreign assets and income had statistically significant effect on the high powered money. The estimation results for currency ratio and quasi deposit ratio showed income as the only important variable. The reserve ratio responded very much to changes in required liquidity.

5.2 Conclusions

Given the empirical analysis of money supply in Kenya, the following concluding remarks can be made.

High powered money is the most important determinant of money supply in Kenya. The ability of the Monetary Authorities
to manipulate the high-powered money so as to control money supply is limited. This is because the Monetary Authorities have less control over the balance of payments and the credit requirements of the government.

The major source of variation in the money multiplier is attributed to reserve-deposit ratio. The money multiplier was shown to exhibit dramatic fluctuations. This suggests that the liquid assets of the commercial banks are not fully controllable.

The use of interest rate policy to influence the basic ratios of money multiplier may not be effective as these ratios are not responsive to changes in the various interest rates.

The responsiveness of treasury bills to own rate means that treasury bills rate can be used as a policy tool to regulate commercial banks liquidity and therefore to control money supply.

5.3 Policy Implications

From the discussion of the empirical results, the following policy implications emerge:

(i) The net foreign assets are important determinant of high-powered money. Therefore, to be in a position to have some control or predictability over high-powered money, by the Monetary Authorities, there is need for the Kenya Government to try to achieve greater stability in balance of payments. This can be done through an aggressive and successful export
diversification programme. The stability in the balance of payments would result in stable flow of foreign assets which can make the high powered money to be predictable.

(ii) Another component of high powered money that causes inability of the Central Bank to manipulate high powered money and hence money supply is credit requirements of the government. The implications for this is a need for an improved budgetary out-turns and a lower public sector borrowing requirement. This requires strengthening of fiscal situation which would involve a rise in tax rates. This can assist to narrow the budget gap, and thus reducing government domestic credit. There is also a need to improve predictability of budget outcomes.

(iii) The commercial banks are important in determination of money supply as shown by the importance of reserve-deposit ratio. Therefore, there is need for more predictable commercial bank response to changes in their liquidity and better ways of regulating bank credit. This would involve more effective control over the banks’ reserve base. The required minimum reserve ratio should be raised to such level as to affect the lending decisions of the majority of the banks.

(iv) The development of capital market is necessary so as to manipulate bank liquidity by use of open market operations. This strategy is likely to succeed as the treasury bills were found to be very responsive to own rate.
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Galbraith, J.A. and Anna L. Gulthre, "Cash Reserve Ratios and Banking reserve Behavior", *Journal of political Economy*, vol.78 no.6 (November - December, 1970) p.82.


APPENDIX

Table I: Descriptive Statistics for Money Supply Function

The number of observations used is 69.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.3965</td>
<td>0.0700</td>
<td>0.3063</td>
<td>0.5884</td>
</tr>
<tr>
<td>Q</td>
<td>0.8531</td>
<td>0.2242</td>
<td>0.4874</td>
<td>1.373</td>
</tr>
<tr>
<td>R</td>
<td>0.984</td>
<td>0.287</td>
<td>0.0452</td>
<td>0.2054</td>
</tr>
<tr>
<td>H</td>
<td>7228</td>
<td>1810</td>
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The data in table 2 indicate the lowest and the highest values of the variables used in estimation of real money supply. These values are for the period 1972-IV to 1989-IV. They are real quarterly data. The table also shows the mean values and standard deviations of the explanatory variables.
### Table II: Correlation Matrix of High-powered Money Function

<table>
<thead>
<tr>
<th></th>
<th>NFA</th>
<th>GD</th>
<th>P</th>
<th>Y</th>
<th>Dummy4</th>
<th>Dummy3</th>
<th>Dummy2</th>
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### Table III: Correlation Matrix for Currency and Qausi Ratios

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<th>LogRS</th>
<th>LogRT</th>
<th>LLogC</th>
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<th>X11</th>
<th>X12</th>
<th>X10</th>
<th>X11</th>
<th>X12</th>
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