RESERVE RATIOS AS MONETARY POLICY INSTRUMENTS IN KENYA

BY

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To Margaret, Eric,
Edward and Ellias

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

Maurice John Pette Kanga

This research paper has been submitted for examination with our approval as University Supervisors.

Professor P. Nagarajan

Professor T.C.I. Ryan

TABLE OF CONTENTS

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ABSTRACT

In this study, the possibility of making reserve ratios effective monetary policy instruments in Kenya was examined.

Deposit components of money stock were found to be sensitive to changes in the ratio of the reserve assets to all deposit liabilities. This suggested effectiveness of reserve ratio as a monetary policy control instrument. It was also found that banks do not maintain separate reserve ratios for different categories of deposits.

It was found that the commercial banks consider vault and till cash in addition to balances they hold with the Central Bank, and interbank balances including those held with banks abroad as the only reserve assets. Treasury bills were found not to be considered as part of the reserve assets by the commercial banks.

In the course of the study, it was found that demand for both money and quasi-money in Kenya is mainly determined by current or expected income. Demand for money was found to have an elasticity of less than, or just about one while quasi-money had an elasticity of above one. Inflation and interest rates were found to be unimportant in the determination of demand for both money and quasi-money. A lag of about three fourths of a period (a quarter of a year in this study) was found to be operative in demand for money and quasi-money. About 72% of money stock was found to be predetermined on the basis of this lag.

CHAPTER I

INTRODUCTION

1.1 THE ROLE OF THE CENTRAL BANK:

The Monetary Authority, which is made up of the Central Bank of Kenya and the Treasury, is charged with the responsibility of initiating and implementing the monetary policy in Kenya[1]. The Central Bank of Kenya is the more active arm of the Monetary Authority and is more often than not responsible for the monetary policy pronouncements. The Governor is the Chairman of the Board of Directors of the Central Bank while the Permanent Secretary to the Treasury is an ex-officio member of the Board. Other members of the Board, including the Deputy Governor, are appointed by the President of the Republic of Kenya.

The Central Bank is empowered in the Act to use a number of policy instruments in the course of implementing the monetary policy of the government. The Act, in addition to the Banking Act[2], obliges every commercial bank to maintain a current account with the Central Bank. The other financial institutions which do banking business, do not maintain any accounts with the Central Bank but the two Acts empower the Central Bank to impose regulatory requirements in

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[1] Central Bank of Kenya Act CAP. 491 Revised ed. 1967, Part II sections 3 through 6.

[2] Ibid. Section 38

case of need. The monetary policy instruments available to the Central Bank in the Central Bank of Kenya Act are specifically spelled out in parts VII and VIII of the Central Bank Act. The instruments are numerous but they can be grouped into two classes: those which are purely monetary policy instruments and those which have direct relationship with the fiscal operations of the government. Our focus is not on the fiscal policy but we shall briefly examine the implications of these fiscal policy instruments on those of monetary policy in section 1.2.

The monetary policy instruments available to the Central Bank are, as would be expected, aimed at enabling the Bank to control supply of and demand for bank credit and consequently the demand for and supply of money. In addition to "reserve requirements" with which our study is concerned, the Central Bank is not only empowered to peg interest rates on deposits and therefore indirectly on lending rates but can also dictate on volumes and maturity periods of loans extended by banks and other specified financial institutions[3]. The focus of this study is on reserve ratios as effective monetary policy instruments. Although the Central Bank of Kenya Act, in

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[3] Ibid. Sections 39 through 41.

section 38, empowers the Bank with a somewhat ineffective reserve ratio as a monetary control tool, the Bank has never used the reserve ratios to control the growth of money supply. According to the Central Bank Act section 38, the reserve requirements which the Central Bank is supposed to expect the commercial banks to observe are as follows:-

(a) The Bank-meaning the Central Bank of Kenya - may, from time to time, require specified banks to maintain minimum cash balances on deposit with the Bank as reserves against their deposit and other liabilities: Provided such balances shall not exceed 20% of each specified bank's total liabilities.

(b) Subject to the limit specified in sub-section (a) of this section, the Bank may specify different ratios for different types of liabilities and may further specify the method of computing the amount of the total liabilities of a specified bank: Provided that the ratios specified shall be the same for all specified banks.

(c) Any specification of, or increase in, the minimum reserve requirements under sub-sections (a) and (b) of this section shall take effect only after the expiration of thirty days' notice to the specified banks of the Bank's intention to take such action.

(d) The Bank may impose on any specified bank which fails to maintain sufficient cash balances required under subsection (a) or subsection (b) of this section a penalty interest charge not to exceed one-tenth of one percent per day on the amount of the deficiency for each day for which the deficiency continues.

(e) The Bank may, if in its opinion circumstance of an unusual nature render it desirable so to do, pay interest at such rates and subject to such qualifications as it may determine on minimum cash balances deposited with the Bank in accordance with this section.

1.2 RESERVE RATIOS AS MONETARY POLICY INSTRUMENTS:

The Central Bank of Kenya is in a position to control credit creation by both the commercial banks and non-bank financial institutions, hereafter NBFIs'. When the ratio is raised, other things remaining the same, outstanding loans should contract. Given the demand for credit, the reverse should occur when the reserve ratio is lowered. As credit contracts or expands, according to the change in the reserve ratio, the change in money supply should be in the same direction as that of credit. Underlying this mechanism is that the reserve assets in question can be sterilized or released for circulation in accordance with the monetary policy requirements. The use of the reserve ratio as a monetary policy tool can be demonstrated by use of the following identity equation the formulation of which is developed in details in chapter II:

If we denote money supply by M_s, high powered money by H, the ratio of currency outside banks to the deposit liabilities of banks from the private sector by c and the reserve ratio by r, we can have the following identity:

$$M_s = \frac{(1 + c)}{(r + c)} H \tag{1.1}$$

from which: $\dfrac{\partial M_s}{\partial r} = - \dfrac{(1 + c)}{(r + c)^2} H$, iff $c \neq f(r)$, $H \neq f(r)$

and : $\Delta M_s = - \dfrac{(1 + c)}{(r + c)^2} H . \Delta r$

The partial derivative of M_s with respect to reserve ratio r is negative so that when the reserve ratio is raised money supply M_s, will decline. A lowering of the reserve ratio will lead to an increase in money supply provided there is demand for credit at that rate of interest.

The Central Bank of Kenya Act defines reserve assets as being only cash balances with the Central Bank as we have noted in the previous section. Cash in vaults and tills are not considered as reserve assets. Since its inception in 1966, the cash reserve ratio as provided in the Act has only been used in three brief periods: a cash ratio as stated in the Central Bank Act was imposed at 5% for two months during the fiscal year 1971/72 and then from 1978/79 to early 1983. The Central Bank has never used a reserve ratio which includes all reserve assets. Whatever objectives for imposing it - which would have been to squeeze or expand credit and money supply - it was bound to fail because of ommiting the two components.

As an analogy of reserve ratio, the Central Bank has been using a liquidity ratio since 1969. For the liquidity ratio, the liquid assets include not just cash balances with the Central Bank but also include cash in vaults and tills, and short-dated government securities, namely the treasury bills in addition to interbank balances even with the banks abroad. This definition of liquidity ratio could be a perfect substitute for reserve ratio but for two major weaknesses.

(a) The inclusion of interbank balances with the foreign banks presupposes that commercial banks can maintain cash balances abroad which the Central Bank of Kenya can easily count on as a redeeming asset in case of a run on the banks. The Banking Act 1968 does not allow for this[4].

(b) The more serious aspect of the liquidity ratio which the Central Bank has been and still relies on is to define it so as to include treasury bills. The seriousness of including treasury bills amongst reserve assets undermines the effectiveness of the reserve (liquidity) ratio as a monetary weapon when the government runs a budget deficit which is financed by borrowing from the banks as has been the case in Kenya throughout the 1970s and 1980s to date. This weakness undermines the use of liquidity ratio as a policy tool.

As long as the Government runs budget deficits and finances all or part of it by borrowing from the banks by way of sales of treasury bills to the banks, who actually have been the main purchasers of the treasury bills, raising the liquidity ratio will not squeeze the banks or the financial system as a whole. This

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[4] Exchange Control Act. CAP 113, Revised Ed. 1967, Part I Section 3.

is because, on raising the liquidity ratio, a bank which may be tight reserve-wise, will just recall some of its credit to the private sector and purchase the treasury bills; the proceeds from which the government will finance its deficit, thus the money which was recalled from the private sector, goes back into circulation. If the negative relationship between reserve assets and treasury bills as held by the banks is one to one, money supply which initially declined on raising the liquidity ratio, will grow back to its level at the time of raising the liquidity ratio: of course with a time lag. The Central Bank's objective of squeezing the banking system and reducing the level or growth of money supply by raising the liquidity ratio will have been defeated. This mechanism may be clarified by using equation (1.1) modified by inclusion of Treasury bills in the reserve ratio which we may now call liquidity ratio r_L.

In the case of reserve assets the calculation of r excludes Treasury bills: that is,

$$r = \frac{RA}{D} \quad \text{where}$$

RA = Reserve Assets

D = Deposits

In the case of liquidity ratio, r_L now includes Treasury bills so that,

$$r_L = \frac{RA + TB}{D} \quad \text{where}$$

TB = Treasury bills

The relationship between reserve assets and treasury bills is negative since reserve assets earn no interest while treasury bills do. This enable us to write:

$$RA = -\alpha TB \qquad (1.2)$$

from which we can deduce that as long as there are treasury bills to purchase, budget deficit to finance, a bank will just hold minimum reserves to meet cash withdrawal as it thinks appropriate, and invest as much as possible in treasury bills which also enables it to meet the Central Bank's minimum liquidity requirements. The minimum reserves to hold, and therefore reserve ratio to maintain, is entirely a bank's choice.

From equation (1.2) the quantity of treasury bills can be written as:

$$TB = -\frac{RA}{\alpha}$$

so that liquidity ratio r_L can be written in terms of reserve ratio r as:

$$r_L = \frac{(\alpha - 1)}{\alpha} \frac{RA}{D}$$

$$= \frac{(\alpha - 1)}{\alpha} r$$

The modified money supply expression in equation (1.1) then becomes:

$$M_s = \frac{(1 + c)}{(r_L + c)} H$$

$$= \frac{(1 + c)}{[\frac{(\alpha - 1)}{\alpha} r + c]} H \qquad (1.3)$$

from which $$\frac{\partial M_s}{\partial r} = \frac{-\frac{(\alpha - 1)}{\alpha}(1 + c)}{[\frac{(\alpha - 1)}{\alpha} r + c]^2} H$$

and $$\Delta M_s = - \frac{\frac{(\alpha - 1)}{\alpha}(1 + r)}{[\frac{(\alpha - 1)}{\alpha} r + c]^2} .H.\Delta r \qquad (1.4)$$

which shows that given a government budget deficit to finance, the success in squeezing the financial system will depend on the size of α. If α is unity, as it is likely to be, the impact of raising the liquidity ratio will be zero.

1.3 PAST EXPERIENCE WITH THE USE OF LIQUIDITY RATIO:

Despite the power bestowed on it to impose reserve requirement as noted in section 1 of this chapter, the Central Bank has never used reserve ratio as a policy instrument to control the money stock. Only on three occasions has the Bank used a ratio, defined in the Central Bank Act, section 38, as the ratio of "cash balances with the Central Bank to the banks' deposit and other liabilities". Table 1.1 shows the absolute changes in the components of reserve and liquid assets, and the dates and durations when cash and or liquidity ratios were effective. The observations are up to end September 1984.

TABLE 1.1: ABSOLUTE CHANGES IN THE COMPONENTS OF RESERVE AND TREASURY BILLS DURING PERIODS WHEN DIFFERENT LIQUIDITY OR LIQUIDITY AND CASH RATIOS WERE EFFECTIVE

The years when the change was effected	Cash ratio cr		Liquidity ratio r_L		Absolute changes in reserve assets of commercial banks			Treasury Bills	Ratio of reserve assets to Treasury bills
	Balances with the Central Bank cr	Duration in years	r_L	Duration in years	Cash in vaults and tills shs m	Cash with Central Bank shs m	Total reserve assets 1 shs m	2 shs m	1 ÷ 2
1966/69	Free	3.16	Free	3.16	59	419	478	100	4.780
1969/72	5%	0.16	12½%	2.67	39	-221	-182	196	-0.929
1972/76	Free	3.83	15%	3.83	91	88	179	815	0.220
1976/78	4%	0.13	18%	1.50	97	789	886	303	2.924
1978	3%	0.45	20%	0.50	26	-312	-286	-7	40.857
1978/79	3%	1.08	18%	1.08	-28	-167	-195	538	-0.362
1979/81	3%	1.29	16%	1.67	5	92	125	-413	-0.303
1981/83	3%	0.29	15%	1.75	269	49	318	619	0.514
1983/ Sept. 1984	Free	1.83	20%	1.83	-53	63	10	1377	0.007

Source: Central Bank of Kenya Annual Reports 1967-1983; Computations from consolidated commercial banks' monthly statements.

From table 1.1 we observe that when the Central Bank started operating, it imposed no reserve, cash or liquidity requirements. The position remained that way for 3.16 years. Nevertheless the commercial banks maintained cash in tills and vaults in addition to cash balances with the Central Bank at levels of their own choice. Over this period, the government fiscal operations sharply changed: in 1963 when the country was about to be independent, there was a budget surplus equivalent to about 1% of the government total expenditure. In 1969, the government ran a deficit equivalent to 4.4% of its total expenditure. The foreign financing of the government expenditure which was shs 181m in 1963 fell to shs 30.6m in 1969 while total expenditure increased by 75%[5].

It was this dramatic change in the fiscal operations that prompted the Monetary Authorities to introduce a liquidity ratio requirement in November 1969. The liquidity ratio of 12½% was introduced and defined to include treasury bills clearly to provide a source for financing the increasing deficit[6]. This ratio remained in force for 2.67 years before it was increased to 15%. During this period a cash ratio of

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[5] Economic Survey, 1969, Ministry of Economic Planning and Development: see tables 9.2 and 9.9.

[6] Note that fiscal year ended in June, 1969 while liquidity ratio of 12½% was introduced in November 1969.

5% was introduced in February 1972 but was quickly withdrawn after 2 months (0.16 years). The introduction of a cash ratio was apparently aimed at reducing growth in domestic bank credit especially credit to the private and other quasi government sectors. The growth of their borrowing from the banks increased from an average of 3.14% per annum during the time of no reserve requirements, to 28.18% in the second

TABLE 1.2: INEFFECTIVENESS OF LIQUIDITY RATIO AS A MONETARY POLICY TOOL

	CASH AND LIQUIDITY RATIO				COMPOUND ANNUAL RATE OF GROWTH IN BANK CREDIT AGGREGATES			COMPOUNDED ANNUAL RATE OF GROWTH IN MONETARY AGGREGATES	
The years when the change was effected	Cash ratio cr	Duration in years	Liquidity ratio r_L	Duration in years	Total domestic bank credit in percentage	Net government bank credit in percentage	Private and other public sector credit in percentage	Currency outisde banks plus demand deposits M1 in percentage	M1 plus quasi-money M2 in percentage
	cr		r_L						
1966/69	Free	Free	Free	3.16	6.74	-	3.14	n/a	n/a
1969/72	5%	0.15	12½%	2.67	33.09	125.04	28.18	15.04	16.33
1972/76	5%	0.08	15%	3.83	22.45	33.49	20.21	18.32	18.03
1976/78	4%	0.08	18%	1.50	29.71	6.81	35.34	37.84	41.36
1978	3%	0.45	20%	0.50	36.39	44.33	34.96	-3.07	15.96
1978/79	3%	1.08	18%	1.08	10.93	39.22	5.55	17.73	11.13
1979/81	3%	1.77	16%	1.67	21.65	44.83	15.26	3.41	8.17
1981/83	Free	1.75	15%	1.75	25.39	27.89	20.05	16.41	17.77
1983/ Sept. 1984	Free	1.83	20%	1.83	4.96	7.90	3.54	5.85	4.06

Source: Central Bank of Kenya Annual Reports: 1967-1984.

Various Central Bank Circulars to commercial banks.

n/a - not available.

period and required an action: introducing a cash ratio as shown in table 1.2. Government which previously hardly borrowed from the banks, had its indebtedness to the banking system increasing at 125% per annum when the liquidity ratio was introduced. Money supply both M1 and M2 increased at relatively lower rates of 14% and 16% respectively. This was because some of the credit created was absorbed by the deficit on the balance of payments especially the current account. The current account deficit which was shs 21m in 1967 worsened to shs 54m in 1971 with overall balance of payments position worsening from a deficit of shs 4m to shs 32m in the same years[7].

The failure of the liquidity ratio, r_L, as a tool to control the expansion of credit and therefore the control of money supply is revealed in table 1.2. For example when the liquidity ratio was raised from 15% and 18% in 1976 through 1978, one would have expected a slow growth in domestic bank credit but instead we observe that domestic credit expanded by an annual rate of 30% compared to 22% before the change. Money supply, both M1 and M2 accelerated, increasing by 38% and 41% respectively. The more than growth in domestic credit in money supply is explained

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[7] Central Bank of Kenya Annual Report, 1972 pp. 15-16.

by the large surplus in the balance of payments during the coffee boom period of 1976/77. Again, though for a brief period, when liquidity ratio was raised from 18% and 20%, annualized growth in domestic credit accelerated from 30% to 36%, but because the country recorded a huge deficit of shs 1496m, growth of money supply M2 decelerated from 41% to 15%: in fact M1 declined by 3% during that short period. In 1978 through 1979 the monetary authorities, for whatever reason, lowered the liquidity ratio from 20% back to 18% and one would have expected an acceleration in the growth of credit and monetary aggregates. But because this measure was accompanied with an import deposit scheme, growth of both credit and money supply M2, decelerated. Money supply M1, however accelerated. The deceleration in bank credit and even in M2 were explained by the import deposit scheme which required importers to deposit with the Central Bank, 25% or 100% of the value of certain categories of imports. This measure had a direct negative impact on the growth of credit for importation[8]. The scheme remained in force until January, 1983.

The period from 1979 through 1982 was still ridden with large budget deficits as the growth rate of net

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[8] Central Bank of Kenya Annual Report, 1979 p. 18

government borrowing shows in table 1.2. Also the monetary authorities lowered the percentages of the import deposit scheme[9] so that accelerated growth in bank credit both in total and in its components was arising mainly due to these events but conclusively because of lowering the liquidity ratio from 18% to 16% then to 15%. There was an increase in deficit financing mainly through sales of the bills to the Central Bank whose holdings of these bills increased from shs 888m in June, 1979 to shs 3199m in June 1982. Besides this more than tripling of treasury bills purchases by the Central Bank, the government direct borrowing from the Central Bank increased from shs 200m by a multiple of 8.355 to shs 1671m[10].

With this direct injection of liquidity into the economy by the Central Bank, the observed relatively smaller accelerations in bank credit between 1979 and 1982 as shown in table 1.2 cannot be attributed to the lowering of liquidity ratio. It was a result of deficit financing from the Central Bank most of which was spent on imports as indicated by the relatively slower growth in the supply of money and a cumulative deficit of shs 5609m on the balance of payments.

The liqudity ratio was raised again in early 1983 from

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[9] Central Bank of Kenya Annual Report, 1980 pp. 80-81.

[10] Central Bank of Kenya Annual Reports 1979 pp. 32-33 and 1982 pp. 30-31.

18% to 20% and again one would expect growth in credit and monetary aggregates to decline. This is what we observe in table 1.2, but again not as a result of raising liquidity ratio. There has been a stringent administration of importation leading to a drastic decline in demand for credit for imports in addition to the recession from which the economy was just recovering. The most important factor in the then slow growth in bank credit compared to the past, was the sharp drop in the growth of the budget: The deficit as a ratio of total government expenditure dropped from 28% in 1980/81 to 14% in 1983/84.

We conclude this section by noting that the liquidity ratio right from the time it was introduced in 1969 to date, is aimed at providing a source of financing the budget deficit and not a tool to control growth of bank credit and money supply. Yet the commercial banks have always maintained reserves, the ratio of which to their deposit liabilities they have been left free to choose.

1.4 OBJECTIVE OF AND PURPOSE FOR THE RESEARCH WORK

The objective of this study is to determine the behaviour of the appropriate structure of the reserve ratio or ratios which the commercial banks in Kenya have been so free to choose for themselves with almost no intervention from the monetary authorities over the last eighteen years. The understanding of the structure and behaviour of the appropriate reserve ratio in relation to the deposit liabilities will reinforce the monetary authority's ability to control credit and money supply.

On the assumption that wealth or income; inflation, and interest rates are singly or jointly significant determinant factors in demand for money, defined either as M1 or M2 or the components of the two, reserve ratio should prove to be a useful monetary policy tool for the monetary authority to influence the real sector by using it to control the supply of credit and hence the money supply. That is if demand or desired money is M_d and wealth or its proxy income is y while inflation and interest rate are $\dot{p}$ and i, respectively, the demand for money can be specified as:

$$M_d = f(y, \dot{p}, i) \qquad (1.5)$$

Equating equation (1.1) to equation (1.5) would yield:

$$\left(\frac{1 + c}{r + c}\right)H = f(y, \dot{p}, i) \qquad (1.6)$$

which briefly says that if we target y, $\dot{p}$, i, H and c, we can use the reserve ratio r to achieve these targets[11].

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11 Appendix 1.1

To determine the behaviour, and appropriate structure of reserve ratio r, we intend to do the following:

(i) Determine the monetary aggregate, the demand for which is best determined by wealth or expected income y^e, inflation $\dot{p}^e$, and interest rate i^e: either singly or jointly.

(ii) Having identified the right monetary aggregate which may be M1, M2 or their separate components in real terms we intend to use the deposit components of the identified monetary aggregates to test for the financial assets which the banks actually consider to be reserve assets.

(iii) We intend to find out whether the commercial banks maintain a single reserve ratio for all categories of deposits, or whether the portfolio of reserve assets reflects the categories of deposits by the maturity periods of the deposits.

(iv) Lastly we further intend to find out whether the reserve ratios are constant, or whether they increase or decrease with respect to deposit liabilities in total or by components namely demand and term deposits.

To address these issues, we intend to use quarterly data except for real gross domestic product gdp, and inflation rate, ṗ, on the gdp deflator which are available only annually. We shall enter these annual data repeatedly to correspond with the data which are available on a quarterly basis.

1.5 QUANTITATIVE TECHNIQUES:

In testing our hypotheses, the details of which are spelt out further in chapter III, we shall use both statistical and econometric techniques. Statistical techniques will be used to determine the right reserve assets and whether the banks maintain two different reserve ratios: one for demand deposits and the other for term deposits that is, any deposits which are not available on demand without any breach of contract. The econometric technique we shall use will be Ordinary Least Squares applied on data transformed into their logarithms.

Because we shall use time series, most of which are stocks rather than flows, we expect to encounter serious autocorrelation problems in some of our estimations. We intend to correct for these problems by repeated use of the Cochrane-Orcutt Itterative method. Our conclusions will be based on the significance of the parameter estimates using Student's statistics test while the size of the coefficient of determination will be measured by the adjusted $\bar{R}$. The overall significance of a particular equation will be measured by the Fisher's Statistics F-test.

Before formulating a theoretical framework to follow, we review the evolution of reserve ratio from the times of the goldsmith to the present in the next chapter. We also briefly review the theory of demand for money in the chapter because demand for money is our starting point in the process of determining a useful structure of reserve ratio or ratios which can enable the monetary authorities to influence the real sector.

Accordingly chapter II is organized into six sections: section 2.1 is a review of the evolution of the reserve ratio. Section 2.2 and 2.3 are on refinements of the reserve ratio structure while section 2.4 is on review of the structure of reserve ratios incorporating the existence of the NBFIs in the process of credit creation. Section 2.5 is a survey of empirical work or related empirical analysis on the structure of reserve ratios. The final section, sęction 2.6 is a brief review of the theory of demand for money.

CHAPTER II

LITERATURE REVIEW

2.1 THE ORIGIN OF THE RESERVE RATIO:

Reserve ratios emerged during the seventeenth century when the forerunners of the commercial banks, namely the goldsmiths in cities, and traders in the countryside, started issuing receipts to acknowledge deposits of valuables such as gold, silver and money which were lodged with them for safe keeping in return for payment of a fee. Depositors of the valuables gradually became accustomed to using their receipt holdings as media of transactions; and with the emergent confidence in the depositories, the latter, in time, learned that they did not need to keep the whole money left with them. All they learned to do was to lend out part of the deposits for a return, and keep a fraction[12] of the deposits to meet the likely withdrawals. This fraction maintained was essentially the reserve ratio.

By lending out part of the deposits a process of creating further deposits was initiated as the lent-out portion would be redeposited with another depository or even with the same one, and a second round of deposit creation was thus started; then

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[12] Perry, F.E., <u>The Elements of Banking</u>, Methuen and Co. Ltd., London, 1975 pp. 13-14

a third round and so on. This turned out to be a profitable business, and the depositories, far from making a charge for keeping money safe, began to offer interest[13], so as to get more money deposited for on lending to maximize gains. The deposits which were initially to be paid back on demand thus partially gave way to term deposits of varied periods with different likelihood of being withdrawn before maturity.

This process of deposit creation was hardly recognised by classical economists as an adverse activity which created inflation - even though this was their main preoccupation. The classical economists focused their attention on the effects of prices on money supply which they strictly defined as gold or commodity money, with special attention to its exogenous origin from external trade[14]. Their view was best presented around 1752 in Hume's statement to the effect that it was inflation which retarded external trade:

> Suppose four-fifth of all money in Great Britain to be annihilated in one night, and the nation reduced to the same

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13 Perry, F.E., Ibid., pp. 13-15

14 Harris, L., Monetary Theory, McGraw-Hill, New York, 1981 pp. 109-110

> condition, with regard to specie (gold or commodity money), as in the reigns of Harrys and Edwards, what would be the consequence? Must not the price of all labour and commodities sink in proportion, and everything be sold as cheap as they were in those ages? What nation could then dispute with us in any foreign market, or pretend to navigate or to sell manufactures at the same price which to us would afford sufficient profits?[15]

Even by 1844 when the Bank Charter Act was enacted to give the Bank of England the monopoly in note issuing, it never occurred to the law makers that deposits were money and so they were left uncontrolled[16]. By late nineteenth century economists started taking notice of the ability of banking system in creating deposits as recorded in a statement by Marshall, who never defined money to include deposits, in his theory of the bank-deposit multiplier:

> Thus I should get a geometrical progression; the effect being that if each bank could lend two thirds of its deposits, the total

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15 Hume D.,: Essays, Moral, Political and literary ed. by T. H. Green and T. H. Gross (London: Longmans, Green, 1875) See Harris (23) p. 10.

16 Perry, F.E., Op. Cit., pp. 32-35

> amount of loaning power got by the banks would amount to three times what it would otherwise be. If it could lend four-fifths, then it will be five times; and so on.[17]

Marshall's observation was actually a money multiplier theory in a nutshell, short of consideration for cash drain in a reserve system of banking. Put differently, Marshall's observation was that when banks maintain a fraction r of their deposits, an initial unit increase in deposits, say from external trade surplus, would, through the money multiplier, amount to total deposits of 1/r and total loans of 1/(r - 1), on the assumption that there was no cash leakage as Marshall implied. This could have not been the case because there were gold and silver coins in circulation and money supply was still defined to include gold and commodity money only: there was cash drain. Accordingly, the right position of final increase ΔDD, in deposits and ultimately in loans ΔL, arising from a unit initial increase in deposits, would have to take account of the fact that some of the money that was lent out was not redeposited with the banks.[18]

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17 Marshall, A.: Official papers, ed. by J.M. Keynes (London: Macmillan, 1926), See Harris (23) pp. 111-112

18 Bain, A.D., The Control of Money Supply, third ed., Penguin Books, 1980 pp. 37-38

Assuming that money holders held a fraction c of their money in currency, then the final increase in deposits and in loans arising from this unit infusion were respectively as follows:

$$\Delta DD = \frac{1}{1+c} \left[\left(\frac{1-r}{1+c}\right)^0 + \left(\frac{1-r}{1+c}\right)^1 + \left(\frac{1-r}{1+c}\right)^2 + \ldots\ldots\right] \quad (2.1)$$

$$\Delta L = \frac{1}{1+c} \left[\left(\frac{1-r}{1+c}\right)^0 + \left[\left(\frac{1-r}{1+c}\right)^1 + \left(\frac{1-r}{1+c}\right)^2 + \ldots\ldots\right] \quad (2.2)$$

The final cash drain ΔCY, into the hands of money holders was in this situation equal to

$$\Delta CY = \frac{c}{1+c} \left[\left(\frac{1-r}{1+c}\right)^0 + \left(\frac{1-r}{1+c}\right)^1 + \left(\frac{1-r}{1+c}\right)^2 + \ldots\ldots\right] \quad (2.3)$$

However Marshall is recorded as having developed the theory of deposit creation under a banking system or as it is now known, the bank-deposit multiplier.[19] That banks maintain reserve ratio r in their business of money lending, had clearly emerged from Marshall's work. It is also further noteworthy from the three equations derived from Marshall's Statement that the geometric progression he observed was a converging one because the common ratio (1-r)/(1+c) is less than unity since r and c are both positive and less than unity. Accordingly a unit change in initial

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19 Harris, L., Op. Cit. pp. 111-112

deposits amounted to the following changes in deposits, loans and currency held respectively.[20]

$$\Delta DD = 1/(c+r) \qquad (2.4)$$

$$\Delta L = (1-r)/(c+r) \qquad (2.5)$$

$$\Delta CY = c/(c+r) \qquad (2.6)$$

2.2 REFINEMENT OF THE ROLE OF RESERVE RATIO:

While Marshall had noted the banks' power to create deposits, economists like Giffen in their preoccupation with the effects of money on prices, had recognised that banks maintained cash reserves which were influenced by the level of nominal income and ultimately influenced bank deposits.[21] A debate ensued as to what caused changes in the money supply which was already being defined by some economists to include deposits. In the course of the debate, Pigou in 1917 remarked:

> In the real world we cannot always hope to meet only with causes that act either on demand alone or on supply alone, The same cause may easily act upon both.[22]

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[20] See Appendix 2.1

[21] Giffen, R., Essays - Finance (London: G. Bell, 188) See Harris (23) p. 112

[22] Pigou, A.C.: "The Value of Money", Quarterly Journal of Economics, Vol. 32 pp. 38-65, November 1917.

Until well into the first half of this century economists did not pay much attention to the supply of money, and therefore demand for cash reserves by banks, as they did to demand for money.[23] It was Friedman and Schwartz[24] in 1963 and Cagan[25] in 1965, in their studies of factors which determine demand for and supply of money, who formalized the money multiplier theory to near what it is today. Money supply M(PS), was defined to include currency CY(PS) held by the private sector and banks[26] demand deposits DD(PS) owned by the private sector so that

$$M(PS) = CY(PS) + DD(PS) \tag{2.7}$$

from which

$$\begin{aligned} DD(PS) &= M(PS) - CY(PS) \\ &= M(PS)\left[1 - \frac{CY(PS)}{M(PS)}\right] \end{aligned}$$

which on dividing through by cash held as reserves R(BS) by the banking system, yields:

$$\frac{DD(PS)}{R(BS)} = \frac{M(PS)}{R(BS)}\left[1 - \frac{CY(PS)}{M(PS)}\right]$$

from which,

$$\frac{R(BS)}{M(PS)} = \frac{R(BS)}{DD(PS)}\left[1 - \frac{CY(PS)}{M(PS)}\right] \tag{2.8}$$

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[23] Teigen, R.L., Demand and Supply functions for Money in United States, Econometrica, Vol. 32, No. 4 October, 1964

[24] Friedman, M., and Schwartz, A.J.,: A Monetary History of the United States, 1867-1960, National Bureau of Economic Research in Business Cycles No. 12 (Princeton, N.J.: Princeton University Press 1963a); See Harris (23) pp. 133-135.

[25] Cagan, P.: Determinants and Effects of Changes in the Stock of Money 1875-1960, National Bureau of Economic Research Studies in Business Cycles, No. 13 (New York: National Bureau of Research 1965); See Harris (23) pp. 135-136.

[26] Niehans, J., The Theory of Money, John Hopkins University Press, Baltimore and London 1978, p. 166. (see for the definition of banks).

Friedman defined cash in hands of private and banking sectors as "high-powered money" H(PBS) so that,

$$H(PBS) = CY(PS) + R(BS) \tag{2.9}$$

which on dividing through by M(PS) yields

$$\frac{H(PBS)}{M(PS)} = \frac{CY(PS)}{M(PS)} + \frac{R(BS)}{M(PS)} \tag{2.10}$$

Replacing R(BS)/M(PS) by right hand side of equation (2.8), we find,

$$\frac{H(PBS)}{M(PS)} = \frac{CY(PS)}{M(PS)} + \frac{R(BS)}{DD(PS)} \left[1 - \frac{CY(PS)}{M(PS)}\right] \tag{2.11}$$

$$= \frac{CY(PS)}{M(PS)} + \frac{R(BS)}{DD(PS)} - \frac{R(BS)CY(PS)}{M(PS)DD(PS)}$$

which can be written as:

$$M(PS) = H(PBS) \frac{1}{\frac{CY(PS)}{M(PS)} + \frac{R(BS)}{DD(PS)} - \frac{CY(PS)R(BS)}{M(PS)DD(PS)}} \tag{2.12}$$

Clearly Friedman established, as can be seen from equation (2.12), that money supply was determined by currency to money supply ratio CY(PS)/M(PS), cash reserve ratio R(BS)/DD(PS), and the high-powered money H(PBS). The coefficient of the high powered money is the money multiplier.

2.3 FURTHER REFINEMENT OF THE ROLE OF RESERVE RATIO;

In his study, Friedman arrived at a money multiplier α which incorporates currency holdings of the private sector as a ratio of total money stock, and banks' cash reserves as a ratio of demand deposits. The modern approach[27] defines money multiplier as a function of cash reserve ratio, as was arrived at by Friedman, and currency to deposits (not money stock) ratio. By defining money supply as Friedman did, the money multiplier which incorporates currency to deposits ratio is easily arrived at by dividing equation (2.7) by equation (2.9) to get:

$$\frac{M(PS)}{H(PBS)} = \frac{CY(PS) + DD(PS)}{CY(PS) + R(BS)} \qquad (2.13)$$

which on dividing through by demand deposits DD(PS) yields the money multiplier:

$$\frac{M(PS)}{H(PBS)} = \frac{1 + c}{c + r} \qquad (2.14)$$

so that money supply,

$$M(PS) = H(PBS)\,\frac{c + 1}{c + r} \qquad (2.15)$$

The money multiplier (c+1)/(c+r) is also obtainable from bank-deposit and cash drain multipliers derived from Marshall's observation: that is the sum of equations (2.4) and (2.6) which is an increase in money supply resulting from a unit increase in initial deposit say from a surplus balance in external trade:

$$\Delta M(PS) = \Delta DD + \Delta CY = \frac{1}{c + r} + \frac{c}{c + r}$$

$$= \frac{1 + c}{c + r} \qquad \text{,and}$$

is equal to $\Delta M(PS) = \Delta H(PS)\,(c+1)/(c+r)$ when $\Delta H(PS)$ is unity.

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[27] Dennis, G.E.J., Monetary Economics, London and New York, 1981 pp. 183-185.

The reserve ratio which emerges from Friedman's study is the simplest to be found in the real world today. It is however more realistic to consider a study of reserve ratio within a framework which takes into account the fact that banks create deposits not only out of demand deposits but also out of term (time and savings) deposits.[28] This is because it makes a difference to the size of money multiplier: equation (2.14). This is demonstrated by assuming that banks maintain reserve ratios r_d and r_t for demand and term deposits DD(PS) and TD(PS) owned by the private sector such that TD(PS) is a ratio g of DD(PS) so that

$$TD(PS) = gDD(PS) \tag{2.16}$$

We can then rewrite equation (2.9) for high-powered money as:

$$\begin{aligned} H(PBS) &= CY(PS) + R(BS) \\ &= CY(PS) + r_d DD(PS) + r_t TD(PS) \\ &= CY(PS) + r_d DD(PS) + r_t gDD(PS) \end{aligned} \tag{2.17}$$

By still defining money stock as demand deposits owned by the private sector, plus currency held by the sector, money multiplier as in equation (2.13) is now M(PS) in equation (2.7) divided by H(PBS) in equation (2.17):

$$\frac{M(PS)}{H(PBS)} = \frac{CY(PS) + DD(PS)}{CY(PS) + r_d DD(PS) + r_t gDD(PS)} \tag{2.18}$$

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[28] Johnson, H.G., Macroeconomic and Monetary Theory, Garry-Mills 1971, pp. 139-140

which when divided through by DD(PS) yield the money multiplier,

$$\frac{M(PS)}{H(PBS)} = \frac{c + 1}{c + r_d + r_t g} \qquad (2.19)$$

The multipliers in equations(2.14) and (2.19) can be equal only if,

$$c + r = c + r_d + r_t g$$

that is only if g is zero which cannot be the case because private sector holds term deposits with banks. Without any further analysis, the multiplier in equation (2.14) is larger than the multiplier in equation (2.19). That is, the fact that private sector holds term deposits with banks affects the ability of the banks to create deposits even when the reserve ratio r_d for demand deposits is equal to reserve ratio r_t for term deposits. The two reserve ratios r_d and r_t are not likely to be equal[29] because of the difference in contractual arrangements between the banks and the deposit owners: demand deposits can be withdrawn any time without any contingent loss while term deposits can only be withdrawn before maturity date on payment for the breach of contract. The probability of demand deposits being withdrawn is higher than that for term deposits and this should lead us to expect r_d to be greater than r_t. The longer the contractual period the smaller the reserve ratio r_t[30]. Money multiplier

[29] Chandler, L.V., The Economics of Money and Banking, Harper and Row, New York sixth ed., 1973, pp. 259-262

[30] Chandler, L.V., Ibid. p. 261

on the other hand will be larger, the smaller the reserve ratio r_t for term deposits. From equation (2.19), the money multiplier,

$$\frac{M(PS)}{H(PBS)} = \frac{c + 1}{c + r_d + r_t g}\text{, from which we find}$$

that $$\frac{\partial[M(PS)/H(PBS)]}{\partial r_t} = -\frac{g(c + 1)}{(c + r_d + r_t g)^2}\text{,}$$ so

that when contractual maturity period increases banks maintain lower reserve ratio r_t of term deposits and money multiplier increases. Even with the assumption that term deposits have uniform contractual maturity periods, the money multiplier in equation (2.19) is not sufficient in handling a realistic study of the size of reserve ratios which banks maintain in economies which have NBFI's. Certainly not in Kenya where such financial institutions command deposits which are no less than 45% of deposits of the commercial banks.[31]

2.4 NBFI'S AND BANKS' RESERVE RATIOS:

The NBFI's do not accept demand deposits but create credit out of term deposits DN(PS) which they receive from the private sector. Out of these deposits, the NBFI's have to maintain cash reserves R(N) with the commercial banks in form of demand deposits such that,

$$R(N) = eDN(PS) \tag{2.20}$$

where e is actually a reserve ratio for the NBFI's.

[31] Central Bank of Kenya Annual Report, 1983. My calculation from the Statistical Annex therein.

Naturally the banks will have to use the R(N) from the NBFI's along with the demand deposits DD(PS) from the rest of the private sector to create credit and hence more deposits, ensuring that sufficient cash reserves are maintained to meet the probable demand.

The private sector on the other hand have a portfolio behaviour in which liquidity preference is shared between the banks and NBFI's, depending on a number of factors like interest rate differential, such that the term deposits owned by the sector at the NBFI's is a proportion h of term deposits owned by the sector at the banks:

$$DN(PS) = hTD(PS) \tag{2.21}$$

which by substitution, from equation (2.16) turns out to be:

$$DN(PS) = hgDD(PS) \tag{2.22}$$

Defining money stock as currency plus demand deposits owned by both NBFI's and the private sector at the banks, money supply will now be:

$$M(PS) = CY(PS) + DD(PS) + R(N)$$

which from equations (2.20) and (2.22) yields:

$$\begin{aligned} M(PS) &= CY(PS) + DD(PS) + ehgDD(PS) \\ &= CY(PS) + DD(PS)\,[1 + ehg] \end{aligned} \tag{2.23}$$

The deposits with banks now entail demand deposits DD(PS) owned by the private sector, demand deposits R(N) owned by the NBFI's, and term deposits TD(PS) owned by the private sector, so that on assumption that banks maintain reserve ratios, r_d and r_t for demand and term deposits respectively, the cash reserves R(BS) of the banks is now as follows:

$$R(BS) = r_d[DD(PS) + R(N)] + r_t TD(PS)$$

which, by substitutions from equations (2.16), (2.20) and (2.22) yields:

$$R(BS) = r_d(1 + ehg)\ DD(PS) + r_t gDD(PS) \qquad (2.24)$$

The high-powered money, that is, the currency CY(PS) plus the reserves R(BS) of the banks is now:

$$H(PBS) = CY(PS) + r_d(1 + ehg)DD(PS) + r_t gDD(PS) \qquad (2.25)$$

The money multiplier, as before, is money supply M(PS) divided by the high-powered money H(PBS), which is now equation (2.23) divided by equation (2.25):

$$\frac{M(PS)}{H(PBS)} = \frac{CY(PS) + DD(PS)\ [1 + ehg]}{CY(PS) + r_d(1+ehg)DD(PS)+r_t gDD(PS)}$$

which on dividing through by DD(PS) yields;

$$\frac{M(PS)}{H(PBS)} = \frac{c + 1 + ehg}{c + r_d(1 + ehg) + r_t g}$$ which, for simplicity

we may write as:

$$\mu = \frac{c + 1 + ehg}{c + r_d(1 + ehg) + r_t g} \qquad (2.26)$$

where μ is the money multiplier.

One of the issues which one may wish to address is the extent to which banks are able to create credit and, therefore deposits, more than the NBFI's in Kenya. By comparing the ability of banks and NBFI's to create credit, Guttentag and Lindsay have found that banks' ability to create credit is higher than that of NBFIs in the United States.[32] By definition credit extended by the banks (c_b) is the difference between deposit liabilities and cash reserves. Similarly credit extended by the NBFI's (C_n) is the difference between their deposit liabilities and cash reserves. In terms of our notations, credit extended by banks and NBFI's are respectively:

$$C_b = R(N) + DD(PS) + TD(PS) - R(BS) \quad (2.27)$$

and $C_n = DN(PS) - R(N)$ (2.28)

so that total credit C_t, in the system at any time is the sum of equations (2.27) and (2.28). That is,

$$C_t = DN(PS) + DD(PS) + TD(PS) - R(BS) \quad (2.29)$$

To prove that banks have greater ability than NBFI's to create credit, we express deposits DN(PS), of the private sector with NBFI's as a proportion k, of the total deposits [DD(PS + TD(PS).] owned by the sector at the banks[33]. We also express the total cash reserves R(BS) of banks as a proportion r, of total deposits [R(N) + DD(PS) + TD(PS)] of banks.[34] That is in equation form, k and r_0 are respectively as follows:

$$k = \frac{DN(PS)}{DD(PS) + TD(PS)} \quad (2.30)$$

and

$$r_0 = \frac{R(BS)}{R(N) + DD(PS) + TD(PS)} \quad (2.31)$$

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[32] Guttentag, J.M., and Lindsay, R., "The Uniqueness of Commercial Banks", Journal of Political Economy, October 1968. See Coghlan (12)

[33] See Appendix (2.2)

[34] See Appendix (2.3)

From equations (2.20), (2.29), (2.30) and (2.31), total credit C_t, extended by the NBFI's and banks can be expressed in terms of the ratio k, cash reserves, R(BS) of banks, and cash ratios e, and r., for NBFI's and banks respectively.[35] That is,

$$C_t = \frac{(1 + k) - r_o(1 + ek)}{r_o (1 + ek)} R(BS) \qquad (2.32)$$

from which,

$$\frac{\partial C_t}{\partial r_o} = \frac{(1 + k)}{r_o^2(1\ 1\ ek)} R(BS) \quad \text{and}$$

$$\frac{\partial C_t}{\partial e} = \frac{k(1 + k)}{r_o(1 + ek)^2} R(BS)$$

By making $\partial C_t/\partial r_o$ equal to $\partial C_t/\partial e$ we should arrive at the value of $\bar{k}$, that is a measure of the portfolio behaviour of the private sector, required to make NBFI's have the same ability as banks to create credit, given that they each maintain single reserve ratios r, and e, for all their deposit liabilities. That is to say:

$$\frac{\partial C_t/\partial r_o}{\partial C_t/\partial e} = \frac{1 + e\bar{k}}{r_o \bar{k}} = 1 \quad \text{from which}$$

$$\bar{k} = \frac{1}{r_o - e} \qquad (2.32)'$$

Clearly $\bar{k}$ is infinity when reserve ratio r and e for banks and NBFI's respectively are equal. That is, by equation (2.30) the private sector would have to hold all their deposits with NBFI's. The banks would have R(N), that is cash reserves of the NBFI's as the only deposit liabilities. Banks will have more ability than NBFI's to create credit as long as k>0, that is as long as the private sector hold deposits with both

[35] See Appendix (2.4)

NBFI's and banks, and reserve ratio, (r) for banks is greater than reserve ratio, (e) for NBFI's.

The superiority of banks in credit, and therefore deposit creation, is affected by the portfolio behaviour of the private sector and NBFI's. The cash reserve ratio (e) for NBFI's reflect their liquidity preference as affected by factors such as required reserve ratio, uncertainty of net deposit flow, the cost of borrowing in case of a liquidity shortfall, and interest earned on credit.[36] The ratio is therefore likely to vary with factors. The allocation of term deposits by the private sector between banks and NBFI's is reflected in the ratio (h) and is a function of, among other factors, interest rate differential between the two types of depositories. Other indicators of the private sector's liquidity preference are the currency to deposit ratio (c) and term to demand deposit ratio (g). While the term to demand deposit ratio is a function of the interest rate paid on term deposits, the currency to deposit ratio is primarily a function of payments habit, and the share of consumption in total expenditure.[37] Changes in the reserve ratio (e) of NBFI's, and those reflecting the liquidity preference of private sector, namely (h), (g) and (c), will be reflected in the levels of reserve ratios that banks would want

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[36] Dornbusch, R., and Fisher, S., Macroeconomics, MacGraw-Hill, New York, 1981, pp. 264-265

[37] Ibid. pp. 262-263

to maintain. The question is: how do changes in these ratios affect liquidity preference of banks?

From equation (2.26) we find that

$$r_d = \frac{(c + 1 + egh) - \mu(c + r_t g)}{\mu(1 + ehg)}, \text{ or}$$

$$r_t = \frac{(c + 1 + ehg) - \mu[c + r_d(1 + ehg)]}{g\mu}$$

The impact which the liquidity requirements by NBFI's can have on the reserve holdings of the banks can be gauged by taking first partial derivatives of r_d and r_t with respect to the reserve ratio e maintained by the NBFI's:

$$\frac{\partial r_d}{\partial e} = \frac{\mu hge(\mu - 1) + \mu^2 hg^2 r_t}{[\mu(1 + ehg)]^2}, \text{ and}$$

$$\frac{\partial r_t}{\partial e} = \frac{h}{\mu}(1 - \mu r_d)$$

Because the value of money multiplier μ is assumed to be equal to or greater than unity, $(\mu - 1) \geq 0$. It follows that $\partial r_d/\partial e$ is positive, and we conclude that an increase in reserve ratio of NBFI's is likely to lead to contraction in demand for cash reserves by the banks but the contraction will not be as fast as the contraction in demand deposit liabilities of the banks. Similarly, an increase in reserve ratio of NBFI's leads to a contraction of cash reserves held by the banks to meet payments of term deposits but the contraction will not be as fast as in term deposits, This is because $\partial r_t/\partial e$ is positive and $(1 - \mu r_d)^h/_\mu \geq 0$.[38]

The choice of the private sector, as influenced by interest rate differential, as to where they should hold their liquid assets, between banks and NBFI's, also has impact on liquidity preference of banks. The choice is measured by the ratio of deposits owned by the private sector at NBFI's to term deposits owned by the sector at the banks. The impact is measured by taking the first partial derivatives of r_d and r_t with respect to the ratio h; that is,

$$\frac{\partial r_d}{\partial h} = \frac{\mu egc(\mu - 1) + \mu^2 eg^2 r_t}{[\mu(1 + ehg)]^2}$$

and $$\frac{\partial r_t}{\partial h} = \frac{e}{\mu}(1 - \mu r_d),$$

both of which turn out to be positive.[39] This points out that banks will want to maintain higher levels of cash reserves when they are faced by NBFI's in competing for deposits mobilization. This means that increased activities of NBFI's in deposit mobilization is contractionary in terms of credit and deposit creation by the banks.

The form in which the private sector hold liquid assets also determines the banks' liquidity preference; that

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38 See Appendix (2.5)

39 Ibid. (2.5)

is the proportion in which the private sector holds demand and term deposits with banks, is also a factor that banks take into account when deciding on levels of reserve ratios to maintain. The impact of shift between demand and term deposits, held by the private sector with banks, on reserve ratios r_d and r_t is measurable by taking the first partial derivative for r_d and r_t with respect to g as follows:

$$\frac{\partial r_d}{\partial g} = \frac{\mu ehc(\mu - 1) + \mu ehgr_t}{[\mu(1 + ehg)]^2}$$

and $$\frac{\partial r_t}{\partial g} = \frac{c(\mu - 1) + (\mu r_d - 1)}{g^2 \mu}$$

$\partial r_d/\partial g$, like in the case of $\partial r_d/\partial e$, is unambiguously positive, indicating that increased demand for term deposits, relative to demand deposits, by the private sector calls for maintaining higher reserve ratio against demand deposits, by the banks.

The impact of a shift from demand to term deposits on the reserve ratio r_t maintained for term deposits is indeterminate.[40] However because r_t declines with increasing r_d, shift from demand to term deposits by the private sector is likely to lead banks to maintain lower reserve ratio for term deposits.[41]

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40 See Appendix (2.6)

41 *Ibid*. (2.6)

Increased demand for currency relative to term deposits also has an impact on levels of reserve ratios to be maintained by the banks. This impact is measurable by taking partial derivatives of r_d and r_t with respect to currency to deposit ratios:

$$\frac{\partial r_d}{\partial c} = \frac{(1-\mu)}{\mu(1+ehg)} \text{, and}$$

$$\frac{\partial r_t}{\partial c} = \frac{(1-\mu)}{g\mu}$$, both of which, with our assumption that $\mu \geq 1$, are negative. That is, a shift to currency holdings relative to demand deposits will lead banks to maintain lower reserve ratios against both demand and term deposits.

2.5 SURVEY OF EMPIRICAL WORKS:

The closest research work to this study, ever done and published using Kenya data, is the work of Bolnick.[42] Bolnick focused his study on the sensitivity of the money multiplier to the changes in the behaviour of the banking and private sectors as represented by changes in currency and reserve ratios to deposits. Our study, unlike Bolnick's, is not on the impact of reserve ratio on the money multiplier. As put in the introductory chapter, our analysis is on the structure of the reserve ratio (or ratios) in Kenya's banking system. Our approach is to question the assumption that reserve ratios are endogenous variables, not

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42 Bolnick, B.A., "A note on behaviour of the proximate determinats of money in Kenya" EAER, Vol. 7, 1975

exogeneous as Bolnick treated the liquidity ratio in his study. However Bolnick's study is of some relevance to our task here.

Faced with unconventional definitions of money stock and liquidity ratio, Bolnick modified the multiplier theory to provide a suitable framework to analyse the banking data.[43] Because liquid assets were defined, as they are still, to include treasury bills, and as a ratio of not just deposits owned by the private sector, but of total deposits, Bolnick adjusted the high-powered money in the money supply as shown here:

$$M2 = \frac{1 + \alpha}{\alpha + \beta} [C - \beta D_{bg}]$$

where money stock M2 was first defined to exclude deposits owned by the private sector at the Post Office Savings Bank, hereafter just PSOB, and C was the high-powered money while D_{bg} was deposits of the central government held with the commercial banks. α was the ratio of currency held by the private sector to total deposists held by the sector and β was the liquidity ratio.[44] Using the modified money supply identity, Bolnick found money multiplier to be more elastic with respect to the liquidity ratio

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43 <u>Ibid</u>. pp. 81 - 82

44 <u>Ibid</u>. pp. 81 - 84

than with respect to the ratio of currency to deposit:

$$\eta_{z\alpha} = \frac{\beta - 1}{(\alpha+\beta)^2} \cdot \frac{\alpha}{z} = - .30,$$

and $$\eta_{z\beta} = \frac{-(\alpha+1)}{} \cdot \frac{\beta}{z} = - .47$$

where $z = \frac{1+\alpha}{\alpha+\beta}$, and η is elasticity.

When money stock was defined to include deposits of POSB, the money supply identity was modified as follows:[45]

$$M_k = \frac{\alpha+1+\gamma}{\alpha+\beta+\gamma(\Sigma+\beta\sigma)}(C - \beta D_{bg})$$

where γ is the ratio of private sector's deposits with POSB to the sector's deposits with banks; σ is the ratio of POSB's deposits with banks to its deposit liabilities; and Σ is the ratio of the POSB's cash reserves to its deposit liabilities. On adopting a value 0.01 for Σ, Bolnick found that the impact of a change in liquidity ratio on money multiplier was essentially the same.

Bolnick's findings were, nevertheless, based on deficient definitions and banking structure. First the observations on liquidity ratio could not have been a more appropriate indicator of liquidity preference than cash reserve ratio (or ratios) that the banks were voluntarily maintaining. Liquidity ratio included treasury bills which were themselves investments and could have been held by banks even without necessarily

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45 Ibid. pp. 88-90

being included amongst liquid assets. Purchasing treasury bills left, as is still the case, the liquidity of the purchasing bank unaltered in the immediate run but amounted to increasing liquid assets when the cash transferred to government accounts is spent. Within Bolnick's analytical framework, purchases of treasury bills by banks increases β, thereby temporarily increasing z as follows:

$$M2 = \frac{\alpha' + 1}{\alpha' + \beta} (C - D_{bg})$$

$$\beta = \frac{C'_b + T}{D_b}$$

$$z = \frac{\alpha' + 1}{\alpha' + \beta}$$

where T is the treasury bills holdings by the banks, C'_b is liquid assets other than treasury bills held by the banks, and D_b is commercial banks' deposit liabilities. The other notations are as before. When a bank purchases treasury bills, C'_b declines but T rises by the same amount so that (C'_b+T) remains unchanged but β declines and z rises both instantly and afterwards. The reaction is more severe when treasury bills are not included as liquid assets, and therefore conclusions on the sensitivity of money multiplier to changes in liquidity ratio would be different.

Secondly, Bolnick, by his treating liquidity ratio as unique and exogenous, was likely to have based his analysis on wrong premises because by 1975 term deposits at the commercial banks in Kenya were already composing half of deposit liabilities of the commercial banks.[46] Even though banks just report their total liquidity, it is likely that they consider categories of their deposit liabilities when arranging their liquidity portfolio so that the total liquid assets reflect this consideration. As observed in equations (2.14) and (2.19) the multiplier is different when banks are assumed to maintain different reserve ratios instead of a single one for all deposit categories.

Thirdly Bolnick based his analysis on money stock data as it was then defined to include deposits owned by the private sector at the POSB. If such deposits were included in money stock as of then, there was no reason for excluding deposits of NBFI's which by 1975 were about a quarter of bank deposits: far much in excess of the three percent represented by POSB.[47]

As we have already noted, the choice of reserve ratio by a bank or NBFI, depends on three factors in

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[46] Central Bank of Kenya Annual Report 1982 pp. 42-53

[47] Ibid. pp. 42-53

addition to the required reserve ratio, that is:

$$r = f(i, i_D, r_R, \sigma)$$

$$f_i < 0,\ f_{i_D} < 0 \quad f_{r_R} > 0,\ f_\sigma > 0$$

where r is the maintained reserve ratio; i is the loan rate; i_D is the cost of borrowing; r_R is the required reserve ratio; and σ is the indicator of the uncertainty characteristics of the bank's deposit inflows and outflows.[48] This hypothesis may also be put as follows:

$$\frac{RR + ER}{DD + TD} = f(\quad)$$

where RR is required reserves; ER is excess reserves; DD is demand deposits; and TD is term deposits so that:

$$RR + ER = f(i, i_D, r_R, \sigma)[DD + TD]$$

Assuming a single reserve ratio situation, and writing f( ) for $f(i, i_D, r_R, \sigma)$,

$$RR + ER = f(\quad)DD + f(\quad)TD \qquad \ldots\ldots(2.33)$$

In a situation where banks are not required to maintain reserve ratios, the coefficient of DD and TD in equation (2.33) will reflect the average liquidity ratios that banks maintain. However, when banks are required to observe a reserve ratio (or reserve ratios), RR can be treated as a given proportion of total deposits so that,

$$ER = -RR + f(\quad)DD + f(\quad)TD \qquad (2.34)$$

In his work on a monetary policy model for India,

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[48] Dornbusch, R., and Fisher, S., Op. Cit. pp. 264-265

Gupta,[49] using two stage least squares estimation, estimated equation (2.34) including yield on government bonds, bank loan rate, Central Bank rate, and lagged excess reserves as additional explanatory variables. He found the following results:

$$ER = \underset{(1.39)}{673} + \underset{(2.90)}{.047DD} + \underset{(3.65)}{.0453TD} - \underset{(0.15)}{30.69i_g} - \underset{(1.48)}{114.95i_I} + \underset{(0.05)}{.75i_{BI}} - \underset{(1.47)}{.284ER_{-1}}$$

$R^2 = .8738$ $\qquad$ DW = 2.1518

The coefficients of DD and TD measure the ratio of excess reserves to demand and term deposits. The ratio with respect to demand deposits is slightly higher than that with respect to term deposits. In Chapter III we contend that the reserve ratio with respect to demand deposits is not only different from, but is also always greater than that with respect to term deposits. In the study by Gupta, the ratio with respect to demand deposits is higher by 3.6 per cent. Both coefficients of DD and TD were significant at 99 per cent level. Gupta, in the same study, experimented with data on demand for excess reserves by state cooperative bank; this time DD and TD entering the equation as DD plus TD, and found the following results.[50]

$$ER = \underset{(2.24)}{4.75} + \underset{(0.94)}{.0075(DD + TD)} - \underset{(1.04)}{4.89(i_g - i_B)} + \underset{(1.33)}{.441ER_{-1}}$$

$R^2 = .7651$ $\qquad$ DW = 2.2414

[49] Gupta, G.S., A Monetary Policy Model for India, The Indian Journal of Statistics: Series B (year not known to me) pp. 487-488.

The unsatisfactory outturn from this specification, relative to the previous one, points out further that banks are likely to maintain different reserve ratios for different deposit categories. Gupta points out in a footnote that when DD and TD were combined in the first experiment, one of the explanatory variables carried a wrong sign.[51]

In a study of money and prices in Argentina, Adolfo Cesar Diz found results similar to those found by Gupta.[52] Diz, unlike Gupta who experimented with data on absolute excess reserves, estimated the determinants of the quarterly reserve ratio in Argentina in two periods: 1935-45 and 1958-1962. In general, the model entailed the following explanatory variables:

$$r = f(r^1, d, i, \frac{1}{R}\frac{dR}{dt}, S, u)$$

where r is the reserve ratio; r^1 is a "policy" variable representing the level of legal reserve coefficients; d stands for the amount of demand deposits relative to time deposits; i represents the actual or expected opportunity cost of holding reserves; S is a dummy variable representing seasonal factors working through the legal or the excess reserve components; $\frac{1}{R}\frac{dr}{dt}$ is the actual or expected

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51 Ibid. p. 497

52 Diz, A.C., Money and Prices in Argentina 1935-1962, in Meiselman D. (ed.), Varieties of Monetary Experience, Chicago, University of Chicago Press, 1970 pp. 81-21

flow of total reserves; and u represents other influences on reserve ratio.[53] In both periods, the reserve ratio was found to be related to the explanatory variables as was expected. The variables explained about 90 per cent of the observed variability of the reserve ratio and the standard errors of estimate ranged from 6 to 10 per cent of the mean value of the reserve ratio which were 21.13 and 22.05 for the first and second periods respectively.[54] The reserve ratio was found to be positively correlated to the ratio of demand deposits to time deposits, thereby confirming our analysis of the response of reserve ratios r_d and r_t, from equation (2.26), to the ratio g for term to demand deposits.

2.6 THE LINK WITH THE REAL SECTOR:

The reserve ratios are linked to the real sector through the money market. The ratios are, as in equation (2.26), components of the money multiplier in the supply of money identity. Changes in a reserve ratio will cause changes in the supply of money, the changes of which will have an impact on the demand for money and hence on real sector variables such as output, prices, employments, and interest rates. For the reserve ratios to be useful as a monetary policy tool therefore, it is necessary to identify which money stock, M1, M2 or

[53] Ibid. pp. 82-85

[54] Ibid. pp. 87-91

M3, and so on, is appropriate for monetary policy in a given economy. The identified money stock should then form a basis for specification of reserve ratios. The appropriateness of a money stock takes us to the consideration of studies in demand for money which is in two competing schools of economic thought, namely the Keynesian, and the monetarist theories consecutively reviewed here:

As a revolution to the classical quantity theory of money, Keynes postulated a compartmentalized demand for real money in which money L_1 demanded for transactions and precautionary motives, was a function of income y, and money L_2, demanded for speculating on bond rates, was a function of interest rate i paid on bonds, so that total real money balances m_d, held by an individual at any time was separately presented as:[55]

$$m_d = L_1(y) + L_2(i), \qquad (2.35)$$

which implies that money holders maintain two separate quantities of money: L_1 which is uniquely related to the level of income (y) and L_2 which may be of any form but is inversely related to interest rate (i) paid on bonds. Economists, Keynesians and monetarists alike, have been uneasy with this compartmentalization of money holdings and, to quote Johnson, "Keynes' theory of demand for money

55 Dennis, G.E.J, Op. Cit. pp. 71-79, Laidler D.E.W., The Demand for Money, Theories and Evidence, New York, 1977, pp. 63-98

is a rather awkward hybrid of two theoretically inconsistent approaches, with the transactions demand being regarded as technologically determined and the asset demand being treated as a matter of choice."[56] To remove this awkwardness, attempts have been made to prove that money balances held for transactions and precaution are not just functions of income only but are also, like speculative demand, functions of interest rate.

Baumol, a keynesian, concentrating on transactions demand for money, was the first to attempt to link to the interest rate on bonds, the three motives to hold money.[57] Baumol first assumed that transactions (T) are foreseen and that cash balances (M) held by money holders are withdrawn in equal amounts for which the money holders incur a constant brokerage fee (b) per withdrawal and also forego interest (i) which would have been earned on the withdrawn cash. Money balance (M) is further assumed to fall linearly from (M) at the beginning to zero at the end of the period so that the average cash held is M/2. From these assumptions and with a further assumption that expenditures precede

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[56] Johnson, H.G., Essays in Monetary Economics, second ed., George Allen and Unuin Ltd., London, 1969 p. 92

[57] Baumol, W.J., (1952) "The transactions demand for cash: An inventory theoretic approach", Quarterly Journal of Economics, 66 November, pp. 545-546

receipts, the total cost (C) of holding money is:

$$C = i\frac{M}{2} + b\frac{T}{M}$$ which the money holders will have to minimize. The cost is minimum when:

$$\frac{\partial C}{\partial M} = \frac{i}{2} - b\frac{T}{M^2} = 0,$$ from which

$$M^{*} = \sqrt{\frac{2bT}{i}} \qquad (2.36)$$

which shows that money held for transactions (T) is also related to interest rate i. with the sensitivity of M to changes in T and i being measured by the elasticity η_t and η_i. That is:

$$\eta_t = \frac{\partial M}{\partial T} \cdot \frac{T}{M}$$

$$= \frac{1}{2}\sqrt{\frac{2b}{Ti}} \cdot \frac{T}{\sqrt{\frac{2bT}{i}}}$$

$$= \frac{1}{2} \qquad (2.37)$$

and $$\eta_i = \frac{\partial M}{\partial r} \cdot \frac{i}{M}$$

$$= -\frac{1}{2}\sqrt{\frac{2b}{Ti}} \cdot \frac{T}{\sqrt{\frac{2bT}{2}}}$$

$$= -\frac{1}{2} \qquad (2.38)$$

Baumol also reversed the assumption that expenditures precede receipts, to receipts preceding expenditure, and assumed further that the transaction period is split into two parts: the initial time period when expenditure is financed with money (R) withheld from bonds, and the second period when expenditure is financed with money (I) received on encashing bonds which were purchased in the initial period. The transactions T, is then the sum of R and T, and the cost of holding money during the initial period is the interest (i) foregone on the average cash balance R/2, or (T - 1)/2 held, and brokerage cost (b_d) incurred in acquiring bonds or depositing the balance as an alternative to bonds at the beginning of the initial period so that the cost C_1, of holding money in the initial period for a fraction (T-I)/T of the total transactions is;

$$C_1 = \frac{T-I}{2} \cdot i \cdot \frac{T-I}{T} + b_d$$

In the second period the money holders are assumed to incur a constant cost (b_w) per withdrawal in withdrawing in equal amounts, money M, or encashing bonds. The cash holders then forego interest (i) on these holdings so that the cost C_2, of holding money during the second period for a fraction 1/T of the total transactions is:

$$C_2 = \frac{M}{2} \cdot i \cdot \frac{I}{T} + b_w \frac{I}{M}$$

The total cost TC, of holding cash throughout the initial and secondary periods is:

$$TC = C_1 + C_2$$

$$= \frac{T - I}{2} \cdot i \cdot \frac{T - I}{T} + \frac{M}{2} \cdot i \cdot \frac{I}{T} + b_d + b_w \frac{I}{M} \qquad (2.39)$$

which the money holders will have to minimize. The total cost is minimum when:

$$\frac{\partial TC}{\partial M} = \frac{1}{2} i \frac{I}{T} - \frac{b_w I}{M^2} = 0 \text{ from which}$$

$$M = \sqrt{\frac{2 b_w T}{i}}, \qquad (2.40)$$

which also shows that money held for transations T, is related to interest rate (i) with elasticities as in the cases of equation (2.37) and (2.38): that is η_T is $\frac{1}{2}$, and η_i is $-\frac{1}{2}$ as before.

This attempt to link transactions balances with interest rate has been challenged by Brunner and Meltzer, monetarists.[58] They argued that the case with the assumption of expenditure preceding receipts is unrealistic for aggregated demand for cash balances by money holders such as firms; and that it is only possible for a short time period for a single holder such as a firm. For the case with the assumption that receipts precede expenditures, they argued that the outcome regarding the elasticities would only follow when there are no variable brokerage, depositing, or withdrawal costs. To prove their case, Brunner and Meltzer introduced the variable costs k_d, and k_w for investing in bonds or in deposits, and withdrawing cash or encashing bonds respectively, so that total cost of holding cash in equation (2.39) becomes:

$$TC = \frac{T-I}{2}\, i\, \frac{T-I}{T} + \frac{M}{2} i \frac{I}{T} + b_d + k_d I + (b_w + k_w)\, M \frac{I}{M}$$

$$= \frac{T-I}{2}\, i\, \frac{T-I}{T} + \frac{M}{2} i \frac{I}{T} + b_d + k_d I + b_w \frac{I}{M} + k_w I$$

The optimal cash (T-C)/2 to be withheld from bonds or deposits at the start of the first part of the period is found by minimizing total cost with respect

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[58] Brunner, K., and Meltzer, A.H., (1967) "Economies of scale in cash balances reconsidered," Quarterly Journal of Economics, 81 August pp. 422-36

to bonds purchased (or deposits placed) I. That is:

$$\frac{\partial TC}{\partial I} = -\frac{(T-I)}{T}i + \frac{Mi}{2T} + \frac{b_w}{M} + k_d + k_w = 0$$

so that:

$$\frac{(T-I)}{T}i = \frac{Mi}{2T} + \frac{b_w}{M} + (k_d + k_w)$$

and $$\frac{T-I}{T} = \frac{M}{2T} + \frac{b_w}{Mi} + \frac{k_d + k_w}{i}$$

and $$T - I = \frac{M}{2} + \frac{b_w T}{Mi} + T\left(\frac{k_w + k_d}{i}\right)$$

which, by using equation (2.40) leads to:[59]

$$T - I = M + T\left(\frac{k_w + k_d}{i}\right)$$

so that $$\frac{T-I}{2} = \frac{M}{2} + \frac{T}{2}\left(\frac{k_w + k_d}{i}\right) \qquad (2.41)$$

The average money balances (M) held throughout the initial and second periods is the sum of the weighted balances held during the initial and second periods. That is:

$$M = \frac{T-I}{2}\left(\frac{T-I}{T}\right) + \frac{M}{2}(I/T)$$

which, from equations (2.40) and (2.41) leads to:

$$M = \sqrt{\frac{b_w T}{2i}}\left[1 + \frac{(k_w + k_d)}{i}\right] + \frac{T}{2}\left[\frac{k_w + k_d}{i}\right]^2 \qquad (2.42)$$

which again like in equations (2.36) and (2.40) shows that money held for transactions T, is related to both level of T and interest rate i, but with different elasticities η_T and η_i as follows:[60]

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59 See Appendix (2.7)

60 Ibid. (2.7)

$$\eta_T = \frac{\frac{1}{2}T[\sqrt{\frac{b_w}{2Ti}} + \sqrt{\frac{b_w}{2T}} \cdot \frac{1}{i^{3/2}}(k_d + k_w) + \{(k_d + k_w)/i\}^2]}{\sqrt{\frac{b_w T}{2i}}[1 + \frac{k_d + k_w}{i}] + \frac{T}{2}[\frac{k_d + k_w}{i}]^2} \qquad (2.43)$$

and

$$\eta_i = \frac{-\frac{1}{2}[\sqrt{\frac{b_w T}{2i}} + \sqrt{\frac{b_w T}{2}} \cdot \frac{3}{i^{3/2}}(k_d + k_w)] - T(\frac{k_d + k_w}{i})^2}{\sqrt{\frac{b_w T}{2i}}\ [1 + (\frac{k_d + k_w}{i})] + T/2\ [\frac{k_d + k_w}{i}]^2} \qquad (2.44)$$

Brunner and Meltzer's formula shows that elasticity of demand for transactions balances with respect to interest rate has a limit of -2 when brokerage cost (b_w) tends to zero or when transactions (T) tends to infinity.[61] This formulation therefore does not invalidate Baumol's finding of the relationship between transactions money balances and the interest rate: Brunner and Meltzer's formulation, observes Ahmad,[62] is both further away from and closer to the quantity theory in that while elasticity with respect to transaction moves closer to unity as the quantity theory requires, elasticity with respect to interest rate moves away from zero, contrary to the requirement of the quantity theory. The debate between the Keynesian and monetarist economists then crystallizes on empirical observations on the elasticities of demand for money balances with respect to interest rate and transactions.

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61 Ahmad, S., (1977) "Transactions demand for money and the quantity theory" Quarterly Journal of Economics, 91 pp. 327-35

62 Ibid. pp. 327-35

That transactions money demand has a non-zero elasticity was further justified by Tobin in 1956.[63] Tobin, adopted Baumol's assumption of "receipts preceding expenditure," and assumed a constant cost (α) per transaction for a variable number (n) of transactions out of a periodical income (Y). He further assumed that transactions balances are held in both cash (C) and bonds (B) with an interest rate (i) paid on bonds. The total balances of cash and bonds is assumed to be equal to the income at the beginning of the period but decline linearly towards zero at the end of the period. Because bonds are purchased in the first transaction, and subsequently sold, the number of transactions (n) cannot be any number less than two: that is $n \geq 2$. The number of transactions in purchasing bonds is 1 while the rest of transactions ($n - 1$) are occasions of encashing the bonds. On these premises, the average transactions balances are:

$$\begin{aligned} \frac{Y}{2} &= \bar{T} \\ &= \bar{C} + \bar{B} \end{aligned} \qquad (2.45)$$

with average bond holdings as:

$$\bar{B} = \frac{n - 1}{2} \cdot \frac{Y}{n} \qquad (2.46)$$

and average cash holdings as:

$$\begin{aligned} \bar{C} &= \frac{n-(n-1)}{2} \cdot \frac{Y}{n} \\ &= \frac{1}{2n} Y \end{aligned} \qquad (2.47)$$

63 Tobin, J., (1956) "The interest-elasticity of transactions demand for cash", Review of Economics and Statistics, 38 August, pp. 241-7

The net return, NR_B on bonds in this case is:

$$NR_B = i \cdot \frac{n-1}{2} \cdot \frac{Y}{n} - n\alpha \qquad (2.48)$$

while net return on cash balances is zero.

From equations (2.45), (2.46), and (2.47), the average transactions balances (Y/2) is:

$$\frac{Y}{2} = \frac{n-1}{2} \cdot \frac{Y}{n} + \frac{1}{2} \cdot \frac{Y}{n} \qquad (2.49)$$

with total net return NR_T as:

$$NR_T = i \frac{n-1}{2} \cdot \frac{Y}{n} - n\alpha \qquad (2.50)$$

which the money holders would want to maximize. It is maximum when the first order condition for maximum is met. That is:

$$\frac{\partial NR_T}{\partial n} = \frac{iY}{2n^2} - \alpha = 0$$

from which:

$$n = \sqrt{\frac{iY}{2\alpha}} \qquad (2.51)$$

which when substituted in equation (2.47) yields a cash balance function as:

$$\bar{C} = \sqrt{\frac{\alpha Y}{2i}} \qquad (2.52)$$

so that again transactions balances are shown to be both a function of income Y and interest rate i with elasticities η_Y and η_i turning out to be:

$$\eta_Y = \frac{\partial \bar{C}}{\partial Y} \cdot \frac{Y}{\bar{C}}$$

$$= \frac{\frac{1}{2}\sqrt{\frac{\alpha Y}{2i}}}{\sqrt{\frac{\alpha Y}{2i}}}$$

$$= \frac{1}{2} \qquad (2.53)$$

and $$\eta_i = \frac{\partial \overline{C}}{\partial i} \cdot \frac{i}{\overline{\overline{C}}}$$

$$= \frac{-\frac{1}{2}\sqrt{\frac{\alpha Y}{2i}}}{\sqrt{\frac{\alpha Y}{2i}}}$$

$$= -\frac{1}{2} \qquad (2.54)$$

as earlier on shown in equations (2.37) and (2.38).

The proof that transactions and precautionary balances are related to interest rate so as to invalidate the compartmentalized demand for money in equation (2.35), would be incomplete unless it is also proved that money balances held for precautionary motives are also related to interest rates. Laidler has sought to accomplish this task by assuming that a money holder starts an income period with money holdings (M_h) so that when his income (Y) falls short of his expenditure (E) by an amount in excess of money holdings, he will have to encash bonds, incurring brokerage fee (b) and also foregoing interest (i) by holding money instead of bonds.[64] Laidler assumes further that the frequency, during the period, in which the money holder falls short of cash is equal to the frequency in which his income exceeds expenditure; and that the occasions, and amounts of discrepancies between income and expenditures are normally distributed so that the money holder, by holding cash (M) is able to estimate the average brokerage cost he is likely to incur by holding

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64 Laidler, D.E.W., *Op. Cit.* pp. 81-82

that balance. Since the discrepancies are normally distributed, and brokerage cost(b) is likely to be incurred when he starts with money holdings (M_h), the likely average brokerage cost(c) is the probability of expenditure exceeding money holdings times the brokerage fee(b) for the entire period.

By using a density function,[65] the likely average brokerage cost may be presented as:

$$C = \left[\int_0^{(y-E)} \frac{1}{\sqrt{2\Pi\sigma}} e^{-\frac{1}{2}\left[\frac{M-\mu}{\sigma}\right]^2} dM - \int_0^{M_h} \frac{1}{\sqrt{2\Pi\sigma}} e^{-\frac{1}{2}\left[\frac{M-\mu}{\sigma}\right]^2} dM \right] b$$

where μ and σ are mean and deviation of money holdings.

By integration,

$$C = \left[A + \frac{\sigma^2 e^{-\frac{1}{2}\left[\frac{M-\mu}{\sigma}\right]^2}}{\sqrt{2\Pi\sigma}(\mu - M)} \right]_0^{(Y-E)} - \left[A + \frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{1}{2}\left[\frac{M-\mu}{\sigma}\right]^2} \right]_0^{M_h} b$$

$$= \left[\frac{\sigma^2 e^{-\frac{1}{2}\left[\frac{Y-E-\mu}{\sigma}\right]^2}}{\sqrt{2\Pi\sigma}(M-Y+E)} - \frac{\sigma^2 e^{-\frac{1}{2}\left[\frac{M_h-\mu}{\sigma}\right]^2}}{\sqrt{2\Pi\sigma}(\mu - M_h)} \right] b$$

Money holder will reduce this average brokerage fee by holding more money until the cost saved is off-set by the interest foregone on money holdings. That is until;

$$b \left[\frac{\sigma^2 e^{-\frac{1}{2}\left[\frac{Y-E-\mu}{\sigma}\right]^2}}{\sqrt{2\Pi\sigma}(\mu - Y + E)} - \frac{\sigma^2 e^{-\frac{1}{2}\left[\frac{M_h-\mu}{\sigma}\right]^2}}{\sqrt{2\Pi\sigma}(\mu - M_h)} \right] = i$$

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65 Karmel, P.H., and Polasek: Applied Statistics for Economists fourth ed., Pitman Australia, 1978 pp. 138-140

from which:

$$\frac{e^{-\frac{1}{2}\left[\frac{M_h-\mu}{\sigma}\right]^2}}{(\mu-M_h)} = \frac{b\sigma^2 e^{-\frac{1}{2}\left[\frac{Y-E-\mu}{\sigma}\right]^2} - i\sqrt{2\Pi\sigma}(\mu-Y+E)}{b\sigma^2\sqrt{2\Pi\sigma}(\mu-Y+E)} \qquad (2.55)$$

which shows that precautionary money holdings are also a function of interest rate paid on bonds. Thus demand for money function need not be presented in a compartmentalized form as in equation (2.35). The presentation can now take a general form as:

$$M_d = M_d(y,\ i) \qquad (2.56)$$

Even with this weakness of compartmentalization corrected, the Keynesian theory of demand for money has been criticized, particularly by Friedman as a leading monetarist, for the narrowness of income y as major explanatory variable in demand for money function.[66] Furthermore, the monetarists consider money to be an asset, the demand for which is like that for any market commodity, constrained by a budget constraint and influenced by changes in its own price as well as by changes in prices of its substitutes.[67] The budget constraint is not just the money holder's income, but his wealth (w) as well as his future income from his skill often referred to as human wealth (H).

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[66] Friedman, M., "The Quantity theory of money - a restatement" in Friedman (ed) Studies in the Quantity Theory of Money, University Press, Chicago, See Dennis (13) p. 113

[67] Dennis, G.E.J., Op. Cit. p. 114
Laidler, D.E.W., Op. Cit. p. 74

The price of money is the rate of change of its purchasing power over time, that is inflation $(\frac{1}{P_t}\frac{dP_t}{dt})$ while the substitutes are financial assets, the prices of which are returns on them adjusted for capital gains or losses over time, that is: if a return on the substitute asset is i, the variable to enter the function would have to be $(i_t - \frac{1}{i_t}\frac{di_t}{dt})$ These assets are themselves substitutes of each other such that when a return on one changes, returns on the rest also change; hence all returns on the available financial assets need not enter the function: a single return on one would fully serve the purpose.[68] Because of the limited substitution between human wealth and other assets, the ratio of nonhuman wealth to human wealth, $(W/_H)$, enters the function on the arguement by Friedman; that as the ratio falls, the proportion of human wealth in the total stock of wealth rises, leading to an increase in demand for money to off-set the movement towards illiquidity brought about by the decline in the ratio. On these premises, the monetarist's demand for money, deflated by the price level P is:

$$\frac{M_d}{P} = f\,[W_t,\ (i_t - \frac{1}{i_t}\frac{di_t}{dt}),\ \frac{1}{P_t}\frac{dP_t}{dt},\ W_{t}/H_t] \qquad (2.57)$$

$$f_{W_t} > 0; \quad f_{(i_t - \frac{1}{i}\frac{di}{dt})} > 0;$$

$$f_{(\frac{1}{P_t}\frac{dp}{dt})} < 0; \quad f_{W_t/H_t} > 0$$

The monetarist approach to explaining motives for holding money is much wider than the Keynesian

68 Laidler, D.E.W., Op. Cit. p.72

approach as can be observed in equations (2.56) and (2.57). The Keynesian's narrow financial market which consisted of money and bonds only is, in the monetarist approach, replaced with one in which all financial assets can be substituted for money and should such assets be non existent, other assets, not necessarily financial, can be held as wealth. Furthermore, in the Keynesian approach money is not an asset and, with price fixed, it is costless so its purchasing power is irrelevant. More realistic, especially for economies with undeveloped or without financial markets, is the replacement of income with wealth as the main explanatory variable for transactions demand. This aspect of the monetarist theory on demand for money, observes the late Harry Johnson, "is probably the most important development in monetary theory since Kenynes' general theory."[69]

As already noted, the monetarist approach is probably the better approach to adopt in investigating the demand for money function in an economy such as that of Kenya where the financial market is not fully developed and in fact bonds, in the sense of Keynesian approach, do not exist. The case of Kenya is further closer to the monetarist view because of the ever declining purchasing power of money. Rate of price

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[69] Johnson, H.G., "Monetary Theory and Policy, American Economic Review, 52 June pp. 335-84

inflation will naturally be one of the explanatory variables. The problem with the monetarist approach is the scarcity or, in the case of Kenya, absence of data when it comes to empirical analysis. This problem is overcome by using, instead of wealth, permanent income: defined as the present value of the future stream of labour income or that income which if consumed will leave wealth intact.[70] The permanent income itself is an elusive concept and Friedman suggested the use of expected income proxied by the sum of present and past values of measured income with geometrically declining weights attached to past income levels.[71]

Empirical analyses by various researchers have confirmed the superiority of permanent income, or more accurately its proxy, the expected income, over measured income as an argument in the demand for money function; however the significance of the role played by interest rate is still inconclusive. Meltzer for example, found elasticity of demand for money with respect to interest rate to vary between -0.40 and -1.04 with high t-values, and elasticity with respect to measured income generally less than unity, but on substituting wealth for measured income, wealth dominated in explaining demand for money.[72]

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70 Friedman, M., (1957) A theory of the consumption function, University Press, Princeton quoted in (13)

71 Friedman, M. Ibid.

72 Meltzer, A.H., "The Demand for Money: The Evidence from the Time Series" Journal of Political Economy, June 1963, p. 241 See also Laidler (29) pp. 145-146

The significance of expected price inflation as a powerful factor in explaining demand for money has also been established for both developed and developing economies. Cagan working with data from several European countries found that the ratio of the quantity of money to the price level-real balances-tended to fall during hyperinflation.[73] Estimating from the data of five South East Asian countries, Wong found inflation to be a significant factor in explaining the demand for money in three of them, namely: Sri Lanka, Taiwan and Thailand.[74] Inflation in the estimates with data of Korea and Philippines carried the expected sign but were not statistically significant. Wong also found the negative of the ratio of bank credit to nominal income to be an appropriate proxy for interest rate as a restraint in holding money in four of the five countries.

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[73] Cagan, P., (1956), The Monetary dynamics of hyperinflation in Friedman (16)

[74] Wong, C., "Demand for Money in developing countries, Journal of Monetary Economics, January, 1977, pp. 24-27.

CHAPTER III

THEORETICAL FRAMEWORK AND THE MODEL

This chapter is in two sections: section 3.1 is on the theoretical framework while section 3.2 is on the model which further specifies to detail, the hypotheses set out in section 1.4 of Chapter I; and also sets out the equations to be estimated for empirical analysis in the next chapter. Needless to say, the equations set out in the model for the purpose of testing the hypotheses, are derived from section 3.1 of this chapter.

3.1 THEORETICAL FRAMEWORK:

This section is a brief consideration of both demand and supply sides of the money market. We first consider the demand side of the money market and draw attention to the difference in a priori expectations regarding the signs of the coefficients, and the disaggregation of monetary aggregates which may be necessary following a definition appropriate for use as a monetary policy tool to control the real sector.

3.1.1 Demand for Money:

Demand for money[75] is the link with the real sector and we postulate that the amount of money which the

[75] See Friedman, M., and Schwartz, A.J., Monetary Statistics of the United States, Columbia, University Press, New York, p. 91

wealth owners would demand or desire to hold is:

$$m^d = m^d(y^e, \dot{p}^e, i^e) \qquad (3.1)$$

$$m^d_{y^e} > 0, \; m^d_{\dot{p}^e} < 0, \; m^d_{i^e} < 0$$

where in real terms,[76] (m^d) is the narrow definition of money stock (m1): that is the sum of currency outside banks, and chequing account balances owned by the private sector at the banks.[77] (y^e) is the expected income in real terms, ($\dot{p}^e$) is the expected rate of inflation;[78] and (i^e) is the expected nominal interest rate.

When the demand for money is specified as m2, that is to include term deposits, (hereafter quasi-money) owned by the private sector at the banks, there will be need to estimate the quasi-money separately because the expected coefficient of the expected interest rate (i^e) in the estimate ought to be positive unlike in the case of m1. That is to say:

$$qm^d = qm^d(y^e, \dot{p}^e, i^e) \qquad (3.2)$$

$$qm^d_{y^e} > 0; \; qm^d_{\dot{p}^e} < 0; \; qm^d_{i^e} > 0$$

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76 The stock of real money balances (m1) is defined as nominal money balances (M1) deflated with the GDP-deflator; that is:

$$m1 = M1/P$$

77 The private sector is defined to embrace the whole economy with the exclusion of the central government, the banking system and non-residents of Kenya.

78 This specification ignores the Pigou or real balances effect; were this to be taken into account the impact of $\dot{p}^e$ could be the reverse of the stated direction.

where in real terms,[79] is the demand for quasi-money: that is to say term deposits owned by the private sector. These are expected to increase with the interest rate. The other variables are defined as before.

Demand for m2 would then have to be the sum of m1 and qm, separately estimated. It is, the demand for money which the monetary authorities would want to control the money supply to be equal to so as to achieve objectives in the real sector. That is to say:

$$m^s = m^d \qquad (3.3)$$

where m^s, and m^d, are supply of and demand for money in real terms respectively, no matter how money stock is defined.

The problem posed in this section is that we cannot observe the values of y^e; $\dot{p}^e$; and i^e. Nor can we differentiate m^d from m^s in the actual observations. Solutions to these two problems are tackled in the next section in the model where we formulate the equations for estimation after considering the supply side of the money market.

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79 The stock of real balances of quasi-money (qm) is defined as nominal term deposists deflated with the GDP-deflator.

3.1.2 Money Supply:

Money supply or money stock in nominal terms is the monetary aggregate to be controlled by the Monetary Authorities through the use of a reserve ratio or ratios. This is made possible through transactions between the Central Bank and Treasury (Government), and transactions between the Central Bank and the commercial banks. The involved theoretical transactions are best explained by considering the intra- and inter-relationships between the Central Bank; the commercial banks; the NBFI's as recorded in their balance sheets, as the rest of the economy as follows:

(a) The Central Bank balance sheet can be condensed into a single identity as:

$$H = CY(PS) + R(BS) = NFA + NDC_B + \overline{OI}_B \qquad (3.4)$$

where H is the high-powered money and is the sum of currency outside banks CY(PS) and R(BS) being the deposits of the commercial banks plus cash they hold in vaults and tills. The high-powered money is the liability of the Central Bank. NFA is the net foreign assets, that is claims on the rest of the world less foreign liabilities of the Central Bank. NDC_B is the net Central Bank lending to the 'economy'[80]

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[80] The net domestic credit of the Central Bank is defined to include lending to commercial banks plus lending to central government by both the banking system and NBFI's less deposits due to the central government by both.

while $\bar{OI}_B$ are non-financial assets of the Central Bank less non-financial liabilities.

(b) The commercial banks' consolidated balance sheet can also be condensed into a single identity as:

$$R(N) + DD(PS) + TD(PS) = R(BS) + DC_b + \bar{OI}_b \quad (3.5)$$

where R(N) and DD(PS) are respectively demand deposits of NBFI's and the rest of private sector, while TD(PS) are term deposits of the rest of the private sector. On the assets side, R(BS) are as defined in (3.4) while DC_b is domestic credit by the banks. $\bar{OI}_b$, like in (3.4) are non-financial assets less non-financial libailities.

From (3.5) we make an abstraction that:

$$R(BS) = r_d.[R(N) + DD(PS)] + r_t.TD(PS) \quad (3.6)$$

where r_d is reserve ratio on demand deposits and r_t is reserve ratio on all other deposits owned by the private sector. Or alternatively:

$$R(BS) = r_o . [R(N) + DD(PS) + TD(PS)] \quad (3.7)$$

where r_o is a weighted sum of r_d and r_t[81]. A further abstraction from (3.5) is that:

$$TD(PS) = g.DD(PS) \quad (3.8)$$

where g can be a constant or a variable but for our purpose it will be a given number in every observation.

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81 See Appendix 2.3

(c) The NBFI's consolidated balances sheet is similarly condensed into an identity as:

$$DN(PS) = R(N) + DC_N + \bar{OI}_N \qquad (3.9)$$

where DN(PS) are term deposits owned by the private sector while R(N) is as in (3.5) and DC_N is the domestic credit by the NBFIs and $\bar{OI}_N$ is non-financial assets less nonfinancial liabilities.

From (3.9) we make an abstraction that:

$$R(N) = e.DN(PS) \qquad (3.10)$$

where (e) can be a constant or a variable but for our purpose it will be a given number in every observation.

A further abstraction from (3.5) and (3.10) is that the private sector own term deposits with commercial banks and NBFIs in a proprtion h, determined by the interest rate differential paid by the two, such that

$$DN(PS) = h.TD(PS) \qquad (3.11)$$

For our purpose however the proportion is a given variable in every observation.

(d) Private sector claims on the banking system in nominal terms can now be defined from the balance sheet identities and the abstractions from them as:

$$M1 = CY(PS) + DD(PS) + R(N) \tag{3.12}$$

where in nominal terms, M1 is the narrow definition of money stock, that is the sum of currency outside banks, and chequing account balances owned by the private sector at banks. The other variables are defined as before. If the claims include term deposits, that is the quasi-money in nominal terms, then money stock becomes:

$$M2 = CY(PS) + DD(PS) + R(N) + TD(PS) \tag{3.13}$$

where in nominal terms, M2 is a broader definition of money stock, that is the sum of M1 and quasi-money QM.

From the Central Bank's balance sheet and the commercial banks' reserves, namely equations (3.4) and (3.6) respectively, the high-powered money is:

$$H = CY(PS) + r_d.R(N) + r_d.DD(PS) + r_t.TD(PS) \tag{3.14}$$

By using relations in (3.8); (3.10); and (3.11) we have:

$$R(N) = ehg.DD(PS) \tag{3.15}$$

from which if follows that:

$$M1 = CY(PS) + [1+ehg].DD(PS) \quad (3.12)'$$

$$M2 = CY(PS) + [1+ehg].DD(PS) + g.DD(PS) \quad (3.13)'$$

$$H = CY(PS) + r_d[1+ehg].DD(PS) + r_t.TD(PS) \quad (3.14)'$$

and: $$\frac{M1}{H} = \frac{CY(PS) + [1+ehg).DD(PS)}{CY(PS) + r_d[1+ehg].DD(PS) + r_t g.DD(PS)}$$

which on dividing through by DD(PS) and rearranging, we finally obtain the nominal money stock equations as:

$$M1 = [\frac{c + 1 + ehg}{c + r_d(1+ehg) + r_t g}]H \quad (3.16)$$

and $$M2 = [\frac{c + 1 + ehg + g}{c + r_d(1+ehg) + r_t g}]H \quad (3.17)$$

3.2 THE MODEL:

As already noted, this section is on the derivation of the equation for estimating the theoretical relations outlined in section 3.1 above. Cobb Douglas type funtion, or multiplicative form of equation, is adopted as a specification to estimate demand for m^d and qm^d in real terms, as well as for estimating equation (3.7) in section (3.1); the estimate from which we derive the formulae for the general reserve ratio r_o and specific reserve ratios r_d and r_t; and their behaviour as a response to changes in deposits.

Corresponding with the hypotheses outlined in section 1.4 in chapter I, this section is divided into four parts: part one specifies how hypotheses on demand for money is to be tested ; part two sets out the formula for the appropriate definition of reserve assets; part three sets-out the formula for deriving estimates of r_d, and r_t; part four shows how the test on economies of scale in maintaining the general reserve ratio r, and specific reserve ratios r_d and r_t will be carried out.

(i) The demand for real balances of money defined as m1, generally presented in equation (3.1) in the previous section is explicitly specified as:

$$m_t^d = (y_t^e)^{\alpha_1} (\dot{p}_t^e)^{\alpha_2} (i_t^e)^{\alpha_3} e^{U_t} \qquad (3.18a)$$

where $\alpha_1 > 0$

$\alpha_2 < 0$

and $\alpha_3 < 0$

in which the constant term has been regarded as carrying no important meaning and hence ignored. If we have to define the money stock to include quasi-money which is generally presented in equation (3.2), we would then have to explicitly specify demand for quasi-money in real terms as:

$$qm^d = (y_t^e)^{\theta_1} (\dot{p}_t^e)^{\theta_2} (i_t^e)^{\theta_3} e^{U_t} \qquad (3.18b)$$

where $\theta_1 > 0$

$\theta_2 < 0$

$\theta_3 > 0$

In both equations (3.18a) and (3.18b) the subscript t denotes time of observation while $U_t = \ln e^{U_t}$ and e = 2.718, that is the base of natural logarithms.

We assume that:

$$E(U_i) = 0$$

$$E(U_i)^2 = \sigma_u^2$$

$$E(U_i U_j) = 0 \quad \text{for } i \neq j \text{ and}$$

$$E(U_i y_t^e) = E(U_i \dot{p}_t^e) = e(U_i i_t^e) = 0$$

that is that Gauss-Markov theorem holds.

It then follows from equations (3.18a) and (3.18b) that:

$$\ln m_t^d = \alpha_1 \ln y_t^e + \alpha_2 \ln \dot{p}_t^e + \alpha_3 \ln i_t^e + U_t$$

$$\ln qm_t^d = \theta_1 \ln y_t^e + \theta_2 \ln \dot{p}_t^e + \theta_3 \ln i_t^e + U_t$$

and demand for money defined as m2 would then by the sum of m_t^d and qm_t^d.

For convenience the logarithm symbol, ln is dropped in the rest of the expressions for estimaing demand for m_t^d and qm_t^d but it is to be borne in mind that we are working in logarithms of the variables. Accordingly equations (3.18a) and (31.8b) are now expressed as:

$$m_t^d = \alpha_1 y_t^e + \alpha_2 p_t^e + \alpha_3 i_t^e + U_t \qquad (3.19a)$$

and $$qm_t^d = \theta_1 y_t^e + \theta_2 \dot{p}_t^e + \theta_3 i_t^e + U_t \qquad (3.19b)$$

Starting with the dependent variables, we cannot differentiate between demand for, and supply of any of the monetary aggregates when it comes to actual observations. We resort to a lag adjustment mechanism[82] which we express here as:

$$\frac{m_t - m_{t-1}}{m_t^d - m_{t-1}} = \rho$$

and
$$\frac{qm_t - qm_{t-1}}{qm_t^d - qm_{t-1}} = \phi$$

so that:

$$m_t = (1-\rho)m_{t-1} + \rho m_t^d \tag{3.20a}$$

and
$$qm_t = (1-\phi)qm_{t-1} + \phi qm_t^d \tag{3.20b}$$

where rho (ρ), and phi (ϕ) are the lag adjustment operators for demand for money m1, and quasi-money qm respectively. Both ρ and ϕ take values which range from zero to unity and measure the speed of adjustment. The slowest speed of adjustment is represented by zero value of ρ and ϕ while the fastest speed of adjustment is represented by a unity for ρ and ϕ.

For the explanatory variables in equations (3.19a) and (3.19b), we resort to the adaptive expectation hypothesis or error learning hypothesis which is similar to the adjustment mechanism but this time, the past expectation value is taken into consideration. This will not only solve the non-observance of the expected value of explanatory variables problem but will also help in getting rid of the unobservable desired or demanded money stock m_t^d or quasi-money money stock qm_t^d in equations (3.19a) and (3,19b).

[82] Laidler, D.E.W., Op. Cit. pp. 105-107

Starting with the expected income at the end of period t,

$$y^e_t = y^e_{t-1} + \beta(y_t - y^e_{t-1}) \quad (3.21)$$

where beta (β), a constant elasticity, also takes any values between zero and unity and measures the speed of adjustment. Equation (3.21) is rearranged so that:

$$y^e_t = \beta y_t + (1 - \beta)y^e_{t-1} \quad (3.22)$$

By lagging equation (3.22) by one period at a time, and substituting the lagged equation back into equation (3.22), we are able to obtain expected income as follows:

$$\begin{aligned} y^e_t &= \beta y_t + \beta(1-\beta)y_{t-1} + \beta(1-\beta)^2 y_{t-2} + \ldots\ldots \\ &= \beta \sum_{n=0}^{\infty} (1-\beta)^n y_{t-n} \end{aligned} \quad (3.23)$$

Assuming money holders have the same and identical expectations about inflation and interest rates as they have about income, the expected inflation and interest rates can be expressed exactly in the same way as expected income so that:

$$\begin{aligned} \dot{p}^e_t &= \beta \dot{p}_t + \beta(1-\beta)\dot{p}_{t-1} + \beta(1-\beta)^2 \dot{p}_{t-2} + \ldots\ldots \\ &= \beta \sum_{n=0}^{\infty} (1-\beta)^n \dot{p}_{t-n} \end{aligned} \quad (3.24)$$

and

$$\begin{aligned} i^e_t &= \beta i_t + \beta(1-\beta)i_{t-1} + \beta(1-\beta)^2 i_{t-2} + \ldots\ldots \\ &= \beta \sum_{n=0}^{\infty} (1-\beta)^n i_{t-n} \end{aligned} \quad (3.25)$$

With equations for expected variables now known in observable variables, we can express the demand for money m_t^d defined as m1 and demand for quasi-money qm_t in equations (3.19a) and (3.19b) as follows:

$$m_t^d = \alpha_1\beta \sum_{n=0}^{\infty} (1-\beta)^n y_{t-n} + \alpha_2\beta \sum_{n=0}^{\infty} (1-\beta)^n p_{t-n} + \alpha_3\beta \sum_{n=0}^{\infty} (1-\beta)^n i_{t-n} + \rho U_t \qquad (3.26a)$$

and,

$$qm_t^d = \theta_1\beta \sum_{n=0}^{\infty} (1-\beta)^n y_{t-n} + \theta_2\beta \sum_{n=0}^{\infty} (1-\beta)^n p_{t-n} + \theta_3\beta \sum_{n=0}^{\infty} (1-\beta)^n i_{t-n} + \phi U_t \qquad (3.26b)$$

By substituting (3.26a) and (3.26b) into (3.20a) and (3.20b) for m_t^d, and qm_t^d respectively, we obtain:

$$m_t = (1-\rho)m_{t-1} + \rho\alpha_1\beta \sum_{n=0}^{\infty} (1-\beta)^n y_{t-n} + \rho\alpha_2\beta \sum_{n=0}^{\infty} (1-\beta)^n p_{t-n} +$$

$$\rho\alpha_3\beta \sum_{n=0}^{\infty} (1-\beta)^n i_{t-n} + \rho U_t \qquad (3.27a)$$

and,

$$qm_t = (1-\phi)qm_{t-1} + \phi\theta_1\beta \sum_{n=0}^{\infty} (1-\beta)^n y_{t-n} + \phi\theta_2\beta \sum_{n=0}^{\infty} (1-\beta)^n p_{t-n} +$$

$$\phi\theta_3\beta \sum^{\infty} (1-\beta)^n i_{t-n} + \phi U_t \qquad (3.27b)$$

which on writing out in full, and applying Koyck transformation yields:[83]

$$m_t = [(1-\rho)+(1-\beta)]m_{t-1} - (1-\rho)(1-\beta)m_{t-2}+(\rho\alpha_1\beta)y_t+ (\rho\alpha_2\beta)\dot{p}_t + (\rho\alpha_3\beta)i_t +[\rho U_t-\rho(1-\beta)U_{t-1}] \qquad (3.28a)^*$$

and

$$qm_t = [(1-\phi)+(1-\beta)]qm_{t-1}-[(1-\phi)(1-\beta)]qm_{t-2}+(\phi\theta_1\beta)y_t+ (\phi\theta_2\beta)\dot{p}_t + (\phi\theta_3\beta)i_t + [\phi U_t-\phi(1-\beta)U_{t-1}] \qquad (3.28b)^*$$

All relevant variables in equations (3.28a)* and (3.28b)* are observable. We are therefore in a position to estimate the equations and subsequently solve for the parameters (α_1; α_2; α_3; θ_1; θ_2; θ_3; ρ; and ϕ) for estimating demand for money and quasi-money because the expected variables are also now determinable.

When there is no error learning about the expectations in income, inflation and interest rates, that is when β is unity, equations $(3.28a)^*$ and $(3.28b)^*$ reduce to:

$$m_t = (1-\rho)m_{t-1}+(\rho\alpha_1)y_t+(\rho\alpha_2)\dot{p}_t+(\rho\alpha_3)i_t+\rho U_t \qquad (3.29a)^*$$

and

$$qm_t = (1-\phi)qm_{t-1} +(\phi\theta_1)y_t+(\phi\theta_2)\dot{p}_t+(\phi\theta_3)i_t+\phi U_t \qquad (3.29b)^*$$

When there is error-learning about expectations but demand for m and qm adjust instantly: that is ρ and ϕ are each unity but $0<\beta<1$, equations (3.28a)* and (3.28b)* reduce to:

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[83] See Appendix 3.1

$$m_t = (1-\beta)m_{t-1}+(\beta\alpha_1)y_t+(\beta\alpha_2)\dot{p}_t+(\beta\alpha_3)i_t+$$

$$[U_t-(1-\beta)U_{t-1}] \quad (3.30a)^*$$

and

$$qm_t = (1-\beta)qm_{t-1}+(\beta\theta_1)y_t+(\beta\theta_2)\dot{p}_t+(\beta\alpha\theta_3)i_t+$$

$$[U_t-(1-\beta)U_{t-1}] \quad (3.30b)^*$$

When there is neither error-learning nor adjustment lag: that is when ρ; ϕ; and β are each unity, equations (3.28a)* and (3.28b)* reduce to:

$$m_t = \alpha_1 y_t + \alpha_2 \dot{p}_t + \alpha_3 i_t \quad (3.31a)^*$$

and $$qm_t = \theta_1 y_t + \theta_2 \dot{p}_t + \theta_3 i_t \quad (3.31b)^*$$

(ii) From equation (3.7) we express the general reserve ratio r_o as:

$$r_o = \frac{R(BS)}{[R(N)+DD(PS)+TD(PS)]}$$

$$= \frac{R(BS)}{[ehg+1+g]DD(PS)} \quad (3.32)$$

which varies with different definitions of R(BS), that is, the reserve assets.

From equations (3.4), (3.7), (3.12), and (3.13), the general reserve ratio which corresponds with the observed money stock and high-powered money is:

$$r_T = \left(\frac{c + 1 + ehg}{g + 1 + ehg}\right)H/M1 - \frac{c}{(g + 1 + ehg)}$$

or $$= \left(\frac{c + 1 + ehg + g}{g + 1 + ehg}\right)H/M2 - \frac{c}{(g + 1 + ehg)} \qquad (3.33)$$

where r_T is an implicit reserve ratio in money supply identity in equation (1.1).

For an effective general reserve ratio in controlling the money stock, the difference between reserve ratios as defined in equations (3.22) and (3.33) should be zero. That is to say the definition of reserve assets for which $(r_O - r_T)$ is zero or is not significantly different from zero is the "right one".

Alternatively we can test for the overall significance of a model for different definitions of reserves maintained in respect of different categories of deposits as follows:

$$R(BS) = R(BS)\{[R(N)+DD(PS)], TD(PS)\} \qquad (3.34)$$

where

$$\frac{\partial R(BS)}{\partial [R(N)+DD(PS)]} > 0$$

and $$\frac{\partial R(BS)}{\partial TD(PS)} > 0$$

The definition which yields the best overall fit and significance of the coefficient is the "right one". The general reserve ratio in this case is:

$$r_0 = \frac{R(BS)\{[R(N)+DD(PS)],\ TD(PS)\}}{R(N)+DD(PS)+TD(PS)} \tag{3.35}$$

which is also amenable to sensitivity measurement.

(iii) The formulae for testing the difference between reserve ratios (r_d) and (r_t) for demand and term deposits respectively, are derived from the fact that reserve assets R(BS), for the banking system, equals the sum of reserve assets R_d(BS), and R_t(BS) held in respect of demand and term deposits; and that the general reserve ratio (r_o), equals the sum of weighted reserve ratios (r_d) and (r_t). That is:

$$R(BS) = R_d(BS) + R_t(BS) \tag{3.36}$$

and
$$\frac{R(BS)}{R(N)+DD(PS)+TD(PS)} = \frac{W_d R_{d(BS)}}{R(N)+DD(PS)} + \frac{W_t R_{t(BS)}}{TD(PS)} \tag{3.37}$$

where
$$W_d = \frac{1 + ehg}{1 + ehg + g} \tag{3.38}$$

$$W_t = \frac{1}{1 + ehg + g} \tag{3.39}$$

and
$$W_d + W_t = 1 \tag{3.40}$$

as shown elsewhere.[84]

From (3.36) the reserves R_d(BS) and R_t(BS) may be expressed as:

$$R_t(BS) = R(BS) - R_d(BS) \tag{3.41}$$

and
$$R_d(BS) = R(BS) - R_t(BS) \tag{3.42}$$

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[84] See Appendix 3.3

By substituting (3.41) and (3.42) in (3.37) each at a time, and rearranging, we obtain reserve $R_d(BS)$ and $R_t(BS)$ as follows:

$$R_d(BS) = R(BS)(1/A - \frac{W_t}{TD(PS)})/(\frac{W_d}{R(N)+DD(PS)} - \frac{W_t}{TD(PS)}) \tag{3.43}$$

and

$$R_t(BS) = R(BS)(1/A - \frac{W_d}{R(N)+DD(PS)})/(\frac{W_t}{TD(PS)} - \frac{W_d}{R(N)+DD(PS)}) \tag{3.44}$$

$$\text{where } A = R(N)+DD(PS)+TD(PS) \tag{3.45}$$

The values of $R_d(BS)$ and $R_t(BS)$ are shown in appendix table (4.3).

Dividing equations (3.43) and (3.44) by R(N)+DD(PS) and TD(PS) respectively yields reserve ratios (r_d) and (r_t) as follows:

$$r_d = \frac{R(BS)}{R(N)+DD(PS}(1/A- \frac{W_t}{TD(PS)})/(\frac{W_d}{R(N)+DD(PS)} - \frac{W_t}{TD(PS)}) \tag{3.46}$$

$$r_t = \frac{R(BS)}{TD(PS)}(1/A - \frac{W_d}{R(N)+DD(PS)})/(\frac{W_t}{TD(PS)} - \frac{W_d}{R(N)+DD(PS)}) \tag{3.47}$$

the values of which are shown in appendix table 4.5.

The difference between r_d and r_t is tested by making use of equations (3.46) and (3.47). The hypothesis tested in Chapter IV is that:

$$r_d - r_t > 0 \tag{3.48}$$

Alternatively, we can specify reserves $R_d(BS)$ and $R_t(BS)$ as being functions of (R(N)+DD(PS) and TD(PS) respectively, and test for the significance of the coefficients, and the difference between the slopes of the two functions. That is:

$$R_d(BS) = R_d(BS)\{[R(N)+DD(PS)]\} \tag{3.49}$$

$$\text{where} \quad \frac{\partial R_d(BS)}{\partial[R(N)+DD(PS)]} > 0$$

and

$$R_t(BS) = R_t(BS)\{TD(PS)\} \tag{3.50}$$

$$\text{where} \quad \frac{\partial R_t(BS)}{\partial TD(PS)} > 0$$

We then test the hypothesis that

$$\frac{\partial R_d(BS)}{\partial[R(N)+DD(PS)]} - \frac{\partial R_t(BS)}{\partial TD(PS)} > 0 \tag{3.51}$$

Dividing equations (3.49) and (3.50) by $R(N)+DD(PS)$ and $TD(PS)$ respectively results in formulae for r_d and r_t as follows:

$$r_d = \frac{R_d(BS)\{[R(N)+DD(PS)]\}}{[R(N)+DD(PS)]} \tag{3.52}$$

$$\text{and} \quad r_t = \frac{R_t(BS)\{TD(PS)\}}{TD(PS)} \tag{3.53}$$

(iv) The test on economies of scale in maintaining reserve ratios by keeping reserves to meet payments for deposit liabilities is carried out by using equations (3.35), (3.52), and (3.53). The hypothesis to be tested is that the reserve ratios decline with increasing deposits (in respect of which they are maintained) at an increasing rate. In terms of equations (3.35), (3.52) and (3.53), the hypothesis is that:

$$\frac{\partial^2 r_o}{\partial [R(N)+DD(PS)+TD(PS)]^2} > 0 \qquad (3.54)$$

$$\frac{\partial^2 r_d}{\partial [R(N)+DD(PS)]^2} > 0 \qquad (3.55)$$

$$\frac{\partial^2 r_t}{\partial [TD(PS)]^2} > 0 \qquad (3.56)$$

By way of concluding this chapter, we note that demand for m and qm were estimated in logarithms of the two monetary aggregates in real terms while the supply side has been presented in nominal terms. The estimated demand for the monetary aggregates will have to be changed into nominal terms by multiplying the estimated anti-logarithms of m1 and qm (or the sum of the two) by the GDP-deflator because this is the most representative price index for diverse categories of money holders as argued in appendix 3.4.[85] We accordingly point out that the inflation rate in our estimated functions is the percentage change in the GDP-deflator.

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85 See Appendix 3.4

CHAPTER IV

EMPIRICAL ANALYSIS

This chapter discusses the results of the computations carried-out to test the hypotheses which were specified in the previous chapter. The chapter is divided into six sections. Sections (4.1) through (4.4) are on the tests of the hypotheses one to four while section (4.5) is on the elasticities of deposits, and section (4.6) is a summary and conclusion. Accordingly, section (4.1) discusses the results of the estimates on the demand for money and quasi-money. It is in two subsections: subsection (4.1.1) discusses the estimated results of the demand for money, m1, and subsection (4.1.2) discusses demand for quasi-money, qm.

Section (4.2) is on the quest of the appropriate definition of reserve assets and hence the general reserve ratio which does not differ from the implicit reserve ratio, r_T. The section is in four subsections: subsection (4.2.1) is on the test for the reserve ratio in which only vault and till cash in domestic currency plus interbank balances; and balances with the Central Bank were considered as reserve assets. Subsection (4.2.2) is on the test for the reserve ratio in which vault and till cash in foreign currency was included in addition to those in (4.2.1). Subsections (4.2.3) and (4.2.4) discuss reserve ratios emerging from broader definitions of reserve assets which include balances with banks abroad in addition to those included in section (4.2.2); and a further addition of treasury bills.

Section (4.3) is on the efforts to test of hypothesis that the reserve ratio (r_d) in respect of demand deposits is different from the reserve ratio (r_t) in respect of term deposits, and that (r_d) is always greater than (r_t). Section (4.4) is on the results of the tests on economies of scale in maintaining the reserve ratios while section (4.5) is on the analysis of sensitivity of deposits to changes in reserve ratios, and section (4.6) is a summary of the findings and conclusion of the study. All the estimations of regression equations are in logarithmic forms and the logarithm symbol (ln) is reintroduced.

4.1 HYPOTHESIS ONE:

The estimates for demand for money, and quasi-money were carried out separately as specified in section (3.1.1). The results are accordingly discussed separately in this section.

4.1.1 Demand for Money, (m1):

The demand for real balances of money m1, specified in equation (3.18a) was estimated by fitting equation (3.28a)* in four versions as follows:[86]

$$\begin{aligned}\ln m1_t = {} & \underset{(0.626)}{0.4465} + \underset{(4.827)}{0.6545} \ln m1_{t-1} + \underset{(1.042)}{0.1559} \ln m1_{t-2} \\ & + \underset{(0.701)}{0.1123} \ln y_t + \underset{(0.211)}{0.0026} \ln \dot{p}_t + \underset{(0.198)}{0.0039} \ln i_t\end{aligned} \tag{4.1}$$

$$R = 0.96 \qquad D.W. = 1.98 \qquad F = 124$$

$$\begin{aligned}\ln m1_t = {} & \underset{(0.347)}{0.2616} + \underset{(7.227)}{0.7609} \ln m1_{t-1} + \underset{(1.322)}{0.1773} \ln y_t \\ & + \underset{(0.187)}{0.0021} \ln \dot{p}_t - \underset{(-0.127)}{0.0021} \ln i_t\end{aligned} \tag{4.2}$$

$$\bar{R} = 0.96 \qquad D.W. = 2.05 \qquad F = 162$$

$$\begin{aligned}\ln m1_t = {} & \underset{(0.270)}{0.1729} + \underset{(7.610)}{0.7482} \ln m1_{t-1} + \underset{(1.677)}{0.1974} \ln y_t \\ & - \underset{(-0.408)}{0.0064} \ln i_t\end{aligned} \tag{4.3}$$

$$\bar{R} = 0.96 \qquad D.W. = 1.89 \qquad F = 225$$

$$\begin{aligned}\ln m1_t = {} & \underset{(-1.317)}{-1.5660} + \underset{(8.491)}{0.9734} \ln y_t + \underset{(0.739)}{0.0114} \ln \dot{p}_t \\ & - \underset{(-1.099)}{0.0219} \ln i_t\end{aligned} \tag{4.4}$$

$$\bar{R} = 0.74 \qquad D.W. = 1.99 \qquad F = 24$$

The first three estimates for the stock of real money m1 indicate that the holdings of money stock

[86] See Appendix table 4.2 for multicollinearity; the figures in parantheses are t-values.

three months (one quarter lagged) prior to the current time is a significant determinant of the current money holdings. All the four estimates confirmed that the holdings of money stock m1, are not only positively correlated to income (which is also a proxy for wealth) but, except in estimate (4.4), also has elasticity of less than unity as argued in Chapter II by both monetarists and Keynesians led by Friedman and Tobin respectively. The last two estimates, namely equations (4.3) and (4.4) showed that wealth as proxied by income is an important determinant of money stock m1. In equation (4.3) the current real income is significant at 90% level of confidence while in equation (4.4) it is significant at a confidence level of 99%.

All the four estimates showed that both inflation and interest rates are not important in the determination of the level of real money stock. The inflation variable not only carried the wrong sign in the context of the argument in Chapter II by the monetarists as led by Friedman, but also its omission tended to improve the significance of all other variables and the overall significance of the estimates as shown by the statistics of equation (4.3) compared to those of equations (4.1), (4.2) and (4.4). Although interest rate turned out to be insignificant in the determination of money stock, it carried the right sign and the elasticity of the money stock with respect to interest rate lay between 0.5 and 2 as suggested in both Tobin's and the Brunner-Meltzer work discussed in Chapter II.

In terms of the overall significance of the estimate (measured by F-statistics), and theoretical expectations regarding the signs of the coefficients of the explanatory variables, and assuming that inflation is an irrelevant variable in the determination of the money stock (having carried a wrong sign) throughout the estimates, equation (4.3) is the best estimate of the theoretical specification for demand for real money m1, in equation (3.18a). That equation (4.3) is a good fit is further shown by its estimation for money stock m1 compared to actual observation in table 4.1.

TABLE 4.1: ACTUAL MONEY STOCK (m1) AND ESTIMATES FROM EQUATION (4.3)

Kshs m

End of year: December	Actual real money stock	Predicted real money stock	$\frac{\text{Error}}{\text{Actual}}$ %
1969	3688	3684	-0.00
1970	4449	4297	-3.42
1971	4547	4550	0.00
1972	4767	4560	-4.34
1973	5327	5107	-4.13
1974	5021	4932	-1.18
1975	4949	4670	-5.64
1976	5188	5003	-3.57
1977	6293	6495	3.21
1978	6588	6304	-4.31
1979	7747	6841	-11.69
1980	6438	6627	2.94
1981	6426	6296	-2.02
1982	6218	5935	-4.55
1983* 1st Quarter	6106	6555	7.35
2nd Quarter	5673	5462	-3.72
3rd Quarter	6009	6116	1.78
4th Quarter	6387	6385	0.00

*These observations were not part of the sample.

Since lag adjustment and expectations operators are equal,[87] we can solve for their value by using the estimates of equation (3.28a)* in equation (4.1). Ignoring insignificant coefficient of ($\ln m1_{t-2}$), we have:

$$(1-\rho) + (1-\beta) = 0.6545$$

where 0.6545 = coefficient of $\ln m1_{t-1}$ in equation (4.1)

[87] See Appendix 3.2

$$\text{and} \quad 2(1-\rho) = 0.6545$$

$$\text{or} \quad 2(1-\beta) = 0.6545$$

$$\text{so that } \rho = \beta = 0.6728$$

From the coefficient of (3.28a)* and (4.1), we obtain:

$$\rho\alpha_1\beta = \rho^2\alpha_1 = \beta^2\alpha_1 = 0.1123$$

$$\rho\alpha_2\beta = \rho^2\alpha_2 = \beta^2\alpha_2 = 0.0026$$

$$\text{and } \rho\alpha_3\beta = \rho^2\alpha_3 = \beta^2\alpha_3 = 0.0039$$

which yield the estimates of parameters of equation (3.16a) as follows:

$$\alpha_1 = 0.2481$$

$$\alpha_2 = 0.0057$$

$$\text{and} \quad \alpha_3 = 0.0086$$

The demand for real balances of money m1 specified in equation (3.18a) can be written as:

$$\ln m1^d_t = 0.2481 \ln y^e_t + 0.0057 \ln \dot{p}^e_t + 0.0086 \ln i^e_t \qquad (4.5)$$

$$\text{where } y^e_t = 0.6728 \sum_{n=0}^{\infty} (0.3272)^n y_{t-n}$$

$$\dot{p}^e_t = 0.6728 \sum_{n=0}^{\infty} (0.3272)^n \dot{p}_{t-n}$$

$$\text{and} \quad i^e_t = 0.6728 \sum_{n=0}^{\infty} (0.3272)^n i_{t-n}$$

Equation (4.5) shows that demand for real money balances m1 is positively correlated to expected income (a proxy for wealth) and that elasticity of demand or, for m1 with respect to expected income is less than unity as argued by the monetarists (see Chapter II). The results in equation (4.5) further support the monetarists' arguement that elasticity of demand for real balances of money m1 with respect to interest rate is about zero.

The usefulness of equation (4.5) is that it is capable of predicting a substantial proportion of desired money holding once the lagged variables are known. This is argued as follows:

Equations (3.23) and (3.25) in Chapter III, section (3.2) can be written with a known expectation operator β as:

$$y_t^e = 0.6728y_t + 0.6728(0.3272)^1 y_{t-1} + \ldots\ldots +$$

$$\dot{p}_t^e = 0.6728\dot{p}_t + 0.6728(0.3272)^1 \dot{p}_{t-1} + \ldots\ldots +$$

$$\text{and } i_t^e = 0.6728i_t + 0.6728(0.3272)^1 i_{t-1} + \ldots\ldots +$$

Assuming that values of y_t, $\dot{p}_t$ and i_t are zero, we are still able to arrive at parts of the expected values of y_t^e, $\dot{p}_t^e$ and i_t^e; and consequently able to arrive at part of demand for money m1 using the values of y_t^e, $\dot{p}_t^e$ and i_t^e which exclude the impacts of y_t, $\dot{p}_t$ and i_t. This was done for the end of the year 1983 for which y_t, $\dot{p}_t$ and i_t were first assumed to be zero. The predicted demand for real money balances with zero impacts from y_{1983}, $\dot{p}_{1983}$ and i_{1983} was found to be Kshs 2,157m while the prediction which allowed for the impact of y_{1983}, $\dot{p}_{1983}$ and i_{1983} was found to be Kshs 2,993m. The prediction which excluded the impact of y_{1983}, $\dot{p}_{1983}$ and i_{1983} was found to be 72% of the prediction which included the impact of the current values of the three variables. Thus a substantial amount of demand for real money balances is predetermined a year in advance. A stable relationship between demand for real money balances $m1^d$ and actual real money stock $m1_t$, would suggest that even the actual real money stock is substantially predetermined and predictable.

4.1.2: Demand for quasi-money, qm:

The demand for real balances of quasi-money, qm specified in equation (3.18b) was estimated by fitting equation (3.28b)* in four versions as follows:[88]

$$
\begin{aligned}
\ln qm_t = &-4.1151 + 0.8365\ln qm_{t-1} - 0.1920\ln qm_{t-2} \\
&\;(-2.800) \qquad (5.809) \qquad\qquad (-1.589) \\
&+ 0.6880\ln y_t - 0.0152\ln \dot{p}_t - 0.0190\ln i_t \qquad (4.6) \\
&\;\;(3.060) \qquad\quad (-1.334) \qquad (-1.431) \\
&\bar{R} = 0.99 \quad D.W. = 1.78 \quad F = 628
\end{aligned}
$$

$$
\begin{aligned}
\ln qm_t = &-3.0718 + 0.6223\ln qm_{t-1} + 0.6867\ln y_t \\
&\;(-2.856) \quad (5.477) \qquad\qquad (3.102) \\
&+ 0.00001\ln \dot{p}_t - 0.01441\ln i_t \qquad (4.7) \\
&\;\;(0.045) \qquad\quad (-0.026) \\
&\bar{R} = 0.98 \quad D.W. = 1.73 \quad F = 429
\end{aligned}
$$

88 See Appendix table 4.2 for multicollinearity; figures in

$$\ln qm_t = -3.6515 + 0.6688\ln qm_{t-1} + 0.6203\ln y_t$$
$$(-2.272) \quad (5.302) \quad (2.448)$$
$$- 0.0087\ln \dot{p}_t \qquad (4.8)$$
$$(-0.656)$$
$$\bar{R} = 0.98 \quad D.W. = 1.92 \quad F = 534$$

$$\ln qm_t = -2.4330 + 0.7416\ln qm_{t-1} + 0.4442\ln y_t$$
$$(-2.197) \quad (8.318) \quad (2.519)$$
$$- 0.0106\ln i_t \qquad (4.9)$$
$$(-0.855)$$
$$\bar{R} = 0.99 \quad D.W. = 1.57 \quad F = 1009$$

Like in the case of demand for real money balances, holdings of real balances of quasi-money three months prior to the current time is a significant determinant of current holdings of quasi-money as shown in the first three estimates of equation (3.28b)*. All the four estimates confirmed that the stock of quasi-money like the stock of money is positively correlated to income, with an elasticity with respect to income less than one. The coefficient of income was significant at 99% level of confidence in all the four estimates of equation (3.28b)*.

In all estimates of this demand, inflation and interest rates were found to be statistically insignificant determinants of stock of quasi-money. While inflation carried the expected sign in equation (4.6) and (4.8), the interest rate variable was not only insignificant but also carried a wrong sign in all the estimates of equation (3.28b)*. The theory of demand for money reviewed in Chapter II is analysed by both monetarists and Keynesians with the understanding that the money stock in question is currency plus demand deposits. Quasi-money is understood to be a financial asset like bonds and equities and so more of it is desired when interest rate rises. One would consequently expect that the stock of quasi-money is positively correlated to interest rate unlike money stock which is theoretically negatively correlated to interest rate. Although in the equation interest rate remained statistically insignificant and carried unexpected sign, its omission as in equation (4.8) reduced the overall significance of the estimate. The elasticity of the quasi-money stock with respect to interest rate remained close to zero as postulated by the monetarists in the case of financial assets which qualify to be money. This finding for Kenya data appears to suggest that wealth holders in Kenya consider quasi-money as money and not as financial assets. If Kenyans consider term deposits as money and not interest earning assets, then equation (4.6) would turn out to be a very good fit to analyse demand for term deposits. However it would be difficult to justify for one's holdings of both money and quasi-money (term deposits). Equation (4.8) which rules out the importance of interest rate in the determination of the level of quasi-money holdings appears to be the best fit but it is not suited for deriving the demand for quasi-money specified in equation (3.18b). Its quality is further demonstrated in table 4.2.

TABLE 4.2: ACTUAL QUASI-MONEY STOCK (qm) AND ESTIMATES FROM EQUATION (4.8)

Kshs m

End of year: December		Actual real quasi-money	Predicted real quasi-money	Error/Actual %
1969		1939	1932	0.00
1970		2557	2309	-9.70
1971		2682	2720	1.42
1972		2537	2632	3.74
1973		2945	3029	2.85
1974		2746	3016	9.83
1975		3179	3193	0.44
1976		3335	3275	-1.80
1977		4346	3971	-8.62
1978		5175	4937	-4.60
1979		5177	5089	-1.70
1980		5383	5413	0.55
1981		5604	5605	0.00
1982		6168	6057	1.80
1983*	1st Quarter	5348	6338	18.51
	2nd Quarter	5431	5759	6.04
	3rd Quarter	5561	5821	4.68
	4th Quarter	5825	5914	1.53

* These observations were not part of the sample.

As in the case of demand for money (m1), lag adjustment and expectations operators are equal[89] in demand for quasi-money (qm). By using equation (3.28b)* and (4.6), we can calculate the estimate of β and ϕ in demand for quasi-money. Again ignoring insignificant coefficient of ($\ln qm_{t-2}$) we have:

$$(1-\phi) + (1-\beta) = 0.8365$$

where 0.8365 = coefficient of $\ln qm_{t-1}$ in equation (4.6)

$$\text{and } 2(1-\phi) = 0.8365$$

$$\text{or } 2(1-\beta) = 0.8365$$

$$\text{so that } \phi = \beta = 0.5818$$

From the coefficients of (3.28b)* and (4.6), we obtain:

$$\phi\theta_1\beta = \phi^2\theta_1 = \beta^2\theta_1 = 0.6880$$

$$\phi\theta_2\beta = \phi^2\theta_2 = \beta^2\theta_2 = 0.0152$$

and $\phi\theta_3\beta = \phi^2\theta_3 = \beta^2\theta_3 = 0.0190$

which yield the estimates of parameters in equation (3.28b)* as follows:

$$\theta_1 = 2.0325$$

$$\theta_2 = -0.0449$$

and $\theta_3 = -0.0561$

Demand for real balances of quasi-money is then expressed as follows:

$$\ln qm_t^d = 2.0325 \ln y_t^e - 0.0449 \ln p_t^e - 0.0561 \ln i_t^e \tag{4.10}$$

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89 See Appendix 3.2

where $y_t^e = 0.5818 \sum_{n=0}^{\infty} (0.4182)^n y_{t-n}$

$$p_t^e = 0.5818 \sum_{n=0}^{\infty} (0.4182)^n p_{t-n}$$

$$i_t^e = 0.5818 \sum_{n=0}^{\infty} (0.4182)^n i_{t-n}$$

Equation (4.10) shows that although demand for quasi-money is positively correlated to expected income (a proxy for wealth) as was the case in demand for money, its elasticity with respect to expected income was greater than unity; contrary to the expectation for a liquid asset which is regarded as fulfilling the functions of money. While elasticity of the stock of quasi-money with respect to income in all the estimated equations remained below unity, the elasticity of desired holdings of quasi-money with respect to expected income remained above unity in all the cases of estimated equations for which expectation operators could be approximated. This elasticity may mean that in Kenya wealth holders consume proportionately less and save proportionately more as income rises.

However elasticity of both stock of quasi-money and desired holdings of quasi-money with respect to interest rate remained close to zero as argued for demand for money by the monetarists in Chapter II. This was also the case for elasticity with respect to rate of inflation.

Like in the case of demand for money, the derived demand for quasi-money in equation (4.10) can be used to predict about 72% of stock of quasi-money well in advance provided that a stable relationship exists between desired holdings of real balances of quasi-money and actual real balances of stock of quasi-money. Unlike in the case of desired real balances of money, demand for quasi-money is highly in excess of the actual observations. This is revealed in equations (4.5) and (4.10) in which elasticity with respect to expected income are found to be 0.2481 and 2.0325 for money and quasi-money respectively.

4.2 HYPOTHESIS TWO:

As was demonstrated in Chapter I in equation (1.1), and further elaborated in Chapter III in equations (3.16), (3.17) and (3.33), the reserve ratio can be used to equate the supply of money and the likely demand for money, no matter how money stock is defined provided that the aggregate fulfils the functions of money. In section (4.1) demand for real money balances and real quasi-money balances were found to be mainly determined by lagged stocks, and income. The predictions were in real terms but by applying the GDP-deflator which was used to deflate the nominal stocks of the two aggregates, we easily obtain the nominal predictions.[90] The nominal predictions can then be applied in equations (3.16), (3.17) and (3.33) to arrive at the reserve ratios which should be observed to lead to the predicted stocks of the monetary aggregates.

The implicit reserve ratio r_T, arrived at by using equation (3.33), and listed in the tables of both appendices (4.3) and (4.4) for the sample data, was found to have a mean and a standard deviation as follows.[91]

$$\bar{r}_T = 0.1133$$

and $$S_{r_T} = 0.0436$$

The difference between the implicit reserve ratio and reserve ratios emerging from different definitions of reserve assets were tested as follows:[92]

4.2.1 Reserve ratio r_{01}:

We first defined reserve assets to include only cash in tills and vaults in domestic currency plus

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90 See Appendix 3.5

91 See Appendix 4.1

92 See Appendix 4.4

interbank balances and balances with the Central Bank. The ratio r_{01}, of the sum of these assets to deposit liabilities was computed and the mean $\bar{r}_{01}$, and standard deviation $S_{r_{01}}$, were found to be:[93]

$$\bar{r}_{01} = 0.0984,$$

$$S_{r_{01}} = 0.0436$$

To test for the difference between r_T and r_{01}, the critical value of $t_{0.05}$ for 100 degrees of freedom was found to be 1.986 while the calculated t-value was:

$$t_c = \left| \frac{\bar{r}_T - \bar{r}_{01}}{S_{\bar{r}_T - \bar{r}_{01}}} \right|$$

$$= \left| \frac{0.1133 - 0.0984}{0.0086} \right|$$

$$= |1.7326|$$

Since t_c was less than $t_{0.05}$, we accepted the hypothesis that commercial banks consider vault and till cash in domestic currency plus interbank balances with the Central Bank as reserve assets. We further expanded our definition of reserve assets for further tests to confirm our finding.

4.2.2 Reserve ratio r_{02}:

A reserve ratio r_{02} was derived from a broader definition of reserve assets which included not only vault and till cash in domestic currency but also in foreign currencies in addition to interbank balances

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93 See Appendix 4.4

and balances with the Central Bank. The mean $\bar{r}_{02}$, and standard deviation $S_{r_{02}}$, of the reserve ratio r_{02}, were found to be:[94]

$$\bar{r}_{02} = 0.1079$$

and $$S_{r_{02}} = 0.0430$$

The calculated t-value t_c, for the difference of $\bar{r}_{02}$ from the mean of the implicit reserve ratio $\bar{r}_T$ was found to be:

$$t_c = \left| \frac{\bar{r}_T - \bar{r}_{02}}{S_{\bar{r}_T - \bar{r}_{02}}} \right|$$

$$= \left| \frac{0.1133 - 0.1079}{0.00857} \right|$$

$$= |0.6301|$$

This was less than the critical $t_{0.05}$ of 1.986 for 100 degrees of freedom so we had to accept the hypothesis that banks also considered foreign currencies as reserve assets.

4.2.3 Reserve ratio r_{03}:

To confirm the finding in subsections (4.2.1) and (4.2.2), the definition of reserve assets was expanded to include not only vault and till cash in domestic and foreign currencies in addition to interbank balances and balances with the Central Bank but also balances with banks abroad. The mean

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94. See Appendix 4.4

$\bar{r}_{03}$, and standard deviation $S_{r_{03}}$, were found to be:[95]

$$\bar{r}_{03} = 0.1302,$$

$$\text{and } S_{r_{03}} = 0.0458$$

The calculated t-value for the difference between the mean of the implicit ratio $\bar{r}_T$ and $\bar{r}_{03}$, was found to be:

$$t_c = \left| \frac{\bar{r}_T - \bar{r}_{03}}{S_{\bar{r}-\bar{r}_{03}}} \right|$$

$$= \left| \frac{0.1133-0.1302}{0.00885} \right|.$$

$$= \left| 1.9096 \right|$$

This was also less than the critical $t_{0\cdot05}$ value of 1.986 so we concluded that commercial banks also consider balances due by banks abroad as reserve assets.

4.2.4 Reserve ratio r_{04}:

We further broadened the definition of reserve assets to include treasury bills in addition to reserve assets considered in subsection (4.2.3). The mean $\bar{r}_{04}$, and standard deviation $S_{r_{04}}$ were found to be:[96]

$$\bar{r}_{04} = 0.2209$$

$$\text{and } S_{r_{04}} = 0.0412$$

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[95] See Appendix 4.4

[96] See Appendix 4.4

The calculated t-value t_c, for the difference between the mean of the implicit reserve ratio $\bar{r}_T$ and r_{04} was found to be:

$$t_c = \left| \frac{\bar{r}_T - \bar{r}_{04}}{S_{\bar{r}_T - \bar{r}_{04}}} \right|$$

$$= \left| \frac{0.1133 - 0.2209}{0.00840} \right|$$

$$= \left| 12.8095 \right|$$

This was found to be greater than the critical $t_{0.05}$ value of 1.986. We accordingly concluded that banks did not consider treasury bills as reserve assets.

We decisively concluded from the above tests that commercial banks consider only till and vault cash in domestic and foreign currencies plus interbank balances, balances with the Central Bank and balances with banks abroad as reserve assets in their portfolios. Treasury bills are, in themselves, investment on which interest is being paid and their rediscounting means incurring a loss for the holders. Furthermore, rediscounting the bills require time which may be too long to be borne by the bank customers without questioning the liquidity position of the bank.

4.3: <u>HYPOTHESIS THREE:</u>

The hypothesis that banks maintain different reserve ratios, (r_d) and (r_t), in respect of demand and term deposits respectively, and that (r_d) is greater than (r_t) was tested by using equations (3.46) through (3.47). A series of r_d and r_t were calculated by using the two equations. The series for the two reserve ratios are provided in table appendix 4.5. The means and standard deviations of reserve ratios (r_d) and (r_t) were found to be:

$$\bar{r}_d = 0.102694$$

$$S_{r_d} = 0.042942$$

$$\bar{r}_t = 0.102696$$

and $$S_{r_t} = 0.042942$$

From these, it was observed that the mean of (r_d) was unexpectedly less than the mean of (r_t). We then proceeded to test the hypothesis that (r_t) is always greater than (r_d). On a one tail test at $t_{0.05}$, the tabulated t-value was found to be 1.662 while calculated t-value was as follows:

$$t_c = \left| \frac{\bar{r}_t - \bar{r}_d}{S_{\bar{r}_t - \bar{r}_d}} \right|$$

$$= \left| \frac{0.102696 - 0.102694}{0.0085} \right| ,$$

$$= 0.000235$$

Since the calculated t-value was less than the tabulated t-value, we concluded that the reserve ratio (r_d) was not different from the reserve ratio (r_t).

We then tested for the difference of the means of (r_d) and (r_t) to confirm whether the two reserve ratios were always unequal. The calculated t-value for the difference was found to be:

$$t_e = \left| \frac{\bar{r}_t - \bar{r}_d}{S_{\bar{r}_t - \bar{r}_d}} \right|$$

$$= \frac{|0.102696 - 0.102694|}{0.0085}$$

$$= |0.000235|$$

which was less than tabulated critical $t_{0.05}$ value of 1.986 for 100 degrees of freedom in a two-tail test. We concluded that reserve ratio maintained in respect of demand deposits was not significantly different from the reserve ratio maintained in respect of term deposits. We observed, as already noted that reserve ratio maintained in respect of term deposits is, on the contrary, slightly higher than that maintained in respect of demand deposits. We note however that in pooling the reserves, for precautions to meet deposit payments, reserve ratio in respect of demand deposits is more heavily weighted than the reserve ratio maintained in respect of term deposits.

4.4: HYPOTHESIS FOUR:

To test for economies of scale in observing reserve ratios, equations (3.34), (3.45) and (3.46) were estimated using multiplicative form. The estimated reserve ratio $(\hat{r})$ of the general reserve ratio (r_0) was then found from the estimate of equation (3.34).[97]

$$\ln R(BS) = \underset{(1.052)}{0.8744} + \underset{(0.558)}{0.0563} \ln [R(N)+DD(PS)] + \underset{(5.7142)}{0.6368} \ln TD(PS) \tag{4.11}$$

$$\bar{R} = 0.71 \quad D.W. = 2.06 \quad F = 26$$

Equation (4.11) can be written multiplicatively as follows:

$$R(BS) = 2.3974[R(N)+DD(PS)]^{0.0563}[TD(PS)]^{0.6368} \tag{4.12}$$

The estimated reserve ratio $(\hat{r})$ for the general reserve ratio (r_0) was then obtained by dividing equation (4.12) by the total deposits as follows:

$$\hat{r} = \frac{2.3974[R(N)+DD(PS)]^{0.0563}[TD(PS)]^{0.6368}}{R(N)+DD(PS)+TD(PS)} \tag{4.13}$$

$$= \frac{2.3974g^{0.6368}[ehg+1]^{0.0563}[DD(PS)]^{0.0563+0.6368}}{[ehg + 1 + g][DD(PS)]}$$

$$= \frac{2.3974g^{0.6368}[ehg+1]^{0.0563}[DD(PS)]^{-0.3069}}{[ehg + 1 + g]}$$

from which

$$\frac{\partial \hat{r}_0}{\partial [DD(PS)]} = \frac{-0.7358g^{0.6368}[ehg+1]^{0.0563}[DD(PS)]^{-1.3069}}{[ehg + 1 + g]}$$

which was negative since the ratios e, h, and g are always positive.

---

[97] See Appendix table 4.2 for multicollinearity; figures in parentheses are t-values.

$$\frac{\partial^2 \hat{r}_0}{\partial[DD(PS)]^2} = \frac{0.9616g^{0.6368}[ehg+1]^{0.0563}[DD(PS)]^{-2.3069}}{[ehg + 1 + g]}$$

was positive and indicated that the general reserve ratio (r_0) declined with increasing demand deposits at an increasing rate.

Similarly,

$$\hat{r}_0 = \frac{2.3974g^{0.9437}[ehg+1]^{0.0563}[TD(PS)]^{-0.3069}}{[ehg + 1 + g]} \qquad (4.14)$$

so that:

$$\frac{\partial \hat{r}_0}{\partial[TD(PS)]} = \frac{-0.7358g^{0.9437}[ehg+1]^{0.0563}[TD(PS)]^{-1.3069}}{[ehg + 1 + g]}$$

and

$$\frac{\partial^2 \hat{r}_0}{\partial[TD(PS)]^2} = \frac{0.9616g^{0.9437}[ehg+1]^{0.0563}[TD(PS)]^{-2.3069}}{(ehg + 1 + g]}$$

which were again negative and positive respectively, indicating that the general reserve ratio (r_0) declined with increasing term deposits at an increasing rate. We observed that the decline was faster in the case of term deposits than in the case of demand deposits.

The reserve ratio (r_d) maintained in respect of demand deposits was derived from the estimate of equation (3.45) as follows:[98]

$$\ln R_d(BS) = \underset{(0.0191)}{0.6644} + \underset{(5.7920)}{0.6322}\ln [R(N)+DD(PS)] \qquad (4.15)$$

$$\bar{R} = 0.63 \quad D.W. = 1.98 \quad F = 33$$

which can be written as:

$$R_d(BS) = 1.9433[R(N)+DD(PS)]^{0.6322} \qquad (4.16)$$

---

98 Figures in parentheses are t-values

On dividing equation (4.16) by demand deposits, [R(N)+DD(PS)], we obtained the reserve ratio ($\hat{r}_d$) as:

$$\hat{r}_d = 1.9433[R(N)+DD(PS)]^{-0.3678} \quad (4.17)$$

from which we obtained

$$\frac{d\hat{r}_d}{d[R(N)+DD(PS)]} = -\ 0.7147[R(N)+DD(PS)]^{-1.3678}$$

and $$\frac{d^2 r_d}{d[R(N)+DD(PS)]^2} = \ 0.9776[R(N)+DD(PS)]^{-2.3678}$$

which showed that reserve ratio (r_d) declined with increasing demand deposits at an increasing rate.

Similarly reserve ratio ($\hat{r}_t$) maintained in respect of term deposits was estimated from the estimate of equation (3.46) as follows:

$$\ln R_t(BS) = -2.0084 + 0.8637 \ln TD(PS) \quad (4.18)$$

t-values (2.5806) (9.1243)

$\bar{R} = 0.79$ D.W. = 2.15 F = 83

which can be written as:

$$R_t(BS) = 0.1342[TD(PS)]^{0.8637} \quad (4.19)$$

and on dividing equation (4.19) by the term deposits TD(PS), we obtained the estimate ($\hat{r}_t$) of the reserve ratio (r_t) as:

$$\hat{r}_t = 0.1342[TD(PS)]^{-0.1363} \quad (4.20)$$

from which

$$\frac{d\hat{r}_t}{d[TD(PS)]} = -0.0183[TD(PS)]^{-1.1363}$$

and $$\frac{d^2\hat{r}_t}{d[TD(PS)]^2} = 0.0208[TD(PS)]^{-2.1363}$$

Again we concluded that reserve ratio (r_t), declined with increasing term deposits at an increasing rate. We also observed that the rate of change in (r_t) was faster than in (r_d).

4.5: SENSITIVITY OF DEPOSITS TO RESERVE RATIOS:

The sensitivity of the deposits to changes in reserve ratios was estimated by calculating respective elasticities of demand and term deposits with respect to general reserve ratio, and specific reserve ratios using the derived equations for (r_0), (r_d) and (r_t). The demand deposits equation was written as a function of the estimate of the general reserve ratio ($\hat{r}$) as in equation (4.13).
From equation (4.13), let:

$$\alpha = 2.3974g^{0.6368}[ehg+1]^{0.0563}$$

$$\text{and } \beta = [ehg+1+g]$$

so that: $$\hat{r} = \frac{\alpha}{\beta}[DD(PS)]^{-0.3069}$$

and $$DD(PS) = [\frac{\beta}{\alpha}\hat{r}]^{1/-0.3069}$$

$$= (\beta/\alpha)^{-3.2584}\ \hat{r}^{-3.2584} \qquad (4.21)$$

from which we observe that elasticity $\eta_{DD(PS)\hat{r}}$ is -3.2584.

Similarly from equation (4.14), term deposits were written as a function of the general reserve ratio as follows:

$$\text{Let } \gamma = 2.3974g^{0.9437}[ehg+1]^{0.0563}$$

$$\text{and } \beta = [ehg+1+g]$$

so that $\quad r = \frac{\gamma}{\beta}[TD(PS)]^{-0.3069}$

and $\quad [TD(PS)] = [{}^{\beta}/_{\gamma}\,\hat{r}]^{1/-0.3069}$

$$= ({}^{\beta}/_{\gamma})^{-3.2584}\,\hat{r}^{-3.2584} \tag{4.22}$$

Elasticity of term deposits with respect to changes in general reserve ratio $\eta_{TD(PS)\hat{r}}$ is also observed to be -3.2584.

The sensitivity of demand and term deposits to changes in reserve ratios (r_d) and (r_t) were similarly found from equations (4.17) and (4.20) respectively as follows:

$$\hat{r}_d = 1.9433\,[ehg+1]^{-0.3678}\,[DD(PS)]^{-0.3678}$$

Let $\sigma = 1.9433\,[ehg+1]^{-0.3678}$

so that:

$$\hat{r}_d = \sigma\,[DD(PS)]^{-0.3678}$$

and $\quad DD(PS) = [\hat{r}_{d}/_{\sigma}]^{1/-0.3678}$

$$= (1/_{\sigma})^{-2.7189}\,\hat{r}_d^{\,-2.7189} \tag{4.23}$$

from which the elasticity ($\eta_{DD(PS)\hat{r}_d}$) is observed to be -2.7189.

For elasticity $\eta_{TD(PS)\hat{r}_t}$, we know that:

$$\hat{r}_t = 0.1342\,[TD(PS)]^{-0.1363} \qquad \text{(equation (4.20))},$$

from which:

$$TD(PS) = [0.1342]^{-7.3368}\,\hat{r}_t^{\,-7.3368}$$

and we observe that elasticity $\eta_{TD(PS)\hat{r}_t}$ is -7.3368.

We observed that term deposits were more sensitive to changes in reserve ratio (r_t) than demand deposits were to changes in reserve ratio (r_d): elastivity of demand deposits with respect to reserve ratio (r_d) was found to be 2.7189 compared to 7.3368 elasticity of term deposits with respect to reserve ratio (r_t).

4.6 SUMMARY AND CONCLUSION:

The findings of the analyses in sections (4.1) through (4.5) are summarized in subsection (4.6.1) while the conclusions of the study are presented in section (4.6.2).

4.6.1 Summary of the findings:

From the tests of demand for money and quasi-money it was found that the elasticities of the two monetary aggregates to changes in inflation and interest rates were close to zero. The demand for real balances of money (m1), was found to be positively correlated to both inflation and interest rates, contrary to a priori expectations as argued by the monetarists in Chapter II. Demand for real balances of quasi-money was found to be negatively correlated to interest rate, contrary to the theoretical expectation in view of the fact that quasi-money like bonds carry interest earnings and therefore should have a positive correlation to interest rate. The demand for real balances of quasi-money was however found to be negatively correlated to the rate of inflation as was expected.

Both of the monetary aggregates were found to be mainly functions of expected income (proxy for wealth) with all of them being positively correlated to the expected income variable as was expected. Demand for real balances of money (m1), was found to have an elasticity of 0.2481 with respect to expected income. This was less than unity and therefore supported the monetarists arguement of a less than unity elasticity of demand for transactions balances of money. The predicted demand for real money balances (m1), appeared to be less than actual stocks of real balances and seemed to suggest excess supply of real balances. Demand for real balances of quasi-money was found to have an elasticity of 2.0325 with respect to expected income. This was contrary to the monetarists arguement for a liquid asset which may be considered to fulfil the functions of money. The demand for real balances of quasi-money appear to be in excess of actual stocks of real quasi-money.

In both real stocks of money and quasi-money, lagged stock over a period of three months was found to be a significant determinant with elasticities of 0.6545 for money and 0.8365 for quasi-money. A six month lag in both stocks was found to be statistically insignificant with elasticities of 0.1559 and -0.1920 for money and quasi-money respectively. In the estimation process the lagged stock over a period of six months carried a positive sign in the case of real stocks of money (m1), in line with the expectation but carried a negative sign contrary to expectation in the case of real stocks of quasi-money.

In estimating the demand for both stocks of monetary aggregates, an expectation lag of about seven months was found to be operative in income expectation: 0.6728 of a period in the case of demand for real balances of money (m1), and 0.5818 of a period in the case of demand for real balances of quasi-money (qm). The findings in demand for both real balances of money and quasi-money also showed that about 72% of the two stocks is predetermined through the past levels of determinants, mainly actual past income.

From the tests on reserve ratios, it was found that commercial banks consider only vault and till cash in domestic and foreign countries in addition to inter-bank deposits, deposits with the Central Bank and deposits with banks abroad as reserve assets. The ratio of these reserves to deposit liabilities was found to be declining with increasing deposit liabilities at an increasing rate. The deposit liabilities were found to have an elasticity of -3.2584 with respect to changes in the reserve ratio.

The commercial banks were found to be maintaining only one reserve ratio for all categories of deposits. This was not in line with the findings of Gupta cited in Chapter II. Reserve ratio maintained in respect of demand deposits was however found to be slightly smaller than reserve ratio maintained in respect of all term deposits, contrary to expectation. Both reserve ratios maintained in respect of demand and term deposits were found to decline with increasing demand and term deposits at an increasing rate. The elasticity of demand deposits with respect to reserve ratio (r_d) was found to be -2.7189 while elasticity of term deposits with respect to reserve ratio (r_t) was found to be -7.3368.

4.6.2: <u>Conclusions from the findings</u>:

The insignificance of interest rate in the determination of demand for both real balances of money (m1) and quasi-money (qm); and a less than unity elasticity of demand for the two monetary aggregates with respect to interest rate seem to suggest that interest rate may not be an effective monetary policy tool with which to promote investment or control inflation in Kenya. For interest rate to be an effective monetary policy instrument, the demand for liquidity by the wealth holders has to be sensitive to changes in interest rate: that is demand for money has to be elastic with respect to interest rate. The conclusion of insensitivity of demand for money and quasi-money to interest rate in this study is a general one. It may very well be that demand for liquidity by firms is interest rate elastic. However the fact that we arrived at the conclusion of insensitivity of demand for money and quasi-money to interest rate after aggregating demand by households and firms suggests that a large proportion of monetary aggregates in Kenya is held by wealth holders who may not be sensitive to changes in interest rate.

The insensitivity of demand for money and quasi-money to changes in interest rate may be a result of scarcity of financial assets to trade with, in response to changes in interest rate. The money market in Kenya is dominated by an oligopoly of commercial banks whose common liability (financial assets) for sale is only term deposits. Treasury bills are almost solely traded between the commercial banks and the Central Bank, and of late with NBFI's most of which are subsidiaries of the commercial banks. The treasury bills themselves are denominated in large amounts which are unlikely to be affordable by the small money holders. In addition the authorities have always pegged the interest rates: All circumstances which militate against the sensitivity of demand for money or quasi-money to changes in the interest rates.

The insensitivity of demand for money and quasi-money to inflation is a further pointer to the lack of an adequate financial market to foster fast movement from and to holding money by the wealth holders. It is also, in part, a pointer to the lack of awareness by the wealth holders of the impact that inflation may have on wealth held in the form of money balances. Again, firms may very well be behaving differently from households regarding their response to inflation. Our aggregated approach to studying the demand for liquidity in Kenya does not permit us to draw separate conclusions on this issue, . However the findings suggest that a large proportion of the liquidity is held by wealth holders who may be insensitive to inflation.

The significance of expected income (or just income) in the determination of demand for both money and quasi-money leads to the conclusion that most of liquidity held by wealth holders in Kenya is for the current and a near future transactions. Because of lack of financial assets, and pegged interest rates, speculative motives for holdings liquidity is almost non-existence. Nor would the liquidity be held for purposes of speculating on the exchange rate as this would only mean losing money in terms of foreign currency because the Kenya currency, like currencies in most developing countries, is only likely to be devalued. This situation in the money market leaves the authorities with almost no monetary policy variable on the demand side to manipulate to promote investment or control inflation and stem the loss of foreign exchange reserves.

The reserve ratios, properly constituted, should prove to be an extremely powerful monetary policy instrument with which to control the supply of money in Kenya. Deposits which are already about 80% of money stock in Kenya were found to be very sensitive to changes in reserve ratio. Reserve assets which should be included in defining reserve ratio should include cash in both domestic and foreign currencies in addition to the balances which the commercial banks have among themselves together with balances with banks abroad and balances with the Central Bank. The authorities may not need to impose different reserve ratios for demand deposits, and all term deposits. The elasticities of -2.7189 and -7.3368 for demand and term deposits with respect to their respective reserve ratios lead to the conclusions that small changes in the reserve ratios will be effective enough to bring desired adjustment in the stock of money. The commercial banks were found not to consider treasury bills as being reserve assets so their inclusion in reserve assets simply distorts the authority's view of the commercial banks' port-folio management and also renders the reserve ratio (as a control tool) ineffective.

A P P E N D I C E S

1.1 TARGETTING HIGH-POWERED MONEY:

While y, $\dot{p}$ and i are explanatory variables in demand for money function dealt with in the subsequent chapters, c and H are part of determinants of supply of money. While c is treated as a given variable, H is an indogeneous variable determined by the monetary and fiscal policies as follows:

From the balance sheet of the monetary authorities, H can be expressed as:

$$H_t = NFA_t + (DC_t - GD_t) + \overline{OI}_B$$

Where NFA_t is net foreign exchange reserves of the monetary authorities, DC_t is the Central Bank credit, GD_t is the deposits of the Government with the Central Bank, and $\overline{OI}_B$ are all other financial assets less all other non-financial liabilities.

Taking total derivative and assuming $\overline{OI}_B$ to be constant, the change in high-powered money may be expressed as

$$\Delta H_t = \Delta NFA_t + (\Delta DC_t - \Delta GD_t).$$

ΔNFA_t is actually the overall balance of payments during the period t while $(\Delta DC_t - \Delta GD_t)$ is partly budgetary deficit financed by Central Bank credit and partly Central Bank lending to commercial banks.

$$H_t = H_{t-1} + \Delta H_t = NFA_{t-1} + \Delta NFA_t + (DC_{t-1} - GD_{t-1}) + (\Delta DC_t - \Delta GD_t).$$

2.1 RESERVE RATIO AND MULTIPLIERS:

If we assume that private sector held only demand deposits DD(PS) and currency CY(PS) such that the currency to deposit ratio is c; and that banks maintain cash reserves R(BS) such that cash reserves to deposit ratio is r, an initial unit increase in cash holdings of the private sector will be in the first instance divided between deposits and currency holdings such that the sum of currency holdings and deposits is unity. The banks will find themselves with excess cash and therefore loan out the excess, ensuring that they maintain only r of the deposits. The loaned funds will lead again to excess cash holdings of the private sector and then again to excess holdings of the banks for a second round. This will continue until there is no more excess cash. The process is summarized in the table below.

INCREASE IN CURRENCY DEPOSITS AND LOANS FROM A UNIT INCREASE IN CASH HOLDINGS OF PRIVATE SECTOR

Items held	First round	Second round	Third round	----	Last round
Initial cash holdings of the private sector (prior to a round)	1	$\left(\frac{1-r}{1+c}\right)$	$\left(\frac{1-r}{1+c}\right)^2$	----	$\left(\frac{1-r}{1+c}\right)^{n-1}$
Currency CY(PS) holdings by the private sector	$\frac{c}{1+c}$	$\frac{c(1-r)}{(1+c)^2}$	$\frac{c(1-r)^2}{(1+c)^3}$	----	$\frac{c(1-r)^{n-1}}{(1+c)^n}$
Deposits DD(PS) owned by the private sector at the banks	$\frac{1}{1+c}$	$\frac{1-r}{(1+c)^2}$	$\frac{(1-r)^2}{(1+c)^3}$	----	$\frac{(1-r)^{n-1}}{(1+c)^n}$
Loans L	$\frac{1-r}{1+c}$	$\left(\frac{1-r}{1+c}\right)^2$	$\left(\frac{1-r}{1+c}\right)^3$	----	$\left(\frac{1-r}{1+c}\right)^n$

The series in parenthesis are in geometric progressions with a common ratio (1-r)/(1+c) less than unity. Changes in currency holdings $\Delta CY(PS)$, demand deposits $\Delta DD(PS)$ and loans ΔL are therefore summarized as follows:

$$\Delta CY(PS) = \frac{c}{1+c}\left[1 + \left(\frac{1-r}{1+c}\right) + \left(\frac{1-r}{1+c}\right)^2 + \text{------} + \left(\frac{1-r}{1+c}\right)^n\right]$$

$$= \frac{c}{c+r}$$ which measures the amount of cash that would remain circulating without any experience of excess cash holdings either by the private sector or the banks. In this case it is the cash drain resulting from a unit initial increase in cash holdings of the private sector.

$$\Delta DD(PS) = \frac{1}{1+c}\left[1 + \left(\frac{1-r}{1+c}\right) + \left(\frac{1-r}{1+c}\right)^2 + \text{-------}\left(\frac{1-r}{1+c}\right)^n\right]$$

$$= \frac{1}{c+r}$$ which measures the total increase in deposits resulting from the initial unit cash excess in the hands of the private sector. It is the bank-deposit multiplier.

$$\Delta L = \left(\frac{1-r}{1+c}\right)\left[1 + \left(\frac{1-r}{1+c}\right) + \left(\frac{1-r}{1+c}\right)^2 + \text{---}\left(\frac{1-r}{1+c}\right)^n\right]$$

$$= \frac{1-r}{c+r}$$ which measures the total increase in credit resulting from the initial unit cash excess in the hands of the private sector, some of which had to be deposited with the banks. It is the credit multiplier.

We note that increase in cash reserves of banks will equal the increase in deposits less increase in credit:

$$\Delta R(BS) = \Delta DD(PS) - \Delta L$$

$$= \frac{1}{c+r} - \frac{1-r}{c+r}$$

$$= \frac{r}{c+r}$$

to which when added the increase in currency holdings equals the initial unit increase in cash holdings:

$$\frac{r}{c+r} + \frac{c}{c+r} = 1$$

(2.2) <u>INDICATORS OF PRIVATE SECTOR'S PORTFOLIO MIX (k)</u>:

In equation (2.21) we expressed the term deposits DN(PS) owned by the private sector at NBFI's as a proportion h, of term deposits TD(PS) owned by the sector at the banks. In equation (2.30) we expressed the same deposits as a proportion k of all deposits [DD(PS) + TD(PS)] owned by the sector at the banks. The following is the relationship between k and h:

From equations (2.21) and (2.30)

$$k = \frac{DN(PS)}{DD(PS) + TD\ (PS)}$$

$$= hTD(PS) \div \frac{(1+g)\ TD(PS)}{g}$$

$$= h\frac{g}{(1+g)}$$, so that in equation (2.21), $h = k(1+g)/g$

which incorporates the behaviour of the private sector in holding demand deposits and term deposits.

(2.3) THE WEIGHTED RESERVE RATIO (r_0):

In equation (2.31) we expressed cash reserves to total deposits ratio as if banks maintain a single such ratio. This is actually a weighted reserve ratio which takes into account the fact that banks may very well be maintaining different reserve ratios for different categories of deposits. The weighted reserve ratio was arrived at as follows:

$$r_0 = \frac{R(BS)}{R(N)+DD(PS) + TD(PS)}$$

which from equations (2.16), (2.20), (2.21) and (2.24) can be expressed in terms of the ratios as follows:

$$r_0 = \frac{[r_d(1+ehg) + r_t g]\ DD(PS)}{ehgDD(PS) + DD(PS) + gDD(PS)}$$

$$= \frac{[r_d(1+ehg) + r_t g]}{(ehg + 1 + g)}$$

$$= \frac{r_d(1+ehg)}{(ehg+1+g)} + \frac{r_t g}{(ehg + 1+g)}$$

It is clear from here that, to have an average reserve ratio for all types of deposits, reserve ratios for demand deposits will have to be more heavily weighted. The weights will increase with the length of maturity periods. Since e; h; and g are always positive, it is clear that the weight on (r_d) will always be higher than the weight on (r_t).

(2.4) TOTAL CREDIT OF NBFI's AND BANKS:

Total credit C_t by NBFI's and banks as in equation (2.29) can be expressed in terms of cash reserves R(BS) of banks and ratios k, e, and r as follows:

$$C_t = DN(PS) + DD(PS) + TD(PS) - R(BS)$$

which, from equation (2.30), can be expressed as:

$$C_t = k[DD(PS) + TD(PS)] + [DD(PS) + TD(PS)] - R(BS)$$

$$= (k+1)\,[DD(PS) + TD(PS)] - R(BS)$$

From equations (2.20), (2.30) and (2.31),

$$R(N) = eDN(PS)$$

$$= ek[DD(PS) + TD(PS)] \text{ and}$$

$$DD(PS) + TD(PS) = R(BS)/r - R(N)$$

$$= R(BS)/r - ek[DD(PS) + TD(PS)]$$

$$(1+ek)[DD(PS) + TD(PS)] = R(BS)/r$$

$$[DD(PS) + TD(PS)] = R(BS)/r(1+ek)$$

so that $C_t = \dfrac{(1+k)}{r(1+ek)} R(BS) - R(BS)$

$$= \frac{(1+k) - r(1+ek)}{r(1+ek)}\, R(BS)$$

from which:

$$\frac{\partial C_t}{\partial r} = \frac{(1+k)}{r^2(1+ek)} R(BS) \text{ and}$$

$$\frac{\partial C_t}{\partial e} = \frac{k(1+k)}{r(1+ek)^2} R(BS)$$

which are compared for the ability of credit creation by banks and NBFI's.

(2.5) POSITIVITY OF THE FUNCTIONS OF THE RESERVE RATIOS:

The functions for the slopes $\partial r_t/\partial e$ and $\partial r_t/\partial h$ include the term $(1-\mu r_d)$ in the numerator. This term can be positive only if μr_d is less than unity. That μr_d is less than unity can be proved as follows:

We know that $\mu \geq 1$ and $1 \geq r_d \geq 0$. Further more,

$$\mu = \frac{c+1+ehg}{c+r_d(1+ehg) + r_t g} \text{ so that}$$

$$\mu r_d = \frac{r_d c + r_d + ehg r_d}{c+r_d(1+ehg)+r_t g} \text{ which if less than unity,}$$

the denominator less the numerator must be positive. That is:

$$c+r_d(1+ehg)+r_t g - (r_d c+r_d+ehgr_d)$$

$$= c(1-r_d) + r_t g \text{ which is positive.}$$

We therefore conclude that $(1-\mu r_d) \geq 0$ so that the slopes $\partial r_t/\partial e$ and $\partial r_t/\partial h$ are unambiguously positive.

(2.6). RESERVE RATIO (r_t) AND PRIVATE SECTOR LIQUIDITY PREFERENCE:

That the slope $\partial r_t/\partial g$ is indeterminate is explained as follows:

$$r_t = \frac{(c+1+egh) - \mu[c+r_d(1+ehg)]}{g\mu}$$

from which $\frac{\partial r_t}{\partial r_d} = -\frac{(1+ehg)}{g}$ which is unambiguously

negative, confirming that r_t declines as r_d rises.

$$\frac{\partial r_t}{\partial g} = \frac{c(\mu-1) + \mu r_d - 1}{g^2\mu}$$ and from equation

(2.26) for money multiplier,

$$\mu = \frac{c+1+ehg}{c+r_d(1+ehg)+r_t g}$$ so that when reserve

ratio r_d is at its minimum value of zero,

$$\mu = \frac{c+1+ehg}{c+r_t g}$$ which is greater than unity,

and $\partial r_t/\partial g$ is positive. However when r_d is maximum that is when banks keep all the demand deposits so that r_d is unity,

$\mu = \dfrac{c+l+ehg}{c+l+ehg+r_t g}$ which is not only outside the range of μ by being less than unity, but also makes $\partial r_t / \partial g$ unambiguously negative. Between the values of zero and unity for r_d, the slope $\partial r_t / \partial g$ is indeterminate.

(2.7) ELASTICITY OF DEMAND FOR MONEY WITH RESPECT TO T, AND i:

From equation (2.40), we note that:

$$M = \sqrt{\left(\frac{2b_w T}{i}\right)}$$

$$\text{so that } M^2 = \frac{2b_w T}{i} \text{ and}$$

$$\text{therefore } \frac{M}{2} = \frac{b_w T}{Mi}$$

Average money balances held throughout the period are given by:

$$M = \frac{T-I}{2}\left(\frac{T-I}{T}\right) + \frac{M}{2}(I/T)$$

which from equation (2.41) can also be expressed as:

$$M = \left[\frac{M}{2}+\frac{T}{2}\frac{(k_w+K_d)}{i}\right]\left(\frac{T-I}{T}\right) + \frac{M}{2}(I/T)$$

$$= \frac{M}{2}\left(\frac{T-I}{T}\right) + \left(\frac{T-I}{2}\right.\frac{(k_d+k_w)}{i} + \frac{M}{2}\left(\frac{I}{T}\right)$$

$$= \frac{M}{2} + \frac{T-I}{2}\,\frac{(k_d+k_w)}{i}$$

$$= \frac{M}{2} + \left[\frac{M}{2} + \frac{T}{2}\,\frac{(k_d-k_w)}{i}\right]\,\frac{(k_d+k_w)}{i}$$

$$= \frac{M}{2} + \frac{M}{2}\left(\frac{k_d+k_w}{i}\right) + \frac{T}{2}\left[\frac{k_d+k_w}{i}\right]^2$$

$$= \frac{M}{2}\left[1+\left(\frac{k_d+k_w}{i}\right)\right] + \frac{T}{2}\left[\frac{k_d+k_w}{i}\right]^2$$

$$= \tfrac{1}{2}\left(\frac{2b_wT}{i}\right)^{\frac{1}{2}}\left[1+\left(\frac{k_d+k_w}{i}\right)\right] + \frac{T}{2}\left[\frac{k_d+k_w}{i}\right]^2$$

$$= \left(\frac{b_wT}{2i}\right)^{\frac{1}{2}}\left[1+\left(\frac{k_d+k_w}{i}\right)\right] + \frac{T}{2}\left[\frac{k_d+k_w}{i}\right]^2$$

From which:

$$\frac{\partial M}{\partial T} = \tfrac{1}{2}\left[\left(\frac{b_w}{2Ti}\right)^{\frac{1}{2}} + \left(\frac{b}{2T}\right)^{\frac{1}{2}}\frac{1}{i^{\frac{3}{2}}}\,(k_d+k_w) + \left(\frac{k_d+k_w}{i}\right)^2\right]$$

and $$\frac{\partial M}{\partial i} = -\tfrac{1}{2}\left(\frac{b_wT}{2}\right)^{\frac{1}{2}}\left[\frac{1}{i^{\frac{3}{2}}} + \frac{3}{i^{\frac{5}{2}}}(k_d+k_w)\right] - T\,\frac{(k_d+k_w)^2}{i^3}$$

so that $\eta_T = \frac{\partial M}{\partial T} \cdot \frac{T}{M} = \dfrac{\frac{1}{2}T\left[\left(\frac{b_w}{2Ti}\right)^{\frac{1}{2}} + \left(\frac{b_w}{2T}\right)^{\frac{1}{2}} \cdot \frac{1}{i^{3/2}} \cdot (k_d + k_w) + \frac{(k_d + k_w)^2}{i} \right]}{\left(\frac{b_w T}{2i}\right)^{\frac{1}{2}} \left[1 + \frac{(k_d + k_w)}{i} \right] + \frac{T}{2} \left[\frac{k_d + k_w}{i} \right]^2}$

and $\eta_i = \frac{\partial M}{\partial i} \cdot \frac{i}{M} = \dfrac{-\frac{1}{2} \left[\sqrt{\left(\frac{b_w T}{2i}\right)} + \sqrt{\left(\frac{b_w}{2T}\right)} \cdot \frac{1}{i^{3/2}} (k_d + k_w) + \{ (k_d + k_w)/i \}^2 \right.}{\left(\frac{b_w T}{2i}\right)^{\frac{1}{2}} \left[1 + \left(\frac{k_d + k_w}{i} \right) \right] + \frac{T}{2} \left[\frac{k_d + k_w}{i} \right]^2}$

(3.1) <u>TRANSFORMATION OF (m_t^d) AND (qm_t^d) TO (m_t) AND (qm_t) RESPECTIVELY</u>:

By expanding equation (3.27a), we obtain the following:

$$\begin{aligned} m_t = {} & (1-\rho)m_{t-1} + \rho\alpha_1\beta\, [y_t + (1-\beta)y_{t-1} + (1-\beta)^2\, y_{t-2} + \text{------}] \\ & + \rho\alpha_2\beta\, [\dot{p}_t + (1-\beta)\,\dot{p}_{t-1} + (1-\beta)^2\,\dot{p}_{t-2} + \text{-------------}] \\ & + \rho\alpha_3\beta\, [i_t + (1-\beta)\, i_{t-1} + (1-\beta)^2\, i_{t-2} + \text{-------------}] \\ & + \rho U_t \end{aligned}$$

Lagging by one period, we obtain

$$m_{t-1} = (1-\rho)m_{t-2} + \rho\alpha_1\beta\, [y_{t-1} + (1-\beta)y_{t-2} + (1-\beta)^2 y_{t-3} + \text{----}]$$

$$+\rho\alpha_2\beta[\dot{p}_{t-1} + (1-\beta)\dot{p}_{t-2} + (1-\beta)^2 \dot{p}_{t-3} + \text{-----------}]$$

$$+\rho\alpha_3\beta[i_{t-1} + (1-\beta)i_{t-2} + (1-\beta)^2 i_{t-3} + \text{----------}]$$

$$+ \rho U_{t-1}$$

which on multiplying through by $(1-\beta)$ yields:

$$(1-\beta)m_{t-1} = (1-\beta)(1-\rho)m_{t-2} + \rho\alpha_1\beta [(1-\beta)y_{t-1}$$

$$+ (1-\beta)^2 y_{t-2} + \text{-----------------------------------}]$$

$$+\rho\alpha_2\beta[(1-\beta)\dot{p}_{t-1} + (1-\beta)^2 \dot{p}_{t-2} + \text{-----------------}]$$

$$+\rho\alpha_3\beta[1-\beta)i_{t-1} + (1-\beta)^2 i_{t-2} + \text{-------------------}]$$

$$+\rho(1-\beta)U_{t-1}$$

Subtracting $(1-\beta)m_{t-1}$ from m_t and rearranging yields:

$$m_t = [1-\rho) + (1-\beta)]m_{t-1} - (1-\rho)(1-\beta)m_{t-2}$$

$$+ (\rho\alpha_1\beta)y_t + (\rho\alpha_2\beta)\dot{p}_t + (\rho\alpha_3\beta)i_t$$

$$+ [\rho U_t - \rho(1-\beta)U_{t-1}]$$

as in equation (3.28a)*

By use of the same method, we obtain:

$$qm_t = [(1-\phi) + (1-\beta)]\, qm_{t-1} - (1-\phi)(1-\beta)qm_{t-2}$$

$$+ (\phi\theta_1 \beta)y_t + (\phi\theta_2 \beta)\dot{p}_t + (\phi\theta_3 \beta)i_t$$

$$+ [\phi U_t - \phi(1-\beta)U_{t-1}]$$

in equation (3.28b)*

(3.2) EQUALITY OF β, ρ AND ϕ IN EQUATIONS (3.28a)* AND (3.28b)*:

From equation (3.28a)*, we write out the coefficients of m_{t-1} and m_{t-2} as:

$$(1-\rho) + (1 + \beta) \quad = \quad A \text{---------------} (i)$$

$$(1-\rho)\ (1-\beta) \quad = \quad B \text{---------------} (ii)$$

Where A and B are constants

Form (i) we find that

$$\rho = 2-\beta - A \text{---------------------------} (iii)$$

which in substituting in (ii) yields:

$$(\beta + A - 1)\ (1-\beta) \quad = \quad B$$

or $$2\beta + A - 1 - \beta^2 - \beta A \quad = \quad B$$

and $$\beta^2 + (A-2)\beta + 1 + B - A = \quad 0 \text{---------------} (iv)$$

Also from (i) we find that

$$\beta = 2-\rho- A \text{------------------------------------} (v)$$

which in substituting in (ii) yields

$$\rho^2+(A-2)\rho + 1+ B-A = 0 \text{------------------} (vi)$$

By comparing (iv) and (vi) we find that (A-2) and (1+B-A) are common in both equations. Since both equations are equated to zero and the powers of β and ρ are the same, it follows that

$$\beta = \rho$$

Similarly it can be proved from equation (3.28b)* that:

$$\beta = \phi$$

It follows from (iii) and (v) that:

$$\rho = 2-\beta-A$$

$$= 2-\rho-A$$

and $\beta = \rho = (2-A)/2.$

(3.3) FORMULAE FOR RESERVE RATIOS (r_d) AND (r_t):

We define R(BS) as a sum of R_d(BS) and R_t(BS); r as a weighted sum of r_d and r_t as follows:

$$R(BS) = R_d(BS) + R_t(BS)$$

and $$\frac{R(BS)}{R(N)+DD(PS)+TD(PS)} = W_d \frac{R_d(BS)}{R(N)+DD(PS)} + W_t \frac{R_t(BS)}{TD(PS)}$$

where $$\frac{R(BS)}{R(N)+DD(PS)+TD(PS)} = r_0 ,$$

$$\frac{R_d(BS)}{R(N)+DD(PS)} = r_d ,$$

$$\frac{R_t(BS)}{TD(PS)} = r_t$$

with $$W_d = \frac{1+ehg}{(ehg + 1 + g)}$$ and

$$W_t = \frac{g}{(ehg + 1 + g)} ,$$ as

shown in appendix 2.3.

We can write the general reserve ratio r_0 as:

$$r_0 = W_d r_d + W_t r_t .$$

noting that:

$$W_d + W_t = 1$$

so that $$W_d = 1-W_t$$

When there is no term deposits, W_t is zero and W_d is unity so that r_d equals r_0. Similarly when W_d is zero

r_t equals r_0

W_d and W_t are equal to ratios of demand and term deposits to total deposits respectively. If reserve ratios r_d and r_t were equal, the reserves maintained in respect of demand and term deposits would be:

$$(1) \qquad \frac{R(BS) \, . \, [R(N) + DD(PS)]}{R(N) + DD(PS) + TD(PS)}$$

and

$$(2) \qquad \frac{R(BS) \, . \, TD(PS)}{R(N) + DD(PS) + TD(PS)}$$

respectively. Because (1) and (2) are unweighted reserves, weighted R(BS) is obtained by multiplying (1) and (2) by W_d and W_t and summing the products.

(3.4) GDP-DEFLATOR AS A WEIGHTED PRICE INDEX :

The GDP deflator is the ratio of nominal income to income at constant prices, given a base year. In the national income accounts, the different wealth holders who need monetary liquidity are represented as follows:

$$Y_t = C_t + \Delta K_t + X_t - M_t$$

where Y_t is equal to total expenditure, C_t is expenditure on consumer goods; ΔK_t is net expenditure on investment goods, X_t is receipts on exported goods while M_t is expenditure on imported goods - all in nominal terms. The subscript t, denotes end of the period being considered.

The identity can be written out in prices and expenditure at constant prices on different components of the total expenditure as follows:

$$P_t y_t = c_t(CPI_t) + \Delta k_t(IPI_t) + x_t(EPI_t) - W_t(MPI_t)$$

from which:

$$P_t = \left(\frac{c_t}{y_t}\right)[CPI_t] + \left(\frac{\Delta k_t}{y_t}\right)[IPI_t] + \frac{x_t}{y_t}[EPI_t] - \left(\frac{W_t}{y_t}\right)[MPI]_t$$

where the low letter cases are expenditures at constant prices and P_t is the GDP deflator while the variables denoted by the letters in the square brackets are respectively consumer price index [CPI_t]; investment price index [IPI_t]; export price index [EPI_t] and import price index [MPI_t]. These price indices are respectively weighted by average propensity to consume $\left(\frac{c_t}{y_t}\right)$; incremental capital-output ratio ($\Delta k_t/y_t$); average propensity to export (x_t/y_t); and average propensity to import (w_t/y_t).

The [CPI_t] is an appropriate index to deflate money balances held by consumers; and [IPI_t] should be the deflator for money balances held by firms. The impact of the net change in the difference betwen weighted [EPI_t] and weighted [MPI_t] is obsorbed by either or both [CPI_t] and [IPI_t]. P_t stands out to be the average or representative price deflator for money balances which are not available in disaggregated form between consumers and firms. Monetary policy on inflation can still be formulated on [CPI_t] provided the various average propensities and the ICOR as well as the other prices and their weights are known. With weights and all prices known in the identity of the GDP deflator, P_t will be known. This will make it possible to find the amount of money supply to control by use of equation (3.3) in section 3.1 of chapter 3 as:

$$M_t^s = P_t \cdot m_t^d$$

where M_t^s is money stock to be supplied after estimating the demand for the money stock, no matter how money stock is defined: that is for $M1_t^s$:

$$M1_t^s = P_t \cdot m1_t^d$$

and for $M2_t^s$:

$$M2^s = P_t \cdot m1_t^d + P_t \cdot qm_t^d$$

4.1 TEST OF THE DIFFERENCE BETWEEN TWO SAMPLE MEANS:

The tests for the appropriate definition of reserve assets, and the difference between reserve ratios (r_d) and (r_t) were carried out using the following formula for testing for the significance of the difference between two sample means:

$$|t| = \left| \frac{X_1 - X_2}{S_{\bar{X}_1 - \bar{X}_2}} \right|$$

where $$S_{\bar{X}_1 - \bar{X}_2} = S\sqrt{\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}$$

and $$S = \sqrt{\left[\frac{(N_1 - 1)\, S_1^2 + (N - 1)\, S_2^2}{N_1 + N_2 - 2}\right]}$$

with the number of degrees of freedom as (N_1+N_2-2).

The standard deviations S_1 and S_2 are obtained by the following formulae:

$$S_1 = \sqrt{\left[\frac{\Sigma(X_1 - \bar{X}_1)^2}{N_1 - 1}\right]}$$

and $$S_2 = \sqrt{\left[\frac{\Sigma(X_2 - \bar{X}_2)^2}{N_2 - 1}\right]}$$

where X_1 and X_2 are any two variables.

4.2: MULTICOLLINEARITY TABLES

Equation (4.1):

Variable	ml_t	ml_{t-1}	ml_{t-2}	y_t	$\dot{p}_t$	i_t
ml_{t-1}	0.96	1	0.96	0.91	0.57	0.17
ml_{t-2}	0.93	0.96	1	0.91	0.57	0.14
y_t	0.90	0.91	0.91	1	0.60	0.42
$\dot{p}_t$	0.56	0.57	0.57	0.60	1	0.10
i_t	0.20	0.17	0.14	0.42	0.10	1

Equation (4.2):

Variable	ml_t	ml_{t-1}	y_t	$\dot{p}_t$	i_t
ml_{t-1}	0.96	1	0.91	0.56	0.19
y_t	0.90	0.91	1	0.59	0.45
$\dot{p}_t$	0.56	0.56	0.59	1	0.15
i_t	0.22	0.19	0.45	0.15	1

Equation (4.3):

Variable	ml_t	ml_{t-1}	y_t	i_t
ml_{t-1}	0.96	1	0.90	0.19
y_t	0.90	0.90	1	0.44
i_t	0.21	0.91	0.44	1

Equation (4.4):

Variable	ml_t	y_t	$\dot{p}_t$	it
y_t	0.75	1	-0.05	0.23
$\dot{p}_t$	0.01	-0.05	1	0.18
i_t	0.09	0.23	0.18	1

Equation (4.6):

Variable	qm_t	qm_{t-1}	qm_{t-2}	y_t	$\dot{p}_t$	i_t
qm_{t-1}	0.99	1	0.99	0.98	0.52	0.34
qm_{t-2}	0.98	0.99	1	0.97	0.53	0.34
y_t	0.98	0.98	0.97	1	0.60	0.42
$\dot{p}_t$	0.53	0.52	0.53	0.60	1	0.13
i_t	0.34	0.34	0.34	0.42	0.13	1

Equation (4.7):

Variable	qm_t	qm_{t-1}	y_t	$\dot{p}_t$	i_t
qm_{t-1}	0.98	1	0.98	0.17	0.34
y_t	0:97	0.98	1	0.18	0.41
$\dot{p}_t$	0.17	0.17	0.18	1	0.08
i_t	0.34	0.34	0.41	0.08	1

Equation (4.8):

Variable	qm_t	qm_{t-1}	y_t	$\dot{p}_t$
qm_{t-1}	0.98	1	0.98	0.41
y_t	0.97	0.98	1	0.50
$\dot{p}_t$	0.42	0.41	0.51	1

Equation (4.9):

Variable	qm_t	qm_{t-1}	y_t	i_t
qm_{t-1}	0.99	1	0.98	0.34
y_t	0.98	0.98	1	0.43
i_t	0.34	0.34	0.42	1

Equation (4.11):

Variable	R(BS)	[R(N)+DD(PS)]	[TD(PS)]
[R(N)+DD(PS)]	0.45	1	0.56
[TD(PS)]	0.73	0.56	1

GLOSSARY OF SYMBOLS TO APPENDIX 4.3

Y	Nominal gross domestic product at current market prices in shs m.
y	Real gross domestic product at 1976 market prices in shs m.
P	Gross domestic product deflator (Y/y).
CPI	Consumer price index (ratio of consumption expenditure at current market prices to real consumption expenditure at 1976 market prices).
PEG	Price index of exports of goods and services (ratio of nominal value of exports of goods and services to value of exports of goods and services at 1976 prices).
PMG	Price index of imports of goods and services (ratio of nominal value of imports of goods and services to value of imports of goods and services at 1976 prices).
$\dot{p}$	Rate of inflation as measured by change in the gross domestic product deflator.
$\dot{CPI}$	Rate of inflation as measured by the change in consumer price index (CPI).

$\dot{P}EG$ Rate of change in exports prices

$\dot{P}MG$ Rate of change of import prices

i Interest rate paid on treasury bills (an average of three months).

M1 Currency outside banks plus demand deposits owned by the private and other public sectors at the banks in shs m.

M2 M1 plus term deposits owned by the private and other public sectors at the banks in shs m.

m1 M1 deflated with the gross domestic product deflator in shs m.

m2 M2 deflated with the gross domestic product deflator in shs m.

H The high-powered money (currency outside the Central Bank plus the deposits of commercial banks with the Central Bank) in shs m.

DD(PS) Demand deposits owned by the private and other public sector at the banks in shs m.

TD(PS) Term deposits owned by the private and other public sectors at the banks in shs m.

CY(PS)	Currency outside banks in shs m.
c	The ratio of currency outside banks to demand deposits held by the private and other public sectors at the banks [CY(PS)/DD(PS)].
C_v	Vault and till cash of the banks in shs m.
g	The ratio of term deposits to demand deposits [TD(PS)/DD(PS)].
C_b	Deposits of the commercial banks with the Central Bank in shs m.
R(BS)	Vault and till cash plus balances with the Central Bank, (C_v plus C_b) in shs m.
r_T	The implicit reserve ratio obtained from equation (3.33).
r_{01}	The observed reserve ratio defined as in the table of appendix 4.4.
DN(PS)	Term deposits held by the private and other public sectors with the NBFI's in shs m.

R(N)	Demand deposits of NBFIs held with the commercial banks in shs m.
e	R(N)/DN(PS)
h	DN(PS)/TD(PS)
R_d(BS)	Vault and till cash plus balances with the Central Bank, held in respect of demand deposits. Own calculation in shs m.
R_t(BS)	Vault and till cash plus balances with the Central Bank, held in respect of term deposits. Own calculation in shs m.

4.3: TIME SERIES FOR EMPIRICAL ANALYSIS

	Year 1968 Quarter / Notation	1st	2nd	3rd	4th
1	Y	9666	9666	9666	9666
2	y	20079	20079	20079	20079
3	P	0.4814	0.4814	0.4814	0.4814
4	CPI	0.4743	0.4743	0.4743	0.4743
5	PEG	0.4021	0.4021	0.4021	0.4021
6	PMG	0.3253	0.3252	0.3253	0.3253
7	p	1.1400	1.1400	1.1400	1.1400
8	CPI	-	-	-	-
9	PEG	-	-	-	-
10	PMG	-	-	-	-
11	i	4.2193	4.0059	3.7763	3.6897
12	M1	1372	1330	1374	1535
13	M2	2055	2045	2145	2301
14	m1	2850	2763	2854	3189
15	m2	4269	4248	4456	4780
16	H	553	572	672	756
17	DD(PS)	944	914	947	1066
18	TD(PS)	683	715	771	766
19	CY(PS)	428	416	427	469
20	c	0.4534	0.4551	0.4509	0.4400
21	Cv	57	52	57	60
22	g	0.7235	0.7823	0.8141	0.7186
23	C_B	68	104	188	227
24	R(BS)	125	156	245	287
25	r_T	-	-	-	-
26	r_o	-	-	-	-
27	DN	-	-	-	-
28	R(N)	-	-	-	-
29	e	-	-	-	-
30	h	-	-	-	-
31	Rd	-	-	-	-
32	Rt	-	-	-	-

Year 1969

	1st	2nd	3rd	4th
1	10418	10418	10418	10418
2	21333	21333	21333	21333
3	0.4884	0.4884	0.4884	0.4884
4	0.4786	0.4786	0.4786	0.4786
5	0.3982	0.3982	0.3982	0.3982
6	0.3281	0.3281	0.3281	0.3281
7	1.4125	1.4125	1.4125	1.4125
8	0.9000	0.9000	0.9000	0.9000
9	0.9699	0.9699	0.9699	0.9699
10	0.8607	0.8607	0.8607	0.8607
11	4.2399	4.0059	3.7763	3.6897
12	1588	1670	1651	1801
13	2392	2519	2560	2748
14	3251	3419	3380	3688
15	4898	5158	5242	5627
16	818	824	832	1029
17	1091	1176	1134	1231
18	804	849	909	947
19	497	494	517	570
20	0.4555	0.4201	0.4559	0.4630
21	62	67	64	66
22	0.7369	0.7219	0.8016	0.7693
23	259	263	351	483
24	321	330	415	459
25	-	-	-	-
26	-	-	-	-
27	-	-	-	-
28	-	-	-	-
29	-	-	-	-
30	-	-	-	-
31	-	-	-	-
32	-	-	-	-

Year 1970

	1st	2nd	3rd	4th
1	11454	11454	11454	11454
2	22894	22894	22894	22894
3	0.5003	0.5003	0.5003	0.5003
4	0.4816	0.4816	0.4816	0.4816
5	0.4300	0.4300	0.4300	0.4300
6	0.3346	0.3346	0.3346	0.3346
7	2.4785	0.4785	2.4785	0.4785
8	0.6268	0.6268	0.6268	0.6268
9	7.9659	7.9659	7.9659	7.9659
10	1.9811	1.9811	1.9811	1.9811
11	3.6149	3.6149	2.1100	2.1100
12	1926	1901	2029	2226
13	2943	2962	3177	3505
14	3850	3800	4056	4449
15	5882	5920	6350	7006
16	1150	1104	1265	1213
17	1351	1315	1408	1529
18	1017	1061	1148	1279
19	575	586	621	697
20	0.4256	0.4456	0.4411	0.4559
21	77	76	77	82
22	0.7528	0.8068	0.8153	0.8365
23	498	442	567	434
24	575	518	644	516
25	-	0.2201	0.2538	0.1865
26	-	0.2149	0.2482	0.1806
27	-	234	256	280
28	-	34	32	49
29	-	0.1453	0.1250	0.1750
30	-	0.2205	0.2230	0.2189
31	-	390	358	285
32	-	288	286	231

Year 1971

	1st	2nd	3rd	4th
1	12702	12702	12702	12702
2	24355	24355	24355	24355
3	0.5215	0.5215	0.5215	0.5215
4	0.5098	0.5098	0.5098	0.5098
5	0.4382	0.4382	0.4382	0.4382
6	0.3657	0.3657	0.3657	0.3657
7	4.2375	4.2375	4.2375	4.2375
8	5.8555	5.8555	5.8555	5.8555
9	1.9070	1.9070	1.9070	1.9070
10	9.2947	9.2947	9.2947	9.2947
11	1.7975	1.5964	1.3107	2.0242
12	2239	2189	2245	2371
13	3570	3577	3698	3770
14	4293	4198	4305	4547
15	6846	6859	7091	7229
16	1236	1045	982	1130
17	1545	1555	1575	1631
18	1331	1388	1453	1399
19	694	634	670	740
20	0.4492	0.4077	0.4254	0.4537
21	88	97	99	94
22	0.8615	0.8926	0.9225	0.8578
23	454	314	213	296
24	542	411	312	390
25	0.1945	0.1449	0.1093	0.1360
26	0.1813	0.1348	0.0990	0.1232
27	392	443	409	440
28	114	107	123	135
29	0.2908	0.2415	0.3007	0.3068
30	0.2945	0.3192	0.2815	0.3145
31	301	224	168	218
32	241	187	144	172

Year 1972

	1st	2nd	3rd	4th
1	15052	15052	15052	15052
2	25597	25597	25597	25597
3	0.5880	0.5880	0.5880	0.5880
4	0.5700	0.5700	0.5700	0.5700
5	0.4783	0.4783	0.4783	0.4783
6	0.4097	0.4097	0.4097	0.4097
7	12.7517	12.7517	12.7517	12.7517
8	11.8086	11.8086	11.8086	11.8086
9	9.1511	9.1511	9.1511	9.1511
10	12.0317	12.0317	12.0317	12.0317
11	3.4761	3.3717	3.4549	3.3888
12	2376	2387	2517	2803
13	3821	3823	4028	4295
14	4041	4060	4281	4767
15	6498	6502	6850	7304
16	1116	993	1195	1238
17	1607	1649	1708	1909
18	1445	1436	1511	1492
19	769	738	809	894
20	0.4785	0.4475	0.4737	0.4683
21	88	95	91	111
22	0.8992	0.8708	0.8847	0.7816
23	259	160	295	233
24	347	255	386	344
25	0.1217	0.0917	0.1270	0.1061
26	0.1086	0.0784	0.1151	0.0984
27	554	652	642	582
28	143	167	134	94
29	0.2581	0.2561	0.2087	0.1615
30	0.3834	0.4540	0.4249	0.3901
31	190	142	212	197
32	157	113	174	147

Year 1973

	1st	2nd	3rd	4th
1	17568	17568	17568	17568
2	27128	17128	17128	17128
3	0.6476	0.6476	0.6476	0.6476
4	0.6529	0.6529	0.6529	0.6529
5	0.5290	0.5290	0.5290	0.5290
6	0.4844	0.4844	0.4844	0.4844
7	10.1190	10.1190	10.1190	10.1190
8	14.5438	14.5438	14.5438	14.5834
9	10.6000	10.6000	10.6000	10.6000
10	18.2329	18.2329	18.2329	18.2329
11	3.3012	2.3012	1.3016	0.5885
12	2984	3153	3129	3450
13	4596	4912	5069	5357
14	4608	4869	4832	5327
15	7097	7585	7827	8272
16	1510	1678	1563	1354
17	2051	2254	2211	2468
18	1612	1759	1940	1907
19	933	899	918	982
20	0.4549	0.3988	0.4152	0.3979
21	93	111	113	138
22	0.7860	0.7804	0.8774	-0.7727
23	484	668	532	234
24	577	779	645	372
25	0.1636	0.1983	0.1590	0.0866
26	0.1518	0.1887	0.1517	0.0843
27	685	679	697	676
28	137	116	102	40
29	0.2000	0.1708	0.1463	0.0592
30	0.4249	0.3860	0.3593	0.3545
31	332	447	351	211
32	245	332	294	161

Year 1974

	1st	2nd	3rd	4th
1	21214	21214	21214	21214
2	28219	28219	28219	28219
3	0.7518	0.7518	0.7518	0.7518
4	0.7676	0.7676	0.7676	0.7676
5	0.6820	0.6820	0.6820	0.6820
6	0.6970	0.6970	0.6970	0.6970
7	16.1081	18.1081	10.1081	10.1081
8	17.5677	17.5677	17.5677	17.5677
9	28.9225	28.9225	28.9225	28.9225
10	43.8893	43.8893	43.8893	43.8893
11	1.7680	4.0450	5.7556	5.9369
12	3613	3683	3500	3775
13	5665	5838	5670	5839
14	4806	4899	4655	5021
15	7535	7765	7542	7767
16	1413	1386	1471	1600
17	2582	2668	2403	2689
18	2052	2155	2170	2064
19	1031	1015	1097	1086
20	0.3993	0.3804	0.4565	0.4039
21	109	117	127	253
22	0.7947	0.8077	0.9030	0.7676
23	273	254	247	261
24	382	371	374	514
25	0.0844	0.0788	0.0833	0.1096
26	0.0814	0.0760	0.0811	0.1072
27	814	846	906	816
28	56	57	41	43
29	0.0688	0.0674	0.0452	0.0527
30	0.3967	0.3926	0.4175	0.3953
31	215	207	198	293
32	167	164	176	221

Year 1975

	1st	2nd	3rd	4th
1	23934	23934	23934	23934
2	28475	28475	28475	28475
3	0.8405	0.8405	0.8405	0.8405
4	0.8837	0.8837	0.8837	0.8837
5	0.8805	0.7705	0.7705	0.7705
6	0.8707	0.8707	0.8707	0.8707
7	11.7984	11.7984	11.7984	11.7984
8	15.1251	15.1251	15.1251	15.1251
9	12.9765	12.9765	12.9765	12.9765
10	24.4921	24.4921	24.4921	24.4921
11	6.4342	6.0268	5.9036	5.9193
12	3657	3747	3629	4160
13	5935	6146	6238	6832
14	4351	4458	4318	4949
15	7061	7312	7422	8128
16	1557	1474	1521	1533
17	2563	2725	2551	2625
18	2278	2399	2609	2672
19	1094	1022	1078	1235
20	0.4268	0.3750	0.226	0.4222
21	135	161	160	174
22	0.8888	0.8804	1.0227	0.9135
23	328	291	283	124
24	463	452	443	298
25	0.0987	0.0917	0.1620	0.0581
26	0.0939	0.0862	0.0831	0.0517
27	978	1026	1188	1251
28	90	122	169	162
29	0.0920	0.1189	0.1423	0.1295
30	0.4293	0.4277	0.4553	0.4682
31	249	245	226	160
32	214	207	217	138

Year 1976

	1st	2nd	3rd	4th
1	29072	29072	29072	29072
2	29072	29072	29072	29072
3	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000
7	18.9766	18.9766	18.9766	18.9766
8	13.1606	13.1606	13.1606	13.1606
9	29.7859	29.7859	29.7859	29.7859
10	14.8501	14.8501	14.8501	14.8501
11	6.2939	6.2489	5.8217	3.9119
12	4541	4555	4691	5188
13	7414	7598	7874	8523
14	4541	4555	4691	5188
15	7414	7598	7874	8523
16	1783	1668	2033	1938
17	3302	3361	3380	3563
18	2873	3043	3183	3335
19	1239	1194	1311	1625
20	0.3752	0.3553	0.3879	0.4561
21	176	189	199	205
22	0.8701	0.9054	0.9417	0.9360
23	368	285	523	108
24	544	474	722	313
25	0.0927	0.0782	0.1144	0.0506
26	0.0855	0.0719	0.1067	0.0441
27	1282	1306	1413	1410
28	191	188	201	205
29	0.1490	0.1440	1.1423	0.1454
30	0.4462	0.4292	0.4439	0.4228
31	298	255	382	166
32	246	219	340	147

Year 1977

	1st	2nd	3rd	4th
1	37198	37198	37198	37198
2	31820	31820	31820	31820
3	1.1690	1.1690	1.1690	1.1690
4	1.0829	1.0829	1.0829	1.0829
5	1.3408	1.3408	1.3408	1.3408
6	1.0762	1.0762	1.0762	1.0762
7	16.9000	16.9000	16.9000	16.9000
8	8.2900	8.2900	8.2900	8.2900
9	34.0800	34.0800	34.0800	34.0800
10	7.6200	7.6200	7.6200	7.6200
11	4.4685	2.6962	0.4375	1.2028
12	6147	6928	7514	7357
13	10164	11124	12072	12437
14	5258	5926	6428	6293
15	8695	9516	10327	10639
16	2638	3222	3620	3153
17	4385	5163	5582	5175
18	4017	4196	4558	5080
19	1762	1765	1932	2182
20	0.4018	0.3419	0.3461	0.4216
21	247	217	250	241
22	0.9161	0.8127	0.8166	0.9816
23	629	1240	1438	730
24	876	1457	1688	971
25	0.1093	0.1597	0.1705	0.1014
26	0.1009	0.1510	0.1613	0.0906
27	1614	1771	1888	2101
28	283	293	322	457
29	0.1753	0.1654	0.1706	0.2175
30	0.4018	0.4221	0.4142	0.4136
31	471	824	953	511
32	405	633	735	460

Year. 1978

	1st	2nd	3rd	4th
1	41164	41164	41164	41164
2	34153	34153	34153	34153
3	1.2053	1.2053	1.2053	1.2053
4	1.1644	1.1644	1.1644	1.1644
5	1.2022	1.2022	1.2022	1.2022
6	1.1396	1.1396	1.1396	1.1396
7	3.0967	3.0967	3.0967	3.0967
8	7.5261	7.5261	7.5261	7.5261
9	10.3371	10.3371	10.3371	10.3371
10	5.8911	5.8911	5.8911	5.8911
11	2.0826	2.5006	5.2972	6.7948
12	7703	7311	7415	7940
13	13208	13246	13375	14178
14	6391	6066	6152	6588
15	10958	10990	11097	11763
16	3286	3230	3076	3038
17	5521	5153	5221	5735
18	5505	5935	5960	6238
19	2182	2158	2194	2205
20	0.3952	0.4189	0.4202	0.3845
21	276	284	287	338
22	0.9971	1.1518	1.1415	1.0877
23	828	788	575	495
24	1104	1072	882	833
25	0.1075	0.1041	0.0867	0.0757
26	0.0952	0.0916	0.0748	0.0667
27	2209	2416	2593	2726
28	573	609	606	525
29	0.2594	0.2521	0.2337	0.1926
30	0.4013	0.4071	0.4351	0.4370
31	580	528	436	417
32	524	544	446	416

Year 1979

	1st	2nd	3rd	4th
1	45437	45437	45437	45437
2	35458	35458	35458	35458
3	1.2814	1.2814	1.2814	1.2814
4	1.2620	1.2620	1.2620	1.2620
5	1.2799	1.2799	1.2799	1.2799
6	1.3127	1.3127	1.3127	1.3127
7	6.3226	6.3226	6.3226	6.3226
8	8.3820	8.3820	8.3820	8.3820
9	6.4632	6.4632	6.4632	6.4632
10	15.1895	15.1895	15.1895	15.1895
11	7.3530	6.6422	5.6666	4.4406
12	7831	8477	8676	9927
13	14198	14988	15140	16689
14	6111	6615	6771	7747
15	11080	11697	11815	13024
16	3388	3151	3166	3856
17	5620	6274	6316	7254
18	6367	6511	6464	6762
19	2211	2203	2360	2673
20	0.3934	0.3511	0.3737	0.3685
21	246	259	271	370
22	1.1329	1.0378	1.0234	0.9327
23	931	689	535	813
24	1177	948	806	1183
25	0.1041	0.0811	0.0700	0.0913
26	0.0940	0.0703	0.0601	0.0805
27	3119	3539	3509	3671
28	535	698	639	680
29	0.1715	0.1972	0.1821	0.1852
30	0.4899	0.5435	0.5429	0.5429
31	579	490	418	639
32	598	458	388	634

Year 1980

	1st	2nd	3rd	4th
1	52649	52649	52649	52649
2	37053	37053	37053	37053
3	1.4209	1.4209	1.4209	1.4209
4	1.4513	1.4513	1.4513	1.4513
5	1.5241	1.5241	1.5241	1.5241
6	1.6978	1.6978	1.6978	1.6978
7	10.8865	10.8865	10.8865	10.8865
8	15.0000	15.0000	15.0000	15.0000
9	19.0796	19.0796	19.0796	19.0796
10	29.3365	29.3365	29.3365	29.3365
11	4.4772	4.8446	5.7630	5.7660
12	9793	9436	9134	9148
13	16440	16369	16733	16797
14	6892	6641	6428	6438
15	11570	11520	11776	11821
16	3780	3511	3567	4236
17	7181	6813	6468	6116
18	6647	6933	7599	7649
19	2612	2623	2666	3032
20	0.3637	0.3850	0.4122	0.4957
21	411	377	337	413
22	0.9256	1.0176	1.1748	1.2507
23	757	511	564	791
24	1168	888	901	1204
25	0.0915	0.0726	0.0723	0.0970
26	0.0804	0.0612	0.0605	0.824
27	4114	4362	4661	4796
28	705	771	819	844
29	0.1714	0.1768	0.1757	0.1760
30	0.6189	0.6292	0.6134	0.6270
31	414	441	574	756
32	424	460	630	897

Year 1981	1st	2nd	3rd	4th
1	60772	60772	60772	10772
2	38573	38573	38573	38573
3	1.5755	1.5755	1.5755	1.5755
4	1.6848	1.6848	1.6848	2.6848
5	1.6395	1.6395	1.6395	1.6395
6	2.1343	2.1343	2.1343	2.1343
7	10.8804	10.8804	10.8804	10.8804
8	16.0890	16.0890	16.0890	16.0890
9	7.5717	7.5717	7.5717	7.5717
10	25.7097	25.7097	25.7097	25.7097
11	5.7950	5.9939	8.0558	9.9675
12	9111	9203	9401	10124
13	17291	17172	17953	18953
14	5783	5841	5967	6426
15	10975	10899	11395	12030
16	4599	3802	4471	4555
17	6165	6309	6252	6555
18	8180	7969	8552	8829
19	2946	2894	3149	3569
20	0.4779	0.4587	0.5037	0.5445
21	376	376	419	422
22	1.3268	1.2631	1.3679	1.3469
23	1277	532	903	564
24	1653	908	1322	986
25	0.1223	0.0697	0.969	0.0710
26	0.1098	0.0611	0.0850	0.0615
27	4641	4867	5454	5638
28	705	572	747	639
29	0.1519	0.1175	0.1370	0.1133
30	0.5674	0.6107	0.6377	0.6386
31	756	421	595	443
32	897	487	727	543

Year 1982

	1st	2nd	3rd	4th
1	67989	67989	67989	67989
2	39272	39272	39272	39272
3	1.7312	1.7312	1.7312	1.7312
4	1.8243	1.8243	1.8243	1.8243
5	1.7738	1.7738	1.7738	1.7738
6	2.3682	2.3682	2.3682	2.3682
7	9.8826	9.8826	9.8826	9.8826
8	8.2799	8.2799	8.2799	8.2799
9	8.1915	8.1915	8.1915	8.1915
10	10.9591	10.9591	10.9591	10.9591
11	12.2023	12.9329	13.4992	10.8031
12	9934	9467	9507	10764
13	19055	18753	19873	21442
14	5738	5468	5492	6218
15	11007	10832	11479	12386
16	4868	4136	5176	5558
17	6734	6345	6287	7040
18	9121	9286	10366	10678
19	3200	3122	3220	3724
20	0.4752	0.4920	0.5122	0.5290
21	441	403	471	436
22	1.3545	1.4635	1.6487	1.5168
23	1227	611	1485	1398
24	1668	1014	1956	1834
25	0.1108	0.0706	0.1262	0.1147
26	0.1013	0.0625	0.1103	0.0960
27	5342	6105	6455	7112
28	609	591	1078	1386
29	0.1140	0.0968	0.1670	0.1949
30	0.5857	0.6574	0.6227	0.6660
31	744	434	812	809
32	924	580	1144	1025

Source: Economic Surveys, various eds.
Central Bank of Kenya statistics
My own calculations.

4.4: DEFINITION OF RESERVE ASSETS RATIOS TO DEPOSITS

Year & end of Quarter of the year			(1) Implicit reserve ratio	(2) Domestic cash holdings, Interbank deposits & deposits with CBK	(3) No.(2) plus Foreign currency holdings	(4) No.(3) plus balances with foreign banks	(5) No.(4) pl Treasury bills
			r_T	r_{o1}	r_{02}	r_{03}	
1970	2	1	0.2201	0.2149	0.2201	0.2525	0.2525
	3	2	0.2538	0.2488	0.2551	0.2911	0.2911
	4	3	0.1865	0.1806	0.1870	0.2254	0.2954
1971	1	4	0.1945	0.1813	0.1895	0.2364	0.3033
	2	5	0.1449	0.1348	0.1403	0.1699	0.2086
	3	6	0.1093	0.0990	0.1040	0.1321	0.1867
	4	7	0.1360	0.1232	0.1300	0.1516	0.1801
1972	1	8	0.1217	0.1086	0.1150	0.1363	0.1989
	2	9	0.0917	0.0784	0.0836	0.1002	0.1973
	3	10	0.1270	0.1151	0.1212	0.1367	0.2317
	4	11	0.1061	0.0984	0.1020	0.1164	0.2066
1973	1	12	0.1636	0.1518	0.1586	0.1728	0.2525
	2	13	0.1983	0.1887	0.1949	0.2108	0.3122
	3	14	0.1590	0.1517	0.1563	0.1703	0.2736
	4	15	0.0866	0.0843	0.0862	0.1081	0.2121
1974	1	16	0.0844	0.0814	0.0837	0.1075	0.2160
	2	17	0.0788	0.0760	0.0778	0.1076	0.1914
	3	18	0.0833	0.0811	0.0835	0.1192	0.1821
	4	19	0.1096	0.1072	0.1096	0.1340	0.2020
1975	1	20	0.0987	0.0939	0.0975	0.1206	0.2147
	2	21	0.0917	0.0862	0.0894	0.1134	0.1942
	3	22	0.1620	0.0831	0.0870	0.1070	0.1956
	4	23	0.0581	0.0517	0.0566	0.0836	0.1701
1976	1	24	0.0927	0.0855	0.0915	0.1077	0.2096
	2	25	0.0782	0.0719	0.0756	0.0917	0.2153
	3	26	0.1144	0.1067	0.1124	0.1281	0.2533
	4	27	0.0506	0.0441	0.0477	0.0687	0.2117
1977	1	28	0.1093	0.1009	0.1065	0.1375	0.2935
	2	29	0.1597	0.1510	0.1567	0.1713	0.3266
	3	30	0.1705	0.1613	0.1675	0.1825	0.3231
	4	31	0.1014	0.0906	0.0969	0.1061	0.2341
1978	1	32	0.1075	0.0952	0.1022	0.1195	0.2295
	2	33	0.1041	0.0916	0.0981	0.1106	0.1894
	3	34	0.0867	0.0748	0.0806	0.0962	0.1901
	4	35	0.0757	0.0420	0.0711	0.0855	0.1857
1979	1	36	0.1041	0.0940	0.0999	0.1196	0.2221
	2	37	0.0811	0.0703	0.0752	0.0933	0.1989
	3	38	0.0700	0.0601	0.0642	0.0854	0.1968
	4	39	0.0913	0.0805	0.0864	0.1056	0.2179
1980	1	40	0.0915	0.0804	0.0863	0.1108	0.2265
	2	41	0.0726	0.0612	0.0659	0.0865	0.1799
	3	42	0.0723	0.0605	0.0655	0.0838	0.1765
	4	43	0.0970	0.0825	0.0891	0.1101	0.1740
1981	1	44	0.1223	0.1098	0.1170	0.1417	0.2258
	2	45	0.6970	0.0611	0.0646	0.0903	0.1890
	3	46	0.9690	0.0850	0.0908	0.1132	0.2193
	4	47	0.0710	0.0615	0.0659	0.0950	0.1899
1982	1	48	0.1108	0.1013	0.1069	0.1349	0.2085
	2	49	0.0706	0.6250	0.6620	0.0928	0.1599
	3	50	0.1262	0.1103	0.1185	0.1389	0.2069
	4	51	0.1147	0.0960	0.1048	0.1250	0.2446
Mean			0.1133	0.0984	0.1079	0.1302	0.2209
S^2			0.0019	0.0019	0.00185	0.0021	0.0017
S			0.0436	0.0436	0.0430	0.0458	0.0412

Source: Computed from Central Bank of Kenya Statistics

4.5: RESERVE RATIOS AND WEIGHTS

			Reserve ratio for demand deposits	Reserve ratio for term deposits	Weight of (r_d) in the general reserve ratio	Weight of (r_t) in the general reserve ratio	The general ratio (r_o)
Notation & Quarter	Year		r_d	r_t	W_d	W_t	$W_d r_d + W_t r_t$
1970	2	1	0.2150	0.2149	0.5598	0.4402	0.2149
	3	2	0.2488	0.2488	0.5564	0.4436	0.2488
	4	3	0.1806	0.1807	0.5522	0.4478	0.1806
1971	1	4	0.1813	0.1813	0.5548	0.4452	0.1813
	2	5	0.1347	0.1348	0.5449	0.4551	0.1348
	3	6	0.0990	0.0990	0.5389	0.4611	0.0990
	4	7	0.1232	0.1232	0.5580	0.4420	0.1232
1972	1	8	0.1086	0.1086	0.5477	0.4523	0.1086
	2	9	0.0784	0.0784	0.5584	0.4416	0.0784
	3	10	0.1151	0.1151	0.5494	0.4506	0.1151
	4	11	0.0984	0.0984	0.5731	0.4269	0.0984
1973	1	12	0.1518	0.1518	0.5758	0.4242	0.1518
	3	14	0.1887	0.1887	0.5439	0.4561	0.1517
	4	15	0.1517	0.1516	0.5681	0.4319	0.0843
1974	1	16	0.0843	0.0843	0.5625	0.4375	0.0814
	2	17	0.0815	0.0814	0.5584	0.4416	0.0760
	3	18	0.0760	0.0760	0.5297	0.4703	0.0811
	4	19	0.1801	0.0811	0.5696	0.4304	0.1072
1975	1	20	0.1172	0.1072	0.5380	0.4620	0.0939
	2	21	0.0939	0.0939	0.5427	0.4573	0.0862
	3	22	0.0862	0.0862	0.5104	0.4896	0.0831
	4	23	0.0831	0.0831	0.5360	0.4640	0.0517
1976	1	24	0.0517	0.0517	0.5487	0.4513	0.0855
	2	25	0.0855	0.0855	0.5384	0.4616	0.0719
	3	26	0.0719	0.0719	0.5294	0.4706	0.1067
	4	27	0.1067	0.1067	0.5305	0.4695	0.0441
1977	1	28	0.0441	0.0441	0.5375	0.4625	0.1009
	2	29	0.1009	0.1009	0.5653	0.4347	0.1510
	3	30	0.1510	0.1509	0.5642	0.4357	0.1613
	4	31	0.1612	0.1614	0.5258	0.4742	0.0906
1978	1	32	0.0907	0.0906	0.5254	0.4746	0.0952
	2	33	0.0916	0.0952	0.4926	0.5074	0.0916
	3	34	0.0748	0.0748	0.4944	0.5056	0.0748
	4	35	0.0667	0.0666	0.5009	0.4991	0.0667
1979	1	36	0.0939	0.0941	0.4908	0.5092	0.0940
	2	37	0.0703	0.0703	0.5171	0.4829	0.0703
	3	38	0.0601	0.0601	0.5183	0.4817	0.0601
	4	39	0.0805	0.0806	0.5397	0.4603	0.0805
1980	1	40	0.0804	0.0804	0.5426	0.4574	0.0804
	2	41	0.0612	0.612	0.5224	0.4776	0.0612
	3	42	0.0605	0.0605	0.4895	0.5105	0.0605
	4	43	0.0824	0.0824	0.4764	0.5236	0.0824
1981	1	44	0.1098	0.1098	0.4565	0.5435	0.1098
	2	45	0.0611	0.0611	0.4634	0.5366	0.0611
	3	46	0.0850	0.0850	0.4501	0.5499	0.0850
	4	47	0.0615	0.0615	0.4490	0.5510	0.0615
1982	1	48	0.1013	0.1013	0.4460	0.5540	0.1013
	2	49	0.0625	0.0625	0.4276	0.5724	0.0625
	3	50	0.1103	0.1103	0.4154	0.5846	0.1103
	4	51	0.0960	0.0960	0.4411	0.5589	0.0960
Mean			0.102694	0.0955	0.5236	0.4764	
s^2			0.0018	0.0018			
			0.0429418				

Source: Own computation from Central Bank of Kenya Statistics

BIBLIOGRAPHY

1. **Ahmad**, S., (1977) "Transactions demand for money and the quantity theory," Quarterly Journal of Economics 91.

2. **Bain**, A.D. The Control of Money Supply, third edition Penguin Books, 1980.

3. **Baumol**, W.J., (1952) "The transactions demand for cash: An inventory theoretic approach," Quarterly Journal of Economics 66, November.

4. **Bolnick**, B.A., "A note on behaviour of the proximate determinants of money in Kenya" Eastern Africa Economic Review, 7, 1975

5. **Branson**, W.H., Macroeconomic Theory and Policy Harper and Row, New York, 1972.

6. **Brunner**, K., and Meltzer, A.H., (1967) "Economies of scale in cash balances reconsidered," Quarterly Journal of economics 81, August.

7. **Burrows**, P., and Hitiris, T., Macroeconomic Theory, (University of York), William Clowes and Sons Ltd., London 1974.

8. **Cagan**, P.,: Determinant and Effects of changes in the stock of money 1875-1960, National Bureau of Economic Research, Studies in Business cycles, No. 13 (New York: National Bureau of Economic Research 1965).

9. ____________, (1956) The monetary dynamics of hyper-inflation, in Friedman, M., edited, Studies in the Quarterly Theory of Money, University Press, Chicago.

10. Chandler, L.V., The Economics of Money and Banking, Harper and Row, New York sixth edition, 1973.

11. Chow, G.C., "Tests of Equality Between sets of coefficients in Two Linear Regression" Econometrica, Volume 28, 1960.

12. Coghlan; R., Theory of Money and Finance; Macmillan Press Ltd., London and Basingstoke, 1980.

13. Dennis, G.E.J., Monetary Economics, London and New York, 1981.

14. Diz, A.,C., Money and Prices in Agentina 1935-1962 in David Meiselman edited, Varieties of Monetary Experience, Chicago, University of Chicago Press, 1970.

15. Dornbusch, R., and Fischer, S., Macroeconomics MacGraw-Hill, New York, 1981.

16. Friedman, M., "The Quantity theory of money - a restatement" in Friedman edited Studies in the Quantity Theory of Money, University Press, Chicago.

17. ____________, and Schwartz, A.J., A Monetary History of the United States 1867-1960, National Bureau of Economic

Research, Studies in Business Cycle No. 12 (Princeton N.J.: Princeton University Press 1963a)

18. ______________, (1957), A theory of the consumption function, University Press, Princeton.

19. ______________, and Schwartz, A.J., Monetary Statistics of United States, New York: Columbia University Press, 1970.

20. Ghatak, S., Monetary Economics in Developing countries, Macmillan Press Ltd., London and Basingstoke, 1981.

21. Gupta, G.S., A monetary Policy Model for India, The Indian Journal of Statistics: series B. 19--

22. Guttentag, J.M., and Lindsay, R. "The Uniqueness of Commercial Banks" Journal of Political Economy, October 1968.

23. Harris, L., Monetary Theory, McGraw-Hill, New York, 1981.

24. Hume, D., : Essays, Morals, Political and Literary edited by T. H. Green and T. H. Grose (London: Longmans, Green 1875).

25. Johnson, H.G., Macroeconomic and Monetary Theory, Gary-Mills, 1971.

26. ______________, Essays in Monetary Economics, second edition, George Allen and Urnuin Ltd., London 1969.

27. ______________, "Monetary theory and policy," American Economic Review 52 June.

28. Karmel, P.H., and Polasek, Applied Statistics for Economists, fourth edition Pitman Australia, 1978.

29. Laidler, D.E.W., The demand for money, Theories and Evidence, New York, 1977.

30. Marshall, A.,: Official Papers, edited by J.M.Keynes (London: Macmillan, 1926).

31. Meigs, A.J., Free Reserves and the Money Supply, University of Chicago Press, Chicago and London, 1968.

32. Niehans, J., The Theory of Money, John Hopkins University Press, Baltimore and London 1978.

33. Perry, F.E., The Elements of Banking, Methuen and co. Ltd., London, 1975.

34. Pigeu, A.C.: "The value of Money," Quarterly Journal of Economics, Volume 32, November, 1917.

35. Teigen, R.L., Demand and Supply functions for money in the United States, Econometrica, Volume 32, number 4, October, 1964.

36. Wong, C., "Demand for Money in Developing Countries," Journal of Monetary Economics, January, 1977.