"THE DETERMINANTS OF THE LEVEL OF INTERNATIONAL RESERVE HOLDINGS IN KENYA

AN EMPIRICAL ANALYSIS "

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This Research Paper is my orginal work and has not been presented for a degree in any other University.

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This Research Paper has been submitted for Examination with our approval as University Supervisors.

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DEDICATION

I dedicate this paper to my family and especially the departed souls: Dad, Andy and Ben.

ABSTRACT

International reserves form an integral part of a nation's overall portfolio of foreign assets. These reserves are held by monetary authorities so as to enable intervention in the foreign exchange market, finance an external imbalance, provide a buffer to cushion the economy against future adverse fluctuations and form part of the basis for money supply.

This paper sought to find out the determinants of the level of these international reserves in Kenya. It utilised yearly data of the variables used. The time series properties of these variables were explored in great detail. The variables were found to be non-stationary and cointegrated. To run a non-spurious regression, the data used are in first difference and an ECM incorporated.

The findings of the paper are that international reserve holdings are positively related to the country's wealth (proxied by GDP), the level of variability of international payments, and the openness of the economy. On the contrary, reserve holdings are negatively related to the level of imports, the nominal exchange rate and domestic credit.

A number of diagnostic tests were conducted and proved that the model tracks the data well. The instablity of the parameters of the model is attributed to the shifts in exchange rate regimes.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

The Central Bank of Kenya (CBK) was established in September 1966. Before then, the East African Currency Board used to handle the monetary affairs of the three East African countries: Kenya, Uganda and Tanzania. The Board was charged with the responsibility of supplying local currency in exchange for sterling and also redeeming local currency in sterling on demand. It hence was required to hold reserves in sterling to satisfy these requirements.

With the independence of these countries in the early 1960s, the Board's operations became obsolete since each country desired to establish a Central Bank so as to have independent monetary and financial policies. Kenya established the CBK in 1966. The bank was required by section 26 of the Central Bank of Kenya Act to do its best to maintain a reserve of external assets of an aggregate amount not less than the value of four months' imports as recorded and averaged for the three preceeding years. This was seen as an essential part of the monetary policy as reserves provide means to ensure an uninterrupted flow of development inputs such as imported raw materials, spare parts and capital equipment. When reserves fall below a certain level the CBK adopts policies of restraint to ensure a rise.

Despite this target level of reserves by the CBK, the reserve levels have fluctuated over time, causing concern, especially in 1992, following the suspension of quick-disbursement funds

(Programme Aid) to Kenya by the donor community in November 1991.

This is as depicted in the table below:

TABLE 1: Kenya: Total Gross Reserves in KShs. Millions for selected years.(End of year figures 1970-1993)

YEAR	1970	1975	1980	1985	1990	1991	1992	1993
RESERVES	1586	1427	3784	6807	6630	5339	6315	34527

Source: International Financial Statistics (IFS) (Various Issues)

The reserve trend gets more clearer with quarterly data. The fluctuations from quarter to quarter can be seen as depicted in the table below. All the reserve figures are in Millions of Kenya Shillings.

Table 2: Reserve Movements: Quarterly data 1990(1) to 1994(2)

	QUARTER			
YEAR	1	2	3	4
1990	5622	5566	4591	6630
1991	4604	4985	4690	5339
1992	5869	5183	7319	6315
1993	7080	15120	13464	34527
1994	44588	42197		

Source: International Financial Statistics (IFS) Jan. 1995.

From the table the quarter to quarter fluctuations can be seen. For example reserves stood at 5622 at the beginning of 1990 and dropped to 4604 at the beginning of 1991. They then start

to rise slowly (with lesser fluctuations) through 1992. Sharp increases are evident in 1993 as the level jumps from 7080 in 1993(1) to 34527 in 1993(4).

It must also be noted that throughout this time, the economy has experienced three exchange rate regimes. These are the fixed exchange rate regime (1964 to December 1982), a managed float (dirty float) regime (Dec 1982 to March 1993) and the free float system (March 1993 to the present).

1.2 Definition and Purpose of International Reserves:

International Reserves may be defined as the foreign resources/ assets at the disposal of the monetary authorities of a country for the purposes of intervention in the foreign exchange market. These assets must be liquid and be unconditionally available to the monetary authorities for them to qualify as reserves. The types of assets that qualify and have been in use as reserves vary from time to time and include Government gold holdings, Government's holdings of convertible foreign currencies, the Reserve Position with the International Monetary Fund (IMF), and the Government's holdings of IMF Special Drawing Rights (SDRs). These are contrasted with various types of near-reserves such as other precious metals, credit tranches with the IMF, inconvertible foreign currency and other borrowing arrangements which are available to monetary authorities only on certain conditions.

Monetary authorities hold international reserves also for reasons

other than intervention in the foreign exchange market. These reasons arise out of their policy

priorities and economic circumstances. They include financing cyclical and seasonal external payments imbalances; and hence avoid incurring adjustment costs to every external imbalance and providing a buffer to cushion the economy against future exigencies.

A country with an external imbalance[1] has two options to take: either finance it or make the necessary adjustments. Adjustment policies may broadly be divided into two:

1) Expenditure-switching policies which redirect current spending away from foreign produced goods and towards domestically produced goods by means of change in relative prices[2]. Policy instruments here include devaluation, exchange controls, tariffs and quotas.

2) Expenditure-reducing policies includes all expenditure-switching policies (i.e. both expenditure increasing and reducing). Such measures include changes in tax rates, government expenditures and interest rates. These are designed to affect the level of aggregate spending. But all these measures of adjustment are associated with costs. Financing an external imbalance by a build-up or depletion of international reserves offers an alternative which avoids these costs.

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[1] This arises when the Balance of Payments is in a disequilibrium position. It can either be a deficit (outflow) or a surplus (inflow) of financial resources into/from a nation.

[2] The Marshall - Lerner Condition gives the basic assumption(s) for these policies to work. It states that the sum of exports and imports demand elasticities should be greater than one,(1), for devaluation to improve the Trade Balance in the BOP. The analysis is centred on the real exchange rate.

According to Clark (1970), international reserves permit a country to pursue domestic policy goals in the face of a temporary deterioration in the balance of payments (BOP) and "buy time" in order to adopt the appropriate policies if the deterioration proves permanent. There are two polar cases: Given fixed exchange rates, it would be inefficient to make payments abroad equal to receipts from abroad every moment in time and hence the need to hold reserves to supply the excess demand for foreign currency. On the other hand, at the extreme opposite, no country would wish to hold scarce resources in a stock of reserves so as to enable it incur a deficit of any conceivable size. There is thus need for a country to hold the optimal level of reserves.

Holding of reserves as a buffer to cushion the economy against future exigencies rests on no other basis than expectations and hence it is like an insurance. Monetary authorities expect pressure on the BOP by external shocks out of their control. They also expect fluctuations in the exchange rate. These fluctuations are contrary to the goal of a stable exchange rate. Fluctuations in the exchange rate also have effects that impact negatively on the domestic economy. To avoid situations of being caught illiquid (without adequate reserves) when an imbalance occurs or to stabilize the exchange rate, monetary authorities have to hold reserves to help cushion against such unplanned and costly circumstances.

The World Development Report (1985), pp.83-84, stresses the need for a country to hold or maintain higher reserve levels the more variable its export earnings are, the higher its debt exposure is, the less flexible its economic policies and structures are and the degree to which it has limited access to a steady flow of external capital. It is therefore sensible for less

developed countries to have higher reserve levels than the industrial ones since LDCs are more vulnerable to the world market conditions. Enough reserves enables a country to adjust to domestic or international pressures /shocks without unduly jeopardizing its economic growth. This explains why most developing countries suggest reserve levels equivalent to three months of imports. For Kenya,as stated earlier, the target is four months of imports by value.

1.3 International Reserves and Balance of Payments:

In the national accounts, the reserves are recorded in the Reserve Account of the balance of payments. The various accounts of the BOP are related to one another through the identity.

$$CA+KA+RA\equiv 0$$

Where CA = Current account balance, KA = Capital account balance and RA = Reserve account balance.

(i.e. their total must be identically Zero).

The Current Account (CA) measures the change in a country's net foreign wealth since a deficit in this account must be financed either by a capital inflow or a reduction in the country's official reserves. It gives the position of the country's exports receipts less imports payments- both visible and invisible.

The Capital Account (KA) measures net foreign investment or net lending/net borrowing vis-a-vis the rest of the world. The major components of this account are capital transfers and

acquisition/disposal of nonproduced. nonfinancial assets[3]. It thus shows the position of the country as it relates to Capital Movements between itself and the rest of the world.

The Reserve Account (RA) records purchases and sales of official reserve assets by the central bank. It consists of gold holdings, Special Drawing Rights,(SDRs), reserve position in the Fund, foreign exchange assets, use of Fund credit, and other claims on non residents (IMF, 1993).

Given the identity, then one account can be eliminated in the analysis as it is residual. If the level of any two accounts is

established, then the third one can be obtained. This brings up the problems as to whether each account has independent determinants.

If the world capital market were left free to the forces of demand and supply (no intervention). then capital movements would be influenced by relative interest rates. Capital would flow from areas of low return to areas of higher return. Hence the level of the capital account would be determined by such movements independent from other accounts.

The Current Account balance is determined by the level of export receipts less import payments. The level of export receipts are influenced by developments in the world economy. When developments in the world markets favour a country's exports through increasing demand, prices being constant, then receipts are higher and vice versa. A deficit in this balance therefore calls

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[3] A more detailed explanation of the various accounts in the BOP including the capital account is given in the International Monetary Fund Balance of Payments Manual.

for intervention by the monetary authorities to put into place adjustment policies or financing it. Financing a deficit is done by use of official reserves from the Reserve Account. The reserves thus become important in determining the equilibrium balance of the current account.

A typical balance of payments account for Kenya is presented on the next page.

TABLE 3: Kenya, Balance of Payments, 1993.

(In Kenya Pounds Million)

CURRENT ACCOUNT		
Merchandise (f.o.b)	Dr	890.84
Shipment	Dr	504.35
Other Transportation		461.39
Foreign Travel		1,083.49
International Investment Income	Dr	1,127.81
Other goods, services and income		
: Government		674.59
: Private	Dr	107.75
Unrequited Transfers		
Government		272.45
Private		426.65
TOTAL CURRENT ACCOUNT		287.82
of which: Visible Balance	Dr	890.84
Invisible Balance		1,178.66
CAPITAL ACCOUNT		
Government Long-Term		442.69
Private Long-Term	Dr	25.64
Parastatals Long-Term	Dr	286.50
Short Term		856.83
TOTAL CAPITAL ACCOUNT		987.38
ERRORS AND OMISSIONS		8.90
OVERALL BALANCE		1,284.10
MONETARY MOVEMENTS (RA)		
Change in Reserves	Dr	2,312.46
Transactions with IMF		593.12
Change in other liabilities		435.24
TOTAL MONETARY MOVEMENTS	Dr	1,284.10

Source: Central Bureau of Statistics (CBS), Economic Survey 1995

The above BOP shows an increase in Reserves Account by K£ 1284.10 million. Reserves grew by K£ 2312.46 million in the same period.A debit entry in change in Reserves means building them up. A healthy balance of payments, ceteris paribus, implies larger accumulation of reserves and vice versa.

1.4 Sources and Uses of Foreign Exchange in Kenya:

Earnings from exports form the most important source of foreign exchange. The major exports include tea, coffee, and horticultural produce. Any improvement in exports either in terms of price, quantity remaining constant or volume, price remaining constant means increased foreign exchange reserves.

Another source is the receipts from services. These services include freight and insurance, transportation, foreign travel and transfers. Tourism is also included here.

Capital inflows both public and private also form a vital part of the foreign exchange reserves. This includes both long-term and short-term capital. Table 2 above shows short-term capital as a major component during the year 1993. These capital inflows are usually attributed to favourable climate for private investors with a variety of other concessions like tax reliefs.

Apart from the above sources, the government may increase its level of foreign exchange by borrowing from foreign sources. If it borrows from IMF, this is recorded in the Reserve Account, and if from World Bank then it is accounted for in the Capital Account. Such

borrowed funds are used to support the BOP position.

Import payments accounts for a major portion of foreign exchange use. Kenya imports oil products, manufactured goods and machinery among others which are of relatively expensive. This means a heavy call on foreign exchange supplies. The higher the import payments, either by increased prices, volume constant, or increased volumes, price constant, the higher the resources used and vice versa. Higher import payments also worsen the current account balance and hence the balance of payments. This arguement assumes that exports remain unchanged.

Foreign exchange is also used to repay foreign debt. This is both for the principal and interest payments. Principal payments are accounted for in the capital account, interest payments in the current account.

Payments for services and investment income also puts a drain on foreign exchange. This investment income refers to the profits derived from the ownership of domestic financial and real assets by foreign owned firms as well as interest payments. Other services include management and technical fees, subscriptions to publications and for rentals.

Foreign exchange is also held by monetary authorities as part of the net foreign reserves. It thus forms part of the high powered money reserve of the nation.

1.5 Statement of the Problem:

From the foregoing it is apparent that international reserves form an integral part of a nation's overall portfolio of foreign assets. These reserves are held by monetary authorities for purposes which have been explained above. The Central Bank of Kenya (CBK) was established in

September 1966 and empowered to maintain a reserve of external assets at a level not less than the value of four months' imports. This condition not withstanding, the level of reserves has fluctuated, as was noted from Table 1, from time to time.

The CBK has continued to hold reserves even with the free float exchange rate regime. This is unlike the standard textbook view that with floating exchange rate systems, the need to hold international reserves disappears as payments imbalances are adjusted by movements in the exchange rate. That is, an appreciation of the exchange rate for surpluses and a depreciation for deficits in the BOP.

As was mentioned above, the economy has experienced three exchange rate regimes, namely: fixed, managed float (pegged) and free float regimes. Despite the shifts in exchange rate regimes, a stock of international reservse continue to be held as seen from table 1.

This study seeks to establish the fundamental determinants of the level of reserve holdings and explore whether these determinants have remained stable or shift over the period.

1.6 Objectives of the Study

The main objective of the study is to establish the determinants of International Reserve holdings in Kenya. The specific objectives are :-

(1) To specify a model for the determinants of the level of international reserves based on a thorough review of the existing relevant literature;

(2) Develop an estimable version of the model and test it with secondary data from Kenya:

(3) Test for parameter stability to determine whether the determinants have remained stable or shifted over the period:

(4) Based on the results assess the quality and reliability of the model and hence derive implications and recommendations. It is also intended to make suggestions for further directions of research in this area.

1.7 Significance of the Study

Although various studies in this area have been done for some individual countries and groups of countries, none has been done in Kenya. The study thus expands the locations studied under this topic. The empirical findings are expected to be of use to CBK to strengthen international reserve management policies. The study will also provide a base from which further work can develop.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

At the outset, it is necessary to point out certain areas of the literature that the paper does not cover, even though they are closely related to the subject at hand. The study of international reserves can be approached in two ways viz:

(i) From the Balance of Payments (BOP) under the national accounts

(ii) From the money supply side.

As already discussed, reserves are recorded in the Reserve Account of the BOP. Various scholars have used the first view and studied the various accounts of the BOP.

Khan and Knight (1983) looked at the determinants of the current account balances. They examined the direct quantitative relationship between the current account position and a set of factors that determine it. This was done for a sample of 32 countries (Kenya included). The factors identified were: the terms of trade, the slow down of economic activity in the industrial countries, the real interest rates in the international credit markets, the fiscal deficit and the real effective exchange rate.

They used the following basic equation:

$$CA/X = f(TOT, DYIC, RRI, RER, FP/Y, T)$$

Where CA = Current Account Balance, X = Nominal exports of goods, TOT = Terms of Trade, DYIC = Growth of real GNP in Industrial Countries, RRI = Foreign real interest rate, RER = Real effective exchange rate index, FP = Fiscal position (Revenue - Expenditure), Y = Nominal GDP and T = Linear time trend

and $f_{(TOT)} > 0$, $f_{(DYIC)} > 0$, $f_{(RRI)} < 0$, $f_{(RER)} < 0$, $f_{(FP/Y)} > 0$

The results suggested that all the factors were important in determining the current account balances.

Calvo, Leiderman and Reinhart (1993) among others studied the capital account. They examined the factors behind the massive capital inflows into the Latin America. They emphasized the role of external factors. The factors identified included the sharp drop in U.S. short-term interest rates, continued recession in the United States and other industrialized countries, and the continued decline in Latin America's terms of trade. These increased the current account deficit prompting more capital inflow.

Other variables were the sharp swings in private capital outflows from the U.S. and the important regulatory changes in the capital markets of industrial countries. These regulatory changes reduced the transactions costs for agents accessing international capital markets from Latin America and other developing countries.

The empirical analysis proved these external factors significant and thus played a role in the capital inflows, which in turn contributed to the accumulation of foreign reserves and the appreciation of real exchange rates.

They suggested five ways of policy intervention to such capital flows: a tax on capital imports, trade policy to insulate the export sector from real exchange rate appreciation, fiscal tightening, sterilized and non-sterilized intervention by the Central Bank and a rise in the marginal reserve

requirements on bank deposits and more regulated bank investments in equity and real estate markets.

There are other studies on the current and capital accounts of the BOP. While these are relevant to the study of the BOP, the study at hand emphasises the reserve account. Hence, no more time will be taken reviewing the literature of the two accounts for the purposes of the current study. The focus will mainly be on the reserve account.

Many studies have also been done concerning money supply and demand. These studies are based on the second view above. Net International Reserves are part of the basis for money supply of a nation and hence such studies are relevant to the current study. In this category I take Fairman's work as an illustration. Fairman (1986) studied the money demand, money supply and the Balance of Payments in Zambia. In particular he was testing for the applicability of the monetary approach to the balance of payments. He estimated the following equation:

$$\Delta Fm = \frac{\Delta Md}{m} - \Delta Dm - H_{-1}\frac{\Delta m}{m}$$

Where Fm = NFA of the Monetary authority. Md = Money demand.
Dm = Domestic assets of the monetary authority,
$H_{(-1)}$ = Base Money lagged one year and m = Money multiplier

The results of this reserve model showed that changes in domestic assets virtually have an inverse 'one to one' correspondence with changes in net foreign assets. Thus the monetary approach to BOP holds up well in Zambia. The implication of this is that if domestic credit can

be controlled, the authorities can attain desired balance of payments outcomes based on accurate forecasts of the demand for money.

A similar study was done for Kenya by Grubel and Ryan (1979). They fitted an equation of the following form to Kenyan data.

$$\frac{R}{H}gR=a_0+a_1gP+a_2gY+a_3SE+a_4\frac{D}{H}gD$$

Where R is the net foreign reserves, H is high-powered money, P is the price level, Y is the national income, SE is the Nairobi Stock Exchange index (a proxy for the rate of interest), D is the domestic component of high-powered money and g is the growth operator. The results showed the applicability of the monetary approach to the balance of payments for Kenya.

While these studies are relevant to the area of this study, they focus on money demand and supply as a whole and not reserves only. They also look at net foreign assets.(NFA), and not gross reserves (NFA = Gross foreign assets(reserves) minus Foreign liabilities). In what follows, a review of literature that is relevant to this study is presented. The literature is specific and emphasises the Reserve Account of BOP. It is presented in chronological order.

Clark (1970) contends that reserves permit a country to pursue domestic policy goals in the face of a temporary deterioration in the balance of payments, and they also allow the country to

"buy time" in order to adopt the appropriate policies if deterioration proves to be permanent. By holding an adequate level of reserves, countries are able to avoid the costs of adjustment associated with the BOP, while excess reserve holdings may prove costly if they occur at the expense of alternative gains from domestic consumption and investment.

In this non-empirical article Clark demonstrated with a well reasoned theoretical model the trade off between the speed of adjustment and the level of reserves a country willingly holds. This is based on a number of assumptions such as fixed exchange rates, small country and that balance of payment is in fundamental equilibrium. Country preferences determine the optimal combination between speed at which the disequilibrium is corrected and optimal reserve levels choosing a higher speed of adjustment would require lower reserve levels for a given probability of running out of reserves.

The approach by the author was to treat the speed of adjustment and the stock of reserves as variable which can be controlled by policy makers in order to maximise the welfare of the country. A stock of reserves is regarded as desirable not in and of itself but only in so far as it facilitates the attainment of other more basic objectives such as reducing fluctuation in the level of income and probability of the country becoming completely illiquid.

The major limitation of the paper is that it is based on so many simplifying assumptions most of which will not hold in a dynamic world. But the article sheds light on the optimum relationship between the speed with which the country strives to eliminate a payments deficit and

the extent to which it finances it.

Frenkel (1974) estimated separate demand functions for international reserves by developed and less-developed countries (LDCs).

He assumed the reserve demand function for DCs and LDCs to depend on three variables namely, a measure of variability of international receipts and payments, σ, a scaling variable measuring the size of international transactions, represented by the level of imports, M, and the average propensity to import or relative size of the foreign trade sector, m = M/Y where Y denotes GNP.

His functional form for the demand function was

$$R=Am^{\alpha_1}\sigma^{\alpha_2}M^{\alpha_3}$$

And the estimation equation

$$\log R_t=\alpha_0+\alpha_1\log m_t+\alpha_2\log\sigma_t+\alpha_3\log M_t+U_t$$

The results showed that the behavioral parameters of the two groups with respect to reserve holding were different. It was found that reserve holdings were positively related to the variability of international receipts and payments, to the volume of imports and to the relative size of the foreign trade sector.

The study however leaves out other variables like the opportunity cost of reserves which have been found to be important.

Heller (1974) defines the international reserves and their function as financing an imbalance before examining the factors that determine their demand. He also discusses in detail, the sources of these reserves. He distinguishes reserves from near-reserves which are available only on conditions.

The factors identified include the wealth constraint, the opportunity cost of holding reserves, the magnitude of external imbalance and alternative domestic adjustment costs. These are respectively, positively, negatively, positively, positively and positively related to reserve holdings.

This work, however, apart from lacking mathematical/statistical backing leaves out other important factors like the average propensity to import and imports levels.

Iyoha (1976) formulated the demand for international reserves function in a distributed lag specification, to ascertain the determinants of the demand for international reserves by less developed countries. The aim was to improve on the specification of the reserve demand functions.

Improvements in this work included differentiating the concepts of actual and optimum reserves,

introduction of an expected export earnings variable which was estimated and used as an explanatory variable, and also the introduction of a distributed lag adjustment. The estimation equation was autoregressive and had an AR(2) process.

It was assumed that actual reserves (R) adjust to optimum reserves (R^P) with a lag.

Hence

$$\Delta R=\lambda (R^P-R_{-1}) +\beta \Delta R_{-1}$$
$$0<\lambda<1, \beta<1$$

Optimum level of reserves depends on expected export earnings (X^e), variability of export earnings (σ^2), interest rate on foreign exchange holdings (r) and degree of openness of the economy (P)

Thus

$$R^P=\phi (X^e, \sigma^2, r, P)$$

The final estimation equation was

$$R=\alpha_0+\alpha_1 X^e+\alpha_2\sigma^2+\alpha_3 r+\alpha_4 P+\alpha_5 R_{-1}+\alpha_6 R_{-2}-\epsilon_R$$

The coefficient of R_{-1} was highly significant implying a distributed lag phenomenon in reserve demand.

This study can be viewed as a great improvement to earlier reserve demand function specifications. However it used unobservable variables which required numerous calculations

and simplifying assumptions to calculate.

Grubel (1977) presented a theoretical exposition of the demand for reserves. The study analyses the nature of international reserves and their use in stabilising exchange rates in the face of shifts in demand and supply schedules for foreign exchange. Using a price theoretic model it is shown how exchange rate stabilisation may give rise to positive externalities. That, according to the author, is the only valid reason for holding reserves. The existence of such externalities implies that reserves have a positive social productivity, which are assumed to give rise to a downward sloping demand curve for reserves.

The study also shows that under these conditions, a country has a determinate, efficient target level of reserve holdings and is led on occasion into exchange rate adjustments as reserve levels rise too high or fall too low. With these conditions, the study shows countries to experience socially optimum exchange rate stability through time.

The study concludes by specifying aggregate world reserve demand and supply schedules. Inequalities between supply and optimal demand lead to inefficiently high exchange rate variations or inflationary pressures. Other determinants of the demand for reserves are identified as the propensity to make domestic adjustments, tariffs and direct controls, private short-term capital movements and world price and income levels.

The weakness of this work lies in the fact that most of the reasoning cannot be quantified for

statistical analysis. It also excludes other variables which have been identified and found to be significant in reserve demand functions such as, opportunity costs, level of imports, etc.

Heller and Khan (1978) analyzed the demand for international reserves under fixed and floating exchange rates for a number of country groupings. Their tests were based on the IMF's standard classification of countries according to the level of development.

They used quarterly data covering the period 1964-1976. The estimated functions were examined for parameter stability using tests that could detect significant shifts in parameters and also indicate the time when this occurred. This allows one to ascertain if the movement to floating rates caused a shift or if there was a lagged response.

They specified the model as follows

$$R^D = g(I/Y, I, Z^*)$$

Where R^D = Demand for International Reserves
I/Y = Ratio of Imports to Domestic Income
I = Level of Imports
Z^* = Measure of variability of the balance of payments.

The estimation equation was specified in log-linear form.

The results showed that there was a clear shift in the demand for reserves by industrial countries when the move to the floating rate system occurred. However this change was not sudden and appeared to have taken place towards the end of 1973 rather than in the earlier part of year when the actual change to a floating regime occurred. The move however seemed not to have affected non-oil developing countries to any significant degree.

After the structural change in 1973, the function explaining reserves remained stable in the period of managed floating, for both the industrial and the developing countries.

The empirical evidence supported the hypothesis that the demand for reserves declines as exchange rates become more flexible in the case of industrial countries. On the other hand, the reverse was true for non-oil developing countries. Their reserve holdings tended to be higher during the floating rate period than fixed rate period. Heller and Khan attributed this to the degree of uncertainty and variability in the payments resulting from being pegged to a floating currency.

The major shortcomings of their study lies in the use of broad country groupings. All countries in the group do not have or experience the same economic conditions.

In another study, Edwards (1984) formulated the following model which was derived from an earlier work of John Bilson and Jacob Frenkel (1979).

$$LogR_t^* = \alpha_0 + \alpha_1 LogY_t + \alpha_2 LogAPI_t + \alpha_3 Log\sigma_t + U_t$$

Where R^* = Desired reserves, R = Actual reserves Y = GNP

API = Openness of the economy measured by the average propensity to import, σ = Variability of international payments measured by the coefficient of variation of detrended reserves.

He adopted the following adjustment model

$$\Delta \log R_t = \alpha (\log R_t^* - \log R_{t-1}) + \beta (\log M_t^* - \log M_{t-1})$$

Where M^* = Desired money demand and M = Actual money demand.

Thus disequilibrium in the money market was explicitly introduced into the reserve holdings specification. This was found to hold. The coefficients of log Y_t and log $R_{(t-1)}$ were highly significant, whereas that of (log M_t^* - log $M_{(t-1)}$) was significant only at the 10% level. The partial adjustment coefficient was also significant implying that once a country gets off the long-run demand curve for reserves, it takes some time lag before another equilibrium is restored.

Landell-Mills did a study in 1989 which had the following conclusions. As long as a country is creditworthy, it can go to the market as and when it needs reserves and may hence hold fewer reserves than it would if it could not borrow. It alternatively, might borrow for longer periods before encountering the reserve constraint. Therefore surplus countries may, because of their good credit rating, add to their reserves when investment conditions are good, whereas deficit countries, whose resources are absorbed by debt repayments, will be forced to borrow at a premium to maintain desired reserve levels. For both groups of countries, reserves should be sensitive to the opportunity cost of holding them.

The study showed empirically that reserve holdings of countries that also borrow on international capital markets, particularly countries with debt-servicing difficulties, are significantly affected by the cost of holding these assets as they are more vulnerable to changes in the international

financial markets.

The study likened a country's demand for reserves to an individual's precautionary money demand. Hence it is a positive function of wealth and cost of covering an unplanned deficit and a negative function of returns on other assets. The interest rate 'r' was defined as the interest rate on the individual country's international liabilities less the interest rate on the short-term liquid assets that the country hold as reserves.

The following equation was the final estimating form:

$$R = f(Imp, VARB, r, mpm)$$

Where Imp = Scale variable (proxied by imports)
VARB = Proxy for the entire distribution of the function that captures the probability of deficits occurring
r = The net borrowing cost on International Markets..
mpm = The marginal propensity to import.

It was found r was statistically significant for the 17 countries analysed.

The study can be criticised on various grounds. Measuring or finding the right proxy for r, the cost of reserves, is problematic. Various researchers have used different proxies and found this insignificant (see Heller (1966), Frenkel (1978), Kenen and Yudin (1965), and Kelly (1970). Hence the cost of reserves is not unambiguously defined.

The study assumes that countries borrow to increase their reserves from the international financial markets. In reality few countries go to these markets as the bulk of such borrowed

reserves are negotiated on bilateral basis. It is however, enligthening on reserves as it links reserve holdings of countries to the international financial conditions.

For Malixi and Bahmani-Oskooee (1994), the speed of reserve adjustment depends positively on the excess demand for reserves. They theorised that countries choose a higher speed of adjustment and hence lower reserve levels when faced with deficits in their balance of payments. In surplus situations the response is sluggish resulting in, albeit temporary, higher reserve stocks.

They defined excess demand for reserves as

$$S_t^* = \log(RES)_t^* - \log(RES)_{t-1} > 0$$

Where RES_t = Desired reserves
RES_{t-1} = Reserves at the beginning of period

The adjustment equation is given by

$$S_t^* = \pi(\log RES_t - \log RES_{t-1})$$

Where π measures the speed of adjustment.

Their final estimation equation was of the form:

$$\log RES_t = \beta_0 + \beta_1 \log(INC)_t + \beta_2 \log(VAR)_t + \beta_3 \log(FLEX)_t + \beta_4 \log(RES)_{t-1} + \mu_t$$

$\beta_1 > 0$ $\beta_2 > 0$ $\beta_3 < 0$ $\beta_4 > 0$ and $\pi = (1 - \beta_4)$.

Where RES = Total real reserves, INC = Real GNP,
VAR = Variability measure of the balance of payments, FLEX = Variability measure of the real effective exchange rate and U = Random error

They estimated this equation for groups of both developed and developing countries. Their hypothesis was supported by results of DCs but not LDCs. They attributed this to the dominant effect of the size of the deviation between actual and desired reserves on the speed of adjustment for LDCs.

The high speed of adjustment for both country-groupings suggests that both DCs and LDCs policy aims to achieve the desired stock of reserves and in every period take steps towards eliminating the gap between actual and desired reserves.

Buira (1995) estimates the demand for reserves using equations employed by Frenkel (1983) and Lizondo and Mathieson (1987) in an equilibrium model and by Bilson and Frenkel (1979) in a disequilibrium model. The estimates are more reliable at now than previous ones in that they cover a longer period and include more recent years. The results were however similar to those of earlier works.

There is a stable relation between the demand for international reserves and national output, the average propensity to import and the variability of international transactions. The demand for reserves by developing countries is more sensitive to changes in income and international trade than that of industrial countries. This was attributed this to the limited access to secondary sources of international liquidity by developing countries. The elasticities of the demand for reserves for developing countries with respect to the variables used were higher in the period 1982-1992 compared to 1975-1981 which reflects increased reliance on international

reserves as a source of liquidity. This is more evident after 1982 when developing countries access to international credit was sharply curtailed.

The equilibrium model was specified as:

$$LnR_t = \beta_0 + \beta_1 LnZ_t + \beta_2 LnY_t + \beta_3 Lnm_t + U_t$$

Where
R = International Reserves
Z = Measure of variability of international transactions
m = Average propensity to import
Y = Real output
U = Disturbance term.

The disequilibrium model requires a second equation.

$$LnR_t - LnR_{t-1} = \alpha + \beta(LnRD_t - LnR_{t-1}) + e_t$$

Where RD = equilibrium level of reserves.

The results made it possible to compare the applicability of equilibrium and disequilibrium models to reserve holdings.

2.2 Overview of literature

The literature reviewed above, identifies basic fundamental variables that determine reserve holdings. The major ones being a measure of variability of international receipts and payments, a scaling variable measuring the size of international transactions and the average or marginal propensity to import. Others include a wealth constraint, disequilibrium in the money market, the opportunity cost of reserves and exchange rate flexibility or a measure of exchange rate.

There is a general consensus on the expected signs of the relationship between reserves and the variables except the opportunity cost of reserves. The sign of this variable has been found to be either positive or negative depending on the definition, which might be attributed to the availability of many proxies for it.

The empirical studies have used single equation models with the estimation procedure based on single equation methods. The equations have been specified either based on equilibrium or disequilibrium analysis. Disequilibrium models call for a second, equation: the adjustment mechanism.

The current study deviates from the previous ones by modifying the models used to suit developing countries and Kenya in particular. This will be done by using as many variables as possible in the regression analysis, considering a longer period of time, and the inclusion of domestic credit as one of the explanatory variables.

CHAPTER THREE

3.0 THEORETICAL FRAMEWORK, METHODOLOGY AND DATA ANALYSIS

3.1 Theoretical Foundations

Various variables, both quantitative and qualitative, that influence international reserve holdings have been identified from the literature reviewed above. Reserves in the study are defined as gross reserves or unconditional liquidity. Given the nature of the study - an empirical analysis - focus will be on the quantitative variables. These variables include the wealth constraint, the relative size of the foreign trade sector, the marginal propensity to import, the level of imports, the opportunity cost of holding reserves, variability of external receipts and payments, the flexibility of exchange rate and ameasure of exchange rate.

The nation's wealth or scale provides a constraint on a country's reserve holdings. As wealth increases, the constraint relaxes and hence we consequently expect the country, ceteris paribus, to increase its reserve holdings. Hence reserve holdings are positively related to the wealth constraint as proxied here by nominal GDP.

The openness of an economy is measured by the relative size the foreign trade sector. This is measured by X+M/Y in the study.The effect of the size of this sector on reserve holdings is positive. The more open an economy is, the greater is its susceptibility to external disturbances and hence it requires a higher level of reserves in its optimal portfolio.

Import payments have to be made in foreign exchange. Foreign exchange forms part of the

international reserves. Import payments thus imply a leakage from the reserve levels. It is therefore plausible to expect a negative relationship between imports and international reserves. On the same argument, exports will thus be positively related to the reserves.

Variability of international receipts and payments reflects the theoretical concepts of risk and uncertainty. Greater variability creates greater uncertainty and hence the need for more reserves since one of the purposes of reserves is to serve as a buffer stock accommodating these fluctuations. Hence desired level of reserves is positively related to the variability of external net receipts.

Countries are expected to decrease their reserve holdings as Central Banks allow for greater exchange rate flexibility and suggesting a negative relationship to flexibility even if not quantifiable. Malixi and Bahmani-Oskooee (1994) utilized the real effective exchange rate as a proxy and found its coefficient to be negative. Here in this study the nominal exchange rate (NER) will be used. An increase in the NER implies that imports become more expensive and hence a heavier drain on the reserves. The relationship is thus expected to be negative.

There is an opportunity cost of holding international reserves. The relationship between reserve holdings and the opportunity cost of reserves, r, depends on the proxy used for r. If r = interest rate on reserve assets holdings, then it is positive since a higher r, implies lower opportunity cost. If r = return on alternative assets or market rate on international loans less returns on reserves then it is negative. Kenya holds most of its international reserves in

dollars. Hence the appropriate opportunity cost for these reserves is the gain from investing in these dollars. The US treasury bill rate is considered appropriate and its coefficient is expected to be negative.

The relationship between reserves and money supply is brought out most clearly if we look at the monetarist approach to the Balance of Payments. This approach is based on the money demand and money supply relationships.

Assuming a money demand function as used by Grubel and Ryan (1979) as:

$$M_d = (P^a Y^b)/(i^c)u$$

Where M_d is money demand, P is the price level, Y is real income, i is the interest rate, u is the error term and a,b,c are elasticities,

and money supply function as:

$$M_s = mH$$

Where M_s is money supply, m is the money multiplier and H is the high powered money. H consists of a domestic component, DC, and a foreign component, R, which is net reserves

ie. $H = R + DC$

Hence $M_s = m(R + DC)$

and $M_d/m = M_s = m(R + DC)$ at equilibrium.

Hence $R = M_d - DC$

The relationship between reserves and DC is thus expected to be negative.

3.2 Empirical Specification

The model is thus specified as below

$RES = R (GDP, DC, FSS, M, r, \sigma, NER)$

Where:

$R_{GDP} > 0$, $R_{DC} < 0$, $R_{FSS} > 0$, $R_M < 0$, $R_r < 0$, $R_\sigma > 0$ and $R_{NER} \leq 0$

and:

RES = Level of International Reserves (gross)

GDP = Nominal Gross Domestic Product in market price representing output or wealth constraint.

DC = The level of Domestic Credit

FSS = Foreign trade sector size measuring the openness of the economy as given by X+M/Y where Y = nominal GDP.

M = The level of nominal imports

r = US treasury bill rate measuring the opportunity cost of international reserves

σ = The measure of variability of international payments which is the coefficient of variation of detrended reserves

NER = Official nominal exchange rate. The Kenya Shillings per US Dollar exchange rate was used.

All the figures are end of year figures.

To calculate σ, the measure of variability, the following regression will be run (as was used by

Buira (1995))

$RES_t = \pi_0 + \pi_1 T + U$

where RES_t is nominal gross international reserves and T is the trend.

Then the value of the coefficient π_1 is used to calculate

$$V_t = \sum_T (RES_t - RES_{t-1} - \Pi_1)^2 / T$$

which is defined as the variance of the change in the level of nominal reserves adjusted for trend. Taking the square root and dividing it by nominal imports for the corresponding year, to normalise it, gives the measure of variability of international payments as required.

Following the literature review, we have seen that the estimation equations are of two types

(1) Equilibrium models which assume that desired reserve level equals actual level: Frenkel (1983), Lizondo and Mathieson (1987) and Heller and Khan (1978)

(2) Disequilibrium models which allow supply and demand to differ and hence describe a process of adjustment of reserve holdings: Bilson and Frenkel (1979), Iyoha (1976) and Edwards (1984), Buira (1995).

This study uses a disequilibrium model. This is because reserve holdings in the country are not always at equilibrium. This is clear from an analysis of the BOP as below. The capital account can equilibrate itself almost instantaneously with respect to relative interest rates if world capital markets are free from intervention. Hence it can be said to be in equilibrium all

the time.

The current account oscillates between deficit and surplus depending on export and import conditions. It is hardly ever in equilibrium.

The reserve account cannot be said to be equilibrium either, although it finances the deficit in the current account. In particular, the policy of target level of reserves brings in more complications to equilibrium: which measure to use 3 or 4 months and over what time span to take the average.

Thus there is a desired level of reserves given by

$$RES_t^* = \alpha_0 + \alpha_1 GDP_t + \alpha_2 DC_t + \alpha_3 FSS_t + \alpha_4 M_t + \alpha_5 r_t + \alpha_6 \sigma + \alpha_7 NER + \epsilon_t$$

Where RES^* = Desired Reserves

The adjustment model is given by

$$\Delta RES_t = \alpha + \lambda (RES_t^* - RES_{t-1})$$

Where λ is the speed of adjustment and $0 < \lambda < 1$

Thus the final estimation model is given by substituting for RES_t^* and is as given below:

$$RES_t = \beta_0 + \beta_1 RES_{t-1} + \beta_2 GDP_t + \beta_3 DC_t + \beta_4 FSS_t + \beta_5 M_t + \beta_6 r_t + \beta_7 \sigma_t + \beta_8 NER_t + V_t$$

The estimation procedure is based on Ordinary Least Squares single equation estimation methods, dictated by the nature of the model and data available. Due to dimension problem all the variables are expressed in natural logarithms.

3.3 Data Analysis

3.3.1 Stationarity Analysis

Economic theory is built upon the assumption of stationarity. Until recently this assumption was rarely questioned. Non-stationarity has serious econometric implications which include the violation of the assumption that the error term is identicantly independent and normally distributed with a zero mean and a constant variance. A stationary variable has a constant mean, finite variance, an innovation or disturbance has only a temporary effect. If plotted, the expected length between its crossing the mean is finite and the autocorrelation process Pk decreases steadily in magnitude for large values of k so that their sum is finite.

With non-stationary series, regression results will give promising diagnostic test statistics even in the case where there is no sense in the regression analysis (spurious regression). Hence for regression results to make sense, the data series have to be detrended first. This may be done by use of first differences (i.e the difference between successive observations). Thus for a time series with a stochastic trend of the type

$$Y_t = Y_{t-1} + \epsilon_t \quad \text{.....(3.3.1.1)}$$

The detrended variable is

$$\Delta Y_t = Y_t - Y_{t-1} = \epsilon_t \quad \text{.....[3.3.1.2]}$$

and ΔY_t is said to be stationary if it is integrated of order one.

Sometimes it is necessary to difference a series more than once in order to achieve stationarity - for an integrated series. As a formal definition a non-stationary series is said to be integrated

of order **d**, denoted as $x_t \approx I(d)$, if it requires differencing **d** times to make it stationary.

Thus since stationarity is a prerequisite for sound econometric modelling and reliable results. the following unit root tests will be carried out to check for the order of integration of the variables with a view of detrending data.

The Dickey - Fuller Tests:

i) The DF_t Test.

Given the first-order autoregressive (AR(1) process) equation

$$Y_t = \rho Y_{t-1} + \epsilon_t \quad \text{.....(3.3.1.3)}$$

If ϵ_t is a white noise process then the equation represents a random walk process when $\rho = 1$. The DF_t test is a test of the hypothesis that in (3.3.1.3) $\rho = 1$ (unit root test). This is based on the estimation of an equivalent regression equation, normally

$$\Delta Y_t = \delta Y_{t-1} + \epsilon_t \quad \text{.....(3.3.1.4)}$$

Where ϵ_t is a white noise process and $\Delta Y_t = Y_t - Y_{t-1}$

The null and alternative hypotheses are

$$H_0 : \delta = 0$$

$$H_1 : \delta < 0$$

Rejection of H_0 in favour of H_1 implies that Y_t is I(0). The test statistic is not based on the standard t statistic but on the critical values computed by Dickey and Fuller.

ii) The DF_2 test involves testing the order of integration for a variable generated as a stochastic process with a drift.

$$\Delta Y_t = \mu + \delta Y_{t-1} + \epsilon_t \quad \text{.....(.3.3.1.5)}$$

Where μ = a drift term (constant)

$$H_0 : \delta = 0$$

$$H_1 : \delta < 0$$

iii) A third test, the DF_3 accounts for both a drift and a linear deterministic trend as shown below

$$\Delta Y_t = \mu + \pi T + \delta Y_{t-1} + \epsilon_t \quad \text{.....(3.3.1.6)}$$

Where T is the Trend. In this equation it is possible to test simultaneously ($\delta < 0$) and the existence of a deterministic trend ($\pi * 0$)

As with other tests above the null and alternative hypotheses are:

$$H_0 : \delta = 0$$

$$H_1 : \delta < 0$$

The ADF Test:

iv) The fourth test is the Augmented Dickey - Fuller test, **ADF**. This test takes into account the possibility of autocorrelation in the error process ϵ_t. It uses lagged dependent variables as additional explanatory variables to approximate the autocorrelation. It is specified as below

$$\Delta Y_t = \mu + \pi T + \delta Y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta Y_{t-i} + \epsilon_t \quad \text{.....(3.3.1.7)}$$

The number of lags **k** should be relatively small to save the degrees of freedom. but large

enough to allow for the existence of autocorrelation in ϵ_t.

The testing procedure is the same as with the above tests. The null and alternative hypotheses are

$$H_0 : \delta = 0$$

$$H_1 : \delta < 0$$

3.3.2 Cointegration Analysis

Differencing of variables leads to non-recovery of long-run properties suggested by economic theory since a model in differences is a short-run model. To overcome this problem an Error Correlation Model (ECM) is introduced and is suitable where variables are cointegrated. Cointegration was developed by Granger and Engle (1987) and gave a formal definition as: Two series Y_t and X_t are cointegrated of order **d** and **b** denoted as CI(d.b) if

(i) They are both I(d)

(ii) There is a linear combination of them which is I(d-b)

Given the results above for the unit root tests, it is sometimes necessary to conduct cointegration tests, if the variables are found to be nonstationary, to avoid spurious regression. Tests for cointegration are analogous with the above unit root tests, though applied on the residuals. Stationarity of ϵ_t is important for one to incorporate an ECM. Thus the tests are

$$DF_1 : \quad \Delta\epsilon_t = \delta\epsilon_{t-1} + V_t \quad \text{.....(3.3.2.1)}$$

$$DF_2 : \quad \Delta\epsilon_t = \mu + \delta\epsilon_{t-1} + V_t \quad \text{.....(3.3.2.2)}$$

DF_3 : $\Delta\epsilon_t = \mu + \pi T + \delta\epsilon_{t-1} + V_t$ .....(3.3.2.3)

ADF :

$$\Delta\epsilon_t = \mu + \pi T + \delta\epsilon_{t-1} + \sum_{i=1}^{k} \delta\Delta\epsilon_{t-i} + V_t \text{.....(3.3.2.4)}$$

Where V_t are OLS residuals and interpreted as the deviations of Y_t from its long run path.

In all the tests the null and alternative hypotheses are

H_0 : $\delta = 0$ (no cointegration)

H_1 : $\delta < 1$ (cointegration exists)

3.4 Data: Source and Type

This study will utilise published data (annual) between 1967 and 1993 from Central Bank of Kenya publications, Economic Surveys, Statistical Abstracts, International Financial Statistics etc. The study period chosen is dictated by the fact that the Central Bank of Kenya was established in September 1966 and hence its policy stance on reserves was effective as from 1967.

CHAPTER FOUR

4.0 EMPIRICAL RESULTS AND ANALYSIS

This chapter presents the results of the various stationarity and cointegration tests described in chapter 3 above. It also presents the final estimation equation incorporating the above tests' results, the estimation results and analysis. A number of diagnostic tests are also done and results presented.

4.1 Results of Tests for Stationarity

TABLE 4:**Results of Unit Root Tests**

VARIABLE	DF_1	DF_2	DF_3	ADF 2 LAGS	ORDER OF INTEGRATION
LRES	1.75135	-0.59650	-3.20220	-2.95433	I(1)
LNER	3.88873	3.89037	1.22999	0.80114	I(1)
LDC	6.93768	-1.94337	-0.02772	0.01408	I(1)
LGDP	17.81631	1.00436	-1.95634	-2.25666	I(1)
Lr	-0.45912	-1.48944	-1.18069	-0.70269	I(1)
LM	4.70258	0.26260	-2.51994	-1.55626	I(1)
LFSS	-0.88231	-2.14763	-1.90167	-1.07043	I(1)
LSIGMA	-0.93295	-4.53391	-5.08405	-2.86645	I(1)

The critical values for the tests at 5% are, 1.95 for DF_1, 3.00 for DF_2, 3.60 for DF_3 and ADF. In summary, the results in the Table 4 above reveal the model variables are non-stationary i.e I(1). However, it is also evident that the results of the various tests have some inconsistency. A variable may be shown to be stationary in one or two tests while non-stationary in another. For example LSIGMA is shown to be stationary by DF_2 and DF_3 tests while non-stationary by

DF_1 and ADF. The judgement for non-stationarity was based on acceptance by at least two tests one of which is ADF.

To determine the order of integration second differences were conducted and tested. The results showed mixed results with some variables being I(0) and others I(1). Due to this mixed structure of stationarity, the variables were taken to be I(1) and hence only the first differences used.

4.2 Results of Cointegration Tests

TABLE 5: **Cointegration Test Results.**

TEST/VAR	DF_1	DF_2	DF_3	ADF
$Uhat_{-1}$	-4.52108	-4.40272	-4.38387	-3.79996

Critical values for the tests are, 1.95 for DF_1, 3.0 for DF_2, 3.60 for DF_3 and ADF.

In summmary the above results accept the H_1 implying that cointegration exists. This result means that the residuals of the equation are I(0) and hence the incorporation of the ECM. (ECM_{-1}) in the regression analysis in conjuction with the variables in first difference.

4.3 Final Estimation Equation and Results

The following regression equation was specified and estimated after the data analysis and results as given above. Due to the dimension problem the equation was specified in log-linear form. This was necessitated by the need to rescale the variables. Due to non-stationarity of the variables, the variables were differenced and the ECM incorporated. The estimated model is of the form

$$\Delta \log RES = \beta_0 + \beta_1 \Delta \log RES_1 + \beta_2 \Delta logGDP + \beta_3 \Delta logDC + \beta_4 \Delta logNER + \beta_5 \Delta logr + \beta_6 \Delta logM + \beta_7 \Delta \log \sigma + \beta_8 \Delta logFSS + \beta_9 ECM_{-1} + \epsilon_t$$

The above model was estimated using OLS as the most appropriate single equation estimation method as facilitated by the assumption of weak exogenerity among the variables apart from ΔLRES.

The table below gives a summary of the short-run model before the ECM was incorporated.

TABLE 6: **Table of S.R.model Results:**

EQ(1) Modelling DLRES by OLS

The Sample is 1969 to 1993 less 0 Forecasts

Variable	Coeff.	S.E.	H.C.S.E.	t-Value	Partial r^2
$DLRES_{-1}$	0.157	0.271	0.229	0.579	0.021
Constant	0.208	0.290	0.280	0.718	0.031
DLGDP	5.194	1.873	1.222	2.773	0.325
DLDC	-2.106	0.848	0.822	-2.484	0.278
DLNER	-0.034	0.586	0.710	-0.058	0.002
DLr	0.231	0.270	0.273	0.855	0.044
DLM	-3.271	1.423	1.381	-2.30	0.248
DLSIGMA	0.036	0.036	0.038	1.024	0.062
DLFSS	3.596	1.810	1.806	1.986	0.198

R^2 = 70.94% σ = 0.296 F(8,16) = 4.88 [0.000]
DW = 1.325
S.E. - Standard Error
H.C.S.E - Heteroscedastic Consistent Standard Error.

The ECM was then included in the model as the variables were found to be cointegrated. The following table gives the summary of the results.

TABLE 7: **Table of results:**

EQ(2) Modelling DLRES by OLS

The Sample is 1969 to 1993 less 0 Forecasts

Variable	Coeff.	S.E	H.C.S.E	t-Value	Partial r^2
$DLRES_{-1}$	0.266	0.218	0.161	1.221	0.090
Constant	0.320	0.233	0.240	1.377	0.112
DLGDP	5.441	1.489	0.880	3.653	0.471
DLDC	-2.138	0.673	0.605	-3.175	0.402
DLNER	-0.677	0.506	0.531	-1.337	0.107
DLr	0.424	0.223	0.211	1.904	0.195
DLM	-4.069	1.156	1.209	-3.518	0.452
DLSIGMA	0.076	0.031	0.029	2.478	0.291
DLFSS	4.829	1.487	1.642	3.246	0.413
ECM_{-1}	-0.937	0.291	0.233	-3.222	0.409

R^2 = 82.8% σ = 0.236 F(9,15) = 8.04 [0.0003]
DW = 1.80

From the results above the adjustment coefficient was found to be statistically insignificant at both the 5% and 10% levels. This was thus dropped from the model on the rationale of goodness of fit. The adjustment mechanism is thus captured by the ECM which is highly significant (at 1%). This is in line with the pursuance of a parsimonious model where from a general to specific model approved insignificant variables are set to zero. After setting the adjustment coefficient to zero the following results were achieved as summarized in the table below:

TABLE 8: **Summary of Regression Results[4].**

EQ(3) Modelling DLRES by OLS

The Sample is 1969 to 1993 less 0 Forecasts

Variable	Coeff.	S.E	H.C.S.E	t-Value	Partial r^2
Constant	0.375	0.232	0.233	1.617	0.140
DLGDP	5.001	1.467	1.007	3.409	0.421
DLDC	-2.206	0.681	0.613	-3.239	0.396
DLNER	-0.856	0.491	0.469	-1.743	0.160
DLr	0.397	0.225	0.181	1.763	0.163
DLM	-3.658	1.123	1.212	-3.256	0.399
DLSIGMA	0.079	0.031	0.030	2.523	0.285
DLFSS	4.726	1.508	1.715	3.135	0.381
ECM_{-1}	-0.882	0.292	0.241	-3.024	0.364

R^2 = 81.1% σ = 0.239 F(8,16) = 8.59 [0.0002]
DW = 1.76

4.4 Diagnostic Tests and Analysis of Results

To ensure that the model tracks the data well, further diagnostic tests were conducted. These tests ensure that the model captures the salient features of the data and is consistant with the main implications of economic theory (Adam (1992)).

The Jarque-Bera Test for Error Distribution.

This checks whether the residuals ϵ_t are independent and normally distributed (ie. the normality

[4] Note: All the regression analysis was done using the statistical package PC GIVE version 6.

of the error term). This is essential for the efficiency and consistency of the OLS estimates to hold. A Chi-square test is reported.

The JB test statistics is reported in the table below:

TABLE 9: **The Jarque-Bera Test for Error Distribution**

ANALYSIS of SCALED RESIDUALS

Sample Size 25

Mean	0.0000
Standard Deviation	0.8165
Skewness	-1.0720
Excess Kurtosis	1.1007
Minimum	-2.4151
Maximum	1.0142

CHI-SQUARED Test for NORMALITY :CHI²(2) = 3.872

From the test, it was established that the error term for the model is normally distributed. This is because the computed

X^2 (2) = 3.87 is less than the critical X^2 (2) = 5.99 at 5% level of significance and hence the efficiency and consistency of the OLS estimates.

Regression Specification Test (RESET)

This test investigates any mis-specification due to non-linearities in the model.

Under this test the model under analysis was respecified to include the non-linear part as

$$\Delta \log RES = \Delta \log X_t' \beta_t + \alpha_2 log RES_t^2 + \alpha_3 log RES_t^3 + \ldots + \alpha_n log RES_t^n - V_t$$

The hypotheses tested were

H_0: $\alpha_2 = \alpha_3 = \ldots \alpha_n = 0$ (no non-linearities)

H_1: $\alpha_i \neq 0$ $i = 2,\ldots n$ (non-linearities exist)

This is reported as an F test. The results of the test rejected H_1 in favour of H_0 since the calculated F(3,13) = 2.52 is less than the critical F(3,13) = 3.41 at 5% level or F(3,13) = 5.74 at 1% level for n = 4. Hence the model was properly specified in linear form.

TABLE 10: **The Residual Correlogram Test.**

Lag	1	2	3	4
Coefficient	0.0396	-0.1337	-0.0821	0.1774
S.E's	0.3615	0.3546	0.4424	0.4466

F(4,8) = 0.05 [0.9939].

This test was carried out to test whether the error term is autocorrelated. The results gave a calculated F(4,8) = 0.05 [0.9939] against the critical F(4,8) = 3.84 at 5% level. Hence the errors are not autocorrelated.

The Chow Test:

Finally, the Chow Test was performed to test for parameter constancy over the sample period. This test was however, constrained by inadequate degrees of freedom. The results gave the computed F(2,14) = 4.07. This result implies parameter stability at 1% significance level since critical F(2,14) = 6.51

but reject the same at the 5% level as critical F(2,14) = 3.74 . This instability can be attributed to the shifts in the exchange rate regimes. As was noted earlier the exchange rate regime has shifted from fixed to managed float and finally to free float regime. It is therefore plausible to conclude that these shifts have resulted in the parameter instability. Since the

parameters are unstable, they cannot be utilised to make correct predictions of the dependent variable. Thus we cannot conclusively say that a 1% increase(decrease) in the independent variable causes say a 1% or so increase(decrease) in the dependent variable. A remedy to this could have been splitting the study period into the three regimes and analyse separately. This,however, was not done due to lack of degrees of freedom as a result of using yearly data. The last regime (free float) will have only two observations, not adequate for statistical analysis.

From the above tests, the model can be said to capture the salient features of the data and relatively consistent with economic theory

The results of the estimated model as summarized in table 8 above show an R^2 of 81.1 % which is the models explanatory power. This implies that the various factors/variables identified in the determination of the level of international reserve holdings jointly account for over 81% of the variance in the latter. The remaining 19% can be attributed to qualitative factors like political factors among others. The reliability of the regression above is strengthened by a relatively low overall standard error of the regression $\sigma = 0.24$. The small differences between the corresponding S.E. and H.C.S.E. depict homoscedasticity. This justifies the use of S.E. in the computation of the t-values which are used to determine the significance of the variables used.

The Durbin-Watson test indicates that serial autocorrelation was not a serious problem in this

particular regression, DW = 1.76. The F - statistic reveals that the explanatory variables have a significant influence on the dependant variable. This is because the $F(8,16) = 8.59$ rejects the $H_0: R^2 = 0$ in favour of $H_i: R^2 > 0$.

All the variables identified and used in the model have the expected sign(s) except for the "r", the US treasury bill rate. The ambiguity in the theoretically known inverse relationship between ΔLr and $\Delta LRES$ is due to rival factors thereby making the relation an empirical one (Baltensperger and Milde(1976)). The opposite sign that resulted may also be attributed to definitional problems. In the definition of r, another approach to attempt to bring into consideration the international liabilities the country faces. However in the study this was not done.

The constant term is positive as expected and significant at 10% level. This is the autonomous level of international reserves. This is in line with the policy stance of the monetary authorities over the reserves. The significance of this also allows for the Gauss Markov Test of Best Linear Unbiased Estimates (BLUE).

The coefficients $\Delta LGDP$, ΔLDC, ΔLM, $\Delta LFSS$, ECM_{-1} and $\Delta LSIGMA$ are highly significant at 1% level. They have the expected signs. This conforms with many other studies as reviewed in chapter two. This is also the case with the coefficient of $\Delta LNER$ which has the expected sign and is statistically significant at the 10% level.

As already explained the adjustment coefficient $\Delta LRES_{-1}$ was found to be insignificant at both 5% and 10% and thus dropped from the final model. In its absence, the adjustment mechanism is captured in the cointegrating vector, ECM_{-1}, whose coefficient is statistically significant at 1% level.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

This study sought to find out the determinants of the level of international reserves in Kenya. Using yearly data from 1967 to 1993, a regression model was formulated and estimated. From this the various factors/variables were identified.

Reserve holdings by a country is positively related to the level of the country's wealth or income (here proxied by GDP), the level of variability of international payments and the openness of the economy were given by X+M/Y.

On the other hand the level of reserve holdings is negatively related to the level of imports by that country, domestic credit, and the nominal exchange rate.

The time series data properties of the variables used were examined and the variables were found to be non stationary and integrated of order one. Thus to avoid the problem of spurious regression associated with non stationary data the first differences of the variables were used instead of variables in levels. Further, cointegration tests were conducted and the variables were found to be cointegrated. This necessitated the incorporation of the error correction mechanism, (ECM), in the regression model. The inclusion of the ECM ensures that the model has a long run implication as first difference variables only give short run relationships.

A number of diagnostic tests were also carried out in order to test whether the model tracks

the data well over the sample period. The results of these tests confirmed this and hence the reliability of the model.

The significance of the study cannot be over emphasized given the tough stand taken by international lending institutions like World Bank and IMF. The other donor community is also following suit. It therefore calls for a clear understanding of the determinants of the level of reserves so as to maximize or minimize on them.

The Kenyan reserve position has been relatively non-volatile and hence not drawing much attention until late 1991 when the donor community suspended quick disbursement aid to her at the Consultative Group Meeting in Paris. This caused concern to the monetary authorities and a lot of public outcry. By 1993 the donor community and multilateral donor agencies eased their stand and hence the situation started improving. This state of affairs is likely to remain for some time if not improved upon following the numerous social-political and economical reforms already put into place.

In view of the conclusions made above, various recommendations can be made to ensure adequate levels of international reserves at any particular time.

There is need for the monetary authorities to emphasise favourably factors that positively contribute to this level. In particular every effort should be directed towards enhancing such factors as exports through export promotion policies and opening up new outside markets and

links to increase trade and hence open up the economy more. Any activity towards increasing the growth rate of the economy should be encouraged. This will raise our national income or wealth which has a positive impact on the level of reserves.

The factors that have been identified to be negatively related to reserve levels are the imports level, domestic credit and nominal exchange rate. With the liberalisation of the economy and indeed the exchange rate market, monetary authorities have little control over imports and exchange rate. These are determined by market conditions. However, they can influence these factors in their day to day decision making. For example, introduction of an import levy and encouraging and strengthening the activities of the Kenya Bureau of Standards are some of the positive pointers to this endeavour. A levy and inspection of imports for quality control would influence imports level and the exchange rate.

The monetary authorities should also strive to keep the economic agents updated on both the international and domestic market conditions.

5.1 Limitations of the study

A number of limitations were evident even though the paper succeeded in fulfilling the stated objectives. The paper utilised secondary data from various publications. These publications sometimes gave conflicting data for some variables used. Secondary data also has its own errors of measurement.

Lack of data for some variables like reserves during the formative years of Kenya's independence significantly lowered the degrees of freedom. Low degrees of freedom lowers the reliability of parameter estimates.

5.2 Suggestions for further Research

Research in the field of international reserves is limited in Kenya to date yet the scope of study in this area is wide. For example an investigation into the currency composition of reserves would be highly welcome. Another area would be to look at the reserve adjustment under the various balance of payments positions. The paper 'lumped' the three exchange rate regimes together. A move to analyse each separately would also be highly recommended. All these will be enlightening for policy options on reserves in the economy.

APPENDIX

APPENDIX I

YEAR	RESERVES	M	XGS	GDP	DC
1967	573	2586	2506	8751	1293
1968	737	2709	2644	9595	1341
1969	1225	2814	2881	10416	1440
1970	1586	3407	32072	11499	1879
1971	1230	4259	3423	12845	2527
1972	1416	4323	4002	14447	3019
1973	1603	5036	4812	16761	3990
1974	1347	8676	7144	20342	5101
1975	1427	8260	7138	23846	6414
1976	2301	9232	9434	29072	7475
1977	4259	11752	13004	37197	9254
1978	2732	15860	11862	41163	12570
1979	4780	14732	12002	45437	14352
1980	3784	21054	15066	52649	16230
1981	2577	20914	15474	60462	20264
1982	2957	20188	17552	70279	26058
1983	5459	20284	19927	79626	25944
1984	6444	24639	23410	89279	28628
1985	6807	26540	25524	100831	32174
1986	7115	30129	30334	117472	41025
1987	4753	34682	27992	131169	49139
1988	5558	41086	33084	151194	52529
1989	7310	52247	39554	171589	54686
1990	6630	61390	51186	195536	66589
1991	5339	63326	60512	220870	77992
1992	6315	69041	69287	258081	91325
1993	34527	118783	134918	323012	81226

APPENDIX II

YEAR	NER	r	SIGMA	FSS
1967	7.143	4.33		0.5819
1968	7.143	5.35	0.0837	0.5579
1969	7.143	6.69	0.0007	0.5468
1970	7.143	6.44	0.0182	0.5752
1971	7.143	4.34	0.0883	0.5981
1972	7.143	4.07	0.0282	0.5762
1973	6.900	7.03	0.0223	0.5876
1974	7.143	7.87	0.0302	0.7777
1975	8.260	5.82	0.0163	0.6457
1976	8.310	4.99	0.0133	0.6421
1977	7.947	5.27	0.0378	0.6655
1978	7.404	7.22	0.0366	0.6735
1979	7.328	10.07	0.0294	0.5884
1980	7.569	11.33	0.0188	0.6861
1981	10.286	14.70	0.0209	0.6018
1982	12.725	11.07	0.0013	0.5370
1983	13.796	8.95	0.0241	0.5050
1984	15.781	9.89	0.0049	0.5382
1985	16.284	7.73	0.0011	0.5163
1986	16.042	6.13	0.0013	0.5147
1987	16.515	6.01	0.0180	0.4778
1988	18.599	6.89	0.0017	0.4906
1989	21.601	7.96	0.0051	0.5350
1990	24.084	7.36	0.0039	0.5757
1991	28.074	5.52	0.0561	0.5607
1992	36.216	3.62	0.0014	0.5360
1993	68.163	3.32	0.0449	0.7854

KEY TO THE APPENDICES

The appendices I and II above give the data used in the study. All the variables are as defined in the text and where:

RESERVES = Nominal gross international reserves

M = Nominal imports level

XGS = Level of nominal exports

GDP = Nominal Gross Domestic Product in market price

DC = Level of Domestic Credit

NER = Official nominal exchange rate: The KShs per US$ rate

r = US treasury bill rate

SIGMA = The coefficient of variation of detrended reserves measuring the variability of international payments

FSS = Foreign trade sector size given by X+M/Y

Note: All the values are end of year figures.

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