

THE ROLE AND DETERMINANTS OF MONEY SUPPLY:  
THE CASE FOR ZAMBIA (1970-1998).

BY

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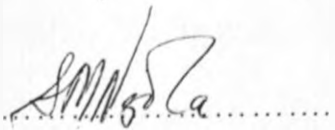
DECLARATION

This research paper is my original work and has not been submitted for a degree in any other University.



ZULU, J.J.

We the undersigned duly declare that this research paper has been submitted for examination with our approval as University supervisors.



Dr. S.M. Ngola

.....  
Mr. E.S. Nyongesa

## DEDICATION

This paper is dedicated to my family (wife Rhoda and children Michael, Rebecca and Joseph J. jr.) who not only supported me through prayers but also bore the brunt of my long absence from home! Particularly I have been a harsh father to my son Joseph in that I only saw him 8 months after he was born! However, the consolation is that the good Lord Jesus Christ was able to succour and "cement" our hearts despite the vast distance between Lusaka and Nairobi.

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Lastly, the views expressed in this paper, as well as any errors thereof, are my sole responsibility and should not be construed as those of the supervisors or any member of the academic staff.

## **ABSTRACT**

This study is an attempt to evaluate the role and determinants of money supply in Zambia using the money multiplier approach over a period of 28 years (1970-1998). Various factors were analysed and from the results it is vividly clear that the constituents of money supply are diverse and unique in their own right. Fiscal operations reflected in significant Bank of Zambia claims on government (BOZCG) which go to finance government expenditure (GEXP) were found to have a dominant influence on the money supply growth patterns in the economy. This empirical evidence is consistent with the commonly held view that there is a close link between fiscal operations and growth in money supply.

The overall impact of balance of payments (BOP) was found to be good for a build up of foreign reserves at the central bank and their total effect on money supply was rather insignificant. Past changes in Net Foreign Assets ( $\Delta NFA_{t-1}$ ) were also found to have some fairly significant dominance in explaining money supply patterns- a condition that suggests that the central bank does not completely sterilise the effects of external influence on the domestic economy. The cash (C/M1) and excess reserve (R/M1) ratios were found to be significantly influenced by changes in the real income (GDP).

The study also brings to the fore the aspect that the exchange rate (XRTE) if left to its own devices as the case is now, could be a source of destabilisation to money supply growth rate and hence needs to be watched closely. In this regard, it was felt that a managed float as opposed to a complete float would be ideal under the current scenario where most economic fundamentals such as GDP growth rate, export earnings, and the manufacturing sector are not performing well. It was further noted that since the central bank is not completely free from political influence, the bank should therefore intensify the usage of OMOs and discount rates as tools for mopping excess liquidity from the main arteries of the economy.



## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 BACKGROUND

In discussions about the efficacy of various monetary policy instruments, attention is often focused on analysing the money supply process. Although the basic framework of analysis is similar in all economies-developed, less developed or undeveloped- the money supply process itself is highly differentiated, depending on a variety of factors, such as the openness of the economy, the level of financial markets, their degree of integration, and so on. If the economy is insulated, monetary policy tends to have a far more pervasive impact on the money supply variations than it does in an open economy where short-term capital movements are unhampered (Khatkhate and Villanueva, 1972,1973).

Similarly, the nature of the institutional environment also influences the behaviour of the financial system, as has been amply borne out by the experiences of the United States and Germany. While variables such as movements in excess reserves, borrowings from the central bank, free reserves and so on, constitute a special feature of the US institutional milieu, there is no such a phenomenon as excess reserves in Germany. Hence, the specification of models of the money supply process in different countries varies qualitatively.

"The first and most important lesson that history teaches is about what monetary policy can do-- and is a lesson of the most profound importance--is that monetary policy can prevent money itself from being a source of economic disturbance"(Milton Friedman, 1968). This statement goes to underscore the significance of money in the economy and why it is necessary to pay particular attention to its growth patterns.

Therefore the formulation of an optimum monetary policy to achieve economic objectives of full employment, rapid economic growth, price stability, and balance of payments equilibrium would be simple and straight forward if policymakers knew completely and precisely how monetary aggregates and money market conditions are

related to the economy. Barring this, the problem of trade-offs and conflicts that exists among policy objectives make macroeconomic management a difficult exercise. For example, in the short-run, an attempt to achieve rapid economic growth may likely generate inflationary pressures, and consequently have adverse effects on the balance of payments situation of a country. In order to minimise the conflicts among policy objectives and to achieve desired policy targets, the monetary authority can manipulate variables that are under its direct control to effect changes indirectly in other policy variables to arrive at its ultimate goal (Meltzer, 1969). This study is an attempt to investigate the role and determinants of money supply in an open and liberalised economy using the money multiplier approach. By money multiplier we mean the number of times by which the money supply exceeds the volume of reserves or the ratio of the stock of money (money supply) to the stock of high-powered money<sup>1</sup> We shall further explore the impacts of fiscal operations on the money supply process as we strongly believe that they are a conduit through which money filters into the main arteries of the financial system.

A cursory glance at the balance sheet of an integrated banking system helps us ascertain the relative contributions of the fiscal deficit financing and other sources, particularly external resource inflows, into monetary developments. The balance sheet of the integrated banking system would be (Anand and Van Wijnbergen, (1989) as quoted in "Ghana: Monetary Targeting and Economic Development" by Dordunoo and Donkor):

<b>Assets</b>	<b>Liabilities</b>
NFA	NW
CG	CU
CP	DD
O	TD

Where,

NFA = net foreign assets

CG = net claims on government

CP = bank lending to private domestic sector

---

<sup>1</sup> Dornbusch and Fischer, 1980.

O = other assets

NW = net worth

CU = currency

DD = demand deposits

TD = time deposits

However, if we use a broader definition of money, M2, the right handside would have two variables only (M2 and NW) since CU, DD, and TD constitutes M2. In this framework, fiscal operations of the government would affect money supply in that the (NCG) item on the assets of integrated banking system balance sheet is raised, and this is balanced in most times by currency issue (CU) on the right handside. This therefore increases money supply.

## 1.2 MONETARY DEVELOPMENTS IN ZAMBIA

### 1.2.1 MONEY SUPPLY

Borrowing from the integrated banking system balance sheet above, the asset side of the Bank of Zambia can be represented in form of an identity as:

$$M_t = NFA + CG + CP + O \quad (i.)$$

Where

NFA = net foreign assets'

CG = claims on government

CP = credit to the private sector

O = other assets

In terms of changes in the equation above, the equation becomes

$$\Delta M = \Delta NFA + \Delta CG + \Delta CP + \Delta O \quad (ii)$$

Representing the money supply in terms of net domestic credit and net foreign assets the equation becomes:

$$M_s = NDC + NFA \quad (iii)$$

$$\Delta M_s = \Delta NDC + \Delta NFA \quad (iv)$$

Where,

NDC = net domestic credit

NFA = as defined before

Ms = money supply

Domestic credit plays a significant role in the money supply developments. Government borrowing reduces the credit that would otherwise be available to the private sector, thereby putting pressure on domestic interest rates. Increases in the domestic interest rates may contribute to a rise in the rate of inflation due to increases in production costs. There is therefore need to restrain government borrowing especially from the central bank. There is evidence of the dominance of domestic lending (loans and advances) in the assets of commercial banks and claims on government for the Bank of Zambia (see Bank of Zambia Annual Reports-1996, 1997, 1998, 1999 Issues).

Commercial bank lending in this case captures the financing of the parastatal sector deficit. All in all, the combination of loans and advances and claims on government shows how the overall deficit financing contributes to high-powered money in the economy. Referring to the balance sheet framework outlined earlier, this would therefore add to monetary developments in the economy. Thus there is a close link between fiscal operations and money supply. This framework is also supported by Collier and Gunning (1991) who, after redefining the fiscal operations to include parastatal borrowing, found a close link between the budget and money supply.

Money matters if variations in the money stock exert a systematic effect upon macroeconomic variables that economists feel are important. Two categories of macroeconomic variables exist: real and monetary. Real variables comprise the level of output, employment, real wages, and real interest rates. In general the criterion used for evaluating the importance of money is whether or not it influences the real equilibrium profile of the economy. If variations in the money supply have no effect on the real system then money is neutral or money does not matter. While some economists also recognise the influence of money on some nominal measures, notably the rate of inflation, the importance of this is seen in the context by which variations in inflation (caused by variations in the rate of growth of the money supply) destabilise the economy and knock it from its equilibrium growth path.

Zambia, like many other developing countries has been grappling with the problem of monetary shocks defined as sudden but persistent changes in the growth of money supply, resulting either in an increase or decrease of the money supply. For instance, in 1970 growth in M1 (narrow definition of money comprising currency in circulation and demand deposits) was 2.6% reaching 20.6% in 1975 only to drop to -0.8% in 1980. The trend continued rising such that by 1990 M1 growth rate stood at 61.9% percentage points (see table of money supply components below). Despite interventionary measures being undertaken by monetary authorities nothing much seemed to have changed. In 1993, money supply grew by 107.2% as against the target figure of 35% (Budget Speech, 1994). It was said that more than 60% of this growth was due to a rapid increase in bank lending. Equally of concern to the monetary authorities are the issues of inflation and interest rates which have been moving in tandem with a persistent upward movement – a sign of overheating in the economy. The reasons being advanced for the high growth rate in money supply, among others, are that the central bank (Bank of Zambia) claims on the government have been rising uncontrollably.

For instance, in 1991 government borrowing from the central bank rose by a staggering 652% reflecting huge fiscal deficit funding from the monetary authorities. The resultant effects of such unprecedented changes in the money supply have been price instability in the economy. Price instability is a recipe for economic chaos as it tends to affect investment and savings decisions adversely. In Zambia, price instability is an old phenomenon that seems to emanate from disequilibrium in the money market occasioned by excessive credit expansion by commercial banks to the private sector, government borrowings from the central bank, and high demand for currency by the non-bank public. This assertion is supported by the sentiments of our Minister of Finance in his 2001 Budget Speech who observed that there had been an unenviable growth in the money supply over the years coming from the banking sector and that this was the source of inflation in Zambia.

Undoubtedly, Zambia in the last three decades has experienced unprecedented volatile upswings in the growth of money supply with severe inflationary and interest rate trends. This has been a source of concern to both the fiscal and monetary authorities as reflected in various policy documents released on the need to contain the growth of money supply as a basis for stabilising the economy. Whatever channel through which domestic money supply increases or decreases, the role of BoZ is crucially important in controlling the sporadic changes in the money supply (see Table below for money supply components).

**Table shows the annual growth rates for various components of Money Supply and Inflation Rates (CPI), (1970-1990).**

Year	Reserve Money Growth	Money, M1 Growth	Money, M2 Growth	Inflation Rate (CPI)
1970	48.0	2.6	-26.3	2.7
1971	-34.9	6.8	-10.4	6.0
1972	18.5	1.4	7.1	5.1
1973	31.2	20.6	21.8	6.5
1974	-7.6	9.4	6.1	8.1
1975	42.9	21.2	11.9	10.1
1976	26.6	17.0	26.5	18.8
1977	-1.4	2.6	12.1	19.8
1978	5.2	1.3	-8.5	16.3
1979	4.8	31.0	30.1	9.7
1980	13.9	-0.8	9.0	11.6
1981	16.5	10.5	8.1	13.0
1982	15.6	21.2	33.5	13.6
1983	14.0	14.7	10.3	19.6
1984	17.7	10.8	17.9	20.0
1985	22.4	41.8	23.5	37.3
1986	170.9	87.3	93.1	51.8
1987	40.7	40.0	54.3	43.0

1988	99.9	62.7	61.6	55.6
1989	30.9	61.6	65.2	127.9
1990	78.2	61.9	48.5	117.5

Source: IMF International Financial Statistics, CSO and the Bank of Zambia.

From the table M1 growth rate stood at 2.6% in 1970 and by 1985 it had peaked 41.8 percentage points representing an increase of 31.9%. By the turn of the 1980s the figure stood at 61.9% while inflation rates shot up from a paltry figure of 2.7% in 1970 to an all high of 117.5% in 1990. The situation is not different for M2 and reserve money which both showed upward trends—a situation indicating excessive growth in money supply.

Implicitly speaking, monetary authorities can determine the pattern and growth of money supply. However, this is an assumption that requires a careful re-evaluation in light of the recent controversy between the monetarists and non-monetarists on the question of the monetary authorities' ability to control the stock of money.

Monetarists, in general, argue that the monetary authorities can exercise effective control over the stock of money; others, especially those who share the new view of monetary theory, argue that the determination of the money stock is part of the simultaneous solution for all variables in the financial and real sectors of the economy. In this view, the stock of money is determined not only by the policy actions of the monetary authorities but also by the behaviour of the public in various assets and commodity markets and is not subject to close control by the monetary authorities. Monetarists do not necessarily deny that both the real and financial sectors influence the stock of money; rather, their argument is that the behaviour patterns of the public and the banking system are stable and predictable enough to permit the monetary authorities to control the stock of money. The issue between the monetarists and non-monetarists is therefore empirical.

### 1.2.2 THE POST 1991 PERIOD

Against a background of severe economic haemorrhage that included high inflationary pressures, distorted domestic interest rates and a misalignment in the exchange rates, the

government of the Movement for Multi-Party Democracy (MMD) launched the New Economic Recovery Programme (NERP) in 1992 under the auspices of the IMF and the World Bank. The main thrust of this Programme was to revamp the ailing economy through a series of reforms and therefore minimise imbalances and establish a path to sustainable growth. To this end, far-reaching reform measures have been instituted over the years which included decontrol of the exchange and interest rates, trade liberalisation, financial management reforms and the rehabilitation of the social and economic infrastructure (Mwansa, 1998). Maintaining money supply growth rates which are consistent with growth in the GDP have been the cardinal feature of the NERP. Efforts have mainly focussed on reducing both budgetary deficits and recourse to bank financing.

Various research works seem to suggest that the monetary authorities could best achieve economic objectives by controlling the growth rate of money supply.<sup>2</sup> In most of the Least Developed Countries (LDCs) the sources of the monetary base are the central bank credit to the government, central bank credit to the commercial banks<sup>3</sup>, and the central bank net holdings of foreign assets. Central bank credit to the government is dominated by the budgetary operations of the government, on which the monetary authorities have little influence. The second source of the monetary base has been used as an instrument of money control in many LDCs. As Laidler (1978) noted, "... it has been those countries which have paid most attention to the behaviour of money supplies that have suffered the least from instability in money income, and those which paid the least attention to monetary policy that have experienced the most instability in money income." This assertion also goes to magnify the importance of money stock as a policy variable that authorities should target. This is especially true for developing countries where the Keynesian transmission mechanism may not work efficiently due to the thinness of the financial markets.

In a strict sense the nominal money supply is exogenously determined, i.e. the monetary authority or the central bank supplies it but the real money supply is endogenously

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<sup>2</sup> Burger, A.E., Kalish, L. and Babb, C.T. (1971)



determined since the price variation cannot be fixed. Put differently it is determined by the following factors: the central bank's behaviour, the behaviour of the non-bank public and the behaviour of the commercial banks.

### 1.3 STATEMENT OF THE PROBLEM

As noted in the introductory remarks, Zambia has over the years sustained a budget deficit of monumental proportions triggering high money supply growth in the economy. For instance, between 1975 and 1991, it averaged 13.8% of the GDP (See Atta, 1998). With dwindling external financial assistance the country has had to rely more on domestic borrowing, i.e. from the central bank and in some instances from the commercial banks. Despite the introduction of cash budgets in 1993 as a tool for checking high government expenditures very little seem to have been achieved in terms of eliminating the fiscal deficits. In fact, one would be excused for arguing that there has been gross fiscal indiscipline on the part of the government that requires some drastic corrective measures.

Furthermore, in an economy where financial markets are not well developed, the non-bank public tends to hold huge amounts of cash in order to meet their day-to day transactions and precautionary demands. All these factors have a bearing on the money supply process of any given economy and Zambia is no exception.

It was in this spirit that the government in conjunction with the International Monetary Fund (IMF) and the World Bank embarked on the structural adjustment programmes (SAPs) in the late 1970s and for most parts of the 1980s. The main objective of these policies was to realign and restore the macroeconomic stability in order to rejuvenate the growth of the economy. Full trade and financial liberalisation reforms were seriously embarked on in 1992 soon after change of political governments (see introductory remarks).

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<sup>3</sup> Here we assume that the Central Bank does not extend credit to the private non-banking public sector directly, but this may not be true in some LDCs.

There have been some attempts to explain the money supply process in Zambia e.g. Atta in 1998 carried out a similar study but using a small sample of 21 observations and the results, in his words, were not very impressive in terms of explanatory power (See Literature Review). This means that there is a gap in information warranting another study that will comprehensively address the role and determinants of money supply in Zambia.

Prior to the introduction of SAPs, especially before 1992 the central bank used to employ credit ceilings, sectoral-guided credits, interest rate controls, reserve requirements, etc as tools for arresting the growth in money supply as a basis for economic stabilisation. Despite these efforts, money supply swings were never smoothed out as reflected in high domestic interest and inflation rates. It was therefore felt that the only way to deal effectively with unstable growth in money supply was for the Bank of Zambia to use indirect control mechanisms such as Open Market Operations (OMOs), discount rates, and repurchase agreements with commercial banks, among others (see Mwenda, 1997). In some countries that had adopted these indirect control measures such as Kenya (Ndung'u, 1999) and Ghana (Dordunoo and Donkor, 1998), these were found to have worked fairly well as tools for mopping excess liquidity from the financial system.

In trying to address the problems of volatility in the money growth, this paper sets to answer the following questions: what constitutes the money supply process in Zambia? Or what economic variables determine the money supply in Zambia? What effects do changes in the various components of money supply have on the overall conduct of monetary policy? To answer these questions, we shall lean on the economic literature which suggests that there are essentially two basic approaches to the analysis of money supply: the money multiplier and the credit counterpart (or flow of funds) approaches (Artis and Lewis, 1990). The multiplier approach, which specifies the quantity of nominal money as the product of a multiplier and high-powered or monetary base, is well known. In most cases what are often not explained well are the determinants of the multiplier and the high-powered money, and which therefore make the money supply

highly endogenous. The flow of funds approach or the credit counterpart approach is used by monetary authorities to identify the sources of liquidity in the economy.

#### **1.4 STUDY OBJECTIVES**

This study takes cognisance of the fact that the Zambian economy has moved from a command oriented to a market driven one under the guise of full trade and economic liberalisation. In light of this, the broad objective of this study is to evaluate the role and determinants of the money supply process in Zambia in the context of pre and post financial reforms of 1992.

The specific objectives of the study are:

- i) To present a robust econometric model or system of equations that capture the various constituents of the money supply;
- ii) Estimate and analyse the empirical results of the econometric model formulated in (i) above
- iii) Draw policy implications based on (i) and (ii).

#### **1.5 JUSTIFICATION AND SIGNIFICANCE OF THE STUDY**

This study is important in understanding the effects of changes in money growth on price stability over extended periods, thus helping policymakers to predict and target the overall objective of economic stabilisation. Thus the study findings are important for both policy making and academic purposes. At the policy level, the control of money supply has been central to both monetary and fiscal authorities in the last couple of years as demonstrated in various Budget Speeches. The concern of the Zambian Government at the moment is to keep money growth and inflation targets within the expected real GDP growth and hence maintain a stable financial system. From what we have highlighted in the "statement of the problem", there is need to carry out a comprehensive study on the role and determinants of the money supply process in order to fill the gap in information in this field.

Though Atta (1998) did try to analyse the money supply process in Zambia, his study was not broad enough to capture the whole components of the money supply. Thus this

present study updates the works of Atta and hopes to provide detailed current information on the money supply process in Zambia. The focus of this study is to give correct and predictable results. It is our contention that the system of equations to be specified and later estimated would go a long way in aiding policymakers to design sound and appropriate monetary policy. On the basis of the stated reasons, this study is justified.

## **1.6 ORGANISATION OF THE STUDY**

This paper consists of five chapters. In the first chapter we present an introduction to the topic of research which highlights the background to Zambia's money supply process. Then comes the statement of the problem, research objectives and justification of the study in that order. Chapter two looks at both theoretical and empirical literature on the money supply process focussing mainly on those studies that have a bearing on the third world conditions in which Zambia is found. As per our academic tradition, a critique on the articles reviewed is provided highlighting the differences with our study and how we intend to improve upon the existing body of knowledge through this current research work. Chapter three provides the methodological framework of this research bringing out the model specification and estimation techniques employed. We further present data description and source. In chapter four, data analysis, empirical model specification and results are presented. Chapter five puts a 'lid' on the research by presenting the conclusions, summary, policy implications, suggestions and findings of the study.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

Theoretical literature on the money supply as it relates to the money multiplier is reviewed after which empirical literature is considered.

### 2.1 THEORETICAL LITERATURE

The most important questions to answer in monetary management are: How broad should the money supply be? Should M1 be the target variable or M2? That is, which monetary aggregate should the central bank work with in order to achieve optimal and consistent results in economic management? What instruments should be used to control monetary targets? How do internal and external shocks impact on the money supply process? In order to address these and many other questions we need *to* provide a theoretical framework within which to operate. The underlying presumption in the effective monetary policy depends among other things, on the constancy and predictability of the money multiplier, that is, a stable relationship between money stock and the economic variables such as prices, interest rates and real income (see Friedman, 1959). Monetarism was at the height of its influence on economic policy-making in the late 1970s and early 1980s and, and has continued to influence modern day policymaking especially in central banks. As can be expected, at the heart of monetary recommendations is the use of monetary policy, by which we mean the conduct of open market operations, discount window restrictions, control of reserve requirements, etc. by the central bank in order to influence output and prices. In contrast, the early Keynesians tended to stress the role of fiscal policy in stabilising the macroeconomy—a position reinforced by the famous 1959 Radcliffe Committee report on British monetary reform, which engendered an intra-Keynesian debate on the role of monetary policy (See Kaldor (1960,1982) as reproduced in Friedman, 1958 for a review).

According to the monetarists, the central bank controls the money supply through its control over high-powered money (Brunner, 1991). They purport to find a high correlation between the rate of growth of money supply and price instability, which has led them to believe that money causes price instability. Thus price instability is attributed

to the central bank policy through which excessive reserves are created, allowing banks to create excessive money balances. When the nominal money supply is increased, this induces an adjustment process through which nominal prices rise and real variables (such as permanent income-to which the demand for real balances is linked) increase until excess nominal balances are eliminated (Friedman, 1989).

Early Chicago economists such as Lloyd Mints (1945,1950) as quoted in Friedman and Schwartz (1963) had recommended the use of monetary policy and specifically changes in money supply for price stability-in lieu of other tools, such as fiscal policy, the gold standard, commodity reserve currencies, etc. which were being proposed in the early 1930s. In particular, following the conventional monetary disequilibrium cycle theories of the day, they believed that a lot of fluctuations in money supply intensified uncertainty and worsened the cycle. What they tended to recommend was a strong central bank with complete control of the supply of money to the point of requiring 100% reserve requirements on deposits. They sought to endow the Federal Reserve Bank (central bank of the United States) with a monetary policy stabilisation mandate restricted to stabilisation of the price--all combined with highly flexible and competitive labour and goods markets that would permit quick adjustment to equilibrium. This stance was referred to as the "Chicago Plan" (See Hart, 1935 as reproduced in Friedman (1956)

In his early pioneer work Milton Friedman (1958) followed on the Simons-Mints "Chicago Plan" views and recommended the use of a counter-cyclical monetary growth policy. Specifically, he proposed that the Federal Reserve set a policy of expanding money supply during recessions and contracting it during boom in order to stabilise the price level in a "buffer stock" manner. Later he reversed his policy stance, particularly in his famous *Program for Monetary Stability* (1959), where he dropped the countercyclical monetary policy rules of the Chicago Plan and opted in favour of a "constant money growth rule." Such a rule had been earlier advocated by James W. Angell (1933,1936) and Clark Warburton (1952 as quoted in Friedman (1959).

Specifically, Friedman, (1959,1962 as quoted in Kilindo (1997)) proposed that instead of trying to smooth out the cycle, the Federal Reserve should just follow a strict rule of expanding the money supply at a steady rate. In his evidence to a Senate investigation of monetary policy in 1980, Professor Milton Friedman criticised the attempt to control the money supply indirectly via income, interest rates, and hence money demand, rather than directly through a system of monetary base control. According to him, if the money multiplier could be relied upon to be stable, the monetary authorities could control the money supply by influencing  $H$ , the stock of high-powered money in the financial system. This is what is known as the monetary base control and forms the backbone of this study.

Friedman's logic can be expressed in terms of the *Quantity Theory of Money*. In dynamic form, the equation of exchange implies  $g_m + g_v = g_p + g_y$ . Assuming  $g_v = 0$  (or nearly so) and given that output has grown at a historical average of 3% per year, then in order to avoid inflation or price instability (i.e. keep  $g_p = 0$ ), the Federal Reserve should expand the money supply yearly by 3% (he actually recommended 3 to 5 percent per year). Most Monetarists took up Friedman's suggestion.

In all these arguments what should be noted is that the Federal Reserve can actually control the supply of money through the monetary base ( $H$ , currency and reserves). Above this, are more fluid categories of "narrow money", M1 (currency and demand deposits) and "broad money", M2 (M1 plus some time deposits) or even broader measures such as M3, etc. All these aggregates are related to each other via a "money supply process", as delineated by Friedman (1958) and followed up by Brunner and Meltzer (1964), Cagan (1965) and many others since. The central ingredient of this process is the "deposit money multipliers" which connect the different money supply aggregates with the supply of monetary base

However, several writings on the subject of money supply while acknowledging the important role of the money multiplier in determining money stock seem to agree that the multiplier is non-constant. One such writer was Jordan (1970) who stated that the factors

that cause changes in the money multiplier are the same factors that influence currency, time deposits, government deposits and the reserve ratios which are behavioural parameters. He contends that lack of constancy of the money multiplier makes the central bank's task of determining the money supply difficult. In this regard, the central bank must predict the value of the multiplier in order to know how much to increase the monetary base to achieve a desired level of the money stock. The article does not go into the techniques of predicting the multiplier. He concludes by saying that the degree of accuracy that can be achieved by the monetary authorities in controlling the money stock is a function of their ability to determine the monetary base, and to predict the net influence of the public's and banks' behaviour as summarised by the multiplier (See also Birech. 1992).

## **2.2 EMPIRICAL LITERATURE REVIEW**

Khatkhate and Villanueva (1972) carried out a study of the behaviour of the money multiplier in the United States. Justifying their study by stating that a distinction is often drawn between changes in money supply arising from changes in the monetary base and those emanating from variations in the value of the money multiplier, they assert that only the former are reasonably regulated by the central bank but changes induced by the latter tend to vary considerably. After various estimations they concluded that if the authorities have confidence in the value of the multiplier derived from the model, they can adjust the magnitude of their open market operations to desired changes in money supply, or they can implement a more aggressive discount rate policy, supplemented by quantitative ceilings in order to discourage bank borrowings.

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

Burger et. al (1971) carried out a study on the control of the money stock and its implications for monetary policy. The study was mainly concerned with the



implementation of policy decisions. The procedure they developed involved the estimation of changes in the source of base (or some other reserve aggregate) required to achieve the policy determined growth path for money.

The procedure requires that the Federal Reserve System has information about the previous three months' of the money multiplier and the effect of the reserve requirement changes. The Federal Reserve would then operate on a day-to-day basis to determine the growth of the source base.

They used the multiplier base framework, where money stock ( $M$ ) is expressed as

$$M = m.B$$

Where,

$B$  = net source base and  $m$  represents the multiplier

They estimated using the OLS technique employing 36 months' observations and came to the conclusion that policymakers must have some means of comparing effects of different control procedures on their ability to achieve their policy objectives in order to decide which procedure is best.

Bhatia (1991) in estimating the factors that influence changes in money supply in the BCEAO countries used the following model:

$$\Delta M = \Delta M_1 + \Delta M_k, \quad \text{and} \quad (1)$$

$$k = \frac{1}{c + r(1 - c)} \dots \dots \dots (2)$$

$c$  = the ratio of the currency with the public to money supply and  $r$  is the ratio of commercial banks' cash reserves to their demand deposits. He found that about 40% of the changes in money supply in the BCEAO countries were attributable to the change in the money multiplier and about 60% were due to changes in the monetary liabilities. These effects varied from country to country. Changes in the  $c$  and  $r$  were also responsible for changes in the monetary supply. Bhatia concluded by saying that the

entire variation in the monetary supply attributable to changes in the money multiplier was behavioural and not policy induced.

Khan (1974) carried out a similar study on the Venezuelan economy. Emphasis was placed on a short-term model constructed for forecasting the whole economy. The portion dealing with money supply was specified as a behavioural function of the monetary base. Assumptions were made that the supply of money in period  $t$  was a linear function of the reserve money  $R$  in period  $t$ , period  $t-1$ , period  $t-n$ , etc.

Khan's model was a linear relationship between reserve money and money supply. This ensures no change in the behaviour of the public or banks, that is, the money multiplier is constant. (See Birech, 1992). In such a model it becomes difficult to analyse the effects on money supply of monetary policy instruments such as legal reserve requirements and/or interest rate relations.

Khatkhate, Galbis and Villanueva (1974) improved upon the works of Khan by analysing the determinants of the money multiplier process in an open developing economy with a fixed exchange rate, using Venezuela as an example. The Venezuelan economy differs from a developed one in that the Venezuelan banking and financial structure is relatively unsophisticated and to some extent internally fragmented. The financial asset holdings by the four sectors of the economy-household, corporate, government, and financial-are relatively less diversified than one would expect in a developed economy. In this respect the Venezuelan economy is a good replica of most LDCs' economies since they have similar characteristics.

They divided the sample period into two: 1950-1970 and 1950-1972 and specified the following model:

$$\ln(C/TD) = a_0 + a_1 \ln RVZ + a_2 \ln GDP; \quad a_1, a_2 < 0 \quad (1)$$

$$\ln(R^e/TD) = b_0 + b_1 \ln RVZ + b_2 \ln Rus; \quad b_1, b_2 < 0 \quad (2)$$

Where,

$C/TD$  = currency-deposit ratio

RVZ = domestic interest rates

GDP = gross domestic product in current prices

$R^e/TD$  = level of excess reserves to total reserves

Rus = foreign interest rates

After estimations they found that the coefficients were of correct signs and the overall performance of the equations as indicated by the adjusted  $R^2$  was also good. In their conclusions they observed that the required reserve ratio was the main policy instrument affecting the value of the money multiplier.

Black (1975) in his study of the money multiplier admitted that the main determinants of the money supply included the monetary base and currency ratio. He went on to examine the British liquidity school which stresses that money should include the deposit liabilities of banks and non-bank financial institutions. After various estimations and tests he arrived at the conclusion that the currency ratio is an important determinant of money supply. In his view the choice of definition of money was an important aspect for monetary authorities.

In another study of a developing nation, Ojo (1975) in an effort to forecast the money multiplier for Nigeria argues that there is nothing unique about the money multiplier but that it is dependent upon the definition of the monetary base and of the money supply itself. He used four money multipliers in his analysis based on the various definitions of money e.g. M1, M2, M3, and M4 and found that broader definitions of money yielded poor results while narrower definitions tended to give good predictive abilities with or without seasonal dummy variables. This suggests that narrow definition of money (M1) is the most useful definition of money stock for purposes of control and economic stabilisation.

Butler et.al (1979) using Switzerland for a case study computed the money multiplier and noted that under conditions of fixed exchange rate any expansion in the monetary base must in practice be due to an increase in foreign exchange reserves. When the flexible

exchange rate was introduced it did not alter the result significantly because Switzerland hardly employed open market operations. The outcome of their analysis indicates that the money multiplier can reliably be predicted.

McCallum (1989) observed that if  $M^*$  is the targeted money stock central bank has two options to achieve it. For a given money demand it can either set the monetary base ( $H$ ) or the interest rates ( $i$ ) such that the money supply function yields  $M^*$ . In McCallum's model, high-powered money and interest rates are both operating instruments directly manipulated by the central bank. In his view interest rate control derives from the institutional fact that the " Fed maintains a huge portfolio of marketable US government securities, including Treasury bills and bonds". In his conclusions, he suggested that in situations where money demand shocks dominate, monetary base targeting should be preferred, while in the case of a dominantly unstable money supply, interest targeting should be the favoured procedure. However, for the Zambian case, monetary targeting would be more appropriate than interest targeting because Situmbeko (1998) and Mutoti (1997) found that the money demand shocks were dominant in the economy.

Johannes and Rasche (1979) attempted through their study to predict the money multiplier. They used time series models of the individual money multiplier components i.e. the currency ratio, time deposit ratio, government deposit ratio, and so on. Following this methodology they concluded that the money stock could be predicted with considerable accuracy over several months given knowledge of the path of the monetary base.

Bolnick (1975) in his analysis found that the monetary base fluctuated more than M2 with changes in the multiplier tending to dampen the instability. By observing the currency ratio and the change with respect to the multiplier, he arrived at the conclusion that cash and bank deposits caused or contributed little to the variation in the money multiplier while the behaviour of the banking system (liquidity ratio) had a significant contribution to the variation. He considered liquidity ratio (reserve requirement) as one factor that explains the instability of the relationship between the monetary base and the

money supply. He thus suggested that the monetary authorities must be able to predict or control credit creation by commercial banks.

Mwega (1990) updated the work of Bolnick and found that the liquidity ratio was more volatile than the currency ratio. In order to explain the causes of changes in the liquidity ratio, he tried such determinants as cost of credit (lending rate), demand for credit and deposit structure, stance of monetary policy measured by minimum liquidity ratio and growth in the monetary base. From his analysis he observed that the growth of the liquidity was the strongest cause of variation in money supply. He observed that while the negative correlation between the multiplier and the monetary base stabilises money supply, it might in the process frustrate monetary policy. This was so because the money multiplier tends to counteract variation in the monetary base.

Birech (1992) basing his study on the Kenyan economy demonstrated that the money multiplier varies depending on the definition of the money stock. He observed that the money multiplier for Kenya was unstable but appeared less unstable when money stock was defined as M1 as opposed to when it was defined as M2. Borrowing from the works of Villanueva et.al (1974), he specified the following model:

$$C/TD = a_0 + a_1TB + a_2Y + a_3DD \quad a_1, a_2 < 0; a_3 > 0$$

$$R^e/TD = b_0 + b_1AD + b_2D + b_3DD + b_4MB + b_5LA \quad b_1, b_2 < 0; b_3, b_4, b_5 > 0$$

Where,

C/TD = currency-deposit ratio

TB = treasury bill rate as a proxy for domestic interest rates

Y = gross domestic product

DD = ratio of demand to total private deposits

R<sup>e</sup>/TD = excess reserves to total deposits

D = total deposit liabilities

MB = growth in liquidity

LA = liquidity ratio

The equations were estimated using the OLS and the results showed that the Durbin-Watson and the F-statistic were generally good but the coefficient of determination ( $R^2$  at 0.519) suggested that some relevant variables might have been left out of the model specification. The signs attached to the coefficients were as hypothesised meaning that theory had not been violated.

He concluded that the money multiplier was non-constant and a narrower definition of money stock might facilitate easier control of the money supply than the broader aggregates of money.

### 2.3 SPECIFIC STUDIES ON ZAMBIA

J.A. Atta (1998) carried out an analysis of the money supply process in Zambia covering a period of 21 years. He estimated the following equations:

$$CR = \omega_0 + \omega_1 ngdp + \omega_2 popu/pop + \omega_3 dum1 + \omega_4 dum2 + \mu \quad (i.)$$

$$RR = \sigma_1 + \sigma_2 rq + \sigma_3 (lenr-disr) + \sigma_4 dum1 + \sigma_5 dum2 + \vartheta \quad (ii)$$

$$NFA = \gamma_1 + \gamma_2 BOP + \gamma_3 dum1 + \gamma_4 dum2 + \eta \quad (iii)$$

Where,

CR = ratio of currency in circulation outside banking system to total deposits of the nonbanking sector held by commercial banks (currency-total deposit ratio)

RR = reserve-total deposit ratio

ngdp = gross domestic product

popu = urban population (thousands)

pop = total population ( thousands )

lenr = lending rate of interest (%)

disr = discount rate of interest (%)

rq = required reserve-total deposit ratio (%)

NFA= net foreign assets

BOP = balance of payments

dum1 = dummy variable for structural breaks

dum2 = dummy variable to capture financial crisis in the economy

$\vartheta, \mu, \eta$  = are error terms.

After estimations the CR equation yielded a poor coefficient of determination and most of the variables were statistically insignificant. For equation (i.), he concluded that it is difficult to explain the portfolio behaviour of the nonbanking sector, given the small variation of CR over time, the assumption that CR has been constant over the years might be an appropriate assumption for monetary policy which has one year horizon.

On the reserve ratio equation, the  $R^2$  was fairly high explaining 87% variations in the dependent variable though the coefficients were not significant at 5% levels. Atta noted that the effect of required reserve ratio and the differential interest rate was doubtful. He went on to say that it would be wrong to assume that the RR was constant, and hence it would be good for monetary policy if the relationship between RR and its determinants could be firmed up by further studies using high frequency data (monthly observations). He further observed that the low reserve ratio could be the cause of the banking crisis instead of banks responding to the crisis by accumulating reserves.

As for equation (iii) the adjusted  $R^2$  was equally high though slightly lower than in equation (ii). It stood at 0.7806 and again the coefficients were statistically insignificant. Atta noted that the overall balance of payments does not appear to influence the net foreign assets. In his words if such a scenario were true then this should give comfort to the monetary policy makers in Zambia, since they can assume that their actions will not be offset by the external sector. The liberalisation of the economy seemed to have been the principal factor explaining net foreign assets. He suggested that the component of the NERP (New Economic Recovery Programme) which influences the NFA be identified. Mwenda (1997) in his study entitled " Indirect Monetary Control in Zambia" specified the following autoregressive model:

$$\ln M_t = \beta_0 + \sum_{i=1}^n \beta_{i-1} \ln M_{t-i} + u_t$$

Where,

$M$  = is broad money supply ( $M_2$ ) equal to the sum of currency (notes and coins in public hands), demand, savings, and time deposits,

$t$  = is time period equal to a month,

$n$  = number of lag length

$\mu_t$  = error term assumed to be normally distributed with zero variance

After estimations the model was found to have passed the tests of heteroscedasticity, first and higher-order serial correlation as well as normality tests. Based on the outcome of the regression results Mwenda concluded that the switch from *direct* to indirect control mechanisms had enhanced monetary policy's effectiveness in stabilising broad money supply growth and inflation in Zambia. According to him, by increasing the stability of broad money supply growth indirect monetary policy had contributed to reducing inflation. He went on to say that to the extent that indirect instruments had only improved monetary policy's effectiveness in stabilising broad money supply growth should not in itself be surprising as it merely confirmed the view that monetary policy was mainly a tool for smoothening out money supply fluctuations.

Per Ake and Boo Sjoo (2000) in their study about inflationary trends in Zambia, noted that prices were driven by money and that the monetary authorities were able to reduce price instability by restricting the money supply process during the period of the Structural Adjustment Programs (SAPs).

## 2.4 OVERVIEW OF LITERATURE

What seems to have come out in the literature is the fact that there is no universal and agreed upon definition of the money stock. This in itself means that different countries will have different money multipliers. This is to say that different economies are expected to pursue different monetary stabilisation policies aimed at arresting price instability occasioned by unchecked money growth.



Atta's findings are of particular interest to us because they form a basis for the current study it being more or less an update of the former. However, we are concerned about the poor results obtained especially in the first two equations, as they do not reflect the prevailing money supply scenario in the country. The poor results could be attributed to, among other things, the restricted number of explanatory variables used in the estimations or the transformation done to the data. We also note that Atta did not in his model capture all the external shocks that have been hitting the Zambian economy over the years. Though fundamentally different from Atta's works e.g., he uses M2 monetary aggregate in his derivation of the money multiplier while ours uses M1, our study improves upon his findings by including more estimable equations which we feel will capture the other aspects of the money supply process.

Mwenda's research is similar to that of Atta in that they both use the broader monetary aggregate, M2, in arriving at their conclusions. However, Mwer Ja does not employ the money multiplier in his approach though essentially both researchers are saying that there is need for the monetary authorities to check and control the growth of money supply as a basis for stabilising the economy. As we have demonstrated in the methodology section, in an economy where financial markets are not well developed as the case is for Zambia, M2, is not an appropriate variable to work with for policy objectives. Thus, Mwenda and Atta's findings should be seen in that context and it is on those lines that our research work differs from theirs.

Furthermore, our study differs from the other works reviewed so far by taking a departure from the traditional and mechanical money multiplier models in which currency and excess reserves are usually expressed as ratios of total private deposits of commercial banks. Ours has opted to express currency and excess reserves as ratios of the narrow monetary aggregate, M1, based on the argument given in the methodology that this variable is always a consistent and appropriate representation of money supply in an economy which lacks financial deepening.

The suggestions of Khatkhate and Villanueva on the use of quantitative ceilings on interest rates are inappropriate to this study as Zambia has fully liberalised the financial markets and it is not in the interest of the authorities to return to direct control mechanisms. As Birech (1992) rightly noted in his paper, the nature of the financial system i.e. the stage of development of the banking sector has a lot of influence on the functioning of the money supply process. Thus the approach to monetary policy formulation in a developing country like that of Zambia would differ greatly from that of a developed economy.

## CHAPTER THREE

### 3.0 METHODOLOGY

#### 3.1 MODEL SPECIFICATION AND DERIVATION

The simplest model of the money supply mechanism assumes that banks are the only financial institutions accepting deposits and that they issue only demand deposits, D. The analysis is based on two main hypotheses: (1) banks maintain cash reserves, R equal to a fixed proportion, r, of deposits reflecting either regulatory requirements or internally determined liquidity needs, and (2) the public's demand for currency, C, is a constant fraction, c, of bank deposits. Banks have no sources of funds other than deposits; they hold their reserves in the form of cash or as deposits at the central bank, and the remainder of their liabilities are utilised for making loans and purchasing debt instruments. However, we must hasten to point out that the assumptions made above are highly superfluous as banks are not the only financial institutions that accept demand deposits at least for the Zambian case. Furthermore, deposits are not the only source of funds for the commercial banks as most of them have demonstrated that they can raise funds by engaging in the buying and selling of bonds and treasury bills.

As earlier mentioned, the central bank can directly control the size of its total liabilities, currency held by the public and banks' reserves. This quantity is often called the monetary base or the high-powered money, and is denoted by H.

$$H = C + R \quad (1)$$

The quantity of money is given by:

$$M1 = C + D \quad (2)$$

Equilibrium in the money market for high-powered money requires that

$$H = C + R = cC + rD = H \quad (3)$$

It readily follows from this market-clearing condition and the definition in (2) that the supply of money is equal to a multiple of the monetary base:

$$M1 = mH,$$

Where,

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

H = High-powered money or reserve money

C = Currency with the general public

R = Reserves held by the central bank

M1 = Money narrowly defined comprising currency in circulation and demand deposits

c = Currency-deposit ratio

r = Reserve-deposit ratio

m = Money multiplier

From the expression above, it can be seen that money supply (M1) is determined by the level of high-powered money (H), the proportion of required reserves (r) and the cash-ratio(c). To control money supply, the monetary authorities must have effective control over the monetary base and the required reserve ratio since the two are under their direct jurisdiction. As for the cash ratio it is not possible to directly control or influence it by the central bank as it is determined by the behaviour of the non-banking public

Again it is evident that the monetary multiplier which is clearly greater than or equal to one since  $0 \leq r \leq 1$ , reduces to the reciprocal of the required reserve-deposit ratio in the limiting case when money consists only of bank deposits. It should be noted that as long as there is a stable and non-negligible demand for currency by the public ( $c > 0$ ) and the monetary base is finite, the quantity of money is finite even if banks are not required and do not choose to hold reserves so that r is zero (Brunner and Meltzer, 1964).

The stability of the multiplier depends on all the factors that affect the behavioural parameters viz, currency ratio, time deposit ratio, saving deposit ratio, foreign currency deposit ratio, government deposit ratio, and the reserve ratio. It is these parameters that the central bank must track down to be able to have control over *m* and hence have impact on the money supply process through changes in reserve money.

### 3.1.1 DERIVATION OF A SIMPLE MONEY MULTIPLIER

$$M1 = CU + DD \quad (i)$$

If we define currency ratio as:

$$c = \frac{CU}{CU + DD} \dots\dots\dots(ii)$$

$$\text{Thus, } CU = c (CU + DD) \quad (iii)$$

Defining excess reserves ratio as:

$$r = \frac{R}{CU + DD} \dots\dots\dots(iv)$$

$$\text{Hence } R = r (CU + DD) \quad (v)$$

Recalling that high-powered Money is given as:

$$H = CU + R \quad (vi)$$

and substituting equations (iii) and (v) into (vi) we obtain

$$\begin{aligned} H &= c(CU + DD) + r(CU + DD) \\ &= (c + r)(CU + DD) \end{aligned} \quad (vii)$$

and recalling that  $M1 = m.H$  ( money supply expressed in terms of the money multiplier and High-powered money ). We can manipulate the expression to obtain:

$$m = \frac{M1}{H} \dots\dots\dots(viii)$$

and further substituting (i) and (vii) into (viii) we obtain the following expression:

$$m = \frac{CU + DD}{(c + r)(CU + DD)}$$

$$m = \frac{1}{c+r} \dots\dots\dots(ix)$$

Hence,

$$M1 = \frac{1}{c+r} H \dots\dots\dots(x)$$

Where,

$$c = \frac{CU}{M1} \qquad r = \frac{R}{M1}$$

The currency and commercial bank excess reserves have both been expressed as proportions of the narrow monetary aggregate, M1. The C/M1 (cash ratio) captures solely the behaviour of the nonbank public and is under control of the central bank while the R/M1 (excess reserve ratio) measures the behaviour of the commercial banks. The excess reserve ratio varies depending on the market opportunities (movements in domestic interest rates), if the rates are high the commercial banks tend to convert most of their excess reserves into loanable funds and the reversal is also true. It is also affected by the central bank through the minimum reserve requirements as well as the discount rate. For instance, if commercial banks expand their credit portfolio due to favourable interest rates in the money market the central bank may be compelled to raise the discount rate or the minimum reserve requirements as a way of checking excess money supply emanating from commercial bank activities. The high-powered money, H, captures the behaviour of the monetary authorities and is wholly under their control. Thus the three economic agents; the nonbank public, the commercial banks and the central bank are in continuous interaction and it is this interaction which determines the money supply process in the economy.

Economic theory postulates that the non-bank public has a preferred ratio of currency to deposits whereas banks have a desired ratio of reserves to deposits. In this regard, the total money stock that can be supported by a given monetary base can be calculated by the help of the money multiplier. The central bank should therefore specify its desired level of money and adjust the monetary base accordingly. For money to be used as a monetary tool, two basic assumptions must hold; the demand for and supply of money functions must be reasonably stable. Secondly, the stock of money must be subject to the control of the monetary authorities (Taradas and Ghatak, 1990). Effective control of money supply as a matter of fact is premised on the prediction of the money multiplier (by estimating the behaviour of its currency, required reserves, and excess reserves components) and control of the monetary base.<sup>1</sup> Therefore, for the monetary authorities to pursue prudent monetary policy, it is vitally important that the forces underlying the increases and fluctuations in the money supply be understood and incorporated in the monetary policy decisions. Lack of such information is the primordial cause of monetary policy crisis in many a country.

In our study we have deliberately opted to use the multiplier approach proceeding on the premise that it can be shown that the two approaches are the same. We also realise that the multiplier approach deals with stock whereas the credit counterpart approach deals with flows (See Atta, 1998). Our choice of the money multiplier approach hinges on the fact that it is a more familiar approach as exemplified in most standard economic textbooks. Specifically, we evaluated the behaviour of the non-bank public, commercial banks, and the central bank in the determination of the money supply process in Zambia.

We further based the choice of M1 on the findings of Ojo (1975) and Birech (1992) who noted that the narrow definition of the monetary aggregate was more appropriate for LDCs than the broader ones. This is also in agreement with observations made by Khatkhate and Villanueva that in most LDCs a bigger chunk of currency is held in form of cash due to the thinness of financial markets – hence M1 in this case is a suitable monetary aggregate.

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<sup>1</sup> Coats and Khatkhate (1980) p. 18.

## 3.2 ESTIMABLE EQUATIONS

### 3.2.1 MONEY SUPPLY COMPONENTS

Net Foreign Assets Equation

$$NFA = \alpha_0 + \alpha_1 XRTE + \alpha_2 BOZCG + \alpha_3 BOP + \alpha_4 Dum92 + \Psi \quad (5)$$

$$\alpha_1, \alpha_2 < 0, \quad \alpha_3 > 0$$

Total claims on government equation

$$BOZCG = \beta_0 + \beta_1 GEXP + \beta_2 TR_{t-1} + \beta_3 Dum92 + \varepsilon \quad (6)$$

$$\beta_1 > 0 \quad \beta_2 < 0$$

Credit to the rest of the economy

$$CRE = \delta_0 + \delta_1 GDP + \delta_2 NFA + \delta_3 DR + \delta_4 RD + \delta_5 Dum92 + \phi \quad (7)$$

$$\delta_1 > 0 \quad \delta_2 > 0 \quad \delta_3 > 0 \quad \delta_4 < 0$$

Currency (with non-bank public) equation

$$(C/M1) = \gamma_0 + \gamma_1 GDP + \gamma_2 TBR + \gamma_3 Dum92 + \gamma_4 Dum95 + \eta \quad (8)$$

$$\gamma_1 < 0, \quad \gamma_2 < 0$$

Demand Deposits equation

$$DD = \omega_0 + \omega_1 GDP + \omega_2 RD + \omega_3 Dum92 + \omega_4 Dum95 + \lambda \quad (9)$$

$$\omega_1 > 0 \quad \omega_2 > 0$$

Money equation

$$M1 = \Phi_0 + \Phi_1 M_{t-1} + \Phi_2 GEX + \Phi_3 TR_{t-1} + \Phi_4 DUM92 + \upsilon \quad (10)$$

$$\Phi_1 > 0 \quad \Phi_2 > 0 \quad \Phi_3 < 0$$

Reserve equation

$$(R/M1) = \hat{c}_0 + \hat{c}_1 RQ + \hat{c}_2 TBR + \hat{c}_3 GDP + \hat{c}_4 Dum92 + \hat{c}_5 Dum95 + \xi \quad (11)$$

$$\hat{c}_1 < 0 \quad \hat{c}_2 < 0 \quad \hat{c}_3 < 0$$

Where,

NFA = net foreign assets

XRTE = real exchange rate

BOZCG = total credit to government defined as the sum of net claims on government and claims on public entities

GEXP = government expenditure (public finance component)



GFD = government fiscal deficits

TR = Total tax revenue

BOP = balance of payments (current account trade balance)

CRE = credit to the rest of the economy

GDP = gross domestic product at 1995 prices

DR = discount rate (bank rate)

RD = deposit rate

CU = currency in circulation

TBR = treasury bill rate as a proxy for domestic interest rates

RQ = required minimum reserves

DD = demand deposits

M1 = money narrowly defined

C/M1 = currency expressed as a ratio of money supply

R/M1 = commercial bank reserves expressed as a ratio of money supply

DUM92 = dummy variable representing the introduction of current new economic recovery program, (NERP) it has values of 1 for the years 1992 onwards, and 0 for other years.

Dum93 = dummy variable to show full implementation of financial liberalisation reforms, it has values of 1 for 1993 and 0 otherwise.

DUM95 = dummy variable representing instability in the financial sector, it has values of 1 for 1995 and 0 for other years.

Dum79 = dummy variable to capture the external oil shock

Dum87 = dummy variable to capture the time when the Zambian government broke ranks with the IMF and World Bank, it has values 1 for 1987 and 0 otherwise.

Dum89 = dummy variable to show the time when the Zambian government resumed cooperation with the IMF and World Bank, it has values 1 for 1989 and 0 otherwise.

$\Psi, \nu, \lambda, \eta, \phi, \epsilon, \xi$  = error terms assumed to be white noise

## **ESTIMATION TECHNIQUES**

Ordinary Least Squares (OLS) estimation technique was used in the estimation of the equations and the computer software package used is the Generalised Instrumental Variable Estimation (PCGIVE 8.0).

### **3.3 DATA SOURCES**

The study utilised secondary data on annual basis for the period 1970 to 1998. This period is long enough to capture the effects of the pre and post financial reforms on the money supply process and therefore be able to make meaningful assessments for comparison purposes. Most of the data was obtained from the Bank of Zambia Reports and Publications, CSO, Annual Economic Reports, and background to the Budgets and key economic indicators were acquired from various publications of the Ministry of Finance and Economic Development. These were supplemented with data from the International Financial Statistics (IFS) of the International Monetary Fund (IMF) and the African Development Indicators of the World Bank Database. However, we are aware that a cocktail of data sources might compromise the results of our regressions thus an attempt was made to minimise data mixing

## CHAPTER FOUR

### 4.0 DATA ANALYSIS AND EMPIRICAL RESULTS

#### 4.1 INTRODUCTION

In this chapter we present data analysis and a discussion of empirical results based on the models given in chapter three. Basically, the purpose of this section is to establish an empirically robust and theoretically consistent system of equations that capture the money supply process in Zambia for the period 1970 to 1998. Although the principal purpose of the section is expositional in outlook, it is imperative to motivate the discussion of results by considering the main features of the process we are seeking to model.

Since the early 1970s Zambia's economy has been prone to exogenous shocks and macro-economic instability largely reflected in perennial inflation, persistent declining Kwacha-Dollar rate, and very high bank lending rates with large spreads. The origins of the economic crisis can be traced to the world oil shock of 1973. For instance, by 1975 the country's terms of trade fell to 54% relative to 1974; a balance-of-payments (BOP) position which had been comfortable in 1974 went into deficit, with the current account amounting to 30% of the GDP; government revenues from minerals which is the mainstay of the economy dropped to less than one-fifth of the previous level, and the budget deficit which had been in surplus in 1974, moved to a deficit equivalent to 24% of the GDP (Seshamani, 1985). Zambia, being a heavily import oriented country with about 75% of industrial needs coming from abroad, the immediate effect of such a shock was to deplete the national reserves at the treasury through high imports while export earnings had drastically dwindled to an all time low (see Seshamani, 1985). The only alternative to fill the gap left by poor export earnings was to resort to massive borrowings from the international lending community as well as the domestic sources mainly from the central bank and the private sector. Another major oil shock was registered in 1979 and just like before, the effects were quite severe on the economy.

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In early 1980s there were attempts to realign the economy through IMF sponsored structural reforms but they lacked the tenacity that goes with these reforms in order to yield positive results. For instance, in 1983 it had become apparent that the copper prices would not recover at the LME, therefore Zambia got her first conditional assistance from the IMF designed to restructure the economy to prevent further problems in the balance of payments and allow for repayment of foreign debt. On May 1, 1987 the government broke ranks with the IMF citing the adverse effects the reforms had inflicted on the economy and instead opted to follow what came to be known as "growth from own resources" (see Mwansa, 1998). It was not long before authorities realised that the economy could not survive without the donor community thus there was a reversal of policy and in 1989 the country went back to the IMF with a promise to institute more reforms. In 1991 there was a change of political governments which saw the new government pledging to carry out far more reaching structural adjustment reforms in form of trade and financial liberalisation (Mwansa, 1998). All these reforms and the external shocks cited earlier have had telling effects on the money supply process in Zambia.

Thus, in accordance with the current practice in modern econometrics, we shall carry out a battery of tests on all the variables we are working with in order to validate our results so that the effects of the reforms and the external shocks on the economy are taken care of.

## 4.2 NORMALITY TESTS.

Normality tests on variables

Variable	Mean	Standard Deviation	Skewness	Excess Kurtosis	Normality $\chi^2(2)$
RXRTE	1761.597393	914.5931	1.5673	2.8381	12.329
RCORES	195.488526	111.0903	0.9883	1.4225	5.5411
RBOZCG	964.249643	682.8734	-0.0121	-1.4020	4.9752
RBOP	408.930704	426.1541	1.9451	3.4250	29.651
RTR	981.555948	439.5007	1.3985	2.2300	9.9682
RGDP	3.867357	1.4290	-0.7086	0.5539	3.1593

RNFA	-544.161054	1859.4972	-0.1282	1.0481	5.8401
RDR	8197.773895	6971.7696	0.3284	-0.8505	1.8535
RRD	6549.585032	5511.0605	0.1499	-1.3919	5.4865
RCU	190.753907	76.8875	-0.3836	-0.1141	1.3861
TBR	6046.388656	500.6829	0.2568	-1.1733	3.6381
RMI	619.653852	276.7152	-0.5299	-0.9917	6.6696
RGEXP	1348.204228	487.9365	-0.0581	-0.7040	0.1378
RHPM	398.816559	179.6808	-0.2912	-0.2912	0.3148
RCOCG	317.271821	226.6022	2.5283	2.5283	10.084
RCPRIV	582.201841	284.4912	-0.7260	-0.7260	0.2177
RCRE	1983.003869	950.8306	-0.5902	-0.5902	3.0703
RDD	471201.698621	417617.1753	11.1451	11.1451	30.5320
RMINRES	195.488526	111.0904	1.4223	1.4225	5.5411
RR/M1	33.548416	15.5693	-0.4871	-0.4871	13.6610
RC/M1	32.462666	4.9604	-0.6356	-0.6356	1.1850
RGFD	-486.353817	408.3199	-0.8287	1.3036	5.0464

Where,

RCORES = real commercial bank reserves

RHPM = real high-powered money

RCOCG = real commercial bank claims on the government

RCPRIV = real commercial bank claims on the private sector

RMINRES = real minimum required reserves

NB: Note that rest of the variables are as defined in the methodology section and all have been converted into real variables.

Basically in carrying out normality tests as researchers we concern ourselves with the mean, standard deviation, skewness, excess kurtosis, minimum and maximum values of the series. The idea is to ascertain normality in the distribution and behaviour of the variables.

The table above shows that most of the variables were normally distributed at 5% level of significance though the RXTRE, TR, RM1, RDD, RBOP, RCOCG and RRC/M1 variables were rejected at the same level of significance. The variables in question were found to have relatively high values of excess kurtosis and skewness. However, since most of the variables had a normal distribution we can safely assert with some hindsight that the results to be obtained from the regressions will not be biased.

## ESTIMATION PROCEDURES

We shall first test for the time series properties of the variables before estimation.

### 4.3 UNIT ROOT TESTS

If the equation is estimated with data that are non-stationary, the  $t$ -statistics of the estimated coefficients are unreliable since the underlying time series would have theoretically infinite variances (See Gujarati, 1995). There are important differences between stationary and nonstationary time series data. Shocks to a stationary time series are necessarily temporary; over time, the effects of the shocks will dissipate and the series will revert to its long-run mean level. As such, long-term forecasts of a stationary series will converge to the unconditional mean of the series. To aid in the identification, we know that a covariance stationary series:

- 1) Exhibits mean reversion in that it fluctuates around a constant long-run mean
- 2) Has a finite variance that is time-invariant.
- 3) Has a theoretical correlogram that diminishes as lag length increases

On the other hand, nonstationary series necessarily have permanent components. The mean and/or variance of a nonstationary series are time-dependent. To aid in the identification of a nonstationary series, we know that:

- 1) There is no long-run mean to which the series returns.
- 2) The variance is time-dependent and goes to infinity as time approaches infinity
- 3) Theoretical autocorrelations do not decay but, in finite samples, the sample correlogram dies out slowly.

Although properties of a sample correlogram are useful tools for detecting the possible presence of unit roots the method is necessarily imprecise (see Walter Enders, 1995). Thus to test if each variable is non-stationary or not, we shall perform the unit root tests on the variables or test for the order of integration of each series. We shall use the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests to test for the presence of unit roots. The ADF test is more or less like the DF test the difference being in terms of augmentations in the lag length of the dependent variable but incorporated as one of the regressors. Below we proceed to demonstrate how these tests are carried out in time series data.

#### 4.4 ANALYSIS OF STATIONARITY

$$y_t = y_{t-1} + \varepsilon_t \quad (1)$$

The Dickey-Fuller (DF) test is based on the estimation of an equivalent equation stated below as:

$$y_t = \Phi y_{t-1} + \varepsilon_t \quad (2)$$

We test the hypotheses as follows:

$$H_0: \Phi = 1$$

$$H_1: \Phi < 1$$

Under the null hypothesis  $y_t$  is non-stationary, being a random walk without a drift or constant while under the alternative hypothesis  $y_t$  is a stationary AR (1) process. If the data are stationary, then estimation of (2) by simple OLS method and testing  $\Phi = 1$  are appropriate. We must point out that the ratio or statistic does not have a student  $t$ -distribution, thus cannot be relied upon in making a decision. This therefore suggests that we use the Dickey-Fuller (DF) tests.

#### 4.5 DICKEY-FULLER TEST (DF).

This test aims at testing the hypothesis in equation (2) that  $\Phi = 0$  as against the alternative hypothesis that  $\Phi < 0$ . Note that the equation is reformulated by subtracting  $y_{t-1}$  from both sides of the equation to give:

$$y_t - y_{t-1} = \rho y_{t-1} + \varepsilon_t \quad (3)$$

Where  $y_t - y_{t-1} = \Delta y_t$  and  $\rho = \alpha - 1$ . Rearranging the equation and making  $y_t$  the subject of our formula gives:

$$y_t = (\rho + 1) y_{t-1} + \varepsilon_t$$

Where  $\Delta$  is the difference operator and  $\rho = \alpha - 1$ . We are mainly concerned with the negativity of  $\alpha$  in the OLS regression of equation (3). Thus our hypotheses of interest are

$$H_0: \rho = 0$$

$$H_1: \rho < 0$$

If  $\rho$  in equation (3) is accepted, then  $\alpha = 1$  in equation (2), but if the null is rejected in favour of the alternative hypothesis, then equation (2) yields  $\alpha < 1$  suggesting that  $y_t$  is integrated of order zero (is stationary). Basically, we carry out four Dickey-Fuller equation tests stated below:

$$i) \quad \Delta y_t = \rho y_{t-1} + \varepsilon_t$$

$$ii) \quad \Delta y_t = \gamma + \rho y_{t-1} + \varepsilon_t$$

$$iii) \quad \Delta y_t = \gamma + \delta t + \rho y_{t-1} + \varepsilon_t$$

$$iv) \quad \Delta y_t = \gamma + \delta t + \rho y_{t-1} + \sum \beta \Delta y_{t-1} + \varepsilon_t$$

As noted earlier, equation (1) is the DF test without drift and trend components while equation (2) incorporates a drift. The third equation includes both the drift and trend components. The fourth equation is the augmented Dickey-Fuller (ADF) equation and is superior over the other three equations for reasons we shall explain later in the paper. We should also note that these are tests in levels but should the variables prove to be nonstationary, the same tests are now performed on differenced variables- an operation which renders the variables stationary. However, we are aware that the critical values of the t-statistics do depend on whether an intercept and/or time trend is included in the regression equation. In their Monte Carlo study, Dickey and Fuller (1979) as quoted in Walters (1995) found that the critical values for  $\rho = 0$  depend on the form of the regression equation and the sample size.

The tests in differences take the form as shown below:

$$\Delta^2 y_t = \rho \Delta y_{t-1} + \varepsilon_t \quad (5)$$

As before,  $\Delta$  is the difference operator and  $\varepsilon_t$  is assumed to be a white noise error term.



## Hypotheses

$$H_0: \rho = 0$$

$$H_1: \rho < 0$$

If we reject the  $H_0$  then  $\Delta y_t$  is stationary and if we fail to reject the  $H_0$  it would imply that  $y_t$  is nonstationary. Next we test for the order of integration. If  $\Delta y_t \sim I(0)$  then  $y_t \sim I(1)$ . If  $H_0$  is accepted the test continues and the equation takes the form:

$$\Delta^3 y_t = \rho \Delta^2 y_{t-1} + \varepsilon_t \quad (6)$$

As mentioned earlier, we are interested in the negativity of the  $\alpha$ . The process continues until stationarity for  $y_t$  is achieved. From experience it has been shown that most economic time series data are not integrated of more than order two. We must guard against overdifferencing which manifests itself in the form of high  $R^2$  and a positive coefficient of the DF (see Charemza and Deadman, 1992).

ii) The second test shown below incorporates a variable generated as a stochastic process with a drift utilising the following equation:

$$\Delta y_t = \gamma + \rho y_{t-1} + \varepsilon_t \quad (7)$$

## Hypotheses

$$H_0: \rho = 0$$

$$H_1: \rho < 0$$

Where  $\gamma$  is the constant or drift term. Rejection of the  $H_0$  suggests stationarity while acceptance of the null hypothesis would imply nonstationarity.

iii) The third equation below incorporates both the drift and a linear deterministic trend and is given as:

$$\Delta y_t = \gamma + \delta t + \rho y_{t-1} + \varepsilon_t \quad (8)$$

Where  $t$  is the trend and the rest of the parameters are defined as before. Here we simultaneously test for the presence of a stochastic trend ( $\rho < 0$ ) and a deterministic trend ( $\delta < 0$ ).

#### 4.6 THE AUGMENTED DICKEY-FULLER (ADF) TEST.

This is the most efficient and widely used simple test for establishing the order of integration. Unlike the first three tests analysed earlier, this one takes into account the possible serial correlation in the error process. The dependent variable is included as a regressor but only after being lagged. This tends to improve the statistical fit of the equation and t-values obtained are more efficient with added information.

It is expressed as:

$$\Delta Y_t = \gamma + \delta trend + \rho_0 Y_{t-1} + \sum_{i=1}^p \rho_i \Delta Y_{t-i} + \varepsilon_t \dots \dots \dots (9)$$

NB: The number of lags of  $y_{t-1}$ , should be large enough to minimise the existence of autocorrelation of the error term, but relatively small to avoid problems of degrees of freedom.

##### Hypotheses

$$H_0: (\gamma, \rho, \delta) = (\gamma, 0, \delta)$$

$$H_1: (\gamma, \rho, \delta) \neq (\gamma, 0, \delta)$$

Where,

$\gamma$  and  $\delta$  are the drift and trend components in the tests.

We place restrictions on the models by omitting the constant and trend components in the first test and then systematically adding these variables in the subsequent tests until final decision of stationarity is established or rejected.

If  $H_0$  is accepted and  $H_1$  rejected, it would indicate nonstationarity of the variables. The reversal is also true.

#### 4.7 COINTEGRATION ANALYSIS

Data observed over a considerable period of time tend to trend up or down in a non-stationary manner but when analysed as a pair or group of variables, these data may tend to drift together. If not checked, trends be they stochastic or deterministic yield 'spurious results' characterised by high  $R^2$ , low Durbin-Watson value and very high and significant t-ratios. The remedy to this lies in differencing the nonstationary variables in order to achieve stationarity. Differencing though very essential in times series data may lead to

loss of long-run information contained in the level variables. Thus to regain the long-run properties, the solution is to estimate the model variables in their level form, obtain the residuals and subject them to stationarity tests. In this paper we shall carry out both the graphical analysis and conventional tests on the error terms. If cointegration among variables is established then we shall run a regression of variables in differences and add a lagged residual (Error Correction Mechanism (ECM)) as one of the regressors. This is meant to capture the short-run dynamics and long run properties simultaneously

But what do we mean by cointegration? It is therefore necessary to consider a simple definition of cointegration: nonstationary variables are said to be cointegrated if a linear combination of these variables assumes a lower order of integration, rendering the linear combination stationary or  $I(0)$  (see Walters, 1995). This suggests the existence of a mechanism or theoretical link that prevents some variables from diverging significantly from each other. The existence of a cointegrating relationship will in this case imply that the regression of nonstationary series in their levels will yield meaningful results and not spurious ones. The point to note about cointegration analysis is that it provides a powerful discriminating test for spurious correlation: conducting cointegration analysis between apparently correlated  $I(1)$  series and finding cointegration validates the regression (Adam, 1992). Adam further says that failing to find cointegration may be a sign that spurious correlation may be present, and thus the invalidity of the inference drawn from such correlation. Thus cointegration is handy as it eliminates the problem associated with loss of information through differencing as well as removes spurious correlation from the model. We must hasten to say that for cointegration to hold, the nonstationary series must be integrated of the same order.

Econometrically speaking, testing for cointegration entails using the Engle-Granger Two Step Procedure (see Engle and Granger, 1987). The beauty with this procedure is that it is simple to employ. It involves testing for unit roots (using the DF and ADF tests) on the individual series, identifying the order of integration and estimating a static model for the cointegrating regression in the first step of the procedure. The second stage allows the researcher to use the residual generated from the static model to evaluate the order of

integration. A stationary I(0) residual will suggest the existence of a cointegrating relationship. If cointegration is rejected, then there is no long run relationship between the non-stationary series and thus there will be no information in the coefficient of the ECM term.

### 4.8 TESTING FOR COINTEGRATION

Like before, cointegration tests make use of the Dickey-Fuller (DF) tests but this time the difference being that we are performing tests on the residuals of the cointegrating regression, rather than the levels of the series. If the residuals from the linear combination of non-stationary series are themselves stationary then we can accept that the I(1) series are cointegrated. The DF tests for cointegration are given below:

$$\Delta \epsilon_t = \rho \epsilon_{t-1} + \lambda_t \tag{i.}$$

Where like in the previous case,  $\Delta$  is the difference operator,  $\lambda_t$  is white noise error term while  $\epsilon_t$  is the residual generated from the initial model.

#### Hypotheses

$$H_0: \rho = 0$$

$$H_1: \rho < 0$$

Accepting  $H_0$  implies that no cointegration exists while if we accept the alternative hypothesis would mean presence of cointegration.

$$\Delta \epsilon_t = \gamma + \rho \epsilon_{t-1} + \lambda_t \tag{ii}$$

$\gamma$  = a constant or drift term

The null and alternative hypotheses are similar to those in (i.) above.

$$\Delta \epsilon_t = \gamma + \delta t + \rho \epsilon_{t-1} + \lambda_t \tag{iii}$$

$t$  = trend while other variables are as defined before

$$H_0: \rho = 0 \text{ (No Cointegration)}$$

$$H_1: \rho < 0 \text{ (Cointegration is present)}$$

### 4.9 THE AUGMENTED DICKEY- FULLER (ADF) TEST ON RESIDUALS

$$\Delta \epsilon_t = \gamma + \beta trend + \rho_0 \epsilon_{t-1} + \sum_{i=1}^n \rho_i \Delta \epsilon_{t-i} + \lambda_t \dots \dots \dots (iv)$$

It involves testing the model with both the trend and the constant term and then imposing restrictions on the constant and trend.

$$H_0: (\gamma, \rho, \delta) = (\gamma, 0, \delta)$$

$$H_1: (\gamma, \rho, \delta) \neq (\gamma, 0, \delta)$$

If the null hypothesis is rejected then there is stationarity in the model and the vector of variables can be said to be cointegrated

#### 4.10 THE ERROR CORRECTION MODEL (ECM)

Having established cointegration among variables suggests that there is a long-run economic relationship that binds the variables together. This means that the variables can be estimated in their levels. The ECM has a number of advantages over other forms of model specifications and these are:

- a) It solves the problems of autocorrelation and multicollinearity
- b) It provides a more general and less restrictive lag structure, allowing for (partial or full) adjustment as a special case.
- c) It captures both the long-run equilibrium and the short-run dynamic relationships associated with a model thereby making it encompassing.

In the event that variables are nonstationary and without cointegrating relationship, the implication is that there is no long-run economic relationship among the series and therefore variables should be estimated in their differences (see Adam, 1992).

In order to capture exogenous impacts or shocks that may have hit the economy during the period under review, we shall test for stability and structural breaks in the models using the Recursive Least Squares (RLS) (see Johnston and DiNardo, 1997). Should we detect any external shocks to the economy, appropriate dummy variables will be incorporated in the models to capture those effects.

**Table 1.**

**Dickey-Fuller tests for the order of integration on variables in their levels**

Variable	DF1	DF2	DF3	ADF	I(d)
RXRTE	-1.813761***	-2.796484*	-2.857390	-2.719714	I(1)

RCORES	-1.151222	-2.117650	-2.200275	-2.051612	I(1)
RBOZCG	-1.378969	-3.240690***	-3.350354*	-3.305980	I(1)
RBOP	-3.992297**	-5.434355**	-6.440627**	-6.795132**	I(0)
RTR	-2.307502**	-3.396386**	-5.116371**	-5.837063**	I(0)
RGDP	-2.529727**	-2.565843	-3.443925***	-3.153321	I(1)
RNFA	-2.307776**	-2.500492	-2.415063	-2.054827	I(1)
RDR	-3.119661**	-2.313716	-3.303443***	-3.228365	I(1)
RRD	-2.774757**	-1.662543	-2.847016	-2.8199931	I(1)
RCU	-0.995486	-0.639393	-2.160821	-1.881500	I(1)
RTBR	-2.404877**	-1.532782	-2.957027	-2.462515	I(1)
RGFD	-2.594389**	-5.312937	-5.767531***	-5.780725	I(0)
RMI	-1.441610	-0.719326	-1.883450	-1.643941	I(1)
RGEXP	-1.242448	-2.277939	-3.375263*	-3.212897	I(1)
RHPM	-1.567891	-2.061039	-2.424598	-2.116543	I(1)
RCOCG	-1.572456	-3.073236	-3.529636*	-3.489191	I(1)
RCPRIV	-1.072319	-0.997513	-2.235892	-1.885463	I(1)
RDD	-3.016130**	-5.388176**	-5.546961**	-5.595701**	I(0)
RMINRES	-1.151222	-2.117650	-2.200275	-2.051612	I(1)
RC/MI	0.307539	-3.002546**	-4.268734**	-4.305001**	I(0)
RR/MI	-0.835687	-2.701750*	-2.900887	-2.816472	I(1)
RCRE	-0.896415	-3.098378**	-2.934011	-2.813979	I(1)

Critical Values:

1%	-2.66	-3.75	-4.38	-4.38
5%	-1.95	-3.00	-3.60	-3.60
10%	-1.60	-2.62	-3.24	-3.24

NB: \* Significant at 10%

\*\* Significant at 5%

\*\*\* Significant at 1%

The table above shows that most of the variables were integrated of order I(1) with a few being stationary in their levels.

**Table 2. Dickey-Fuller tests for order of integration on variables in their first differences.**

Variables	DF1	DF2	DF3	ADF	I(d)
RXRTE	-5.400002**	-5.316203**	-5.201537**	-6.076391**	I(0)
RCORES	-7.903901**	-7.764309**	-8.009928**	-10.2162**	I(0)
RBOZCG	-9.287997**	-9.186528**	-9.084372**	-10.33332**	I(0)
RGDP	-5.213634**	-5.117560**	-5.027058**	-6.767030**	I(0)
RNFA	-4.004528**	-3.926482**	-3.838642**	-3.887620**	I(0)
RDR	-5.432612**	-5.567024**	-5.344877**	-6.562589**	I(0)
RRD	-6.245900**	-6.622118**	-6.374304**	-6.737964**	I(0)
RCU	-4.750487**	-4.741833**	-4.915495**	-5.572042**	I(0)
RTBR	-6.478712	-6.911562**	-6.732462**	-7.957566**	I(0)
RM1	-5.021752**	-5.021674**	-5.189408**	-6.167484**	I(0)
RGEXP	-5.958874**	-5.906047**	-5.835254**	-8.321939**	I(0)
RHPM	-7.130455**	-7.015846**	-7.091716**	-9.237410**	I(0)
RCOCCG	-6.918045**	-6.783366**	-6.841226**	-10.52073**	I(0)
RCPRIV	-4.264249**	-4.224297**	-4.270494**	-4.65129**	I(0)
RMINRES	-7.903901**	-7.764309**	-8.009928**	-10.21962**	I(0)
RR/M1	-7.5416622**	-7.415272**	-7.382862**	-9.097570**	I(0)
RCRE	-7.113111**	-6.982763**	-7.312063**	-11.53022**	I(0)

Critical values:

1%	-2.66	-3.75	-4.38	-4.38
5%	-1.95	-3.00	-3.60	-3.60
10%	-1.60	-2.62	-3.24	-3.24

NB: \*\*\* means that the variables are significant at 1%

\*\* Significant at 5%

\* Significant at 10%

All the variables became stationary after being differenced once meaning that they are an I(1) process. Having satisfied the necessary condition of stationarity we can now proceed to run regressions as we are assured that the results will not be spurious or meaningless.

#### **4.11 DATA ANALYSIS**

All the tests carried out on the variables in their levels showed that only a handful were stationary while the majority were not. As earlier alluded to, regressions on nonstationary variables tend to produce spurious results-an undesirable situation in any meaningful research work. The solution therefore lies in differencing all nonstationary variables in order to make them stationary and hence be in regressable form. If after the first differencing the variables are still nonstationary, we have to go further by differencing them for the second time, the process goes on till all variables have been rendered stationary or proved that they cannot be made stationary through differencing. Most time series data rarely go beyond the second differencing stage but if for some reason they do, then there would be need to look at the data generating process again. Like before in differencing the variables we make use of the DF tests.

Table 2 above presents results of the first differences and as it can be seen all the variables that were nonstationary in levels are now stationary. This means that they are an I(1) autoregressive process since they are rendered stationary after being differenced once.

#### **4.13 EMPIRICAL MODEL SPECIFICATION AND PRESENTATION OF REGRESSION RESULTS**

This study utilises the Hendry's approach to modelling (commonly called the General-to-Specific Approach) which suggests that a researcher starts with an overparameterised model and then systematically reduces it to a parsimonious one dropping all insignificant lags in the process. The general model is over-parameterised and as such it is difficult to interpret it in any meaningful way. It merely allows us to identify the dynamic patterns in the model and then on the basis of that reduce it to a parsimonious one. Thus the general



model is reduced until we get the preferred one and this is usually done by assigning zero coefficients to those variables whose " t " statistics is low in the general model's results. We then check the significance of the F-statistic after the reduction process. Depending on the number of explanatory variables in any given equation, we assigned between 2 and 3 lags in the models. The number of lag length was deliberately kept small in order to avoid problems of degrees of freedom which usually arise in small samples. One should always bear in mind that the number of parameters being estimated in an equation must be less than the sample size if the problem of degrees of freedom is to be avoided.

The Dickey-Fuller tests conducted on variables in the NFA equation failed the test of cointegration, that is, the variables were integrated of different orders. This means that we have to run regressions in first differences and levels-a condition which suggests that we are dealing with short run dynamics. On the basis of the Dickey-Fuller results we proceed to respecify the estimable NFA model as

$$\Delta NFA = \alpha_0 + \alpha_1 \Delta RNFA_{.1} + \alpha_2 \Delta RXRTE_{.1} + \alpha_3 RBOZCG_{.1} + \alpha_4 RBOP_{.1} + \alpha_5 Dum92 + \psi$$

(a)

**Table 4.**

Modelling  $\Delta NFA$  by OLS

Variable	Coefficient	Std. Error	t-Value	t-prob.	PartR <sup>2</sup>
Constant	173.50	216.04	0.803	0.4345	0.0412
$\Delta RNFA_{.1}$	1.0878	0.13866	7.845	0.0000	0.8040
$\Delta RXRTE$	-0.89576	0.17148	-5.224	0.0001	0.6453
$\Delta RXRTE_{.2}$	0.85491	0.26006	3.287	0.0050	0.4188
$\Delta RBOZCG$	-1.0913	0.17076	-6.391	0.0000	0.7314
$\Delta RBOZCG_{.2}$	-0.35570	0.19366	-1.837	0.0861	0.1836
RBOP	0.33042	0.37644	0.878	0.3939	0.0489
Dum92	-430.57	308.49	-1.396	0.1831	0.1149
Dum95	2597.5	684.43	3.795	0.0018	0.4899
Dum89	-5612.0	1500.3	-3.741	0.0020	0.04826

Dum79	1049.6	612.94	1.712	0.1074	0.1635
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**Diagnostic Tests**

$R^2 = 0.924812$   $F(10,15) = 18.45 (0.0000)$   $\sigma = 562.683$   $DW = 2.34$

RSS = 4749188 for 11 variables and 26 observations

AR 1-  $F(1,14) = 2.1144 (0.1680)$

ARCH 1  $F(1,13) = 0.040053 (0.8445)$

Normality  $\chi^2(2) = 1.57 (0.4561)$

RESET  $F(1,13) = 40.421 (0.0000)**$

The coefficients had correct signs as hypothesised apart from the lagged RXRTE and the model's fitting was quite good explaining about 92% of variations in the dependent variable. The AR test for autocorrelated residuals shows that the model does not have autocorrelation, the ARCH test for heteroscedasticity indicates its absence in this particular model. This is expected in time series data as heteroscedasticity is mainly a problem associated with cross sectional data. The normality test for the residual distribution shows that the errors were normally distributed and the RESET test confirms that the model fails specification at 1% level of significance.

Both present and past changes in the exchange rate were found to have a significant bearing on changes in net foreign assets. However, in the Zambian case, since the exchange rate was allowed to float it automatically readjusts itself in case of an upsurge in external inflows or outflows. This is usually reflected in the depreciation and appreciation of the local currency against the major international currencies.

Furthermore it should be appreciated that there is a positive correlation between net foreign assets and balance of payments and when there is an improvement in the latter we expect to see an improvement in the former as well. In a case where the central bank does not sterilise external inflows we should then see the inflows in form of a positive current account trade balance bolstering the national reserves and, thus its capacity to increase domestic liquidity. Since the BOP showed a positive impact on the NFA means that

external inflows do assist in building up foreign reserves at the central bank. This is a healthy situation as the country can fall on those reserves in times of need to meet its import demands and debt service obligations. However, the coefficient of the variable in question was statistically insignificant which suggests that the effect of the BOP on NFA is minimal and thus would not affect the money supply process even if there was no sterilisation of external inflows.

This is consistent with the findings of Atta (1998) who observed that the overall balance of payments did not appear to influence net foreign assets. In his words, such a condition should cheer the monetary authorities in Zambia since they could assume that their actions would not be offset by the external sector. The lagged value of changes in NFA was significant meaning that the past influence of external inflows do not easily peter out and this can be a source of growth in liquidity in the economy if the central bank does not neutralise those effects. We also note that changes in BOZCG have a strong influence on changes in the NFA a situation which suggests that loans to the government affect the net foreign assets substantially. Since claims of the central bank on government which essentially represent loans to the government turned out to be quite significant, this confirms our assertion that government borrowings from the monetary authorities are the main source of growth in money supply. The effect they have on net foreign assets is to reduce them thus affecting the country's volume of foreign reserves adversely

Dummy 89 was found to be significant implying that the policy reversal in that particular year had adverse effects on changes in net foreign assets. Generally, donors were sceptical as to whether the government would honour its promise of sticking to the structural reforms hence they took their time to release the funding. Dummy 92 was found to be insignificant and this is rather surprising as we had expected to see a heavy impact of liberalisation reforms on net foreign assets. However, the non-significance of the dummy in question could be attributed to the fact that the process of reforms had just been introduced and thus its full effects took time before they could be felt in the economy. Dummy95 representing the banking crisis in the economy was significant though with an unexpected sign and this is expected as the government poured huge sums

of money to try and salvage three commercial banks that were threatened with serious problems of insolvency. Despite such a desperate move from the central authority the concerned banks eventually went under receivership. The effect of the government's move to recapitalise these commercial banks was seen in the excessive money supply expansion.

Dummy79 with a wrong sign in the model proved to be statistically insignificant probably suggesting that the oil crisis in that particular year did not immediately impact on net foreign assets but over time we expect high oil prices on the international market to affect the foreign reserves adversely.

The equation dealing with central bank credit to the government for fiscal deficit financing is respecified as follows:

$$\Delta\text{BOZCG} = \beta_0 + \beta_1\Delta\text{RGEXP} + \beta_2\text{TR}_{-1} + \beta_3\Delta\text{BOZCG}_{-1} + \beta_4\text{Dum92} + \varepsilon \quad (\text{b})$$

The tax revenues, RT, are lagged in order to capture the "Olivera-Tanzi" effect which states that government expenditures are a continuous process while taxes are collected once per year. Like in the first case, this model failed the test of cointegration since variables are integrated of different orders. Thus regressions were run in first differences and levels-another case of short run dynamics.

Table 5 below shows regression results with variables in their order of integration.

#### Modelling $\Delta\text{RBOZCG}$ by OLS

Variable	Coefficient	Std. Error	t-Value	t-prob.	PartR <sup>2</sup>
Constant	-533.37	340.96	-1.564	0.1352	0.1197
$\Delta\text{RBOZCG}_{-1}$	-0.31552	0.18120	-1.741	0.0987	0.1442
$\Delta\text{RGEXP}$	0.96233	0.25890	3.717	0.0016	0.4343

$\Delta RGEXP_{-2}$	-0.59984	0.29455	-2.036	0.0567	0.1873
RTR	-0.35345	0.28612	-1.235	0.2326	0.0782
$RTR_{-2}$	0.84371	0.33498	2.519	0.0215	0.2606
Dum95	914.10	473.42	1.931	0.0694	0.1716
Dum93	1615.9	651.97	2.478	0.0233	0.2544

### Diagnostic Tests

$$R^2 = 0.738429 \quad F(7,18) = 7.2593 \quad (0.0003) \quad \sigma = 445.075 \quad DW = 1.97$$

RSS = 3565646.42 for 8 variables and 26 observations.

$$AR \ 1-F(1,17) = 0.0005779 \quad (0.9811)$$

$$ARCH \ 1 \ F(1,16) = 0.0038829 \quad (0.9511)$$

$$\text{Normality } \chi^2(2) = 3.2832 \quad (0.1937)$$

$$\text{RESET } F(1,17) = 0.17843 \quad (0.6780)$$

According to the tests above, the model was correctly specified as evidenced from the RESET test which tests for misspecification. Furthermore, the model did not suffer from the problem of heteroscedasticity (see ARCH test) and there was no serial correlation in the error terms. To sum it all, the residuals had a normal distribution. The coefficient of determination was generally good explaining about 73% of variations in the dependent variable. The coefficients had correct signs save for the lagged tax revenues and lagged government expenditures. From the results above, we can deduce that the mainspring of liquidity into the economy has been the government budget deficit financing as budgetary over-runs have mainly been financed from the banking system especially the Central Bank. This is also supported by the GEXP variable whose coefficient is statistically significant indicating that government expenditures have a strong influence on the loans from the central bank. The lagged TR and GEXP though with a strong influence on the

model had wrong signs which impairs their interpretation. We suspect that the wrong signs attached to the coefficients could be due to several internal and external shocks hitting the economy during the period under review. Dummy93 capturing the full implementation of the liberalisation process showed a heavy impact on the model and this suggests that the effects of the new policies had started taking effect on the macro economic indicators

The function dealing with credit to the rest of the economy is respecified as follows

$$\Delta \text{RCRE} = \delta_0 + \delta_1 \Delta \text{RGDP}_{.1} + \delta_2 \Delta \text{RNFA}_{.1} + \delta_3 \Delta \text{RDR} + \delta_4 \Delta \text{RRD} + \delta_5 \Delta \text{RCRE}_{.1} + \delta_6 \text{Dum92} + \Omega \text{ECM1}_{.1} + \phi \quad (\text{c})$$

Cointegration tests were run on the variables (see Table A). Cointegration was confirmed a condition which entails that the ECM is incorporated as one of the regressors in the equation. The respecification of the model now takes the form shown above.

Where,  $\Omega$  = the coefficient of the ECM and measures the speed of adjustment of the short run model to the long run equilibrium. The results to this model are presented in Table 6.

**Table A. Dickey-Fuller tests on Residuals to establish the order of integration**

Variable	DF1	DF2	DF3	ADF	I(d)	decision
ECM1	-5.120	-5.008	-4.993	-5.765	I(0)	Cointegration exists
ECM2	-4.528	-4.398	-4.449	-4.851	I(0)	Cointegration exists

Critical Values:

1%	-2.66	-3.75	-4.38	-4.38
5%	-1.95	-3.00	-3.60	-3.60
10%	-1.60	-2.62	-3.24	-3.24

Table 6

Modelling  $\Delta$ RCRE by OLS

Variable	Coefficient	Std. Error	t-Value	t-prob.	PartR <sup>2</sup>
Constant	175.04	95.343	1.836	0.0863	0.1835
$\Delta$ RCRE. <sub>1</sub>	-0.39001	0.11484	-3.396	0.0040	0.4347
$\Delta$ RGDP. <sub>2</sub>	520.95	75.604	6.891	0.0000	0.7599
$\Delta$ RNFA. <sub>1</sub>	0.37252	0.091332	4.079	0.0010	0.5259
$\Delta$ NFA. <sub>2</sub>	-0.10912	0.056447	-1.933	0.0723	0.1995
$\Delta$ RTBR. <sub>2</sub>	-0.13992	0.067212	-2.082	0.0549	0.2242
Dum92	-564.91	214.86	-2.629	0.0190	0.3155
Dum95	1026.4	451.53	2.273	0.0381	0.2562
Dum89	-2890.8	854.80	-3.382	0.0041	0.4326
ECM. <sub>1</sub>	-0.20554	0.28500	-0.721	0.4819	0.0335

Diagnostic Tests

$R^2 = 0.880127$   $F(9,15) = 12.237 (0.0000)$   $\sigma = 378.254$   $DW = 2.35$

RSS = 2146141.186 for 10 variables and 25 observations.

AR 1-1F(1,14) = 6.66 (0.0218)\*

ARCH 1 F (1,13) = 0.19666(0.6647)

Normality  $\text{Chi}^2(2) = 1.1732(0.5562)$

RESET F (1,14) = 0.88606(0.3625)

Firstly, we have had to use the RTBR as a proxy for the RDR and RRD variables since the two were found to be correlated after checking for rank correlation using the correlation matrix. The lagged coefficient of RCRE and NFA lagged twice had wrong signs. The model's fitting was fairly good capturing 88% variations in the dependent variable. The model was properly specified as it has been borne out by the RESET test. It also passed the tests of no serial correlation and heteroscedasticity in the error terms. The errors were also normally distributed.

The lagged value of NFA was statistically significant meaning ~~that~~ past external inflows have some strong influence on the credit creation process. Probably the central bank would do well to sterilise those effects if they are to maintain a consistent money supply growth rate that is devoid of past influences. RGDP lagged twice was found to have some strong bearing on the economy's capacity to create credit. This goes to assert that previous growths in national income tend to linger on or persist for some time and thus get transmitted into future economic activities. RTBR lagged twice though statistically significant had a wrong sign. Under normal circumstances we expect a positive relationship between credit creation and domestic interest rates so that when the latter goes up it makes sense for commercial banks to expand their credit portfolio. The dummies 89 and 92 were also significant meaning that the policy reversal when the government decided to go back to the IMF programmes and the latter implementation of trade and financial liberalisation respectively had a strong negative effect as they entailed more austere structural reforms on the economy. Dummy 95's effect on the model was quite strong implying the remaining commercial banks after a few had collapsed had to fill the niche left by the liquidated ones. In terms of credit creation, the surviving banks had to continue giving out massive loans to the general public as a way of instilling confidence in their clients that theirs was a solid base. The attendant effect of such a move is excessive growth in money supply. The ECM's t-ratio in this model suggests



weak cointegration or lack of a long run relationship and hence relegates the model to the short run dynamics.

The currency-money supply ratio is respecified as follows:

$$RC/M1 = \gamma_0 + \gamma_1 \Delta RGDP_{-1} + \gamma_2 \Delta RTBR_{-1} + \gamma_3 Dum92 + \gamma_4 Dum95 + \eta$$

This ratio shows the amount of currency the nonbank public is willing to hold given any level of high-powered money. A high value of this ratio means that the public keeps huge proportions of currency in form of cash. Such a scenario is very common in economies whose financial or money markets are not well developed. If not checked, high currency-money supply ratio leads to low financial intermediation and generally impacts on the investment portfolio adversely.

Table 7 shows regression results with variables in their order of integration

Modelling RC/M1 by OLS

Variable	Coefficient	Std. Error	t-Value	t-prob.	PartR <sup>2</sup>
Constant	31.445	0.63736	49.336	0.0000	0.9931
$\Delta RGDP_{-1}$	-2.0034	0.51101	-3.920	0.0011	0.4748
$\Delta RTBR_{-1}$	-0.00044564	0.00037600	-1.185	0.2522	0.0763
Dum89	-4.1833	2.5281	-1.655	0.1163	0.1387
Dum93	8.8389	3.2220	2.743	0.0139	0.3069
Dum92	7.5490	1.3665	5.525	0.0000	0.6423
Dum79	-7.8433	2.5100	-3.125	0.0062	0.3648
Dum95	-9.6082	2.7108	-3.544	0.0025	0.4249

### Diagnostic Tests

$$R^2 = 0.829012 \quad F(7,17) = 11.775 (0.0000) \quad \sigma = 2.41952 \quad DW = 1.73 .$$

RSS = 99.5196933 for 8 variables and 25 observations.

$$AR \ 1-F(1,16) = 0.58823 (0.4543)$$

$$ARCH \ 1 \ F(1,15) = 0.0005778(0.9811)$$

$$\text{Normality } \chi^2(2) = 5.1852 (0.0748)$$

$$\text{RESET } F(1,16) = 0.39973$$

The coefficients had the expected signs much to our relief in that we had not violated economic theory about the currency-money supply ratio. Again we were cheered that all the diagnostic tests turned out to be insignificant meaning that the classical linear assumptions of the regression model were not violated. The model had been correctly specified as can be seen from the RESET test. Neither autocorrelation nor heteroscedasticity was registered in the model. The errors had a normal distribution. The model's fitting was quite impressive as captured by the coefficient of determination ( $R^2$ ) and in this case explains 82% variations in the dependent variable.

The currency- money supply ratio, RC/MI, is negatively related to the real income, RGDP, since individuals and corporations tend to become more efficient in their cash management as their income rises (see Khatkhate and Villanueva, 1974). The lagged value of RDGP was statistically significant implying that past real income influences have a strong bearing on the currency-money supply ratio. This is expected as current income's growth mostly depends on its previous levels. Furthermore, the currency-money supply ratio is negatively related to the opportunity cost of holding currency as measured by domestic interest rates which in this case have been proxied by treasury bill rates. This is consistent with theory that when interest rates rise at the commercial banks we expect to see people reducing on their idle money holdings by taking them to the banks where they can earn interest. We are operating on the strong assumption that economic agents are rational and always take advantage of market opportunities. Dum92 was statistically significantly different from zero implying that the policy shift in 1992 from direct control

measures to indirect ones had some strong influence in the movement of the cash-ratio and did increase it as reflected in the positive coefficient of the variable. Dum93 was also found to have some strong explanatory power on our model as it represents full implementation of financial reforms in the economy. Its effect on the cash ratio was to increase it as people were now free to hold any amount of currency especially foreign currency which hitherto had been forbidden before. The banking crisis of 1995 as captured by Dum95 impacted negatively on the cash ratio and its influence was quite significant as people's confidence in the banking sector was significantly eroded. Dum93 which captures full trade and financial liberalisation of the economy had a positive and significant impact on the cash ratio as most economic fundamentals adjusted upwards—probably suggesting that financial reforms were bearing the expected fruits. The oil shock of 1979 had a strong and negative influence on the cash ratio as the economy was sent reeling by high petroleum prices on the world market.

The function that deals with demand deposits which are in essence "cost free" liabilities to the commercial banks since no interest is paid on them is respecified as:

$$RDD = \omega_0 + \omega_1 RDD_{-1} + \omega_2 \Delta RDD_{-1} + \omega_3 \Delta RGDP_{-1} + \omega_4 Dum92 + \omega_5 Dum95 + \lambda$$

(d)

**Table 8 shows regression results with variables in their order of integration**

Modelling RDD by OLS

Variable	Coefficient	Std. Error	t-Value	t-prob.	PartR <sup>2</sup>
Constant	8.322e+005	1.4257e+005	5.838	0.0000	0.6421
RDD <sub>-1</sub>	-0.49091	0.19567	-2.509	0.0213	0.2489
$\Delta$ RGDP	1.1800e+005	65326	1.806	0.0867	0.1466
$\Delta$ GDP <sub>-1</sub>	-2.4067e+005	64828	-3.712	0.0015	0.4204
Dum92	-7.3760e+005	1.7857e+005	-4.131	0.0006	0.4731
Dum95	7.5566e+005	3.9681e+005	1.904	0.0721	0.1603

$$R^2 = 0.650044 \quad F(5,19) = 7.0585 (0.0007) \quad \sigma = 302917 \quad DW = 1.87$$

RSS = 1.74344684e+012 for 6 variables and 25 observations

$$\text{AR 1-F}(1,18) = 0.074712 (0.7877)$$

$$\text{ARCH 1 F}(1,17) = 1.3506 (0.2612)$$

$$\text{Normality Chi}^2(2) = 8.1654 (0.0169)^*$$

$$\text{RESET F}(1,18) = 128.59 (0.0000)**$$

The diagnostic AR and ARCH tests were both insignificant suggesting that there was neither serial autocorrelation nor heteroscedasticity in the model. The residuals had a normal distribution though at 5% level of significance did not perform well. The model failed the RESET test at 1% level of significance implying that it had a wrong functional form.

All the coefficients had correct signs apart from the lagged RDD and lagged RGDP which carried wrong signs. The lagged value of real income though carrying a wrong sign was quite significant meaning that past influences of income have some strong bearing on this model so were past effects of demand deposits on current levels of demand deposits. The dummy variable representing the introduction of the New Economic Recovery Programme in 1992 was quite significant implying that the policy change in that year did affect the accumulation of demand deposits strongly. Since the constant was found to be significant, it suggests that there could be other autonomous factors that affect the demand deposits function which have not been captured in this model.

The money supply function is respecified as follows:

$$\Delta \text{RM1} = \Phi_0 + \Phi_1 \Delta \text{RM1}_{-1} + \Phi_2 \Delta \text{RGEXP}_{-1} + \Phi_3 \text{TR}_{-1} + \Phi_4 \text{Dum92} + \Phi_5 \text{Dum95} + \upsilon$$

**Table 9**

Modelling RMI by OLS

Variable	Coefficient	Std Error	t-Value	t-prob.	PartR <sup>2</sup>
Constant	-29.273	49.992	-0.586	0.5654	0.0187
$\Delta \text{RM1}_{-1}$	0.12153	0.14539	0.836	0.4141	0.0374

$\Delta GEXP$	0.051356	0.037793	1.359	0.1910	0.0930
$RTR_1$	-0.18516	0.073643	-2.514	0.0217	0.2599
$RTR_2$	0.17440	0.074053	2.355	0.0301	0.2355
Dum89	-213.86	78.157	-2.736	0.0136	0.2938
Dum79	236.14	77.561	3.045	0.0070	0.3399

### Diagnostic Tests

$$R^2 = 0.690146 \quad F(6,18) = 6.682 (0.0008) \quad \sigma = 74.0276 \quad DW = 1.99$$

RSS = 98641 54152 for 7 variables and 25 observations

$$AR \ 1-IF(1,17) = 0.010113 (0.9211)$$

$$ARCH \ 1 \ F(1,16) = 0.39104 (0.5406)$$

$$\text{Normality } \chi^2(2) = 1.2784(0.5277)$$

$$RESET \ F(1,17) = 0.075909 (0.7862)$$

The diagnostic tests of AR and ARCH confirmed that the model did not suffer from serial correlation or heteroscedasticity in the error terms. The model was correctly specified and the residuals had a normal distribution. The coefficient of determination was generally good explaining about 69% of variations in the dependent variable

RTR lagged twice had a wrong coefficient sign. We expect to see a negative relationship between growth in money supply and tax revenues and since RTR lagged once was significant, it implies that past changes in taxes have a strong but negative bearing on current changes in money supply. We expect to see a situation where as taxes increase money supply should start decreasing as taxes are a withdrawal from the circular flow of income. The dummy79 suggests that the external oil shock in that particular year contributed to the growth of money supply significantly. This is expected, as the immediate effect of the shock was to raise the prices of petroleum products and hence send a price wave to all the sectors in the economy. The government had to procure the oil products at very high costs (or literally imported inflation) which fuelled growth in money supply in Zambia. Dummy89 was found to have some substantial influence on

money supply and the effects were negative due to austere conditionalities the nation had to put up with from the Bretton Woods System.

The reserve-money supply ratio is respecified as follows:

$$\Delta RR/M1 = \hat{c}_0 + \hat{c}_1 \Delta MINRES + \hat{c}_2 \Delta TBR + \hat{c}_3 \Delta RGDP + \hat{c}_4 Dum92 + \hat{c}_5 Dum95 + \xi \quad (f)$$

This ratio is determined by the monetary authorities through manipulation of various instruments at their disposal.

The variables were found to be integrated of the same order and as such cointegration tests were carried out on the residuals to establish cointegration or lack of it (see Table A). Cointegration was confirmed and accepted.

The model is now respecified as follows:

$$\Delta RR/M1 = \hat{c}_0 + \hat{c}_1 \Delta RMINRES_{.1} + \hat{c}_2 \Delta RGDP_{.1} + \hat{c}_3 \Delta RTBR_{.1} + \hat{c}_4 Dum92 + \hat{c}_5 Dum95 + \pi ECM2_{.2} + \xi$$

Where,  $\pi$  is the coefficient of the error correcting term. The results are presented in the table below:

**Table 16**

Modelling the  $\Delta RR/M1$  by OLS

Variables	Coefficients	Std Error	t-Value	t-prob.	PartR <sup>2</sup>
Constant	-0.74203	0.91290	-0.813	0.4299	0.0451
$\Delta RGDP$	-2.4757	0.59251	-4.178	0.0009	0.5550
$\Delta RGDP_{.1}$	-1.4088	0.71037	-1.983	0.0673	0.2193
$\Delta RMINRES$	0.10219	0.0077750	13.143	0.0000	0.9250
$\Delta RTBR$	-0.00075283	0.00052461	-1.435	0.1732	0.1282
Dum92	7.0100	1.8312	3.828	0.0018	0.5114
Dum95	-50.207	3.8475	-13.049	0.0000	0.9240
Dum93	10.791	4.4079	2.448	0.0281	0.2998
Dum89	14.945	3.8394	3.893	0.0016	0.5198
$ECM2_{.1}$	0.21171	0.41754	0.507	0.6200	0.0180

### Diagnostic Tests

$$R^2 = 0.973128 \quad F(9,14) = 56.331 (0.0000) \quad \sigma = 3.21665 \quad DW = 1.77$$

RSS = 144.8559517 for 10 variables and 24 observations.

$$AR\ 1-F(1,13) = 0.050857 (0.8251)$$

$$ARCH\ 1\ F(1,11) = 0.5198(0.4847)$$

$$\text{Normality Chi}^2(2) = 11.545 (0.0031)**$$

$$\text{RESET F}(1,13) = 0.0019679 (0.9653)$$

The coefficients are all carrying the correct signs save for the ECM and MINRES which have unexpected signs. The coefficient of determination was very high suggesting that the model had captured most of the factors that influence the reserve-money supply ratio. It explains about 97% of variations in the dependent variable. The model was correctly specified as it passed the diagnostic tests of specification (RESET Test). The model did not suffer from serial correlation or heteroscedasticity in the error terms. However, it failed normality tests at 1% level of significance.

Like in the currency-money supply equation, the reserve-money supply ratio is inversely related to real income for the same reasons we gave in the previous case. As for the domestic interest rates which in this case have been proxied by the RTBR, we expect to see a negative relationship between interest rates and the reserve ratio. The reason lies in the fact that when the domestic interest rates (which act as the price of borrowing money from commercial banks) rise, it makes sense for the commercial banks to convert their excess reserves into loanable funds and offload them onto the money market to potential borrowers and by so doing earn extra money through interest rate payments on principal.

The legal required minimum reserves have a wrong sign and were quite significant meaning that they have a strong bearing on the reserve ratio. However, the tendency by BoZ now is to move away from reserve requirements to market based control mechanisms such as Open Market Operations (OMOs) and Repurchase agreements with the commercial banks. As to whether the central bank will completely forsake the reserve

requirements as a tool for controlling the activities of the commercial banks only time will tell.

The two dummy variables representing policy changes (Dum89 and Dum92) were positive and quite significant indicating that the policy shifts in those respective years exerted some strong influence on the reserve -money supply ratio. Dummy93 which captures almost full liberalisation of the money market was found to be significant and this means that commercial banks were able to amass excess reserves with minimum interference from the monetary authorities. Dummy95 representing the infamous banking crisis had some profound impact on the economy as most economic agents had lost confidence in the banking community. This affected the pace at which commercial banks could accumulate their reserves. The t-ratio of the ECM was found to be insignificant suggesting that there may be weak or lack of cointegration among variables in the long run and therefore the model should be seen as a short-run phenomenon.



## CHAPTER FIVE

### 5.0 SUMMARY/CONCLUSIONS AND POLICY IMPLICATIONS

#### 5.1 INTRODUCTION

The main aim of this research paper was to establish the role and determinants of the money supply process in Zambia in light of pre and post financial reforms of 1992. Specifically, we sought to find out the impact of changes in the various factors that determine money supply have on the overall conduct of monetary policy. Our study was, to a greater extent, motivated by lack of comprehensive studies done on Zambia as regards to the determinants of money supply. Most studies on the money supply process have usually focussed on the factors that affect the cash and reserve ratios without paying attention to the role of fiscal deficits in the money supply determination. Our paper has established that fiscal policy through taxation and government expenditures play a significant role in the pattern of growth in the money supply. This would suggest that monetary and fiscal policy should not be implemented in isolation but jointly if sporadic growths in the money supply are to be eliminated.

This chapter recapitulates the research findings of chapter 4 and proceeds to offer policy implications, conclusions of the study, limitations, and suggestions for further research work in the same area.

From chapter 4 we draw the following conclusions: The NFA model in Zambia is affected by changes in the real exchange rate, changes in lagged real income (RGDP), changes in the lagged NFA, and changes in lagged BOZCG which are basically loans to the government. The capital inflows in form of balance of payments have a positive impact on the changes in the NFA though their effect is insignificant.

The changes in the real exchange rate impact on changes in the NFA negatively meaning that an increase in the net foreign assets would lead to a depreciation of the local currency. Uncontrolled depreciations if not checked can be a source of money supply growth as the local currency continues to lose its purchasing power. As an example,

currently the Zambian Kwacha exchanges for K3, 750 to 1US\$. This means that people have to carry a lot of cash to meet their day-to-day transactions and precautionary demands. The country has completely liberalised the foreign exchange market a situation which implies that the rate is determined through the interaction of demand and supply forces.

We however, wish to offer some caution here that market forces on their own have no "eyes" hence the need for the monetary authorities to regulate the money market in order to avoid financial chaos. This is not a suggestion to return to a control regime of the exchange rate market but merely stressing the fact that the monetary authorities have a role to play in the money market as there is no economy that functions without a regulator. In this case we echo the sentiments of Nyamongo (1997) who proposed that the central bank should engage in a managed float type of exchange rate as opposed to a complete float. This is essential in an economy that is riddled with money market imperfections and rigidities. Thus timely interventions from the monetary authorities would ensure that wild fluctuations in the exchange rate are systematically smoothed out.

Changes in bank claims on the government which essentially are loans to the central authorities were found to affect changes in NFA negatively and were quite significant. This means that government loans from the central bank have an adverse effect on NFA as they have a tendency to reduce or deplete foreign reserves.

The BOZCG equation was significantly affected by changes in GEXP. The plausible reasons for expecting the government to resort to money creation at the central bank are, among others, the presence of an inefficient tax administration system; inadequate tax programs and a low tax base. Even when there is improvement in the tax administration system poor macroeconomic management has also been pointed to culminate into poor tax performance (see Tanzi, 1988). There is some consensus within a body of economic literature that macro instability is largely attributed to excessive demand pressure fuelled by monetary growth occasioned by fiscal deficit financing. Thus, stabilisation policies under the NERP have mostly involved policies directed at curtailing increases in money supply growth. Since 1993 when the current government introduced cash budgets fiscal

deficit financing has been on the wane probably a sign of prudent fiscal management taking place.

On the aspects of government expenditures which have a strong correlation with fiscal deficits, we would propose that the government should continue adhering to the cash budget as the only means to instil financial discipline among government ministries and departments. Eventually this should culminate into a sizeable reduction of government deficits as the government is made to live within its financial means. This is the hallmark of the NERP.

Tax revenues though with a correct sign were not significant in explaining the changes in government borrowings from the central bank. This could be because taxes are by nature a withdrawal from the circular flow of income as such they have very little influence on the loans that the government is able to access from banks.

The changes in CRE were significantly affected by changes in the lagged value of the NFA. Past values of net foreign assets have a strong bearing on the credit to the rest of the economy and this is expected in a situation where the central bank does not wholly sterilise the influence of external inflows. The past changes in RCRE have a strong effect on the credit capacity of the economy an indication that past influences of credit creation easily get transmitted into the present monetary activities. Since changes in NFA lagged twice do not seem to affect changes in the CRE we are left to speculate that distant external resources in the past in form of grants and loans to support various projects and programmes are not a threat to liquidity in the economy. A substantial proportion of these resources go to balance of payment support hence have very little impact on the credit capacity of the banking system. Dummy variable 89 representing the time when the government decided to go back to the IMF and the World Bank programmes had a significant negative impact on the credit portfolio of the economy. This could be because of the harsh and austere conditions the country had to embrace before it could access loans and grants from the Bretton Woods financial system. The other dummy variables (Dum92 and Dum 95) were also significant in this model. This means that the policy

change in 1992 and the banking fiasco of 1995 had affected the credit portfolio profoundly.

The currency-money supply ratio demonstrated good fitting and the variables had correct signs. From the results, changes in the currency-money supply ratio significantly depend on changes in the real income, RGDP. Real income was found to have some strong influence in explaining variations in the currency -money supply ratio. The results in this function are consistent with those obtained by Birech (1992) and Khatkhate et. al (1974) and in that respect we are cheered that we did not depart from what others have done in the past. Dummies 93,92,79 and 95 had all important explanatory power on our model.

Changes in real demand deposits, RDD, are significantly affected by changes in lagged GDP. However the variable of interest (changes in lagged RDD) was found to be insignificant while dummy92 which captures the introduction of NERP was quite significant implying that the policy change had a strong bearing on the formation of demand deposits in the economy. Since this model had performed poorly in explaining the determinants of demand deposits, it calls for further inquiries in order to come up with satisfactory results.

Changes in money supply are affected by changes in the lagged value of RM1, RGEXP and RTR although the first two variables were insignificant. Dummy89 indicated some strong negative effects of policy change on the growth of money supply while Dummy79 suggests that the oil shock contributed to more than a fair increase in the money supply process. The lagged coefficient of RTR shows that past revenues have some bearing on the money supply process. This is a case of unsatisfactory modelling which calls for further investigations into the factors that impact on the narrow monetary aggregate, M1.

The reserve ratio showed that it was affected by changes in RGDP and changes in the MINRES. The other variables were found to be insignificant while the dummy variables for 1995 and 1989 were found to be significant meaning that the bank crisis and the policy change had some strong influence on the reserve ratio respectively. Dummy92 was

equally significant and its impact on the reserve ratio was positive so also was Dummy93.

## 5.2 POLICY IMPLICATIONS

The outcome of this study is quite important as it can be used to provide policy guidance in improving the conduct and implementation of monetary policy in Zambia. From the results, we have established that the money supply problem in Zambia is a multi-faceted phenomenon with many determinants, as we have been able to illustrate by the number of factors analysed in the study. Thus it is clear that the factors impacting on the money supply process are both endogenous and exogenous in nature. For instance, the external resources are not under the purview of the monetary authorities. Therefore, the control measures to be adopted should be seen in that context. Like the other studies done on Zambia, (Atta (1998) and Mwenda (1997)) there is need for the monetary authorities to tighten control measures for those factors that fall directly under their umbrella. Finally we wish to suggest that the central bank should intensify its usage of discount rates and OMOs as tools for mopping excess liquidity from the economy.

## 5.3 CONCLUSION

The regression results as noted in the introduction to this chapter suggest that the task of monetary control is not an easy one as it involves formulating monetary policy that is in consonance with fiscal policy. Sometimes the fiscal authorities may have their own goals that may not necessary agree with monetary policy ideals and this in itself poses a serious challenge on the efficacy of monetary policy. This is especially true in a situation where the central bank lacks self-autonomy. Since this paper has identified fiscal deficit financing as one major source of money supply growth, there is therefore need for the central bank to constrain the amount of loans extended to the government. The main rationale for constraining central bank credit to the government is the presumed inflationary bias of governments. Attributing monetary policy responsibilities to an independent central bank, subject to a legal mandate to pursue price stability and accountable for its actions, is a possible solution to this bias. The main challenge to removing excessive money growth in the economy lies in the central bank controlling the amount of credit that commercial banks are able to create. This can be done through the

usage of discount rates and the OMOs as opposed to the direct control mechanisms. The amount of cash that the general public holds at any time can be reduced through the introduction of alternatives to cash such as credit and debit cards. Further if the public has confidence in the banking sector people will find it attractive to take money to the banks instead of holding it as idle money balances. To achieve this, the central bank should improve its supervisory role on the activities of commercial banks so that no bank goes into insolvency abruptly. The experience of 1995 where three commercial banks went under thereby trapping depositors' money for many months had badly eroded banker confidence.

#### **5.4 LIMITATIONS OF THE STUDY**

Since the study utilised secondary data collected for various purposes other than what we have put it to, our results should therefore be taken with care and caution. We were also unable to capture the political influence on the money supply process and yet we have strong suspicions that politics tend to prevail on monetary policy decisions. Data on the number of commercial banks in the country was not readily available thereby compelling us to drop it as one of the variables in the estimations. This generally had affected the quality of our results especially its effect on the demand deposit, currency ratio and the excess reserve ratio. Any data collection exercise has inherent measurement errors that tend to compromise the quality of data and our data set is no exception from this bias. Thus, the results from this study may not be very accurate in the statistical terms.

Lastly, we would have wished to extend the study period from 1964 to 2000 but then the data set could not permit us to do so as most observations before 1970 were not available.

#### **5.5 SUGGESTIONS FOR FUTURE RESEARCH**

In light of poor explanatory power in most of the variables in the demand deposit and money supply functions, we wish to suggest that another inquiry be made to evaluate their determinants. In this study we have used the treasury bill rate as a proxy for domestic interest rates, this procedure has one pitfall in that proxies are never exact but merely approximations to the actual variables. Thus results from proxies would not be as efficient as the case would be if we had used the actual domestic rates of interest. In

Zambia there is a common phenomenon where people tend to overspend during periods of festivities. In order to capture those seasonal variations high frequency data such as quarterly or monthly data would have been very ideal or appropriate for this type of study. Unfortunately high frequency data was not readily available. This study was also unable to capture people's access to banking facilities and yet this is an important variable as it measures the degree of financial development in the economy. We would therefore suggest that future research builds on these weaknesses as it will improve the quality of analysis.

Furthermore, foreign interest rates and the domestic rate of inflation were not utilised in this study, we feel that if these variables had been incorporated into the analysis the output would have been slightly better than the case is now.

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GENERAL MODEL OF ARNFA BY OLS

Variable	Coefficient	Std. Error	t-Value	t-prob.	PartR <sup>2</sup>
Constant	405.87	396.23	1.024	0.3324	0.1044
$\Delta$ ARNFA <sub>.1</sub>	1.0725	0.51548	2.081	0.0672	0.3248
$\Delta$ ARNFA <sub>.2</sub>	-0.13384	0.13400	-0.999	.03440	0.0998
RBOP	0.032961	0.5679	0.058	0.9548	0.0004
RBOP <sub>.1</sub>	-0.051635	0.49105	-0.105	0.9186	0.0012
RBOP <sub>.2</sub>	-0.14222	0.48814	-0.2910	0.7774	0.0093
$\Delta$ RXRTE	-0.95751	0.20813	-4.601	0.0013	0.7016
$\Delta$ RXRTE <sub>.1</sub>	-0.12846	0.51141	-0.251	0.8073	0.0070
$\Delta$ RXRTE <sub>.2</sub>	0.47902	0.46569	1.029	0.3305	0.1052
$\Delta$ RBOZCG	-1.2461	0.31587	-3.945	0.0034	0.6336
$\Delta$ RBOZCG <sub>.1</sub>	-0.16010	0.55052	-0.291	0.7778	0.0093
$\Delta$ RBOZCG <sub>.2</sub>	-0.71582	0.52184	-1.372	0.2034	0.1729
Dum92	-817.27	467.80	-1.747	0.1146	0.2532
Dum95	2837.6	966.78	2.935	0.0166	0.4891
Dum93	878.16	1496.9	0.587	0.5718	0.0368
Dum89	-6510.8	3719.3	-1.751	0.1139	0.2540
Dum79	992.06	750.45	1.322	0.2188	0.1626

R<sup>2</sup> = 0.941295 F(16,9) = 9.0193 (0.0011)  $\sigma$  = 641.878 DW = 2.23  
 RSS = 3708066.322 for 17 variables and 26 observations

AR 1-F(1,8) = 0.78141 (0.4025)  
 ARCH 1 F(1,7) = 0.21849 (0.6544)  
 Normality Chi<sup>2</sup>(2) = 3.1995 (0.2019)  
 RESET F(1,8) = 39.611(0.0002)\*\*

GENERAL MODEL FOR  $\Delta$ RBOZCG BY OLS

Variable	Coefficient	Std Error	t-Value	t-prob	PartR <sup>2</sup>
Constant	-338.09	510.60	-0.662	0.5194	0.0326
$\Delta$ RBOZCG <sub>.1</sub>	-0.25193	0.29978	-0.840	0.4159	0.0515
RTR	-0.56455	0.52042	-1.085	0.2977	0.0830
RTR <sub>.1</sub>	0.26610	0.74369	0.358	0.7262	0.0098
RTR <sub>.2</sub>	0.64218	0.58661	1.095	0.2935	0.0844
$\Delta$ RGEXP	0.91303	0.35339	2.584	0.0227	0.3393
$\Delta$ RGEXP <sub>.1</sub>	-0.18670	0.38524	-0.485	0.6360	0.0177
$\Delta$ RGEXP <sub>.2</sub>	-0.66088	0.41770	-1.582	0.1376	0.1615
Dum92	-229.14	393.06	-0.583	0.5699	0.0255
Dum95	975.09	583.31	1.672	0.1185	0.1769
Dum93	1697.4	869.95	1.951	0.0729	0.2265
Dum89	-295.58	609.23	-0.485	0.6356	0.0178
Dum79	-306.27	640.09	-0.478	0.6403	0.0173

$R^2 = 0.75292$   $F(12,13) = 3.0312 (0.0210)$   $\sigma = 509.004$   $DW = 2.06$   
 RSS = 3368104.156 for 13 variables and 26 observations  
 AR 1-F(1,12) = 0.12908 (0.7256)  
 ARCH 1 F(1,11) = 0.16355 (0.6937)  
 Normality  $\chi^2(2) = 1.3523 (0.5086)$   
 RESET F(1,12) = 0.15603 (0.6998)

GENEARL MODEL FOR  $\Delta$ RCRE BY OLS

Variable	Coefficient	Std. Error	t-Value	t-prob	PartR <sup>2</sup>
Constant	74.021	205.82	0.360	0.7297	0.0181
$\Delta$ RCRE <sub>.1</sub>	-0.42932	0.31016	-1.384	0.2088	0.2149
$\Delta$ RCRE <sub>.2</sub>	-0.089892	0.32382	-0.278	0.7893	0.0109
$\Delta$ RGDP	-188.77	342.73	-0.551	0.5989	0.0415
$\Delta$ RGDP <sub>.1</sub>	-43.073	144.13	-0.299	0.7737	0.0126
$\Delta$ RGDP <sub>.2</sub>	449.67	251.45	1.788	0.1169	0.3136
$\Delta$ RNFA	-0.10376	0.14497	-0.716	0.4973	0.0682
$\Delta$ RNFA <sub>.1</sub>	0.32891	0.28951	1.136	0.2933	0.1557
$\Delta$ RNFA <sub>.2</sub>	-0.20772	0.17400	-1.194	0.2715	0.1691
$\Delta$ RTBR	-0.0028703	0.13847	-0.021	0.9840	0.0001
$\Delta$ RTBR <sub>.1</sub>	-0.072624	0.14708	-0.494	0.6366	0.0337
$\Delta$ RTBR <sub>.2</sub>	-0.034876	0.14072	-0.248	0.8114	0.0087
Dum92	-510.21	335.76	-1.520	0.1724	0.2480
Dum95	1013.6	694.96	1.459	0.1881	0.2331
Dum93	-337.64	1322.7	-0.255	0.8058	0.0092
Dum89	-1970.3	2188.7	-0.900	0.3979	0.1038
Dum79	672.60	686.85	0.979	0.3601	0.1205
Ecm <sub>.1</sub>	-0.088161	0.40456	-0.218	0.8337	0.0067

$R^2 = 0.918487$   $F(17,7) = 4.6397 (0.0233)$   $\sigma = 456.597$   $DW = 2.50$   
 RSS = 1459366.931 for 18 variables and 25 observations

AR 1-F(1,6) = 15.295 (0.0079)\*\*  
 ARCH 1 F(1,5) = 0.29443 (0.6107)  
 Normality  $\chi^2(2) = 1.0663 (0.5868)$   
 RESET F(1,6) = 0.056869 (0.8195)

GENERAL MODEL FOR  $\Delta RC/MI$  BY OLS

Variable	Coefficient	Std. Error	t-Value	t-prob	PartR <sup>2</sup>
Constant	26.329	10.177	2.587	0.0253	0.3783
RC/MI <sub>1</sub>	0.18936	0.203580	0.930	0.3723	0.0729
RC/MI <sub>2</sub>	-0.035213	0.22346	-0.158	0.8776	0.0023
$\Delta RGDP$	-0.28460	0.68516	-0.415	0.6858	0.0154
$\Delta RGDP_{1}$	-1.4891	0.68063	-2.188	0.0512	0.3032
$\Delta RGDP_{2}$	-0.42751	0.64948	-0.658	0.5239	0.0379
$\Delta RTBR$	-0.00043984	0.00043238	-1.017	0.3309	0.0860
$\Delta RTBR_{1}$	-0.00042180	0.00045603	-0.925	0.3748	0.0722
$\Delta RTBR_{2}$	-0.00026264	0.00058060	-0.452	0.6598	0.0183
Dum92	7.2160	2.7839	2.592	0.0250	0.3792
Dum95	-10.504	3.2957	-3.187	0.0087	0.4801
Dum93	7.0620	3.8521	1.833	0.0939	0.2340
Dum89	-6.1479	4.0293	-1.526	0.1553	0.1747
Dum79	-8.2604	3.0102	-2.744	0.0091	0.4064

$R^2 = 0.864089$      $F(13,11) = 5.3796 (0.0042)$      $\sigma = 2.68166$      $DW = 1.53$   
 RSS = 79.10405569 for 14 variables and 25 observations

AR 1-IF (1,10) = 0.83385 (0.3826)  
 ARCH 1 F (1,9) = 0.001409 (0.9709)  
 Normality Chi<sup>2</sup>(2) = 1.5555 (0.4594)  
 RESET F (1,10) = 0.0013409 (0.9715)

GENERAL MODEL FOR RDD BY OLS

Variable	Coefficient	Std Error	t-Value	t-prob	PartR <sup>2</sup>
Constant	9.0898	4.7459	1.915	0.0818	0.2501
RDD <sub>1</sub>	-0.45319	0.31505	-1.438	0.1781	0.1583
RDD <sub>2</sub>	-0.18585	0.73061	-0.254	0.8039	0.0058
$\Delta RGDP$	1.0348	9.3129	0.111	0.2902	0.1009
$\Delta RGDP_{1}$	-2.5634	9.1854	0.279	0.0176	0.4145
$\Delta RGDP_{2}$	24735	94761	0.261	0.7989	0.0062
$\Delta RRD$	-27.677	75.048	-0.369	0.7193	0.0122
$\Delta RRD_{1}$	24.485	73.264	0.334	0.7445	0.0101
$\Delta RRD_{2}$	16.718	78.177	0.214	0.8346	0.0041
Dum92	-8.4144	4.3110	1.952	-1.952	0.0769
Dum95	1.1083	4.4521	0.249	0.8080	0.0056
Dum93	1.2676	1.6808	0.754	0.4666	0.0492



Dum89	-18347	4.7154e+005	-0.039	0.9697	0.0001
Dum79	20537	4.6221e+005	0.044	0.9654	0.0002

$R^2 = 0.669303$   $F(13,11) = 1.7125 (0.1891)$   $\sigma = 387001$   $DW = 1.94$   
 RSS = 1.647471536e+012 for 14 variables and 25 observations

AR 1-F (1,10) = 0.014512 (0.9065)  
 ARCH 1 F (1,9) = 0.70868 (0.4217)  
 Normality  $\text{Chi}^2(2) = 11.461 (0.0032)**$   
 RESET F (1,10) = 102.97 (0.0000)\*\*

GENERAL MODEL FOR  $\Delta RMI$  BY OLS

Variable	Coefficient	Std Error	t-Value	t-prob	PartR <sup>2</sup>
Constant	-80.052131	131.22	-0.610	0.5542	0.0327
$\Delta RMI_{1,1}$	0.015028	0.24981	0.060	0.9531	0.0003
$\Delta RMI_{1,2}$	-0.0044852	0.27513	-0.016	0.9873	0.0000
RTR	0.0047761	0.12396	0.039	0.9700	0.0001
$RTR_{1,1}$	0.20014	0.14902	1.343	0.2063	0.1409
$RTR_{2,2}$	-0.15491	0.10949	-1.415	0.1848	0.1539
$\Delta RGEXP$	0.065149	0.055125	1.182	0.2622	0.1127
$\Delta RGEXP_{1,1}$	0.024868	0.073640	0.338	0.7419	0.0103
$\Delta RGEXP_{2,2}$	0.036122	0.082829	0.436	0.6712	0.0170
Dum92	66.610	89.298	0.746	0.4713	0.0481
Dum95	3.5900	107.56	0.033	0.9740	0.0001
Dum93	-115.31	196.34	-0.587	0.5689	0.0304
Dum89	-172.43	113.33	-1.522	0.1563	0.1739
Dum79	250.54	100.88	2.483	0.0304	0.3593

$R^2 = 0.728836$   $F(13,11) = 2.2743 (0.0902)$   $\sigma = 88.5873$   $DW = 1.77$   
 RSS = 86324.84784 for 14 variables and 25 observations

AR 1-F(1,7) = 0.11338 (0.7462)  
 ARCH 1 F (1,6) = 0.16941(0.6949)  
 Normality  $\text{Chi}^2(2) = 1.0475 (0.5923)$   
 RESET F (1,10) = 0.037499 (0.8503)

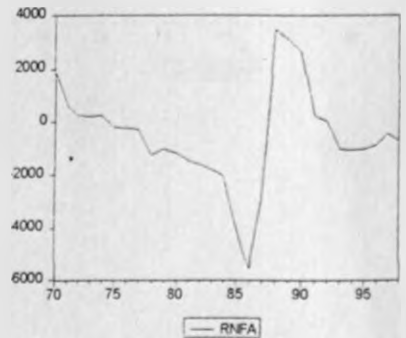
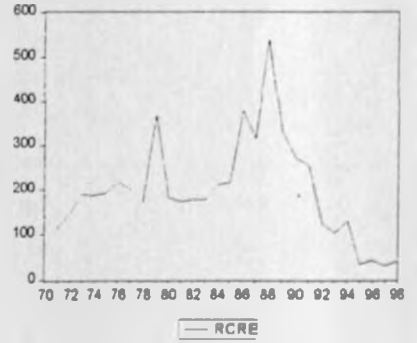
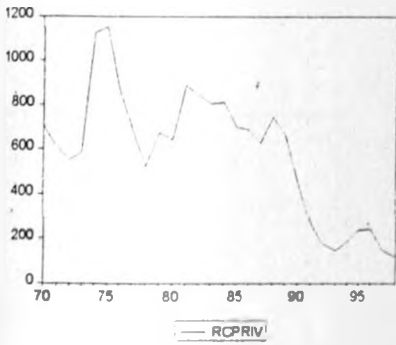
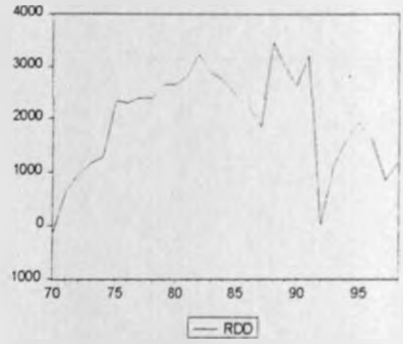
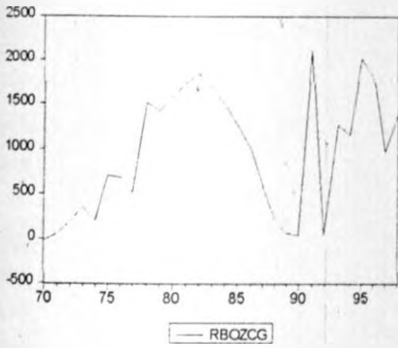
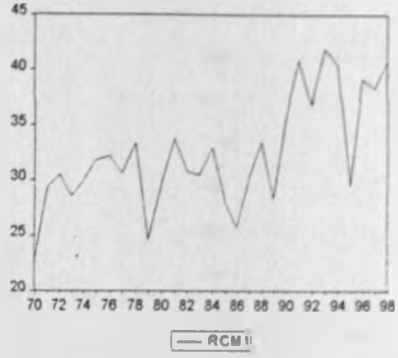
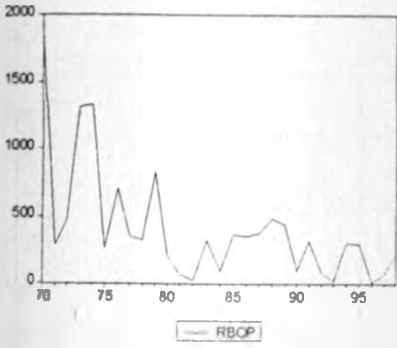
GENERAL MODEL FOR  $\Delta RR/MI$  BY OLS

Variable	Coefficient	Std Error	t-Value	t-prob	PartR <sup>2</sup>
Constant	-0.75869	1.0602	-0.716	0.4974	0.0682
$\Delta RR/MI_{.1}$	0.085053	0.090987	0.935	0.3810	0.1110
$\Delta RR/MI_{.2}$	0.13426	0.096593	1.390	0.2071	0.2163
$\Delta RGDP$	-1.8207	1.0266	-1.774	0.1194	0.3101
$\Delta RGDP_{.1}$	-1.0657	1.2386	-0.860	0.4181	0.0956
$\Delta RGDP_{.2}$	1.2708	0.87377	1.454	0.1892	0.2321
$\Delta RMINRES$	0.095826	0.012127	7.902	0.0001	0.8992
$\Delta RMINRES_{.1}$	-0.0066695	0.017218	-0.387	0.7100	0.0210
$\Delta RMINRES_{.2}$	-0.0081350	0.018076	-0.450	0.6663	0.0281
$\Delta RTBR$	-0.00066985	0.000678995	-0.987	0.3567	0.1221
$\Delta RTBR$	-0.00048820	0.00067288	-0.726	0.4917	0.0699
$\Delta RTBR$	-3.362e-005	0.00076472	-0.044	0.9662	0.0003
Dum92	8.3842	2.6184	3.202	0.0150	0.5943
Dum95	-54.496	5.3506	-10.185	0.0000	0.9368
Dum93	8.9204	6.5971	1.352	0.2184	0.2071
Dum89	12.380	6.6146	1.872	0.1034	0.3335
Dum79	-1.1412	4.4886	-0.254	0.8066	0.0092
Ecm2. <sub>1</sub>	0.13203	0.48722	0.271	0.7942	0.0104

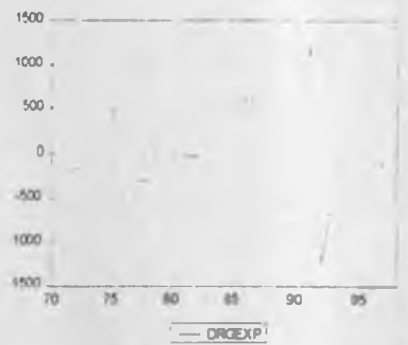
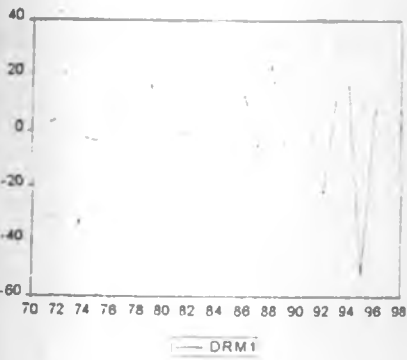
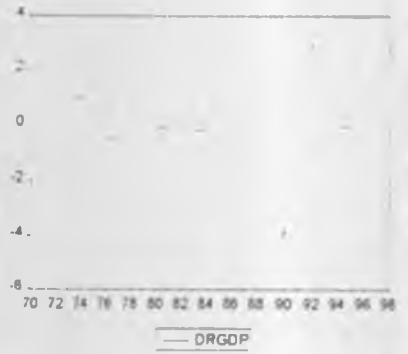
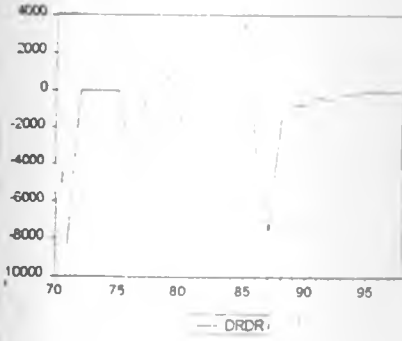
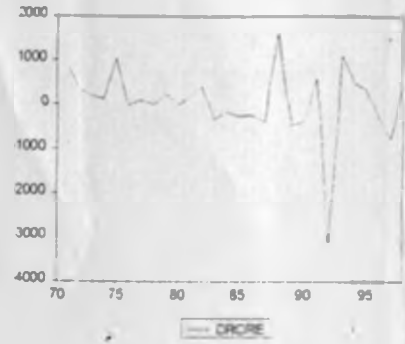
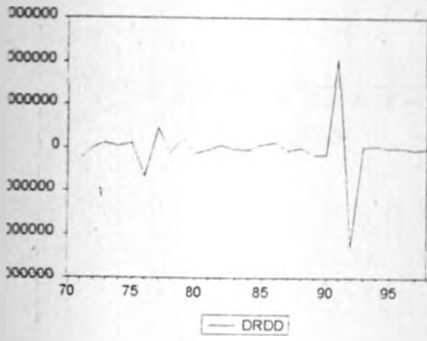
$R^2 = 0.984506$      $F(17,7) = 26.164$  (0.0001)     $\sigma = 3.45619$      $DW = 1.79$   
 RSS = 83.61664255 for 18 variables and 25 observations

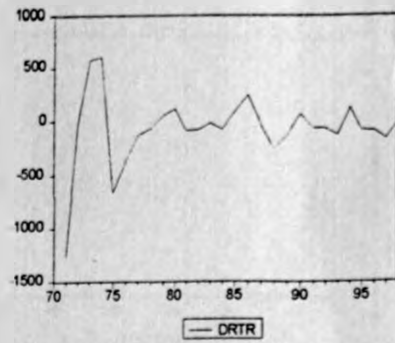
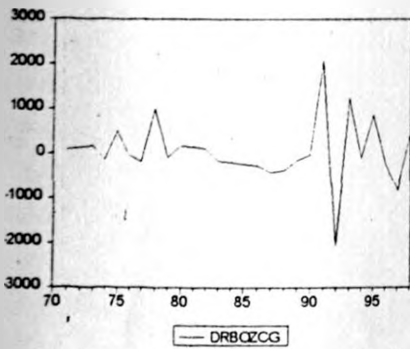
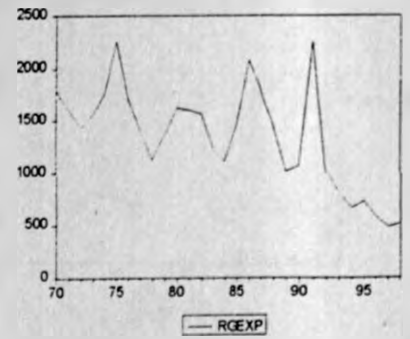
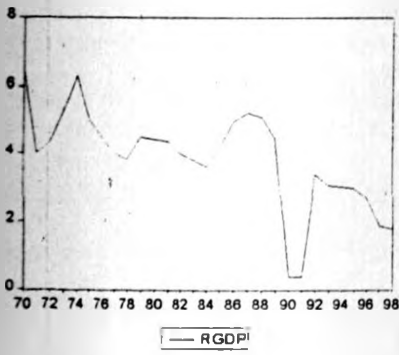
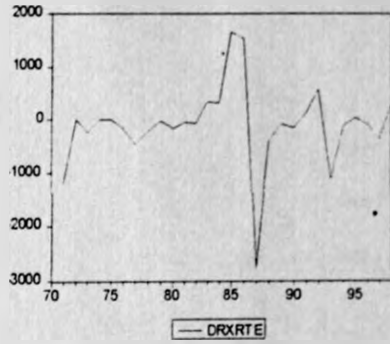
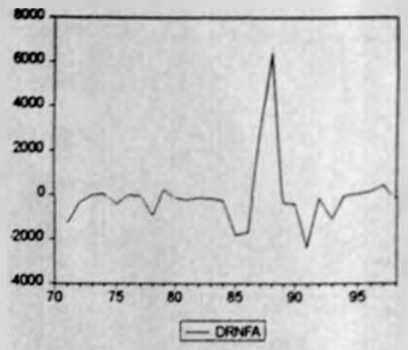
AR 1-F (1,6) = 1.1404 (0.3266)  
 ARCH 1 F (1,5) = 0.21776 (0.6604)  
 Normality  $\chi^2(2) = 6.9637$  (0.0308)\*  
 RESET F (1,6) = 0.43706 (0.5331)

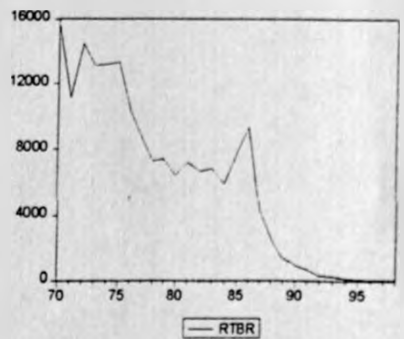
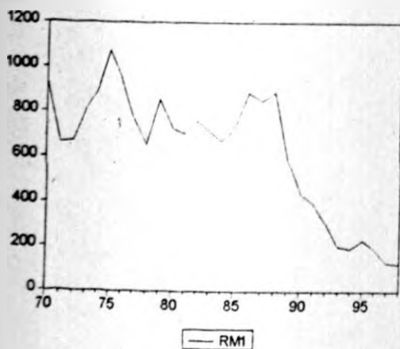
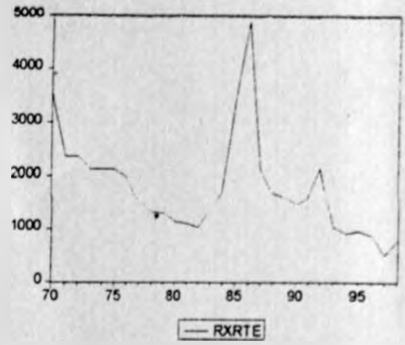
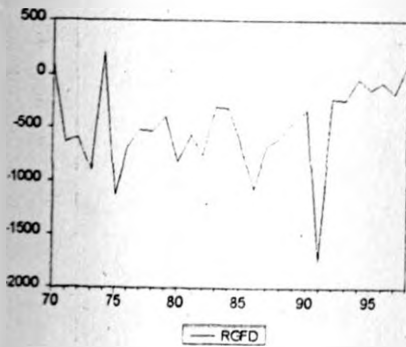
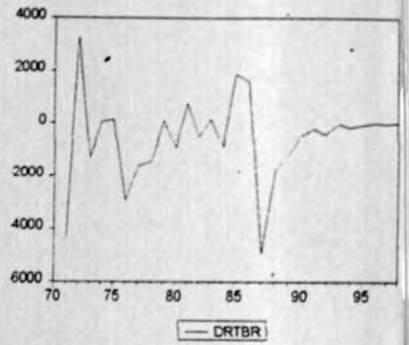
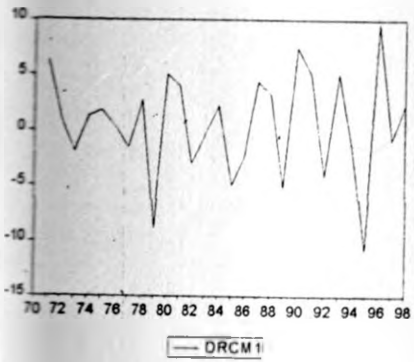
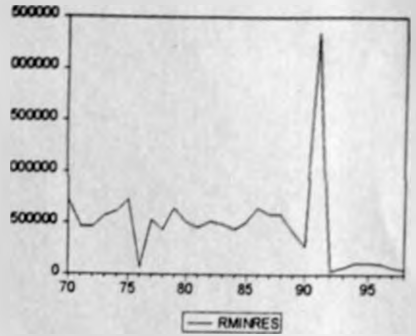
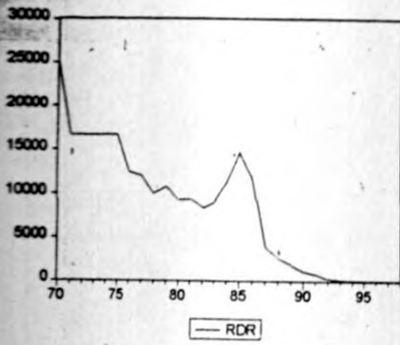
APPENDIX: GRAPHS SHOWING VARIABLES IN THEIR LEVELS



# APPENDIX: GRAPHS SHOWING VARIABLES IN THEIR DIFFERENCES







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EAST AFRICANA COLLECTION