MONEY DEMAND, MONEY SUPPLY, AND THE BALANCE OF PAYMENTS IN ZAMBIA

by

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Money Demand, Money Supply, and the Balance of Payments in Zambia

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ABSTRACT

This thesis analyzes the applicability of the monetary approach to the balance of payments to the Zambian economy. The most important determinants of the usefulness of the monetary approach are that the demand for money should be stable, and that the supply of money of domestic origin can be controlled or predicted. Accordingly this thesis examines the demand and supply of money in Zambia. A money demand function is developed and tested for different components of money in terms of expected income, expected inflation, and the interest rate. Good explanations of changes in the demand for money are achieved. The results are better for base money and M1, than for M2. It is more difficult to explain the performance of M2 because one component of M2, time and savings deposits, appears to act as a buffer against various internal and external shocks.

The estimates of demand for different kinds of money are useful for the estimation of the money multipliers. Good explanations are obtained of changes in the M1 multiplier. In the last chapter, the estimates of money demand, and the multiplier, together with actual values of domestic credit are used to explain and predict the balance of payments. The best results are achieved by using the base money demand equation. This suggests that one need not actually be concerned about explaining the multiplier. In any case errors in explaining the multiplier have only a marginal effect on the balance of payments.

More important is that the monetary authority be able to control its domestic assets. In Zambia this has been difficult because of the financing requirements of government, and the regulated financial market which has impeded the development of a market for public debt.

In conclusion, the monetary approach holds up well in Zambia. It shows that, despite the many shocks Zambia has been exposed to, the monetary processes in the economy are quite stable. This is useful knowledge from the policy point of view. If domestic credit can be controlled, the authorities can attain desired balance of payments outcomes based on accurate forecasts of the demand for money.

DEDICATION

To my wife, Alison, and my children, Katie and Andrew, who coped admirably with the disruptions to family life and life style caused by the writing of this thesis, and who were always a source of strength and encouragement.

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TABLE OF CONTENTS

Approval ii
Abstract iii
Dedication v
Acknowledgement vi
List of Tables viii
List of Figures x

CHAP.1 - INTRODUCTION 1

CHAP.2 - REVIEW OF THE LITERATURE 10
2.1 General Concepts 10
2.2 Variations of the Monetary Approach 21
2.3 Summary and Conclusions 50

CHAP.3 - REVIEW OF THE LITERATURE: AFRICA 55
3.1 Discussion 56
3.2 Summary and Conclusion 79

CHAP.4 - THE ZAMBIAN ECONOMY 83
4.1 Overview of the Economy 83
4.2 Income 84
4.3 Balance of Payments 90
4.4 Money and Credit 96
4.5 Prices, Interest Rates, Exchange Rate 110
4.6 Summary and Conclusions 117

CHAP.5 - MONEY DEMAND IN ZAMBIA 124
5.1 The Velocity of Circulation 124
5.2 Estimation of Money Demand 136
5.3 Forecasts of Money Demand 170
5.4 Summary and Conclusions 176

CHAP.6 - MONEY SUPPLY IN ZAMBIA 180
6.1 The Money Supply Process 181
6.2 The Institutional Framework 187
6.3 Description of Behaviour of Multipliers 194
6.4 Estimation and Forecast of Multipliers 217
6.5 Analysis of Behaviour of Multipliers 243
6.6 Summary and Conclusions 256

CHAP.7 - THE BALANCE OF PAYMENTS IN ZAMBIA 259
7.1 Balance of Payments Models 259

7.2 Estimation of the Balance of Payments 268
7.3 Forecasting of the Balance of Payments 285
7.4 Summary and Conclusions 288

APPENDIX 290

BIBLIOGRAPHY 301

LIST OF TABLES

4.1	Structure of Production	87
4.2	Expenditure	87
4.3	Real Income	88
4.4	Balance of Payments	93
4.5	Balance Sheet of Bank of Zambia	98
4.6	Balance Sheet of Commercial Banks	103
4.7	Money and Credit	109
4.8	Prices, Interest Rates and the Exchange Rate	117
4.9	Real Per Capita Money Balances	122
5.1	The Velocity of Circulation	126
5.2	Estimated Demand Equations for M1	147
5.3	Demand Equations for each Component of Money	164
5.4	Alternative Specifications of Money Demand Functions	168
5.5	Forecasts of Publicly Held Currency	172
5.6	Forecasts of Commercial Bank Reserves	172
5.7	Forecasts of Base Money	173
5.8	Forecasts of Demand Deposits	173
5.9	Forecasts of M1	174
5.10	Forecasts of Quasi-Money	174
5.11	Forecasts of M2	175
6.1	Decomposition of Annual Changes in M1	195
6.2	Decomposition of Annual Changes in M2	197
6.3	Money Multiplier Components	202
6.4	Money Multiplier Components (2)	204
6.5	Contributions to Changes in the M1 Multiplier	208
6.6	Contributions to Changes in the M2 Multiplier	209
6.7	Decomposition of Annual Changes in Bank Credit	211
6.8	Ratio of 'Other Items Net' and Net Foreign Assets of Commercial Banks to Deposits	214
6.9	Estimates of Ratio of Bank Reserves to Demand Deposits	223
6.10	Estimation of Ratio of Bank Reserves to Total Deposits	227
6.11	Simulation of Reserve Ratio, 1977-83	229
6.12	Comparison of Reserve Ratio Predictions	231
6.13	Estimated Multiplier Component Ratios	233
6.14	Predictions of the Money Multipliers, derived from Predictions of M1, M2, and Base Money	236
6.15	Predictions of the Money Multipliers, derived from the Multiplier Components	237
6.16	Predictions of the Credit Multiplier	239
6.17	Predictions of the Currency-Demand Deposits Ratio using Time Series Analysis	242
7.1	Estimation of M2 Reserve Flow Model	269
7.2	Estimated and Actual Balance of Payments	272
7.3	Estimation of M1 Reserve Flow Model	273
7.4	Estimated and Actual Balance of Payments	274
7.5	Estimation of Base Money Reserve Flow Model	275
7.6	Estimated and Actual Balance of Payments	276
7.7	Indirect Estimate of Balance of Payments (M2)	279

7.8 Indirect Estimate of Balance of Payments (M1) 280
7.9 Indirect Estimate of Balance of Payments (Base) 281
7.10 Forecast of Changes in Net Foreign Assets of the Monetary Authority (M2, M1 and Base).................. 287

LIST OF FIGURES

4.1 Change in Bank of Zambia Net Foreign Assets and Net Domestic Credit 119

4.2 Real Per Capita M1 and M2 Balances 123

6.1 Estimated and Actual Ratio of Currency to Demand Deposits 251

6.2 Estimated and Actual Ratio of Currency to Total Deposits 252

6.3 Estimated and Actual Ratio of Bank Reserves to Demand Deposits 253

6.4 Estimated and Actual Ratio of Bank Reserves to Total Deposits 254

6.5 Estimated and Actual Ratio of Time and Savings Deposits to Demand Deposits 255

7.1 Estimated and Actual Changes in Bank of Zambia Net Foreign Assets (M2) 282

7.2 Estimated and Actual Changes in Bank of Zambia Net Foreign Assets (M1) 283

7.3 Estimated and Actual Changes in Bank of Zambia Net Foreign Assets (Base)............................... 284

CHAPTER 1

INTRODUCTION

The purpose of this thesis is to assess the applicability of the monetary approach to the balance of payments to the Zambian economy.

A country's balance of payments can be defined as the change in the net foreign assets of the monetary authority or of the whole banking system. In turn, the change in net foreign assets is identically equal to the change in the monetary liabilities less the change in the domestic assets of the monetary authority or the banking system. Unless exchange rates are freely floating the monetary liabilities are in part determined through the balance of payments, and are therefore partially endogenous. If the change in the demand for a country's monetary liabilities over a time period is greater or less than the change in domestic assets the supply of monetary liabilities will adjust to the change in demand through a change in net foreign assets. If changes in the demand for money and the supply of domestic assets can be explained then past changes in net foreign assets can, in turn, be explained accurately in terms of the difference between changes in the demand for money and changes in domestic assets. From the policy point of view a desired change in net foreign assets is attainable if the monetary authorities can accurately predict changes in the demand for money and can control or predict changes in domestic assets.

The empirical applicability of the monetary approach hinges on the accuracy with which money demand and the domestic component of money supply can be explained and predicted. This thesis is therefore primarily an analysis of money demand and money supply in Zambia.

The originality of this thesis derives mainly from the relative lack of application of the monetary approach to the balance of payments to an African economy. Tests of the monetary approach have rarely been applied to African countries, particularly Eastern and Central African countries. To my knowledge there is no recent test in the academic literature in the case of Zambia. Kimaro (1975) tested the Polak model (a version of the monetary approach) for several African countries, including Zambia, but he had only about 5 years' data to work with: the reliability of his results is therefore questionable. Also, the Polak model assumes that the demand for money is stable, through the assumption of a constant velocity of circulation. It does not try to find reasons for changes in velocity should this assumption not hold true. Paljarvi and Russo (1979) tested for the stability and predictability of money demand and money supply in Zambia for the years 1966 to 1976. Their work therefore does not reflect the experience of the last several years. Also, by their own admission, there are admission, there are areas of their work deserving extra research. The thesis makes a further contribution by highlighting some of the conceptual and empirical pitfalls that, in my opinion, have not been adequately discussed in the literature.

The main conclusion of this thesis is that the demand for money in Zambia can be satisfactorily explained, and that the demand function is stable. There are a priori reasons to suspect this might be the case. Domestic credit creation of the monetary authority has a very high inverse correlation with changes in net foreign assets of the monetary authority. This leads one to suspect that an increase in money supply arising from domestic credit creation leads directly to an increase in expenditures, and thence to an increase in imports. If the money demand function was unstable it would be harder to predict this effect.

Analysis of the money demand function shows that real incomes, the expected rate of inflation, and interest rates explain money demand in Zambia quite well. The main exceptions are in 1978 and 1979. These were the years of the first large scale conditional loan by the IMF to Zambia. The errors in predicting money in those years may reflect changes in expectation formation, and associated behavioral patterns, arising as a consequence of the program.

The estimated changes in money demand, when combined with the changes in the money supply associated with changes in domestic credit creation, satisfactorily explain the performance of the balance of payments. Out of sample forecasts predict the balance of payments very well, and much better than if changes in domestic credit only were used to predict the balance of payments outcome.

The demand equations for base money and M1 perform significantly better than M2, with the base money equation predicting the balance of payments outcome particularly well. The reasons why the M2 demand function does not fare so well appears to be that M2 acts as a buffer against the various shocks that have hit Zambia over the years. When credit is tight, for instance, the stock of time and savings deposits is drawn down, and is replenished when credit is easier. This factor is another reason why the error in estimating money demand in 1978 is so large. The error was much larger for M2 than for M1.

Zambia has been buffeted by several economic and political shocks ever since Independence, more so than perhaps most nations. Her geographical situation has made her vulnerable to disturbances in neighbouring countries. Her almost total dependence on copper as a source of foreign exchange has made her economy very vulnerable to large swings in copper prices. Given these factors it is encouraging that there is at least one thing that is reasonably stable - the demand for money. My findings that the demand for money is stable confirm results obtained in other developing countries, notably in South America (see, for example, the works of Diz and Deaver (1970)).

My findings on the money supply process are also reasonably encouraging. Using demand equations estimated for each component of money I estimate money multipliers. I find that I can predict the M1 multiplier quite closely. However, there are significant errors in predicting the M2 multiplier. This is not very surprizing given the difficulties alluded to above in estimating time and savings deposits.

As it turns out the errors in predicting the M1 multiplier only make a marginal difference to predictions of the balance of payments. If the demand for base money is used as a basis for balance of payments analysis then the multiplier becomes irrelevant. What is more important from the point of view of control over the money supply process is that the domestic component of the money base be an instrument of monetary policy. In Zambia it has become subordinate to the fiscal needs of the government and the mining companies. One probable reason for this state of affairs is that a market for government debt has not evolved, a function of the tight regulation of interest rates. Allowing interest rates to find their market level might make it easier for a debt market to develop.

The positive findings of this thesis will, I hope, stimulate more monetary research in African economies. Monetary analysis in Africa is still in its infancy, at least at the academic level. This thesis shows that monetary factors in these economies are analyzable and predictable. From the policy viewpoint, one might find that more emphasis on analyzing the determinants of money demand will enhance understanding by policy makers of reasons for changes in the balance of payments, and will encourage them to produce policies that will be conducive to balance of payments equilibrium at full employment.

There are undoubtedly areas in this thesis which could be further developed. First, the explanatory variables in the money demand function could be explained in the context of a wider model, rather than being treated as given as in this thesis (some models discussed in this this thesis treat income as endogenous, but they do not give sufficient attention to the best specification of the money demand function). Second, within the money demand function itself, further research might turn up better ways of specifying permanent income and expected inflation, possibly within a rational expectations framework. Other variables (such as the 'harvest' factor) could be built in. Lag structures and adjustment mechanisms could be more precisely specified. 'Institutional' variables, such as Bordo and Jonung (1984) use, could also be defined, and included in the money demand function.

This thesis is organized as follows. In the next chapter I review some of the general academic literature on the monetary approach to the balance of payments. Different versions of the monetary approach are discussed, namely the 'Polak' model, models of the ilk developed by Rhomberg (1977) and Prais (1977), and the reserve flow model developed by Johnson (1976). Differences, if any, between the monetary and non-monetary approaches, and conceptual and empirical problems with the monetary approach are discussed. Some of the empirical work carried out on the monetary approach is described and inferences are drawn. The main conclusion to be drawn is that the monetary approach is not fundamentally different from other approaches. It is not a different theory but a different approach. It emphasizes the monetary aspects of the balance of payments that are not brought out in text-book income-determination models, although the latter are consistent with the monetary approach. In Chapter 3 I discuss some of the monetary-oriented literature on African economies, including Zambia.

Chapter 4 provides an overview of the Zambian economy. This serves as a background to the analysis in the following chapters. It explains the performance of the variables that explain money demand. The chapter offers clues as to why the balance of payments behaved the way it did, and helps in the task of specifying a money demand function. This analysis is continued over into the first section of Chapter 5, where explanations for changes in velocity are sought.

The second section of Chapter 5 focusses on the determination of money demand in Zambia. Money demand models are then developed and tested, taking into account previous work and the discussion in Chapter 4. Money demand is estimated for the period of Zambia's economic history and compared to actual money supply. The size and variance of the differences between actual money supply and estimated money demand provide an indication of the accuracy with which money demand can be explained. Different components of money are analyzed, including base money. Money demand is also predicted for the years 1976-1983 through a simulation exercise. The prediction errors provide an indication of the usefulness of the monetary approach to policy makers. As mentioned above the results are very encouraging.

Chapter 6 focusses on the determinants of money and credit supply, in particular the money and credit multipliers. The multipliers form the link between base money and the broader money aggregates. The accuracy with which changes in the multipliers can be explained and predicted reflects the accuracy with which domestic assets of the banking system can be explained and predicted. As the money multipliers and their component ratios reflect, in large measure, the different components of money considerable use is made of the results from Chapter 5. Again the results are encouraging.

Chapter 7 brings the results of the previous two chapters together in a reserve flow model of the Zambian economy. First, the estimates of money demand and the money multipliers are plugged into the reserve flow model. The estimates of the annual changes in net foreign assets are compared with the actual changes. Changes in net foreign assets are predicted for the years 1976-1983 through a simulation exercise. Second, changes in net foreign assets are explained and predicted by estimating the reserve flow model directly. The results are encouraging. The errors in explaining and predicting the balance of payments are very small.

CHAPTER 2

REVIEW OF THE LITERATURE

In this chapter I discuss some of the theoretical and empirical literature on the monetary approach to the balance of payments outside of Africa.

2.1 General Concepts

There is a vast amount of literature on the monetary approach. The most important literature sources are probably Frenkel and Johnson (1976 and 1978), and the IMF (1977). Officer and Kreinen (1979) provide a useful survey of the literature on the monetary approach.

The key to the monetary approach can be simply summarized. Excess supplies of goods and services (reflecting the balance of exports - excess supply of some goods and services - and imports - excess demand for other goods and services - , or equivalently, the current account) and of future goods and services (represented by the capital account) imply an overall balance of payments surplus, and, equivalently, an excess flow demand for money. The excess demand for money is satisfied by an increase in net foreign assets, which is reflected in the balance of payments statistics as a change in the 'money' or 'below-the-line' account. The increase in net foreign assets, via the balance sheet of the banking system, increases the money supply until the excess flow demand is met. As Rhomberg and Heller (1977) put it, "the change in the money account - in most instances simply the change in international gross reserves - is directly linked to monetary balance in the national economy by the condition that the change in external reserves must equal the difference between the change in the demand for money and the change in the supply of money of domestic origin."

The adjustment mechanism by which net foreign assets adjust to a discrepancy between a change in money demand and a change in domestic assets is as follows (see Rhomberg, 1977). Assume that money demand increases over a time period by a larger amount than domestic credit so that there is a temporary excess flow demand for money. In the process of adjusting money balances to their desired level the public temporarily reduces its expenditures in order to build up balances to their desired level. As imports are largely a function of expenditures, imports fall. To the extent that interest rates are market determined they rise and induce a capital inflow. Both the fall in imports and the capital inflow increase net foreign assets. The rise in interest rates reduces the excess demand for money. The increase in net foreign assets increases the money supply and therefore reduces the excess demand for money. A shortage of domestically supplied credit induces importers to seek foreign supplied credit to finance imports, thereby also inducing short-term capital inflows. The fall in expenditures arising from the attempt by people to build up money balances causes a fall in incomes. This may be in nominal and/or real terms, depending upon the extent of wage and price flexibility in the economy. The fall in incomes reduces the excess demand for money. To the extent that the exchange rate is allowed to appreciate (in lieu of the accumulation of foreign reserves) the price of traded goods falls, thereby decreasing the excess demand for money. After a while the price of non-traded goods might fall also, as a result of the supply of such goods increasing in response to the increase in their relative price, and as a result of a switch in demand to traded goods. This also reduces the excess demand for money.

As Guitian (1977) explains, "the transmission mechanism operates through the behavioural reactions of the public to changes in the policy-controlled variable. It provides a complex link between domestic credit and the balance of payments through major variables, such as expenditure, income, domestic prices and the demand for money. This line of reasoning implies a large degree of stability in the money market, and that the brunt of the adjustment process falls on the flow of expenditure channeled through the goods and services market."

The adjustment process is much less complex if there is full employment, wage and price flexibility, and complete mobility of goods and capital. Real output is therefore exogenous and determined entirely by supply factors. Prices and interest rates are also exogenous, determined by factors outside the economy. A shortage or excess of desired money balances will then be eliminated immediately through the balance of payments. Such a case is not very likely, particularly in developing countries.

When cast in this framework it would appear that the balance of payments of a country can be explained either by analysis of the determinants of the current and capital accounts, that is, by an analysis of the demand and supply of present and future goods and services, or by an analysis of changes in the demand and supply of money. The monetary approach concentrates on the latter. One apparent advantage of the monetary approach, therefore, is its supposed simplicity. All that is needed is a stable money demand function and the assumption that the monetary authority can control or predict the domestic component of the money supply. As Rhomberg and Heller (1977) put it, "this (monetary) approach eliminates the intractable problems associated with the estimation of numerous elasticities of international transactions, and of the parameters ascribing their independence, which are inherent in other approaches ". Another apparent advantage was the greater availability and accuracy of monetary and balance of payments statistics relative to statistics describing the 'real' side of economies. This aspect was of particular appeal to IMF teams negotiating financial packages in developing countries, and is a prime reason underlying the development of the monetary approach in that institution.

However, as Rhomberg and Heller (1977) admit, "the apparent simplicity of the monetary approach is somewhat deceptive". One reason is that the money demand function is not necessarily stable and easy to estimate. Money demand is usually defined to be a function of a small number of variables - income and the opportunity cost of holding money in particular. However, these explanatory variables are usually determined by a wide array of economic forces operating within and outside an economy. The dependent variable, money balances, may itself be an influence on the supposed exogenous variables in the money demand function. From the policy point of view it may be difficult to attain a desired change in net foreign assets on the basis of a predicted change in money demand and an imposed limit on credit expansion, if the credit limit itself affects incomes, prices and interest rates and therefore changes money demand from its original prediction.

Many versions of the monetary approach, particularly those surveyed in Officer and Kreinen (1978), assume that the variables in the money demand function are truly exogenous by assuming price and wage flexibility to ensure full employment, and by assuming that economies are reasonably open, so that prices and interest rates are largely determined externally. This may be true in the long run, but is probably not true for many countries on a year-to-year basis. For example, prices are likely to differ from world prices, at least in the short run, because of the existence of non-traded goods. Exchange and import controls may cause local prices to diverge from world prices, particularly if there is local excess demand. Such controls may also cause local interest rates to be very different from world rates. If businesses are in arrears of payments to overseas suppliers, because of difficulties in procuring foreign exchange, local prices may rise faster than world prices, reflecting higher interest charges.

Full employment is a very unrealistic assumption. In Zambia, for instance, there has been substantial unemployment for several years. People are very sensitive to changes in the purchasing power of their money, with the result that real wages are very inflexible. Businesses and governments take several years to adjust to changed economic circumstances, such as a permanent downward shift in the terms of trade. As a result of these factors an economy may face balance of payments constraints at high employment levels. The use of import and exchange controls to lessen these constraints causes economic activity to decline as the flow of imported intermediate inputs declines.

Even if money demand can be shown to be a stable function of a few variables, the monetary approach loses some of its simplicity and distinguishability if the 'exogenous' variables are really endogenous. Many of the models described in IMF (1977) specify income as an endogenous variable (some of these models are described below). However, these models are not conceptually any different from 'Keynesian'-type or ISLM-type models, as long as the model allows changes in net foreign assets to affect the money supply. In these models, as in standard ISLM-type models, monetary factors tend to have stronger and more predictable economic influences if the money demand function is stable.

Even if the explanatory variables in the money demand function are not exogenous to the economic system the monetary approach still has practical application if a good money demand can be estimated in terms of past values of the explanatory variables, and used to predict money demand, given values for the explanatory variables. Given a predicted money demand, a level of domestic credit can be set by the authorities in order to attain a given balance of payments target. A potential problem is that it may be difficult to identify the money demand function if the same variables that determine money demand also determine money supply (remembering that it is money supply that is directly observable). This is not such a problem if the domestic component of the monetary base is an exogenous or policy-determined variable. However, there may still be a simultaneity problem (resulting in biased coefficients) if the supply of nominal or real balances affects the explanatory variables in the money demand function. From the policy point of view the problem is that the predetermined level of credit may affect income and prices, change money demand and change the balance of payments outcome. A fuller model is needed to find the combination of income and credit consistent with a desired balance of payments outcome.

Laidler (1985) discusses the problems of identification and simultaneous equations bias. He notes that previous studies have indicated that these are not serious problems. The problems can be lessened if one uses long, time -aggregated data series, and if money demand is estimated in real terms.

In practice, the IMF and its clients use an ad-hoc, iterative, trial and error approach in devising financial programs. As Rhomberg and Heller (1977) put it, " There was a theoretical difficulty...:the growth of output and the change in the price level had to be assumed to be known without prior knowledge of the magnitude of domestic credit creation. But this shortcoming can be - and has been - surmounted by iterative calculation carried to the point at which sufficient consistency is obtained between the estimated changes in output and prices, on the one hand, and the calculated value of domestic credit creation, on the other hand."

There still remains the difficulty in estimating money demand functions. Given the lack of financial instruments in less developed countries (LDCs) it could be argued that money demand functions might be more stable than in developed countries as there are fewer alternatives to holding money or spending it. Working against this argument, however, are a number of factors. First, income elasticities may change over time as LDCs become increasingly monetised (see Bordo and Jonung, 1981 1984, and Laidler, 1985)). Second, as residents of LDCs become more financially sophisticated they may become more responsive to changes in interest rates and changes in the purchasing power of their money. Third, there may be greater political and economic instability in LDCs than in developed countries. This may cause more frequent autonomous shifts in money demand functions. For example, fears of intensified exchange restrictions or credit restrictions could cause people to hold more currency per unit of income, or may change expectations regarding future prices and incomes, or the way those expectations are formed.

Another potential difficulty in estimating money demand functions is that it may be difficult to specify the explanatory variables. People may determine their desired money holdings on the basis of expected incomes and inflation as well as current incomes and inflation. As expected incomes and inflation are unknown, proxies such as an average of past and present incomes and prices are often used. This introduces a potential source of error into the estimation process.

Even if the correct specification of the independent variables is found there is still a problem in that adjustment of desired money balances to changes in the explanatory variables may not take place in the time period in which the explanatory variables are measured. The time periods over which variables are measured are artificial; there is no reason why adjustment has to be complete within the period. It may be difficult to specify accurately an adjustment process, particularly if the speed of adjustment changes over time.

A further difficulty that may be encountered in attempting to estimate a money demand function is that the dependent variable is a measure of actual money balances, not desired money balances. If the adjustment of actual money balances to desired balances is not in the same time period this will introduce a source of error into the estimation of money demand. The attempt to obtain the best fit by experimenting with different formats on the right hand side of the equation may reduce considerably residual errors between actual and estimated money demand. In some years, however, errors may be large because actual money balances have not had time to adjust to changes in desired balances or because there has been a change in money supply independently of changes in money demand (for example, an increase in domestic credit), and any excess or deficiency has not been worked out by the end of the time period.

Finally, a major problem with estimating money demand functions is the quality of the data for the explanatory variables. One of the supposed advantages of the monetary approach is that monetary and balance of payments statistics are more accurate and available relative to other statistics. This advantage, however, is spurious as the data necessary to explain money demand is available only with long lags, is subject to revision, and is of questionable accuracy even after it has been revised. Price controls may mean that the official rate of inflation may considerably understate the actual rate of inflation as implied by black market prices.

In order for the monetary approach to have empirical relevance it is necessary to assume that, in principle, domestic credit creation by the monetary authority is a policy variable (although, in practice, it is often the residual financing requirement of the government).

Domestic credit expansion and money creation by the commercial banks are linked to base money by the credit and money multipliers. These need to be stable and explainable in order for the authorities to be able to predict total credit and money supply creation. If the central bank can control bank credit directly through credit ceilings, or can raise minimum reserve requirements easily, then the importance of explaining the multipliers is not so great.

It is useful at this juncture to clear up some possible misconceptions concerning the monetary approach. Although the balance of payments is a monetary phenonemon in the sense that the balance of payments interacts with monetary variables, this does not mean that all changes in the balance of payments are of monetary origin. Clearly changes in exports, imports and capital flows can affect the balance of payments, as well as changes in monetary variables such as domestic credit. This may seem obvious, but one sometimes obtains the impression from the literature (e.g. Officer/Kreinen, 1979; Grubel/Ryan, 1979) that balances of payments disturbances are only of monetary origin. What the monetary approach does say is that balance of payments deficits or surpluses are temporary unless domestic credit is continually changing by magnitudes different from changes in money demand. An increase in exports, for example, will only have a temporary effect on the balance of payments, as imports and income will eventually rise to eliminate the excess money supply originating from the increase in exports.

2.2 Variants of the Monetary Approach to the Balance of Payments

2.2.1 The Polak Model

J.J. Polak, Economic Advisor to the IMF, was the creator of this model in 1957. It is described in detail in various documents (for example, Polak and Argy, 1977; IMF, 1981; King, 1979).

It is essentially the same as a Quantity Theory-type model of an open economy, which, in turn, is the same as a Keynesian-type model that has a constant velocity of circulation and a money supply that is partially determined through the balance of payments. The model is specified as follows:

$$M_t = mY_t \qquad (1)$$

$$Y_t = vMo_t \qquad (2)$$

$$\Delta Mo_t = \Delta NFA_t + \Delta NDC_t \qquad (3)$$

$$\Delta NFA_t = X_t + CM_t - M_t \qquad (4)$$

In equation (1) imports (M) are a constant proportion of income (Y). In equation (2), income is a constant proportion of the money stock (Mo), implying a constant velocity of circulation (v). Equations (3) and (4) are identities. Equation (3) is the identity representing the balance sheet of the banking system. The change in the money supply from the previous period (ΔMo) is identically equal to the change in the net foreign assets of the banking system (ΔNFA) plus the net domestic assets of the banking system (ΔNDC).[1]. Equation 4 is the balance of payments identity. The change in net foreign assets is equal to exports (X) plus capital flows (CM) less

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[1]Net foreign assets and net domestic credit could be defined as those of the monetary authority only. In this case the expression on the right hand side of equation 3 should be multiplied by a term representing a constant money multiplier.

imports.[2] Imports (and therefore net foreign assets), income and the money stock are determined endogenously by the exogenous variables, which are net domestic assets, exports and capital flows. A change in an exogenous variable changes Mo, and therefore Y and M. A change in M negatively affects NFA, Mo, M and so on. The process takes place over time, as implied by the difference operators in the model. If income is defined as an average flow over the period and money stock as an end of the year figure, then there is an implicit adjustment lag of money balances behind income in equation (2). The equations can be solved in terms of 2 reduced form equations for income and net foreign assets:

$$\Delta NFA = \frac{1}{1+mv}\Delta(X+CM) - \frac{mv}{1+mv}\Delta NDC + \frac{1}{1+mv}\Delta NFA_{-1} \qquad (5)$$

$$\Delta Y = \frac{v}{1+mv}\Delta(X+CM) + \frac{v}{1+mv}\Delta NDC + \frac{v}{1+mv}\Delta NFA_{-1} \qquad (6)$$

Equations (5) and (6) show the first period effects on net foreign assets and income of changes in the exogenous variables.

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[2] The formulation assumes a unit price elasticity of demand for imports. The elasticity of substitution of foreign goods for home goods is unity. This allows one to ignore the extent to which a given increase in income is due to price and quantity changes. That is, a change in income owing to a change in the price level has the same effect on imports as a change in real income. There is no need to explicitly model the price level (see Polak(1977) and King (1979)).

In the long run, when all effects have worked themselves out, the change in NFA and Y will be equal in each period. Setting $\Delta NFA=\Delta NFA_{-1}$ and $\Delta Y= \Delta Y_{-1}$, the equations become:

$$\Delta NFA = \frac{1}{mv} \Delta(X+CM) - \Delta NDC \qquad (7)$$

$$\Delta Y = \frac{1}{m} \Delta(X+CM) \qquad (8)$$

In the long run a unit increase in domestic credit leads to a unit decrease in net foreign assets and a zero change in income. The increase in domestic credit first increases the money supply, creating an excess supply of money balances. This causes income to increase, via equation (2). Imports increase as a result, causing net foreign assets, and therefore money supply and incomes to decrease. As the increase in domestic credit is all leaked out of the economy in the form of imports the final change in the money supply is zero (via equation (3)), which, from equation (1), implies a zero change in income. [3]

If domestic credit increases by a constant amount each period, then, in the long run, the change in net foreign assets will still be equal to the change in the previous period, but will not be equal to zero. The loss in net foreign assets in

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[3]Net foreign assets would fall by
$:(mv/1+mv)\Delta NDC + (mv/(1+mv)^2\Delta NDC + (mv/(1+mv)^3\Delta NDC.....$
$= mv/(1+mv)*(1+1/(1+mv)+1/(1+mv)^2 +....)\Delta NDC = \Delta NDC$

each period will be equal to the increase in domestic credit in each period, with income and imports permanently higher.

A once and for all increase in exports raises income by the factor 1/m in the long run. In turn this increases the demand for money which is satisfied by the increase in net foreign assets caused by the increase in exports. Long run equilibrium is reached after income, imports and money demand have stopped growing. That is, imports eventually rise to match the increase in exports so that the increase in net foreign assets per period is eventually matched by a decrease. Money supply is then constant, which implies that income is constant. The stock of net foreign assets levels off at a new higher level. Note that in the long run, the change in income is independent of monetary factors, and is entirely determined by m.

The model is interesting for policy purposes. If domestic credit can be used as a policy instrument and exports and capital flows can be accurately forecast, and the product of m and v treated as a constant, then the desired change in net foreign assets can be calculated. The lag structure of the model also reveals the effect in each year of a change in an exogenous variable, and how many years it will take to achieve the desired target. For example, if m=0.4, v=5, then mv=2. The effect on net foreign assets in the first year of an increase in domestic credit of one unit is therefore -0.67. The effects in the second and third years are -0.22 and -0.074 respectively, so that the total adjustment period is roughly 3 years.

A drawback of this model is that the product of m and v is unlikely to remain constant every year, even if it is constant over a period of several years. Velocity may change because of changes in real income, interest rates, expected inflation, or institutional factors. It may change because of lags between changes in the variables affecting money demand and desired money balances, or lags in the adjustment of actual to desired balances, or because of other shocks that may shift the money demand function, such as exchange controls. The marginal propensity to import may differ from the average propensity in the short run. For example, imports may increase by a greater amount relative to an increase in income at a high point of the business cycle than at a low point. Import controls may also change import propensities. Changes in v and m may offset each other so that the product remains constant, but there is no theoretical reason for this to happen.

One of the differences between the Polak model and the model described at the beginning of this chapter is that income is endogenous in the Polak model. In symbols, the model described earlier is:

$$\Delta NFA = \Delta M_d + \Delta NDC.$$

The first term on the right hand side is the change in money demand. This is the same as the first term on the right hand side of equation (7) in the Polak model. Another difference is that the Polak model assumes a constant income velocity, so that the money demand function is assumed to be perfectly stable. The reserve flow model shown here does not assume this, and indeed implies that the central issue of the monetary approach is whether the money demand function is in fact stable.

The main policy implications of the Polak model are that continual balance of payments deficits or surpluses are only possible if there is continuous monetary disequilibrium. This can only happen if domestic credit changes by different amounts than money demand. If domestic credit expansion is continually greater (less) than increases in money demand there will be continual balance of payments deficits (surpluses). Policy measures, such as devaluation, larger import tariffs and import controls can only have a temporary effect on the balance of payments. A devaluation, for example, raises domestic prices, and therefore money demand. There will be an increase in net foreign assets as people adjust actual balances to desired levels. However, once the adjustment is complete net foreign assets will not change further. Equivalently, a devaluation reduces the stock of real balances, and creates an excess demand for real balances. Expenditures are reduced which reduces the excess demand. Devaluation may stimulate exports, but this will eventually induce a corresponding rise in imports.

There is nothing particularly startling or novel about these results. Argy (1977) and Polak and Argy (1977), show that the Polak model is structurally similar to ISLM-type models, as long as the money supply is allowed to be affected by the balance of payments. The main differences rest on the magnitude of the parameters. The following set of equations represent a more complex model in which the rate of interest affects expenditures, money demand and the balance of payments:

$$Y = C + I + G + X - M \quad (9)$$

$$C = cY \quad (10)$$

$$I = A - br \quad (11)$$

$$M = mY \quad (12)$$

$$CM = V + gr \quad (13)$$

$$r = eY - fMo \quad (14)$$

$$\Delta NFA = X - M + CM \quad (15)$$

$$\Delta Mo = \Delta NFA + \Delta NDC \quad (16)$$

Equation (9) is the GNP identity. Equation 10 represents a consumption function. Equation (11) shows investment as a function of the rate of interest and an autonomous component, A. Equation (12) is an import function. Equation (13) shows capital movements to be determined by the rate of interest and an autonomous component, V. Equation (14) shows the rate of interest to be determined by the level of income and the money supply. Equations (15) and (16) are the balance of payments and money supply identities respectively.

The main differences between this model and the Polak model lie in equations (13) and (14). Equation (14) can be rewritten as

$$Mo = (e/f)Y - (1/f)r$$

In the Polak model, the money demand function can be written as

$$Mo = (1/v)Y$$

This is the same as the more sophisticated model when (1/f) is zero (money demand is insensitive to interest rates) and (e/f) = (1/v).[1] Another important difference between the models is in the capital flows equation, where g>0 in the latter model, but is equal to zero in the Polak model. Another difference is that investment is sensitive to the rate of interest in the second model, but unresponsive in the first model.

The reduced form equations for the second model are as follows (assuming, for simplicity, that g=0):

Short run

$$\Delta NFA = \frac{p}{p+bfm}\Delta W - \frac{m}{p+bfm}\Delta Z - \frac{bfm}{p+bfm}\Delta NDC + \frac{p}{p+bfm}\Delta NFA_{-1} \qquad (17)$$

$$\Delta Y = \frac{bf}{p+bfm}\Delta W + \frac{1}{p+bfm}\Delta Z + \frac{bf}{p+bfm}\Delta NDC + \frac{bf}{p+bfm}\Delta NFA_{-1} \qquad (18)$$

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[1] Note that the larger f is (that is, the more interest inelastic the money demand function) the larger e must be to obtain plausible values of v. e measures the responsiveness of the interest rate to a change in income. In economic terms, the more interest inelastic the demand for money, the more the interest rate has to rise to eliminate an excess demand for money created by an increase in income. In the limit, as f approaches infinity, so must e.

Long Run

$$\Delta NFA = \frac{p}{bfm} \Delta W - \frac{1}{bf} \Delta Z - \Delta NDC \quad (19)$$

$$\Delta Y = \frac{1}{m} \Delta W \quad (20)$$

where:

p = 1 - c + m + be
W = (X + V)
V = Autonomous capital inflows
Z = (A + G + X)
A = Autonomous investment (public and private)

In the short run the coefficient for domestic credit will tend to be lower in the second model than the Polak model, as f approaches infinity in the latter, and is much closer to zero in the former. In economic terms, money supply has a smaller effect on income in the second model. Therefore, an increase in domestic credit, which increases money supply, has a smaller effect on income per unit of time. In the long run, the effect on net foreign assets of a unit increase in domestic credit is the same. The effect, however, takes longer in the second model.

Increases in autonomous expenditures temporarily worsen the balance of payments and improve income in the second model, but have no effect in the first model. The reason is that only money supply affects income in the Polak model. For example, a decrease in government expenditures without a decline in money supply implies excess money balances in the economy, which are then spent, so that there is no net effect on the economy. In the more sophisticated model the excess money supply would lower interest rates, which would increase the demand for money. Not all the excess money supply would be spent. Income would fall and the balance of payments would improve. In the long run, however, autonomous expenditures have no effect on income. As the balance of payments improves as a result of declining income the money supply increases which causes income, and therefore imports, to increase. Also, a lower r will stimulate investment, which will also increase income and imports. During the process of adjustment foreign assets will be increasing as income is lower than its original level.

Finally, the long run effects on income of increases in exports or capital flows are identical in the two models, as imports rise to match the rise in exports. The total gain in reserves is larger in the second model because income, and therefore imports, take longer to adjust to the new level of exports. If the increase in money supply following an increase in exports did not have any effect on income (the 'Keynesian' velocity trap plus an interest - inelastic investment function) the increase in reserves would continue indefinitely. This is the case where b=0.

If g was greater than zero the long run effects on the balance of payments of a unit increase in domestic credit would remain the same. The adjustment would be quicker than if g=0 as the fall in the interest rate following an increase in domestic credit would cause a capital outflow. The effect on the balance of payments of an increase in autonomous expenditures would be ambiguous. A rise in interest rates following an increase in income would cause a capital inflow, offsetting the increase in imports.

Polak and Argy (1977) also consider the case where interest rates are sticky and there is prolonged unsatisfied demand for credit. A restrictive money supply will reduce expenditure indirectly through higher interest rates, and, directly, through unavailability of credit. In this case monetary policy would have a more immediate influence on the balance of payments than implied in the second model.

In summary, the Polak model is structurally the same as the 'Keynesian' model, when the latter allows the money supply to respond endogenously to the balance of payments. The only differences lie in the magnitude of the parameters, and in particular, the assumed constancy of velocity in the Polak model. If the authorities sterilize the effects of the balance of payments on the money supply, both models will yield different predictions. Suppose domestic credit increases. Incomes and imports will start to increase. If money supply is assumed not to decline as imports increase (through, for example, the monetary authority buying bonds on the open market) then this assumes that some (in the limit, all) of the excess balances are willingly held and not spent, implying a marginal propensity to spend of less than 1. This is in contrast to the Polak model and the more complex model, where the marginal propensity to spend is equal to one in the long run.

In the case of an increase in exports, if it is assumed that money supply does not increase, the resultant increase in money demand (as incomes rise in response to the increase in exports) can only be satisfied by a reduction in expenditures. Again, the marginal propensity to spend becomes less than 1, with the result that imports rise by less than exports. Another way of putting this is that the monetary authority sells bonds on the open market to sterilize the effects on the money supply of the increase in exports. The export proceeds are held in the form of bonds rather than being spent.

The assumption that money supply does not change in response to balance of payments is evidently a special case, and should not be associated with Keynesianism. In the long run, attempts to sterilize balance of payments deficits will cause countries to run out of foreign exchange reserves. Also the downward pressure that such an exercise would have on exchange and interest rates might stimulate capital outflows, vitiating the effects of the exercise. The central bank might run out of bonds to sell if it continually tried to sterilize surpluses. The upward pressure on interest and exchange rates might vitiate the exercise by stimulating capital inflows.

2.2.2 The Rhomberg Model

In the Polak model money demand was posited to vary in proportion to income, implying a constant velocity of circulation. Rhomberg (1977) says that this can be interpreted as the long run money demand function. He says that the Polak model does not capture very well the year to year variations in imports and income, implying that velocity may not be constant in the short run.

One reason why velocity (and the propensity to import) may not be constant in the short run is that an excess supply or demand for money does not immediately translate into a change in expenditures on goods and services. For example, some, or all, of an excess money supply may be spent on existing assets (both financial and non-financial). The yield on these assets falls as a result, which induces an increase in expenditures (and causes the demand for money to increase, thereby reducing the excess supply). Expenditures change, therefore, not only because of a change in incomes but also because of a change of yields on assets. Because the yield on assets changes as a result of monetary disequilibrium, expenditures can be postulated to be a function of incomes and the difference between actual and desired balances. Velocity can therefore change in the short run because expenditures do not change in proportion to income in the short run as a result of the extra term in the expenditure equation. The expenditure function he uses was originally developed by Prais (IMF, 1977).

Rhomberg estimates the following model:

$$(Mo^{*} + Mo^{*}_{-1})/2 = (1/v)Y \qquad (19)$$
$$E = a_1Y + a_2Y_{-1} + a_3[(Mo+Mo_{-1})/2-(1/v)Y] + a_0 \qquad (20)$$
$$M = mE + m_0 \qquad (21)$$
$$Y = E + G + X - M \qquad (22)$$
$$Mo = Mo_{-1} + X + CM - M + \Delta NDC \qquad (23)$$

The symbols are the same as in the Polak model, with the addition of E for expenditure, Mo^{*} for desired money balances, and G for government expenditure. Variables without subscripts are in the present period. Equation (19) describes the long run demand for money function, where the left hand side is the average desired balances during the year. Equation (20) describes expenditure as a function of current and past income and the deviation of actual from desired cash balances in the current year (alternatively, there could be a lag of expenditure to the deviation). Equation (21) describes imports as a function of expenditure. Equation (22) is the GDP identity. Equation (23) is the money supply identity.

Rhomberg estimates each behavioural equation by two stage least squares for a number of countries, both developed and developing, using 11 years data. He expresses import and income in terms of the previous year's income, exports and money supply. In turn the change in the money supply can be expressed in terms of the variables in equation (23). He obtains a good fit (with very high R^2s). He finds that a change in the money supply has a large effect on imports in the following year for both developed and developing countries.

Rhomberg's model improves on the Polak model because it allows for changes in velocity in the short run. The main drawback is the assumption of a constant long run velocity, which need not hold true (although it might have done in his sample). Also velocity may change in the short run for reasons such as changes in the expected rate of inflation.

Finally Rhomberg demonstrates the equivalence of his model to a 'Keynesian' model in which expenditure and money demand are both a function of income and the rate of interest.
Given:

$$E = a + bY + cr$$
$$Mo^{+} = d + eY - fr$$
$$Mo^{+} = Mo$$

and substituting for the interest rate (r) from the money demand function into the expenditure function, and combining terms in Y results in:

$$E = (b - dc/e)Y + (c/e)Mo + \text{constant}$$

This is in the form of equation (20), with (c/e) equal to a_3.

2.2.3 Reserve Flow Models

Reserve flow models have already been alluded to. In their simplest form the change in money demand over a period is assumed to be equal to the change in money supply, and is substituted into the balance sheet of the banking system. This produces:

$$\Delta NFA = \Delta Md - \Delta NDC \qquad (24)$$

In contrast to the models outlined above, income, which is the principal argument in the money demand function is, assumed to be exogenous. Other possible explanatory variables, such as prices and interest rates are also assumed to be exogenous. This does not necessarily mean that one has to assume full employment, wage and price flexibility, capital mobility and purchasing power parity. One could assume instead that the values of these variables are calculated outside the reserve flow model, either through a formal model or via some ad-hoc method. The advantage of doing this is that isolates the fundamental principle of the monetary approach, namely that it examines the balance of payments through the money demand function. If the explanatory variables in the money demand function are not exogenous (that is, they interact with other variables in the economic system) then direct estimation of equation (24) by ordinary least squares could lead to problems of simultaneous equations bias, and perhaps multicollinearity. One does not have to estimate the equation directly. The money demand equation can be estimated first, in real terms, and plugged into the equation. This may lessen any econometric problems that may occur.

Equation 24 is a long run equilibrium model, in the same vein as equations (7) and (19). Long run equilibrium may take more than one time period to reach, so it is not necessary to assume monetary market flow equilibrium for the unit of time specified in the equation. The change in net foreign assets per unit of time can be expressed as a fraction of the long run change, so that it takes longer than one time period for NFA to adjust to a change in NDC or Md.

There have been numerous tests of the reserve flow model in its different forms. Examples are Aghevli and Khan (1977), Zecher, Genburg, Bean and Guitian (ed. Frenkel and Johnson, 1976), Wilford (1979), and various authors surveyed in Officer and Kreinen (1978). Variants of the reserve flow model include those where the variables are in first difference form, and rate of growth form. The dependent variable may include the net foreign assets (or some measure of foreign assets) of the whole banking system, or just those of the monetary authority. In some variants, the dependent variable includes, or is restricted, to short term capital flows (see Officer and Kreinen, 1978). Although short term capital flows may well respond endogenously to changes in interest rates, or domestic credit restraints, it is difficult to obtain an independent measure for this variable, as it is usually a residual (often 'errors and omissions'), and is not independent of net foreign assets. Other variants include exchange rate determination models when exchange rates are freely floating (see Frenkel and Johnson, 1978; Connolly and Taylor, 1979), and exchange rate pressure models, where changes in money demand and domestic credit cause changes in both foreign assets and exchange rates (see Girton and Roper, 1979; and Connolly and Da Silveira, 1980).

Some of the reserve flow models are outlined below:

1) Aghevli and Khan (AK)

AK test the model by way of a cross-sectional analysis of 39 countries. They assume full employment, an open economy and capital mobility, so that the explanatory variables in the money demand function are not affected by any monetary variables within the economy. Thus any disequilibrium in the goods or money market is entirely reflected in the balance of payments. As was apparent earlier such assumptions are not necessary for the monetary approach to be valid. Presumably they make these assumptions because, if they hold, there is more chance that monetary equilibrium is restored during the time period used for testing following a disturbance. Various market imperfections would not change the long run predictions but would change the adjustment path (see Swoboda, 1976).

AK define the demand for money in real terms as a function of real income, the interest rate and the rate of inflation. Inclusion of both the rate of inflation and the interest rate is justified on the grounds that in developing countries the range of alternative financial assets to money is limited, so that there is substitution between goods and money. As inflation measures the implicit return on holding goods and the interest rate the opportunity cost of holding money they are both included.

AK then transform the money demand function into rates of growth, with the coefficients representing the relevant elasticities. Using the money multiplier identity, and balance sheet of the monetary authority, converting into rates of growth, and assuming monetary market equilibrium, the following equation is arrived at:

$$(R/H)\Delta R/R=\Delta P/P+\eta_y \Delta Y/Y+\eta_r \Delta r/r+\eta_\pi \Delta\Pi/\Pi-\Delta m/m-(D/H)\Delta D/D$$

AK estimate the money demand function first, both in nominal and real terms. They leave out the interest rate for lack of data. The general fit is poor. However, the income elasticity is well over two. AK say this is to be expected as the public holds most of its savings in money form, and savings tend to increase more than proportionately with economic growth. The inflation coefficient is significantly lower than 1, so that the assumption of homogeneity in prices is rejected.

However, they say that this could be due to multicollinearity between inflation and the rate of change of inflation.

They next estimate the reserve flow model. The fit is much better than for the money demand function. The coefficients for inflation and the rate of change of inflation hardly change. However, the coefficient for the rate of change of inflation reaches significance. The income elasticity falls to unity. AK contradict their previous hypothesis and say that this is to be expected. They do not explain why there is such a large fall in the coefficient. The signs for the multiplier and domestic credit are much lower than unity (in absolute terms). They ascribe this to the possibility that prices and incomes might not be exogenous - an increase in domestic credit might increase prices, and/or real incomes. This increases the demand for money with the result that the effect on the balance of payments of an increase in domestic credit is reduced. In statistical terms, if exogenous variables are highly correlated it is more difficult to obtain the true regression coefficient which measures the partial effect of a variable on the dependent variable, assuming the others are held constant. They do not mention another reason, namely that it may take longer than one time period to reach money market equilibrium. If this is the case, a regression of the change in foreign reserves on the change in domestic credit may therefore not produce a coefficient of -1 on the credit variable. [5] If reserves do not adjust fully to a change in credit within a time period, this implies an excess demand or supply of money, which reflects the error in estimating the change in foreign reserves. Use of a partial adjustment mechanism specifying the adjustment of actual to desired money balances could help in improving the fit of the model.

AK plug the estimates of the money demand function into the reserve flow model. The simulated values of international reserves track the actual values far less closely than the estimates of international reserves obtained directly from estimating the reserve flow equation. They do not explain why this is so.

AK omit to mention that the money multiplier is a ratio of two elements of money and is really determined by the same factors as for money demand. It is therefore not valid to treat it as an exogenous variable. In this

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[5] I tested this on a made-up set of numbers, assuming that a change in credit is not fully reflected in the balance of payments until 2 time-periods. The coefficient on 'credit' was significantly less than 1, using several different sample periods.

light the low significance and low coefficient of the multiplier may not be too surprizing.

2) Zecher

Zecher (1976) tests the role of money in explaining changes in foreign reserves in Australia. Like AK he estimates a money demand function directly and within a reserve flow model. He tests the model on quarterly, semi-annual and annual data from 1950 to 1971. Instead of current income he uses a measure of permanent income, based on a 16 quarter weighted moving average of GNP. A measure of interest rates is the other explanatory variable. His results are difficult to interpret, although he claims that the model explains foreign reserve changes well. There are several anomalies. First, estimated income elasticity is lower using annual data rather than quarterly data. Because of adjustment lags one would expect the opposite. Second, he does not explain why the coefficients for credit expansion, and the money multiplier are higher than their hypothesized values (contrary to AK in the case of domestic credit). This could be because of reverse causation between foreign reserves and the right hand side variables (see Connolly and Taylor, 1979), which biases the coefficient on domestic credit upwards. That is, an increase in foreign reserves increases incomes, which increase money demand and hence reserves, and may, through increased tax revenues, or a deliberate government policy to stabilize incomes, lead to a reduction in domestic credit.[6] Third, the coefficient on domestic credit is lower using annual data than quarterly data, whereas one would expect the opposite.

3) Genburg

Genburg (1976) tests the reserve flow model for Sweden. He includes a short run adjustment formulation in his money demand function, whereby money balances are equal to long run desired balances plus a fraction of the difference between last period's actual and long run desired balances. His estimates of income elasticity are very low, even when he uses 'permanent' income as a variable. He substitutes predicted money demand into the reserve flow equation (in the same form as Zecher's), rather than estimating the model as a whole. He uses actual values for the money multiplier rather than predicted values, which he admits is not valid (for

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[6] Connolly and Taylor (1979) note that such an income stabilization policy is unlikely for a developing country, as it implies, in the case of decreasing foreign reserves, steadily increasing domestic credit which will eventually lead to the exhaustion of foreign reserves. Also increased government revenues may lead to an increase in government expenditures, which increase imports and diminish reserves. Finally, if the policy was to stabilize the balance of payments the coefficient would be biased below one.

reasons explained earlier). He finds a 'high' correlation between actual and predicted foreign reserve flow values. However, an R^2 of 0.76 is not very high. There are significant errors in some years.

Genburg notes that his results show a coefficient for domestic credit different from unity. He attributes this to a time lag in the adjustment of foreign reserves. If the change in reserves per unit of time is a constant fraction, a of the predicted change, ΔR^*, then:

$\Delta R^* = \Delta R/a$

so that,

$\Delta R = a\Delta Md - a\Delta D$

so that the coefficient on ΔD will not necessarily equal -1. This is equivalent to saying that there is a lag in the adjustment of actual to desired money balances. [7] Genburg notes that the lag should be built into the specification of the money demand function. However, he leaves this problem for future research. One problem with building in adjustment lags, that he does not discuss, is that one has to assume that adjustment coefficients are constant. If they are not constant then sizeable errors in predicting reserve flows may occur.

[7] The derivation is explained in more detail in footnote 2 of Chapter 7

Adjustment speeds may vary over time and for different types of disturbances. For instance, the speed of adjustment may be different for excess money demand than for excess money supply. A change in real income may cause foreign reserves to adjust at a different rate than a change in domestic credit, particularly if there is also a lag between the adjustment of desired money balances to changes in income. Policy measures, such as import and exchange restrictions and credit squeezes, may also change adjustment speeds. Import restrictions may lower the speed of adjustment of actual money balances to excess balances.[8]

4) Bean

Bean (1976) tests the reserve flow model for Japan, 1957-70. Although the results are significantly different from those hypothesized, she recognizes this may be due the use of quarterly data, implying that monetary equilibrium will not necessarily prevail over such a short time period.

6) Officer and Kreinen

Officer and Kreinen (1978) (OK) survey various articles on the monetary approach to the balance of payments. I have some general comments to make on their

[8]For a discussion of partial adjustment formulations see the Appendix

work. First, as discussed earlier, the monetary approach is not inherently different from the incomes or absorbtion (or 'Keynesian') approach if it is accepted that foreign exchange reserves are, by definition, part of the money supply under fixed or managed exchange rates. The various articles, surveyed above, in IMF(1977) make this clear. OK wrongly treat the monetary approach as a fundamental new approach.

Second, OK appear to consider that the monetary approach is the one epitomized by the reserve flow equation (and its variants), where the money market is assumed to reach equilibrium in one time period and the arguments in the money demand function are assumed to be exogenous (that is, full employment, capital mobility and purchasing power parity are assumed to hold). All the articles surveyed in the article are assumed to be in this vein. However, as mentioned above, the long run predictions of the monetary approach hold irrespective of the nature of the economy. Neither does the monetary approach preclude looking at short-run effects. What OK fail to emphasize is that the characteristic feature of the monetary approach is the stability and predictability of the money demand function (as Johnson (1976) repeatedly emphasizes).

Third, OK argue that the main difference between the monetary and the non-monetary approach is that the 'offset' coefficient in the reserve flow equation - that is, the coefficient on the domestic credit variable - should be -1 under the monetary approach, and less than -1 (in absolute terms) under the income-absorbtion approach. As pointed out earlier, a long run coefficient of less than -1 assumes a degree of sterilization of the impact of the balance of payments on the money supply. This is only a special case of the income-absorbtion approach. Moreover, as pointed out above, if monetary equilibrium is not restored - following a disturbance - within the unit of time selected for the measurement of variables the coefficient on domestic credit will not equal -1. Failure of the estimated coefficient to equal -1 in no way invalidates the monetary theory. It only indicates that it may take longer than one period to restore equilibrium. It should be remembered that the time unit used for empirical studies is an artificial construct, based on the way that the data is measured, and has little to do with theory.

7) Wilford

Wilford (1977) tests the reserve flow model for Mexico, using data from 1954 to 1976. He first estimates money demand functions using annual data with income and interest rates as explanatory variables. The income coefficient is insignificantly different from one. The interest rate coefficient is insignificantly different from zero but has the expected sign. The R^2 is very low, indicating that much of the variation in the dependent variable is unexplained. He does not consider this to be particularly damaging to the monetary approach, perhaps because he obtains good results when he estimates the reserve flow model directly. However, the estimated money demand function would be a source of concern for the practical applicability of the monetary approach.

He also tests the model using quarterly data. The results are much worse. Surprizingly, he does not attribute this to the probability that the money market is less likely to be in equilibrium on a quarterly basis than on an annual basis. Finally, he expands the model by breaking down the money multiplier into its components. This does not give satisfactory results. Surprizingly he does not consider that it is invalid to use the money multiplier as a separate variable, as it is a ratio of different components of money, and is therefore explainable in terms of the same factors as money demand

2.3 Summary and Conclusions

In Section 2.1 I outlined the general concept of the monetary approach. The essential concept is that a country's balance of payments can be explained in terms of the difference between the change in the demand for money, and the change in the supply of money of domestic origin. The concept implies that for the monetary approach to have any relevance in the real world the money demand function must be stable, and the monetary authority must be able to control the domestic component of the monetary base and be able to predict accurately the money or credit multipliers.

Despite its apparent simplicity, there are conceptual and empirical problems with the monetary approach. It may be difficult to estimate single money demand equations or reserve flow models without running into problems associated with identification and simultaneous equations bias, arising from the endogeneity of the explanatory variables in the money demand function. From the policy point of view, it may be difficult to calculate a domestic credit ceiling, based on forecast money demand, in order to achieve a balance of payments target, as the ceiling may feedback on the variables determining money demand.

Another problem is that it may be difficult to derive a stable money demand function. Frequent economic shocks, such as changes in government policy, bad weather, and wars, may make the function difficult to determine. Another problem is that it may be difficult to specify the explanatory variables accurately, particularly if the variables are of the 'expected'' variety (such as permanent income). There may be time lags in the adjustment of desired money balances to changes in the explanatory variables, and in the adjustment of actual balances to desired balances. These may be difficult to formulate, particularly if the coefficients of adjustment change over time. There may be considerable measurement errors in the explanatory variables, particularly the income variable. On the supply side, the money multiplier may be difficult to explain, for the same reasons as money demand, because the money multiplier is partly demand-determined.

Section 2 examined some of the literature on the monetary approach. The Polak and Rhomberg models, developed in the IMF, recognize that income, the principal explanatory variable in the money demand function, is usually endogenously determined within the economic system. They therefore develop income-determination models, which include a money demand function, and which recognize that the money supply is partially determined by the balance of payments. Reduced form equations are derived, explaining both income and ~~the~~ changes in foreign assets (the below-the-line equivalent of the balance of payments). These models are not conceptually any different from standard, textbook income determination models, as long as the money supply is allowed to respond to the balance of payments. The main problem with these models is that they do not go to any great lengths to accurately specify a money demand function. The models assume a constant income velocity, which in effect assumes the stability of the money demand function.

Another class of models are the 'reserve flow' long-run equilibrium models. The money demand function can be specified in any form, and tested within the model. The literature tends to lay too much importance on estimating the model directly, and getting good coefficients for domestic credit expansion (that is, close to minus one), and not enough importance on getting good results for the money demand function. The reserve flow model is in part an identity, based on the balance sheet of the banking system, so that a strong inverse relationship between domestic credit expansion and changes in net foreign assets is highly likely. Also, failure of the domestic credit coefficient to equal minus one may just mean that it takes longer than one time period to reach monetary equilibrium following a disturbance. The important point is to estimate a 'good' money demand function. To take an extreme example, if the change in money demand over a period is estimated, and is exactly equal to the observed change in the money supply, then, by definition, the estimated change in net foreign assets of the banking system will be equal to the actual change. Any errors in predicting money demand will be reflected by equal errors in predicting the balance of payments.

Alternatively, it is possible to estimate the money demand function separately and then plug it into the reserve flow equation in order to estimate changes in net foreign reserves. This constrains the domestic credit coefficient to be minus 1, thereby assuming money market equilibrium. Any errors in predicting the balance of payments will then reflect random errors in the money demand function or misspecification of that function. Running the reserve flow model directly, and testing whether the domestic credit coefficient is significantly different from minus one, would enable one to determine whether it is valid to assume money market equilibrium. The money multiplier can also be estimated directly from demand functions of various components of money. Estimating the reserve flow model directly usually entails the inclusion of the money multiplier as a 'known' variable, when it is in fact largely demand-determined.

Finally, the literature on reserve flow models seems to suggest that the monetary approach only holds in the long run (that is, with all the explanatory variables exogenously determined outside the economic system). The IMF models show that this assumption is not a prerequisite for the applicability of the monetary approach. However, it may be more difficult to estimate the true money demand function if the explanatory variables are endogenously determined within the economic system. However, the literature on money demand (much of it summarized in Laidler (1985)) suggests that this has not been much of a problem, particularly if the money demand function is specified in real terms.

In conclusion, it seems that the best approach to take is to concentrate directly on specifying and testing a money demand function, as the stability of the money demand function lies at the heart of the monetary approach. Although a multi-equation model could be developed (in which the explanatory variables in the money demand function would be endogenous), which would allow for experimenting with different money demand functions, this would add considerably to the scope of this thesis.

Before going on to develop money demand functions for Zambia I will first discuss briefly some of the monetary work that has been done on African countries. This is the subject of Chapter 3

CHAPTER 3

REVIEW OF LITERATURE - AFRICA

The purpose of this chapter is to discuss some of the monetary analysis that has been undertaken on African economies, including Zambia. Previous work might provide useful guidance on how best to proceed in applying the monetary approach to the balance of payments to the Zambian situation.

Relative to, for example, South American countries (see, for example, ed. Meiselman (1970)), there has been little published academic analysis of African economies from a monetary viewpoint. A probable reason is that most African countries did not obtain independence until the early '60s, and did not have the freedom to pursue independent monetary policies until then. There is probably much unpublished material, particularly within the IMF - a result of numerous missions. Also, if budget speeches and central bank reports in Zambia are anything to go by officials in these organizations are reasonably aware of the influence on the balance of payments of monetary factors. Actual policy measures taken may be at variance with this understanding, but these may reflect political constraints. For example, restrictions in domestic credit creation in order to avoid pressure on the balance of payments may be politically unacceptable

3.1 Discussion of Literature

Kimaro (1975) tested the Polak model (defined in Chapter 2, section 2 above) for several African countries, including Zambia for the years 1964 to 1969. After experimenting with different definitions, he finds that the propensity to import based on customs data displays the greatest constancy.

He then examines the income velocity of money (v), for both broad and narrow definitions. In Zambia, both definitions showed a distinct downward trend. The coefficient of variation was distinctly higher than for m.

The Polak model uses the product of m and v (that is, the ratio of imports to money). The product showed significant variation, thereby casting doubt on the accuracy of the figures, the constancy of the ratios, and the the assumptions of equality between marginal and average values of m and v.

For Zambia, the reciprocal of mv was in the region of 0.3 to 0.4. As shown in the last chapter, this is the long-run foreign reserve multiplier (equal to $\Delta NFA/\Delta(X+CM)$). Kimaro shows that the lower the multiplier (the higher the import -money ratio), the smaller the domestic credit expansion that a country can afford for a given increase in exports, and for a desired ratio of foreign assets to imports. For Zambia, this means keeping net domestic credit at less than 50% of the level of net foreign assets.[9]

Rather than regressing imports directly on the exogenous variables in the Polak model, Kimaro first obtains estimates of the parameters from the structural equations and then substitutes these into the reduced form.[10] He estimates annual percentage deviations of estimated from actual imports. The annual average deviation was about 1.2%. Using a 3 year lag equation, about 70% of the imports were explained in the current year with most of the remainder explained in the previous year. The model estimated imports much better than a variety of single import equations - the best of which stipulated imports as a linear function of exports.

One drawback of the study is the very short time period used. Kimaro could only explain imports in two years (because of the lags involved). A more fundamental drawback is the assumed constancy of mv, when v, in particular, was not constant. As pointed out in the last chapter, the assumption that v is constant presumes a stable money demand function. If v is not

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[9] Money supply (Mo) = Y/v. Imports are postulated to be in proportion to income: M = mY. Let c = desired NFA/Imports. Then desired NFA = cmY. Therefore,
NDC = Mo - NFA = Y/v - cmY, and
NDC/Desired NFA = (1/cmv) - 1.
In Zambia's case, mv is about 2.8, c is about 0.33 so that the ratio of NDC to desired net foreign assets is only about 0.1.

[10] He claims to lessen the errors produced by the unreliability of income figures by computing m as the ratio of (M/Mo)/v and v as the ratio of (M/Mo)/m. He cannot achieve this effect as v and m still have to be computed separately using income figures.

constant, and neither is mv, the model may not track the data well. The model will not enable us to say why it did not track well, and in particular, what the reasons for changes in v were. As was concluded in the last chapter it seems better to concentrate on the reasons for changing velocity, that is, examining the money demand function. However, the model is of interest to policy makers. Even if mv is not constant the model provides a rough guide as to the level of domestic credit the country can afford relative to a desired stock of foreign reserves. The next chapter shows clearly that the level of domestic credit in Zambia was far too high in this regard.[11]

King (1979) examines stabilization policy in Kenya from a monetary viewpoint. He compares the ability of simple income -expenditure models and Polak-style models to explain and predict the balance of payments, prices and employment. He concludes that the monetary theory works much better than the simple income -expenditure model.

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[11] I estimated the reduced form equation for foreign assets in the Polak model (equations 5 and 7 in chapter 2.2). A very good R^2 of 0.99 was obtained, even using the long run model. About 90% of an increase in domestic credit was leaked out within a year. The coefficient for the first term on the RHS was not significant in both the long and short long run equations, showing that changes in export and capital flows do not have a significant effect on the balance of payments, even in the short run. However, the magnitude of the coefficient was not consistent with plausible values for (1/1+mv) and (1/mv). The residuals are quite large in some years, indicating that a more refined analysis of money demand, which allows for changes in v, might produce better estimates.

King's discussion of the differences between the two approaches is, in part, a red-herring. As discussed earlier, the Polak and Keynesian models are analytically equivalent if the unrealistic and unnecessary assumption that money supply is exogenous is dropped from the Keynesian model. Also the income -expenditure model he uses for comparison is only the very simplest kind, without any monetary sector whatsoever. Therefore it is hardly surprizing that it does not depict the real world very well. King makes some misleading comments on the conceptual nature of the monetary approach. He says that the monetary approach implies that, in equilibrium, a change in domestic credit is exactly offset by a change in net foreign assets. However, it is possible to have flow money market equilibrium (a change in money demand equals the change in money supply) so that the change in domestic credit does not equal minus the change in foreign reserves. For example, domestic credit might increase by 40 million units, income might increase so that money demand increases by 20 million units, and money supply might also increase by the same amount. Foreign reserves therefore decrease by 20 million units. In general, as Guitian (IMF, 1977) points out, flow monetary equilibrium is consistent with any combination of changes in domestic credit and foreign reserves.

King uses a modified Polak model to produce a quarterly model of the Kenyan economy for the period 1965-1972:

$$Y = A + X - M \quad (1)$$
$$Mo - SA = -900 + 1.7Y \quad (2)$$
$$M = 100 + 0.4A \quad (3)$$
$$\Delta(Mo-SA) = \Delta NFA - V + \Delta(NDC-SA) \quad (4)$$
$$\Delta NFA = X - M + CM + V \quad (5)$$

In equations 1 and 3 A stands for domestic absorbtion. SA is a seasonal adjustment factor to allow for the bunching of tax payments at the end of the year. V is a factor allowing for changes in autonomous changes in NFA as a result of SDR allocations or revaluations of foreign assets. Equation (2) is a money demand equation, where velocity decreases with increases in income. Equation (3) expresses imports as a decreasing function of domestic absorbtion. This allows for import substitution. As King admits, it is unrealistic as it assumes that exports have no import component.

The coefficients were estimated manually by trial and error until the estimated values of the endogenous variables were close to the actual values. He did not use OLS techniques for a number of reasons, including insufficient data points, measurement errors in variables, use of lagged endogenous variables and simultaneous equations bias. He obtains fairly accurate predictions of NFA. Income is predicted with far less accuracy. This is partly because income is only available on an annual basis.

King then conducts simulations using different values for the exogenous variables. He shows, for example, that foreign reserves at the end of 1972 were considerably lower than if there had been no credit advanced to government. Given a target level of foreign reserves (as a proportion of imports) he calculates the amount of credit expansion to government consistent with the target. His conclusion is that the only safe rule for credit expansion to government is that none should be undertaken.

Although King's modified money demand is more realistic than the one used by Kimaro, as it allows for declining velocity, it still omits other variables, such as interest rates and expected inflation that might affect money demand (although these may not have been significant factors over the period he was analyzing). However, one is inclined to be suspicious of his money demand function, as it implies implausibly high income elasticities of money demand (even after allowing for blocked expatriate money holdings as an explanation).

Another further comment (which is a criticism of the Polak model in general) is that domestic credit of the banking system is treated as an exogenous variable. This is not accurate as only domestic credit of the monetary authority can be treated as exogenous. The model can be modified by introducing a term for the money or credit multiplier. However, this is largely demand-determined and is therefore itself an endogenous variable.

King is criticized by Brough and Curtin (1981). They appear to interpret King as saying that balance of payments problems only arise as a result of credit expansion to government. However this is not a valid criticism. A sustained balance of payments deficits can only arise as a result of continued domestic credit expansion in excess of the growth in money demand. Changes in foreign reserves caused by changes in exports, autonomous imports and capital flows are only temporary. Thus the large fall in foreign reserves in Kenya in 1977-78 can be explained, at least partially, in terms of the increase in imports resulting from the export boom of 1976. This is completely consistent with the monetary approach, which, because it is essentially the same, is also consistent with the income determination approach.

Brough and Curtin also claim that " the main weakness in the monetarist position is the failure to take into account of any government's need to deal with the kind of real world fluctuations Kenya had to face since 1964 (e.g. climate, fluctuations in import and export prices)". The Kenyan Government has felt obliged at times to run high budget deficits financed by credit expansion, in order to stabilize incomes in the wake of balance of payments disturbances. The criticism is invalid, as the monetary approach only addresses, via its policy implications, what policy measures are needed to correct balance of payments problems. It fully recognizes that a fall in credit expansion to induce an increase in foreign reserves may cause a fall in incomes. A government must use other measures in its tool kit if it wants to stabilize both incomes and the balance of payments (see also Polak, Argy (1977)).

If the monetary approach is to be useful the monetary authority needs to be able to exert control over the money supply. One implication of this is the necessity of a stable and predictable relationship between the money base and the money stock. Bolnick (1981) investigated the behaviour of the proximate determinants of the money supply in Kenya. He shows that variations in the money multiplier have been large relative to changes in the money supply and the base. He finds that the banks' reserve ratio has shown much greater variance than the public's currency ratio, and that the sensitivity of the multiplier to changes in the reserve ratio is half again as much as for the currency ratio.

He then looks for explanations for changes in the reserve ratio. He rules out interest rates and inflation as being important as both these variables were low and showed little variance during the period under study (1967-1973). One possible hypothesis was that bank lending is determined by credit demand, which is itself a function of import demand. However regression analysis did not support this hypothesis, possibly because some imports were financed by overseas credit, or possibly because imports were financed by running down money balances.

Another possible hypothesis tested by Bolnick was that the reserve ratio varied with the structure of deposits. The higher the ratio of time and savings deposits to demand deposits the lower the likelihood of sudden withdrawals and the lower the ratio of excess reserves to deposits needed (Diz, (ed. Meiselman, 1970), also advanced this hypothesis for Argentina). However, he found no significant relationship. He also tested the possibility that the reserve ratio was affected by lags between changes in reserves and bank lending. The historical evidence seemed to support this, as changes in the multiplier tended to offset changes in base money in its effects on money supply (Diz also tested a similar hypothesis). He found a significant relationship, particularly when the reserve ratio was adjusted for changes in the legal reserve ratio. However, the results were ambiguous as the actual reserve ratio tended to move, perversely, in the opposite direction from the legal reserve ratio.

Given the inability to explain adequately changes in the reserve ratio, and the changes in the currency ratio (which he does not try to explain) he concludes that control over the money supply is imperfect, given control over the base. However, his conclusion is perhaps premature. First, he does not analyze the determinants of changes in the currency ratio (which also significantly affected the multiplier, although to a much smaller degree than the reserve ratio). Second, he does not adopt another practical approach to the matter (as Diz, 1970, does), which is to analyze the demand for the components of the ratios (either in terms of currency, reserves and deposits, or in terms of deposit-inclusive money and base money). Third, use of annual data (which he did not have enough of) might reveal different conclusions, as the multipier might be more stable on an annual basis.

He also discusses difficulties in controlling the base. He claims that it is difficult for the monetary authority to offset the endogenously (through the balance of payments) determined part of the money base. First, open market operations are impracticable, given the limited market for government bonds. Second, selling financial instruments, such as Treasury bills, to banks is ineffective as these can readily be discounted at the central bank. Third, he claims that the domestic portion of the money base is determined endogenously by the government's financing requirements.

These arguments lack force. Bolnick does not mention the ability of the central bank to vary the legal reserve ratio to offset the liquidity effects of balance of payments disturbances, and the potential discounting of Treasury bills. Although the Treasury's financing requirements might nullify such actions, in principle the domestic component of the monetary base is a policy variable.[12] Also, the reason why open market operations are impracticable is probably not because there is a limited market but because interest rates are not subject to market forces.

Grubel and Ryan (1979) (GR) test a reserve flow model of Kenya's balance of payments, with the variables in growth rate form. Their estimated equation is:

$$\begin{aligned}(R/H)gr = \underset{(1.32)}{0.143} - \underset{(0.11)}{0.92}gy + \underset{(0.06)}{0.57}gP + \underset{(0.76)}{0.15}gSE - \underset{(6.7)}{1.43}(D/H)gD\end{aligned}$$

$R^2 = 0.95$ DW = 2.29

The symbol 'g' is a growth rate. The coefficients are elasticities. R is net foreign assets, y is real income, P is a price index, SE is Nairobi's Stock Exchange Index, serving as a proxy for asset yields, and D is net domestic credit. The money multiplier is missing as the authors recognize that it cannot be estimated independently of money demand.

GR claim that the results show that continuous balance of payments equilibrium is assured if D is varied so that the base grows at the same rate equal to that of real output growth, given exogenously determined disturbances and a stable money multiplier. They claim the money multiplier is stable on an annual basis, based upon the following estimated equation:

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[12] This becomes obvious in the course of negotiations with the IMF.

$$\ln M2 = 3.8 + 0.56\ln H + 0.104T$$
$$(15.5) \quad (15) \qquad (19.4)$$

$R^2 = 0.99 \qquad DW = 1.47$

where T represents trend.

They also claim the money demand function is stable and predictable based upon an estimated equation:

$$\ln M2 = 5.0 - 0.1\ln Y + 0.183P + 0.31\ln SE + 0.162T$$
$$(2.3) \quad (0.15) \quad (0.24) \quad (1.9) \quad (3.5)$$

$R^2 = 0.99 \qquad DW = 2.33$

A number of critical comments are in order. First, a high R^2 for the reserve flow equation (the first of GR's equations above) does not prove anything. A high R^2 is almost inevitable because of the bank balance sheet identity (particularly when changes in D and R are very large relative to money supply). The important factor is the money demand function. When estimated within the reserve flow equation the coefficents on the money demand variables are very unsatisfactory. The signs on y and SE are contrary to expectation, and are insignificant. The sign on P is positive, as expected, but does not indicate that demand for nominal money is proportional to money balances as expected. The coefficient on D is much higher than the hypothesized value of -1. If anything one would expect it to be lower if actual money balances had not had time to adjust to desired balances within the time period. A higher coefficient might be possible if there is reverse causality between foreign reserves and money demand and domestic credit. This may indicate simultaneous equations bias. As noted, however, in footnote 5 in Chapter 2 Connolly and Taylor (1979) consider that any such bias is unlikely in developing countries. A more plausible reason is correlation between domestic credit and the omitted money multiplier variable - an increased demand for credit is likely to be associated with an increase in the money multiplier, as excess reserves may fall. The low coefficients on the money demand variables could indicate multicollinearity with domestic credit. However, GR's money demand function, when estimated separately, is also highly unsatisfactory, with the signs showing little difference from the reserve flow model. The high R^2 is entirely attributable to the time trend. As the key to the monetary approach is a good money demand function GR's results would lead one to conclude that the monetary approach is not applicable to Kenya. However, the results are so bad that one suspects that there was something wrong with the specification, or econometric procedures, or both.

Second, a high R^2 does not guarantee a good year to year fit. Although GR are optimistic about their results, their graph comparing actual and estimated values show large errors in some years (Killick (1983) also makes this point), reflecting, in part, errors in estimating money demand.

Third, GR left out the money multiplier as an explanatory variable. While the reason for doing so is valid (namely, that it is determined by the same variables explaining money demand), it is nevertheless an omitted variable. This creates autocorrelation problems in the errors, and biased variances of the coefficients, making the results harder to interpret.

Fourth, the estimated money supply function is highly questionable. A time trend accounts for much of the explanation of money supply, which disguises the actual factors accounting for changes in the money supply. The coefficient on H implies that changes in the multiplier also account for much of the change in money supply (as Bolnick, (1981) points out).

Fifth, GR conclude from their work that Kenya's balance of payments imbalances are almost solely the result of deliberate monetary authority actions, implying that the authorities only needed to vary credit sufficiently to bring about balance. However, as noted several times already, other factors are responsible for payments imbalances. As GR admit, the high surpluses of 1976 and 1977 were the results of high coffee prices. Killick (1983) attributes the surplus in 1975 to a lowered demand for imports in response to higher import prices, and the imposition of import control. The dissipation of the surpluses in 1977-78 can be attributed to higher imports following higher incomes. It is true that the balance of payments could be kept in constant equilibrium if the monetary authorities could immediately alter the quantity of domestic assets to offset changes in foreign reserves. However to do this they would need a very accurately specified money demand function, and would need to know the true links between base money and the money supply and bank credit. GR's results, which are not reflected in their conclusions, indicate that it would be extremely difficult for the Kenyan monetary authorities to manage the balance of payments in this way.

Killick (1983) also comments on GR. He points out the importance of the industrial and price structure. If full employment income is no longer compatible with balance of payments equilibrium because of, for example, declining terms of trade, structural changes need to be made in order for full employment to be attainable at balance of payments equilibrium. This is a valid point but, of course, does not detract from the monetary approach. He doubts whether key parameters, such as those in the money demand function, the money multiplier, and the import function are sufficiently well-behaved enough to permit accuracy in short-term forecasting.

Paljarvi and Russo (PR), part of the IMF team to Zambia during the 1978-80 Standby Program, produced a detailed study (1979) of the demand for money, credit ceilings and the balance of payments in Zambia. In summary, they find sizeable prediction errors in estimating money demand functions, which imply large errors in predicting changes in net foreign assets, given a predetermined credit ceiling. If the credit ceiling is on the domestic assets of the monetary authority only, there is extra error in predicting the balance of payments outcome, as a result of the error in predicting total credit expansion (arising from the error in predicting the credit multiplier). Because base money comprises a much smaller proportion of changes in foreign assets than deposit-inclusive money, errors in predicting the demand for base money may not imply such large errors in predicting net foreign assets, if a base money demand function can be accurately specified. They conclude that the demand for base money should figure far more importantly in financial programming.

PR first attempt to estimate money demand functions, based on quarterly data from 1966 to 1976. They exclude demand deposits of the government-owned copper mining companies, on the grounds that these can be more accurately derived from their detailed financial projections. They assume that the public's demand for real balances is a function of real income and expected inflation. The latter proxies for the opportunity cost of holding money, given the lack of alternative assets to money apart from real assets. Interest rates are not included as an explanatory variable, perhaps because these showed very little variation over the period under study. An adaptive expectations formulation is used for prices and incomes, which implies a lagged adjustment of desired balances to actual values of incomes and prices.[13]. However, as PR admit, this mechanism assumes that expectations concerning real income and prices are formed in the same way and that adjustment takes place at the same constant speed, which is not necessarily valid, particularly during times of instability. The adaptive expectations mechanism also lacks rationality as it does not provide any mechanism for adjusting the way expectations are formed if they are often wrong. Too much weight tends to be given to past values and not enough to current values of the variable and any other relevant information (such as new government policies) (see Attfield, Emery and Duck, 1985). However, the adaptive expectations mechanism may work better on quarterly data, as the past values used for forming expectations are still fairly recent. PR did not have annual data to work with.

The equation they estimate for M1 (publicly held cash plus demand deposits less mining company deposits) is (t values in brackets):

$$\underset{}{Ln(M/P)} = 0.6 + \underset{(10.5)}{0.74ln(M/P)_{-1}} + \underset{(2.83)}{0.26lnGDP} - \underset{(-2.86)}{2.0ln(P/P_{-1})}$$

$R^2 = 0.92$ SEE = 0.062

This implies a long run income elasticity of

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[13]The adaptive expectations mechanism is described in the Appendix

unity (=0.26/(1-0.74)). Fitting the same equation to time and savings deposits yielded:

$$\text{Ln}(TS/P) = 0.271 + \underset{(2.3)}{0.96}\ln(TS/P)_{-1} - \underset{(-2.3)}{3.1}\ln(P/P_{-1})$$

$R^2 = 0.96$ SEE = 0.106

The adjustment parameter in the second equation is much smaller, (0.04), which, according to PR, may reflect the smaller transactions component in time and savings deposits. GDP was not significant in the second equation. One reason that PR advance is that intensifying exchange restrictions and increasing liquidity after 1972 caused a shift into time and savings deposits, which dominated income changes. However, they also say that the small influence of real income is implausible, given 'the usual presumption that money demand tends to be highly income elastic'. They say that data could be a problem as income figures are only available annually, are subject to measurement error, and are frequently revised. They interpolated the annual series using copper production and manufacturing output as benchmarks. However, this would only produce very rough estimates of quarterly income.

PR do not mention that their econometric procedures are open to question. An equation with an adaptive expectations mechanism has a moving average error structure. PR use the Cochraine-Orcutt procedure to correct for this. However, strictly speaking, it is only valid to use this method for an autoregressive error structure. Moreover, the estimators are inconsistent as the lagged endogenous variable is correlated with the lagged error term, which is also correlated with the current error term (see Kennedy, 1979). Therefore the estimators are biased. This may not in fact be a problem if the equation estimated actually contained a partial adjustment process, whereby actual balances adjust by a fraction of the change in desired balances. In this case the error term is spherical. The estimating equation is identical for both formulations, so that without knowing what the estimated error structure was for PR's work, it is difficult to know what the adjustment coefficient represents.[14]

PR estimate a demand for base money equation, using the same explanatory variables as for other kinds of money. This is justified. Currency held by the public depends on the same variables. Excess bank reserves should vary with the opportunity cost of holding money, and required reserves are derived from demand deposits, which are a function of the same variables as in the money demand function. They admit the formulation could be improved by explicitly adding in reserve requirements as an explanatory variable, and introducing the discount rate, or loan rates. They leave this to future research. The equation they obtain is:

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[14]Laidler (1985) discusses adjustment mechanisms. His views are outlined in the Appendix.

$$Ln(Mb/P) = -2.6 + \underset{(5.0)}{0.7ln(Mb/P)_{-1}} + \underset{(2.0)}{0.5lnGDP} - \underset{(2.5)}{2.1(lnP/P_{-1})}$$

$R^2 = 0.91$ SEE = 0.07

The long-run income elasticity is 1.66, which is considerably higher than for the other elements of money, and, furthermore, is more in accordance with expectations.

PR obtained prediction errors by running the model for the first few years only, predicting one year ahead, rerunning the model, and predicting for the next year, etc. Average prediction errors were 5% for base money, 9% for M1 (other than mining company deposits), 15% for time and savings deposits, and 48% for mining company deposits (estimated by a separate - and unsatisfactory - equation). Base money clearly performed the best. However, when the different elements of money were combined into M2, the errors were much smaller. They also found the average annual prediction errors to be smaller than the quarterly errors, indicating some offsetting during the year (although this was not the case for base money). The prediction errors were large and negative for 1976. PR attribute this to the shocks introduced in that year through intensified exchange and trade restrictions, and a 20% devaluation against the SDR. The underpredictions indicate a possible upward shift of the money demand curve in response to these factors. Another possible reason for the underprediction is that the large increase in the government budget deficit that year may have caused an excess money supply that people had not fully adjusted to by the end of 1976. PR added a dummy variable for 1976, and this considerably reduced the prediction error.

I have a number of comments on their work on money demand. First, PR do not experiment with real GDP adjusted for the terms of trade as an explanatory variable (at least, they do not mention such experiments). This gives a better measure of the purchasing power of nominal income than real GDP.[15]

Second, PR do not use interest rates as an explanatory variable. This is perhaps because interest rates showed little variability before. As discussed in Aghlevi and Khan (1977, and Section 2.2 above), and Laidler (1985) it is usually valid to use both interest rates and expected inflation as explanatory variables, unless nominal interest rates fully reflect expected inflation - which was not the case in Zambia, as will be shown in Chapter 4 (also see Diz, 1970).

Third, they do not consider the possible effect of population as an explanatory variable if the income elasticity

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[15] Real GDP does not necessarily reflect changes in the purchasing power of exports in terms of imports as a result of changes in the terms of trade. These will affect real income, in terms of purchasing power, even if real output of growth and services stays constant. For a discussion see Harvey (1977).

of money demand is not equal to unity. Friedman (1969) demonstrates this point. He expresses per capita real balances as a function of per capita real income (assuming that money demand grows in proportion to population):

$$M/NP = \gamma(Y/NP)^{\delta}$$

so that

$$m = \gamma N^{1-\delta} y^{\delta}$$

If δ does not equal one, then population should enter as a separate variable, if money demand is estimated in aggregate terms. In economic terms, a fall in real income per capita leads to an equal percentage fall in real balances per capita if δ equals unity. The percentage change in total income equals the percentage change in real balances. If the income elasticity is greater than one, a fall in per capita income due to a rise in population will cause a fall in the demand for total real balances, even if total real income stays the same.

Fourth, although PR did not have a long enough time series to estimate money demand functions based on annual data, use of annual data would be preferable. This would avoid the use of questionable proxies for real income, and might avoid the need to use ad hoc expectations formulations, with the restrictive assumptions and possible econometric difficulties these imply. From the policy point of view a quarterly model facilitates the setting of quarterly credit ceilings with a view to attaining predetermined balance of payments targets. However, the lack of accuracy with which money demand can be predicted on a quarterly basis casts doubt on the merits of this process. An annual credit ceiling, based on a money demand function derived from annual data, might achieve more accurate results.

PR then examine the stability of the link between base money and the broader monetary aggregates, including bank credit. They find significant differences between the growth rates of base money and each of the other variables, and considerable variation in these differences, indicating instability in the multipliers. As domestic credit is the policy variable, they examine in detail the bank credit multiplier. This is defined as the ratio of commercial bank credit to base money. In symbols it can be expressed as: [16]

$(1 + e - r - f)/(c + r)$

where: c = ratio of publicly held currency to total bank deposits,
r = ratio of total commercial bank reserves to total deposits;
e = ratio of 'other items net' to total bank deposits,
f = ratio of banks' net foreign assets to total bank deposits;

They find that the contribution of these ratios to changes

[16] Derived from the balance sheet of the commercial banks:
Bank Credit + Reserves + Net Foreign Assets = Deposits + Other Items Net,
and the expression for base money: H = Publicly held Currency + Bank Reserves; and then dividing each element by Deposits. Alternatively, Other Items Net can be consolidated with Domestic Credit so that 'e' disappears.

in the multiplier vary considerably each year.[17] Assuming that the growth rates of these components are normally distributed random variables PR show the confidence limits for changes in bank credit, for changes in each component, given changes in base money. As the annual variation in the ratios is high, the confidence limits are very wide, indicating that it may be very difficult to predict bank credit accurately.

PR admit that they have not attempted to explain the variations in the component ratios, as implied by their assumption that they are random variables. They suggest that the ability to predict these variables, and therefore the money and credit multipliers, could be significantly improved by developing and testing hypotheses about their behaviour. Diz (1970), for example, does this using Argentinian data. I shall discuss Diz' work more fully in Chapter 6.

3.2 Summary and Conclusions

To date the monetary work on African economies has been limited. This chapter has discussed the work of Kimaro, King, Bolnick, Grubel and Ryan, and the IMF. Kimaro (1974) and King (1979) develop Polak-style models of the Zambian and African economies respectively. While they are interesting simple macro

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[17] Changes in the credit multiplier (b) can be represented by:
$db = (\delta b/\delta r)dr + (\delta b/\delta c)dc + (\delta b/\delta f)df + (\delta b/\delta e)de$ + interaction terms

models from which important policy conclusions can be drawn, they are essentially similar to income absorbtion models, as shown in Chapter 2. They do not focus on accurate specification of money demand functions, which are the heart of the monetary approach. Because they either assume velocity to be constant (as in the case of Kimaro) or ignore other explanatory variables, while postulating an implausibly high income elasticity for money balances (as in the case of King) their estimates of the balance of payments are probably not as good as they could have been with more research into money demand. Also both models would probably fail to track the balance of payments well in later years when interest rates and expected inflation may have played a greater role. Another criticism is that they ignore the role of the money multiplier, which is partially demand-determined in the same way as money demand.

Bolnick concentrates on the money supply process in Kenya. He examines the determinants of the changes in the money multiplier, specifically the reserve ratio. He finds this to be quite variable and contributes significantly to the variation in the multiplier, which in turn significantly affects the variability of the money supply. He tries to explain the changes in the reserve ratio in terms of factors such as credit demand, the ratio of time and savings deposits to demand deposits, the rate of change of reserves, and the legal reserve ratio. His success is limited. He does not try to explain changes in the currency-deposits ratio, nor does he try to explain changes in the multiplier by analyzing the demand for the different components of money that are embedded in the multiplier. There are also other factors that he might have included in his equation for the reserve ratio, such as an interest rate, or the rate of inflation (as Diz (1970) considers). However, Bolnick's work points the way to further research. In Chapter 6 I conduct similar work in the Zambian situation.

Grubel and Ryan (1979) estimate Kenya's balance of payments in a reserve flow model, and estimate separately a money demand function. The results they obtain are not good. They claim that their model fits the Kenyan situation well, although their results do not support this claim. Their data and econometric procedures are suspect as it is difficult to rationalize the estimates they derive for the money demand and domestic coefficients. They do not analyze the money supply process, except in very general terms, even though their results indicate that the money multiplier is unstable.

Paljarvi and Russo of the IMF examine money demand and money supply in Zambia in the context of the balance of payments. Their work is limited partly by lack of annual data, which forces them to use quarterly data involving questionable proxies for real income. They also use an adaptive expectations mechanism, which has both empirical and theoretical difficulties. They do not use interest rates as a separate explanatory variable, partly because interest rates showed little variation during their sample period. However, there would be justification for using this as a variable for future research. Their results show considerable prediction errors in their money demand functions, although these are lower for base money, and are lower when averaged out annually.

They also analyze the money supply process, specifically the bank credit multiplier. They show that the multiplier has shown considerable variation as a result of changes in the component ratios. However, they do not analyze reasons for changes in these ratios.

Paljarvi and Russo for the most part recognize possible difficulties in their work, and suggest areas of further research. Specifically, they suggest that the demand function for base money should receive more attention, and that empirically testable propositions explaining changes in the money and credit multipiers should be developed.

Chapters 5 and 6 of this thesis largely continue from where other researchers into monetary factors in African economies have left off. Chapter 5 focusses on the estimation of money demand functions, and Chapter 6 focusses on explanations of changes in the money multiplier. Before we come to these chapters however, Chapter 4 provides a brief description of the economic processes affecting money demand and supply in Zambia.

CHAPTER 4

THE ZAMBIAN ECONOMY

This chapter describes the performance of the Zambian economy with particular emphasis on monetary factors, the balance of payments, and variables eligible for inclusion in a money demand function. This provides the basis for the empirical work in the following chapters. Knowing what happened in the economy over the period of Zambia's history will, for instance, make it easier to understand reasons for shifts in, or movements along the money demand function, and ultimately to interpret the changes in Zambia's balance of payments.

4.1 Overview of the Economy

Zambia is a landlocked country of some 6 million people in Southern Africa, bounded by Angola and Namibia to the west, Zaire to the north, Tanzania, Malawi and Mozambique to the east, and Botswana and Zimbabwe to the south. From 1953 to 1964 it was part of the Federation of Rhodesia and Nyasaland, and was known as Northern Rhodesia. It became independent in 1964.

The copper mining industry has been a large contributor to GDP throughout Zambia's economic history. It has consistently provided 90-95% of Zambia's export receipts, and between 15 and 40% of GDP. The agricultural industry has grown but still only contributes about 15% of GDP.

The Zambian economy grew rapidly from 1965 to 1969. The balance of payments situation was healthy. The economy stagnated from 1970-1972, and incurred sizeable balance of payments deficits in 1971 and 1972. Both economic growth and the balance of payments improved in 1973 and 1974. In 1975, copper prices collapsed, and the terms of trade deteriorated by 50%. The terms of trade have deteriorated nearly every year since then. The economy has registered zero growth since 1975, and per capita incomes have fallen significantly. Zambia has incurred large overall balance of payments in every year since 1975, with the exception of 1979. The level of domestic credit has increased rapidly since 1975, mainly as a result of the government's financing requirements. The rate of price increase has accelerated since 1975.

Zambia is one of the most urbanized countries in Africa, although some 70% of the population still lives in the rural areas. Like most LDCs there is a wide variation in income levels. Incomes have tended to be higher in the urban than in the rural areas, encouraging a rural-urban drift.

4.2 Income

Table 4.1 summarizes the composition of GDP. Copper mining has always been a major element of the economy. Its contribution to GDP fell significantly, however, from 50% in 1969 to 15% in 1983, reflecting both lower copper prices and production.

Agriculture's share of GDP has been small. However, its share increased from 6% in 1969 to 14% in 1983, partly reflecting deliberate government policy to increase agricultural production. Manufacturing industry increased rapidly until 1969. Its contribution to GDP has been in the range of 20-25% since 1970. Services as a proportion of GDP have risen significantly, from 28% in 1969 to 48% in 1983.

Table 4.2 shows the composition of expenditures in terms of percentages of GDP. Consumption, including government consumption, has increased its share of GDP significantly, rising from 58% in 1970-74 to 90% in 1980-82. The share of Net Investment in GDP fell from 33% in 1970-74 to 15% in 1983. Savings, including government savings, fell from 42% in 1970-74 to 14% in 1983. Exports, as a proportion of GDP, fell from 48% in 1970-74 to 33% in 1980-82. Imports rose from 39% to 42% over the same period.

The increasing proportion of the service industry in Zambia's GDP, and the declining ratios of investment, savings and exports imply a deteriorating economic situation. This is shown in Table 4.3. Real incomes increased rapidly at first. In per capita terms they have declined since 1970. There are various reasons for the rapid increase in incomes in the 1960s (see Seidman, 1973; Elliott, 1971; Jolly and Williams, 1972; Harvey, 1971; Bostock and Harvey, 1972,; Harvey, 1977). First, Zambia enjoyed high copper prices and a favourable balance of payments during this period. Government development expenditures were able to increase rapidly without running into balance of payments constraints, and as a result of high revenues stemming from large mining company profits, arising from high copper prices. Second, the Zambian Government acquired, at independence, the mineral royalties that had previously accrued to the British South Africa Company, and which had largely flowed out of the country. These also helped to finance the rapid rise in government expenditures. Third, the new government inherited the tax revenues that had previously accrued to the Federal Government, based in Southern Rhodesia, not all of which had been ~~spent in~~ Northern Rhodesia. It was also able to tax imports from Southern Rhodesia.[18] Fourth, the Unilateral Declaration of Independence (UDI) by Southern Rhodesia in 1965 resulted in the United Nations approving economic sanctions against that country. This factor, combined with the tariffs on Southern Rhodesian goods made possible by Independence, stimulated the large increase in the manufacturing industry in Zambia. The proportion of manufacturing industry to GDP nearly doubled over this period. Fifth, large wage increases were granted over this period as a matter of government policy. These

[18] Faber (1971) estimates an increase in government revenues from the cessation of interterritorial transfers, recovery of mineral rights, and increases in copper prices, of around K (Kwacha)170 million over the 3 years after Independence. This compares to total government (Federal ~~and~~ Territorial) expenditures of K60 million in 1963.

helped to fuel a large increase in consumption.

Table 4.1

Structure of Production
(% of current GDP, period averages)

	65-69	70-74	75-79	80-82	83
Agriculture	9	12	15	14	14
Mining	36	30	15	14	15
Other Industries	18	21	25	24	23
Services	37	37	45	48	48
GDP	100	100	100	100	100

Table 4.2

Expenditure
(as % of current GDP, period averages)

	65-69	70-74	75-79	80-82	83
Income	100	100	100	100	100
Imports	43	39	42	42	31
Exports	59	48	40	33	30
Consumption	57	58	77	90	86
Gross Investment	27	33	25	20	15
(Net Investment)	(21)	(17)	(10)	(6)	(3)
Savings	30	42	23	10	14

Source: World Bank (1984), and Monthly Digest of Statistics, (MDS) Zambian Government.

Table 4.3

Real Income
(K millions, 1975=100)

	GDP	%ch	GDP pc	%ch	Income	%ch	Income pc	%ch	TOT	%ch	Pop. Mill.
65	967	18	261		888		240		208		3.7
66	1097	13	289	11	1213	37	319	33	265	27	3.8
67	1237	13	317	10	1217	0	312	-2	200	-25	3.9
68	1329	7	328	4	1348	11	333	7	209	5	4.05
69	1577	19	383	17	1790	33	434	30	268	28	4.12
70	1397	-11	329	-14	1538	-14	362	-17	241	-10	4.25
71	1398	0	318	-3	1344	-13	306	-15	166	-32	4.39
72	1535	10	339	7	1442	7	318	4	154	-7	4.53
73	1520	-1	325	-4	1714	19	366	15	203	32	4.68
74	1623	7	336	3	1846	8	382	4	197	-2	4.83
75	1583	-3	318	-5	1381	-25	277	-27	100	-51	4.98
76	1652	4	321	1	1516	10	295	7	108	8	5.14
77	1568	-5	296	-8	1399	-8	264	-10	101	-6	5.3
78	1628	4	298	1	1397	0	255	-4	87	-14	5.47
79	1503	-8	266	-11	1398	0	247	-3	97	11	5.65
80	1556	4	267	0	1269	-9	218	-11	67	-31	5.83
81	1628	5	279	5	1276	1	219	0	57	-15	5.83
82	1595	-2	265	-5	1191	-7	198	-10	49	-14	6.03
83	1623	2	260	-2	1356	14	217	10	65	33	6.24

<u>Source</u>: International Financial Statistics, (IFS), MDS, and Bank of Zambia (BOZ) Reports.

<u>Notes</u>: a) Income = Real GDP adjusted for changes in the terms of trade. The methodology for doing this is discussed in Chapter 5.2;
b) pc = per capita, in Kwacha;
c) TOT = Terms of Trade.
d) Pop.= population in millions.

There was a sharp fall in real income in 1970, partly because of a fall in the terms of trade and partly because of a mining disaster which reduced production. Real income also fell in 1971 because of a fall in copper prices. Increases in copper prices underlay the increase in incomes in 1973 and 1974. Copper prices plunged in 1975, while import prices were rising faster in response to the OPEC price-hike of 1974. The 50% fall in the terms of trade underlay the 25% fall in per capita incomes that year.

Since 1975 real incomes have been stagnant, and have fallen in per capita terms. There was a significant rise in the terms of trade in 1979. However, this was offset by a large fall in mining production. Mining production suffered, during this period, from a number of factors, including shortage of skilled personnel, transportation difficulties (in part, related to the civil war in Rhodesia), shortage of inputs arising from a scarcity of foreign exchange, and, lastly, declining ore grades. Another negative influence on real GDP was the weather, which affected agricultural production. Rainfall was excessive from 1977 to 1978, and deficient in most of the following years. The manufacturing and construction industries were adversely affected by a shortage of imported inputs arising from the balance of payments constraint that prevailed during these years. Lastly, as seen in Table 4.2, economic growth was retarded by the diminishing proportion of GDP going to investment, a function of the pressure on the government budget, the balance of payments constraint, and the curtailed availability of credit to the non-government sector in many years.

In general, the declining terms of trade after the 1960s meant that the full employment of the 1960s could not be sustained without a decline in the import -intensiveness of industry and final demand, and the development of other export opportunities. This called for government policies to increase domestic supply which did not materialize, or were slow to materialize.[19][20]

4.3 Balance of Payments

Table 4.4 shows the balance of payments for Zambia over its history. In brief, net foreign assets of the commercial banks are treated as a below-the-line financing item, as, in

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[19]Government controls on prices were in effect over much of this period, with controls being intensified in 1971. This meant that prices have only adjusted slowly in response to market pressures. Most price controls were lifted at the end of 1982. The government has been reluctant to use the exchange rate as an instrument of policy. While the Kwacha depreciated against the SDR by 23% between the beginning of 1975 and the end of 1982, and by 31% against the dollar, the terms of trade depreciated by 112% over the same period. A more active exchange rate policy was not developed until 1983 (see Section 4.5 below). The government has also been reluctant to use interest rates as an instrument of policy. Interest rates rose only very slowly until 1983, when there was a sizeable increase (also see Section 4.5).

[20]The volume of imports in 1983 was only 32% of its level in 1974, whereas real income was 73% of the 1974 level, implying a large fall in the propensity to import. World Bank (1984) attributes the reason for real income not falling further than it has to: a)import controls, which have eliminated the import of 'non-essentials'; b)a degree of substitution of domestic goods for foreign goods, partly in reaction to the foreign exchange constraint; c)deference of maintenance of the capital stock, and draw-down of inventories.

principle, the monetary authority can use them as such. The item 'arrears' refers to unpaid bills that began to accumulate after 1974 as a result of the shortage of foreign exchange. They are treated as foreign liabilities of the monetary authority, although, in the accounting sense, they are unclassified non-monetary liabilities of the commercial banks. IMF credit is treated as a foreign liability of the monetary authority as it is used specifically to finance above the line items.

The trade balance was high from 1965 to 1969, averaging 23% of GDP. The reason for the large jump in 1969 was a large increase in copper sales from a stockpile that had developed in earlier years as a result of transportation difficulties associated with UDI. After 1969 the trade balance became much worse as a proportion of GDP. The trade balance was particularly bad in 1975, because of sharply reduced copper prices, transportation difficulties resulting from the civil war in Angola, a very large issue of import licenses in 1974, that did not become effective until 1975, and a large government deficit financed through the banking system. The trade balance was lower in 1977 and 1978, partly because of low copper prices, and partly because of transportation difficulties associated with the Tanzanian-Zambian railway, which led to copper being stockpiled. The trade balance improved considerably in 1979, mainly as a result of high prices of copper and cobalt (a by-product of copper production). The trade balance was negative in 1981 and 1982, because of low copper prices and a drought in 1982, which necessitated large food imports.

TABLE 4.4

BALANCE OF PAYMENTS: ZAMBIA

(Kwacha millions)

	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
Exports	446	465	534	853	673	479	543	733	898	516	742	701	667	1117	1151	874	886	1125
Imports	264	319	371	325	360	401	405	349	509	610	432	532	495	596	880	934	938	878
Trade Balance	182	146	163	527	313	78	139	384	389	-93	260	169	172	521	271	-60	-52	247
Net Invsib.	-131	-136	-171	-195	-240	-255	-260	-290	-316	-370	-356	-340	-362	-485	-766	-662	-524	-543
Current Balance	51	10	-8	333	73	-177	-121	93	-73	-463	-94	-171	-190	-36	-495	-722	-576	-296
Capital Balance	-42	-24	14	-205	35	-38	6	-110	100	208	-25	-40	-36	146	201	399	253	-118
Overall Balance	9	-14	6	128	108	-214	-115	-17	33	-255	-119	-217	-226	110	-294	-323	-323	-414
Money Movemnt	-9	14	-6	-128	-108	214	115	17	-33	255	119	217	226	-110	294	323	323	414
BOZ NFA	-8	22	-14	-121	-104	180	100	9	-8	229	133	194	260	-80	187	347	195	579
(Arrears)	-	-	-	-	-	-	-	-	-	102	104	157	119	-149	106	47	173	17
Comm. Bank NFA	2	2	8	-7	-10	15	10	1	-	7	-	15	-13	-58	82	-70	95	-57

Table 4.4 (cont.)

	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
Curr. Realign.	-	-10	-	-	-	13	-	8	-41	16	-14	8	-21	14	10	30	33	-108
SDR Alloc.	-	-	-	-	6	6	5	-	9	3	-	-	-	15	15	16	-	-

Source: BOZ Annual Reports, IMF Balance of Payments Statistics, IFS;
Note: Currency realignments and SDR allocations could alternatively be placed 'above the line'. The large item for currency realignment in 1983 reflects the lrrge depreciation in that year.

Net invisibles have increased slightly as a proportion of GDP, despite attempts by government, through exchange control measures, to control the outflow of items such as profits, dividends and remittances.[21] However, the build-up of external debt in the late 70s led to larger increases in interest payments abroad.[22] The drought of 1980 and 1982-83 also led to large outlays on transportation for food imports.

The capital account was generally negative over the first 5 years, reflecting, in part, repatriation of equity by non-Zambians. The surplus in 1972 partially reflects measures (described in section 4.2 below) to induce businesses to obtain trade credit from overseas rather than domestically, and thereby offset to some extent the current account deficit of that year. There was a sizeable inflow in 1974 as a result of government borrowing, and a change in the method of export financing. This more than offset the capital outflow induced by a policy measure encouraging the use of local credit to finance imports, rather

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[21] For example, a series of measures known as the Mulungushi reforms were taken from 1968 to 1970 to control outflows by expatriates and expatriate-dominated companies. The measures included nationalization of several large companies, including the mining companies. Further measures were taken in 1971 and 1974. In 1974, the consulting contract with the minority shareholders of the mining companies was cancelled. Restrictions were intensified after 1975. Trade and exchange restrictions are documented in the IMF's Annual Report on Trade and Exchange Restrictions.

[22] The debt service burden reached the point by 1982, that Zambia was forced to request a rescheduling of her debts.

than foreign credit. There was a sizeable inflow in 1975, mainly because the government asked the mining companies to borrow $230 million from overseas for balance of payments reasons (see PR, 1979). There were large inflows in 1980, 1981 and 1982, reflecting heavy borrowing by government.

The balance of payments deficits of 1971 and 1972 were financed directly out of foreign exchange reserves. This was no longer possible after 1975, as reserves were insufficient. The deficits were financed by a mixture of IMF credits, accumulation of arrears, and, in 1982 and 1983, by borrowing from foreign banks. Zambia used IMF credit to a small degree between 1975 and 1976. A Standby agreement from 1978-1980 provided some SDR 210 million. An Extended Facility agreement in 1981 provided a further SDR 320 million. This was scrapped after one year, and replaced by a new program in 1983, that provided SDR 60 million that year.

4.4 Money and Credit

Table 4.5 shows the balance sheet of BOZ. There was a rapid decline in net foreign assets after 1970, with the exception of 1973, 1974 and 1979. Conversely, domestic credit (both including and excluding 'other items net') rose rapidly in 1971 and 1972, and from 1975 onwards, with the exception of a decline in 1979. Most of the credit went to the government. A major factor underlying this trend was the declining terms of trade which eroded the profitability of the mining sector, and considerably reduced the revenues of the government. Since 1975 the mining companies have contributed very little to government revenues. Before 1975 they contributed between 15 and 60%. Government expenditures, however, continued to increase after 1975, particularly expenditures on food subsidies[23], debt service payments, and defence expenditures[24]. The budget deficits that resulted were largely financed through the banking system. Some of the credit also went to the mining companies as they were producing below cost in some years. Credit to these companies rose substantially in 1977 and 1982.

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[23]These were intended to protect consumers from rising food prices, partly the result of increasing world prices of food and imported inputs used for domestic food production, and partly the result of the inflationary pressures created by rapidly increasing credit to government.

[24]- related to the civil war in Rhodesia.

TABLE 4.5

BALANCE SHEET OF BANK OF ZAMBIA

(Kwacha millions)

	NFA	ch NFA	NDC Gov	NDC Pri	Tot NDC	ch NDC	OIN	OIN +NDC	ch	Cur	Res	Base	ch Base
66	150	7	-103	-	-103	2	-6	-109	2	28	14	42	11
67	129	-21	-73	4	-69	34	-8	-77	32	35	17	52	10
68	142	13	-71	-	-71	-2	-8	-79	-2	40	23	63	11
69	269	121	-163	2	-161	-90	-29	-190	-111	41	32	73	10
70	367	104	-204	2	-202	-48	-95	-297	-114	43	28	71	-2
71	187	-180	-5	2	-3	199	-95	-98	199	58	41	89	18
72	89	-98	79	-	79	82	-61	18	116	61	45	106	17
73	80	-9	111	1	112	33	-69	43	25	69	54	123	17
74	87	7	67	1	68	-44	-27	41	-2	80	48	128	5
75	-142	-229	311	48	359	291	-42	317	276	102	73	175	47
76	-275	-133	542	53	595	279	-111	484	167	121	86	208	33
77	-469	-194	673	124	797	202	-104	693	209	118	104	222	14
78	-729	-260	986	115	1101	304	-136	965	272	131	104	235	13
79	-648	81	937	81	1018	-83	-121	897	-68	126	123	249	14
80	-836	-188	1180	62	1242	224	-129	1113	216	151	126	278	29
81	-1183	-347	1393	62	1455	213	60	1515	402	190	142	332	54
82	-1377	-194	1655	161	1816	361	-60	1756	241	210	170	380	48
83	-1956	-579	2007	166	2173	357	215	2388	632	238	194	432	52

Source: IFS and 802 Reports;

Notes - NFA includes valuation changes, SDRs and arrears for all years, 1975-83, lines 11 and 16c, IFS. The figures above differ from IFS for 1975-77, when arrears were treated as part of the balance sheet of the commercial banks.

- NDC (net domestic credit) includes asset counterpart of arrears for 1975-83, in the form of Treasury bills, lines 12a, 12d, 16d, IFS. The figures differ from IFS for 1975-77, for the same reasons as above;
- OIN is other items net, or 'other assets' less 'other liabilities', line 17r, IFS;
- Base equals Cur (publicly held currency) and Res (commercial bank reserves), lines 14, 14a, IFS.

The government could have avoided borrowing from the central bank by considerably reducing expenditures and undertaking supply-side measures which would eventually increase revenues. However, the initial effects would have been a large decline in incomes. This presumably was politically unacceptable, although it would have relieved pressure on the balance of payments.[25]

This has not always been the case. In the early years the government seemed more concerned about maintaining balance of payments equilibrium then the levels of income. The authorities were concerned about the small balance of payments deficit in 1967, which they attributed to rapidly rising government and private sector demand. They initiated both a credit squeeze in

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[25]An IMF package includes demand-reducing and (particularly in the case of an Extended Facility) supply-increasing measures. As the package includes foreign exchange assistance to tide the country over the period of adjustment, the drop in incomes is not as great, and is more temporary, than if the country restored balance of payments equilibrium without any such financial assistance, and without taking any supply-side measures. Zambia has found it hard to accept even the milder deflationary packages offered by IMF programs. An explosion in government expenditures followed the 1978-80 Standby Agreement. The government broke the terms of the 1981-84 Extended Facility Agreement within a year. The IMF suspended financing of the 1983 Standby Agreement in January, 1985. The IMF has been criticized (see Killick, 1981 and 1983) for placing too much emphasis on demand-reducing measures and not enough on supply-increasing measures. This criticism could be levied at the 1978-80 program, where the performance criteria were mainly restricted to credit ceilings. A recent Washington Post Article (in Guardian Weekly, October 6th, 1985) quotes IMF officials as admitting they might have made a mistake - not including enough supply-increasing measures in the performance criteria, and perhaps being too lenient with the demand-reducing measures.

1968-69, and a fiscal cutback in 1969. Indeed these measures were probably unnecessarily conservative, as the liquidity-draining effects of the 1967 balance of payments deficit were reducing the rate of inflation and improving the balance of payments without any need for government action. For example, the banks were short of liquidity in 1968 even before the credit squeeze (for comments on this, see, for example, Harvey, 1977).

Another example arises from the enforced repatriation from 1969 to 1971 of the profits and foreign exchange proceeds of the mining companies. To prevent these from unduly expanding liquidity in the economy the BOZ ordered much of the proceeds to be kept on special deposit at the Bank of Zambia (this explains the large rise in 'Other Items Net' in Table 4.5).[26]

In 1972, both the government budget and the balance of payments were under pressure. Although the government considered it could not reduce its own demand it felt obliged to enact a severe credit squeeze on the private sector, and to force the private sector to seek more foreign financing for its imports. (see BOZ Annual Report, 1972). In 1973, special deposits were called again from the mining companies to prevent a large

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[26] As it happened the mining companies were reluctant to spend the money anyway because of uncertainty over impending nationalization. Instead, they invested heavily in Treasury Bills and built up their time deposits in the banks (as shown in Table 4.6).

liquidity build-up associated with high copper prices

The growth of base money prior to 1970 was derived from the growth of foreign assets which exceeded the decline in domestic credit. The growth in base money in 1971 and 1972 derived from the growth in domestic credit, which exceeded the decline in foreign assets. After 1974, the growth in base money was, with the exception of 1979, entirely derived from the growth in domestic credit, which exceeded the decline in net foreign assets.

Table 4.6 shows the balance sheet of the commercial banks. Net foreign assets are only a small proportion of net foreign assets held by BOZ. Most of the foreign assets received by the banks are surrendered to BOZ, with the banks retaining enough for day-to-day operations.

Credit to government expanded significantly in 1968 and 1969. This reflected a desire by the banks to increase their liquidity, which had declined significantly in previous years as a result of rapid economic growth - as evidenced by the rapid increase in credit to the private sector. Credit to government also expanded rapidly in 1972 as a result of the latter's budgetary requirements. As mentioned earlier the BOZ initiated a credit squeeze on the private sector. [27]

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[27] Lending by the banks, rather than by BOZ, to government was BOZ policy, as bank lending has less of an expansionary impact on the money supply. Lending by banks to government causes money supply to increase to the extent of excess reserves. Lending to government by BOZ causes bank reserves to increase by an equal

Private sector credit, grew rapidly in 1970 and 1971. Causes included a large budget deficit in 1971, which contributed to liquidity, the policy of Zambianization which was inducing the establishment of local firms, the increased stringency of price controls which reduced profit margins, a good agricultural harvest, and the initiation of a mining investment program (see BOZ, 1971).

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[27](cont'd) amount, and sets off a multiple expansion in the money supply, the size of which depends on the size of the money multiplier. However, the banks still have the capability to initiate a multiple increase in the money supply, as they can sell their Treasury bills at BOZ. BOZ could lessen this danger by inducing a credit squeeze. As PR (1979) point out the banks were reluctant to lend to government during this period because of the pegged interest rate on Treasury bills (see Table 4.8 below).

TABLE 4.6

BALANCE SHEET OF COMMERCIAL BANKS
(Kwacha Millions)

	NFA	ch NFA	NDC Gov	NDC Pri	Tot NDC	ch NDC	OIN	OIN +NDC	ch	Res	Dem	Ts	Tot	ch
66	8	2	16	67	84	25	12	96	28	14	77	40	117	28
67	6	-2	4	93	97	13	15	112	16	16	87	48	135	18
68	-2	-9	33	92	125	28	34	159	57	22	120	58	178	43
69	5	8	44	112	156	31	29	185	26	31	141	80	221	43
70	15	10	34	141	174	18	30	204	19	28	143	104	247	26
71	-	-15	24	181	205	31	21	226	24	34	140	120	260	13
72	-11	-11	69	165	235	30	12	247	21	45	140	140	280	20
73	-12	-1	88	177	265	30	16	281	44	57	174	152	326	46
74	-12	-	11	337	348	83	-32	316	35	57	186	175	361	35
75	-19	-7	4	347	350	2	-6	344	28	58	220	163	383	22
76	-19	-	63	348	411	61	-	411	67	87	256	223	479	96
77	-34	-15	150	348	498	87	10	508	97	100	268	308	574	95
78	-21	14	119	312	431	-67	-10	421	-87	103	261	243	504	-70
79	38	58	252	405	657	226	-213	444	3	222	387	316	713	199
80	-45	-82	243	447	689	32	-27	662	218	128	358	388	746	43
81	26	89	103	711	814	125	-192	622	-40	139	371	415	786	40
82	-71	-95	327	760	1087	273	-84	1003	381	160	473	620	1093	307
83	-13	57	280	887	1167	80	-142	1025	22	196	548	659	1207	114

Source: IFS, BOZ Annual Reports.

Notes:
- NFA is lines 21 and 26c in IFS;
- NDC (net domestic credit) to government is lines 22a and 26d in IFS, except for the years 1975-77. The counterpart to payments arrears was subtracted from line 22a and added to BOZ credit to government for those years;
- OIN is 'other items net', or 'other assets less 'other liabilities'. It is row 27r in IFS, with the exception of 1975-77, for which import deposits representing arrears were subtracted and added to foreign liabilities of BOZ;
- Total deposits are the sum of demand deposits (dem dep) and time and savings deposits, (TS dep) and are taken from rows 24 and 25 of IFS

Private sector credit declined in 1972 as a result of the credit squeeze. The large increase in bank reserves in 1972 reflects one item of the squeeze - the raising of legal reserve ratios on deposits.[28]

Credit to government decreased significantly in 1974, reflecting the large increase in government revenues that year as a result of high copper prices.[29] Credit to the private sector expanded very rapidly in 1974. A major reason was a BOZ directive that imports should be financed locally at interest rates lower than abroad (see BOZ, 1974). Also high copper prices meant that foreign exchange was in relative abundance, with the result that import restrictions were eased. Another reason was that importers needed substantial bridging finance, mainly because of a requirement to pay for goods upon shipment (to avoid high overseas interest rates) which could be many months before arrival.

More stringent import and exchange restrictions after 1974 led to a downturn in economic activity. This factor, plus the

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[28] See Section 6.2 for a description of the monetary measures taken in 1972.

[29] Another reason for the large increase in government revenues was a change in the mining company tax structure made possible by the redemption, in 1973, of bonds issued to mining company minority shareholders issued at the time of nationalization in 1969. A withholding tax on dividends and interest was introduced, the 100% depreciation allowance on new investments in the year of investment was abolished, and majority shareholding dividends were able to accrue direct to government (see BOZ, 1974).

demands for finance by government, plus a BOZ-initiated credit squeeze in 1976 caused credit to the private sector to grow very slowly after 1974, while credit to government increased rapidly in 1976 and 1977. Credit to government decreased in 1978, reflecting an IMF Standby program, which imposed ceilings on credit extension to government. Credit to the private sector also decreased as a result of the credit ceilings, the increases in lending rates under the IMF program and the low level of economic activity.

Bank lending increased significantly in 1979 to both government and the private sector. The government was having difficulty in keeping its budget under control, but was restricted from borrowing direct from BOZ by the IMF program. Much higher copper prices, along with the kwacha devaluation in 1978, (part of the IMF program) enabled the mining companies to pay back some of their loans from BOZ. Under the terms of the IMF agreement, this increased the amount of credit available to other sectors of the economy. The repayment of some arrears made it possible to reopen some lines of credit for imports. Import allocations increased, which increased the demand for credit. The increase in net foreign assets that year provided the liquidity for expanding private sector credit.

There was a large decrease in credit to the government in 1981 and a large increase in credit to the private sector. The decrease in credit to government that year was partly a result of the IMF Extended Facility program that was initiated in 1981, which placed a ceiling on overall credit expansion and a sub-ceiling on credit to government. However, another reason was the big increase in private sector credit demand, which caused the banks to liquidate some of their holdings of Treasury bills in order to provide the resources for satisfying credit demand. The demand for credit had two sources. First, the mining sector was experiencing financial difficulties as a result of increasing costs and falling metal prices. Second, the agricultural sector experienced a bumper harvest, a result of favourable weather and large increases in producer prices and the provision of other incentives. This led to the extension of large overdrafts to the handling and distribution agencies to facilitate the rapid movement of crops to storage depots. The large increase in credit caused the credit ceiling to be broken and led to the suspension of the IMF program.

Government financing requirements led to a large increase in credit to the government in 1982, while credit to the private sector only increased marginally. In 1983 credit to the government decreased as a result of another IMF program which placed ceilings on credit to government. Private sector credit expanded significantly towards the end of the year, mainly as a result of demand by the agricultural sector, for the same reasons as in 1981.

The increase in bank credit over the years was reflected on the liabilities side by an increase in deposits. Time and savings deposits have tended to increase at a faster rate than demand deposits. One reason may be the rise in interest rates over time (see Table 4.8 below). Another reason is that import and exchange restrictions combined with rapid credit expansion have created excess liquidity in many years. People have tended to keep their money in interest earning deposits while awaiting foreign exchange allocations. In 1978 both classes of deposits fell, in response to the IMF-initiated liquidity squeeze of that year. However, time and savings deposits fell further as people divested themselves of the money balances they had built up in previous years when liquidity was high. In 1979 liquidity was more plentiful. It was easier to obtain credit for imports, and consequently easier to dispose of liquidity. The result was that time and savings deposits did not rise as fast as demand deposits.[30]

Table 4.7 shows the behaviour of total assets and liabilities of the banking system. The pattern is clear. Total net foreign assets have declined over time. Domestic credit has increased in most years. Most of the increase has been to government. In 1974 credit to the private sector was four times

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[30] The rapid build-up of time and savings deposits in 1968-70 was explained above by the repatriation of mining company foreign exchange proceeds.

the size of credit to government. By 1983 credit to government was over twice that to the private sector. As domestic assets have increased faster than foreign assets have declined money supply has increased. It rose rapidly in the 1960s, reflecting growth in those years. Since 1975 money supply has risen rapidly in most years, although economic activity has not increased. For reasons given above, the broad definition of money, M2, has increased faster than M1 in many years. Money supply decreased in 1978 in response to the IMF program, but increased by 30% in 1979.

TABLE 4.7

MONEY AND CREDIT: ZAMBIA

	NFA	ch NFA	NDC Gov	NDC Pri	Tot NDC	ch NDC	OIN	OIN +NDC	ch	M1	QM	M2	ch
66	158	9	-87	68	-19	27	7	-12	29	105	40	145	37
67	135	-23	-69	97	28	47	7	35	47	122	48	170	25
68	140	5	-39	93	54	26	25	79	44	161	58	219	49
69	268	128	-121	114	-6	-60	20	14	-65	181	100	281	62
70	382	114	-170	143	-27	-21	1	-26	-40	186	170	356	75
71	188	-194	18	183	201	228	-70	131	157	199	120	319	-37
72	78	-110	148	165	313	112	-50	263	132	201	140	341	22
73	68	-10	200	177	377	64	-34	343	80	243	168	411	70
74	75	7	79	337	416	39	-51	365	22	266	175	441	30
75	-161	-236	315	395	710	294	-54	656	291	322	172	494	53
76	-294	-133	605	401	1006	294	-87	919	263	377	247	624	130
77	-503	-209	823	472	1295	289	-92	1203	284	387	312	699	75
78	-749	-246	1105	426	1531	236	-142	1389	188	392	248	640	-59
79	-610	139	1189	486	1674	143	-232	1442	53	513	319	832	192
80	-880	-270	1423	509	1932	258	-145	1787	345	509	398	907	75
81	-1156	-276	1495	773	2268	336	-132	2135	348	561	417	978	71
82	-1447	-291	1983	920	2903	635	-147	2756	621	682	627	1309	331
83	-1969	-522	2287	1052	3339	436	84	3423	667	787	668	1455	146

Source: IFS, BOZ Reports and Tables 4.5 & 4.6 above.

Notes: - the notes in Tables 4.5 & 4.6 above regarding NFA, NDC and OIN are also applicable here. The relevant rows in IFS are 31n, 32 and 37r;

- M1 refers to publicly held currency and demand deposits. It is row 34 in IFS. QM refers to Quasi-money. This is defined as time and savings deposits plus some public deposits in BOZ of insignificant magnitude. It is row 35 in IFS. M2 is M1 plus QM.

4.8 Prices, Interest Rates, and the Exchange Rate

Prices

Table 4.8 shows the behaviour of prices, interest rates and the exchange rate over Zambia's history.

Prices rose at an average rate of nearly 9% a year between 1966 and 1968. The full employment situation caused by rapid economic growth, cost-push pressures arising from policy-initiated large wage increases, transportation difficulties associated with UDI, the need to find different and more distant sources of imports because of UDI, and the plentiful liquidity during that period were all factors putting pressure on the price level. The credit squeeze and fiscal cutback of 1968 and 1969 helped to moderate the rate of increase in prices. The rate of increase started to rise again in 1973 and 1974 as a result of large increases in the money supply (20% in 1973, and 10% in 1974), and the OPEC oil price increases of 1973-74.

After 1974 the rate of price increase accelerated in response to excess liquidity, import and exchange restrictions, rising world prices, a 20% devaluation of the kwacha in 1976, the loading of import prices by foreign suppliers in response to payments arrears, and difficulties with transportation routes. The rate of inflation reached 20% in 1977. The liquidity squeeze of 1978 and the lower rate of monetary expansion in 1977 caused the rate of price increase to moderate in 1978 and 1979. Prices still increased because of factors such as the 10% devaluation of the Kwacha in 1978, increased agricultural producer prices, and the partial reduction in consumer subsidies in 1978.

The rate started to accelerate again after 1979. This reflected a number of factors - first, the large money supply increases in that year and thereafter, which could not be leaked out of the economy because of import and exchange restrictions; second, the OPEC oil price hike of 1979; third, rising world prices; fourth, loading of import prices by foreign suppliers in response to rising levels of arrears; fifth, policy-sanctioned increases in agricultural producer prices; sixth, a decline in the value of the kwacha against the dollar; seventh, the devaluation and subsequent depreciation of the kwacha in 1983; eighth, the abolition of price controls at the end of 1982.

The existence of price controls and excess liquidity over much of the period means that the price figures stated in Table 4.8 may not be the true price figures. Shortages of goods and long queues have been common in Zambia, implying that there may have been black markets where prices charged were much higher than the official figures. The Bank of Zambia makes reference to these markets (see BOZ, 1983). Official prices were increased periodically in response to the liquidity pressures experienced by companies and pressures on the government budget caused by increasing subsidies. Therefore official prices probably do reflect actual prices but with a lag.

Exchange Rate

The kwacha was pegged to the pound until 1971. In December, 1971 the kwacha was pegged to the dollar implying an 8% devaluation against gold. This at first implied an effective depreciation of 9% against the pound. As the settlement price of Zambian copper depends largely on the London Metal Exchange (LME) price, this implied a rise in kwacha receipts per pound. However, the pound was floated in August, 1972, and depreciated against the kwacha. Although sterling prices were rising, this was not enough to offset the effects of sterling depreciation so that kwacha prices fell. The dollar was devalued by 10% in 1973. However, the kwacha maintained its gold content and therefore appreciated against the dollar peg. However, its value against the SDR stayed the same in 1973 and 1974 as other currencies appreciated against the dollar by a larger amount than the kwacha. The effective (import-weighted) exchange rate stayed the same in 1974 (see BOZ 1974). The kwacha appreciated against the SDR by 4% in 1975 in line with the dollar's appreciation against other major currencies. BOZ (1975) notes that the effective exchange rate appreciated 15% in 1975, mainly as a result of the depreciation of the pound and the rand against the dollar (also see Feltenstein et al., IMF Staff Papers, 1979). This was hardly in Zambia's best interests, given the dramatic decline in her terms of trade that year and the large balance of payments deficit she incurred.[31]

On IMF advice the kwacha was pegged to the SDR in July, 1976, and devalued at the same time by 20% against the SDR. This implied a 20% devaluation against the dollar. In 1977 the kwacha appreciated 5% against the dollar as a result of the appreciation of currencies in the SDR basket against the dollar. In March, 1978 the kwacha was devalued against the SDR by 10%, as a prerequisite of the IMF Standby program that commenced at that time. However, the depreciation against the dollar was only 4%, as major currencies appreciated against the dollar in 1978. The average exchange rate against the dollar hardly changed between 1977 and 1980. Given the declining terms of trade, this may have not been in Zambia's best interests.

The kwacha remained pegged to the SDR at the same rate until 1983 when it was devalued by 20% and pegged to another basket of currencies that, according to BOZ (1983), better reflects Zambia's trading patterns.[32] After 1980, however, the kwacha depreciated substantially against the dollar, reflecting the appreciation of the dollar against the other currencies in

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[31] One benefit of having a high effective exchange rate was that the price level was lower than it would have been if the rate had depreciated. King (1979) analyses the use of exchange rate policy in Kenya to stabilize prices.

[32] BOZ (1983) did not give the composition of the new basket. This information does not appear to have been published.

the SDR basket.

In mid-1983 a far more active exchange rate policy was adopted. The kwacha was allowed to float against its new peg. BOZ (1983) notes that the kwacha had depreciated by 40% against most major foreign currencies by the end of 1983. By the end of 1984, the kwacha had depreciated by 53% against the SDR, relative to two years earlier, and by nearly 60% against the dollar.[33]

Interest Rates

Interest rates showed very little change until 1976. Interest rates are not determined by market forces in Zambia. It would not be surprizing if rates charged by unofficial money lenders were much higher. There is some element of market forces in the Treasury bill rate. In 1969 and 1970 the rate declined, reflecting excess liquidity stemming from large balance of payments surpluses, and the repatriation of mining company foreign exchange proceeds. The resultant demand for treasury bills pushed the rate down.

Interest rates showed a significant rise in 1976, reflecting the announced policy of credit restraint, and an

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[33] Zambia initiated an exchange auction system at the beginning of October, 1985, similar to a system used in Uganda a few years ago. The Economist Intelligence Unit (EIU - first quarter, 1985) makes reference to this. The Kwacha immediately fell by about 55% against the dollar.

effort to increase savings. There was another increase in 1978, reflecting the IMF -imposed credit squeeze. However, political resistance towards increased interest rates meant that there was little further increase until 1983. As with exchange rate policy, the authorities decided to pursue a more active interest rate policy that year, as part of the new IMF program.

Interest rates of other financial intermediaries reflected the same pattern, although rates tended to lag behind changes in commercial bank rates.[34]

Interest rates are clearly low, and in real terms (after allowing for inflation) have been negative. Nevertheless people are clearly prepared to hold their savings in banks and other financial institutions. It is safer than holding savings in the

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[34] The other financial institutions in Zambia are in three broad categories: a) Organizations supplying social security benefits out of accrued past contributions - these comprise the Zambia National Provident Fund and the Zambia State Insurance Company;b) Savings and Credit Organizations, consisting of the National Savings and Credit Bank of Zambia, and the Zambia National Building Society. The former makes a special effort to mobilize rural savings; c) Purely credit organizations with funds directly and indirectly supplied by the government. These include the Development Bank of Zambia, and the Agricultural Finance Corporation. The former provides project loans for industrial projects. The latter provides seasonal loans for crop finance, and longer term loans for equipment and land-clearing (see BOZ Annual Reports, passim).

[35]Crime is prevalent in Zambia

form of cash, [35] and at least provides more interest than cash. [36] Real assets might provide a better return, but suffer from problems of lower liquidity, safety, storage, physical depreciation, and the costs of search for suitable assets during times of excess demand and shortages. Real estate would be the obvious asset to hold, but this is not for sale in Zambia - it can only be leased. People also appear to be responsive to changes in interest rates. There is evidence of this from the rapid rise in time and savings deposits after 1975.[37]

The discount rate appears to have little significance in Zambia. It does not seem to be much of a deterrent to banks using BOZ as a lender of last resort as the loan rates have been above the discount rate. This may be immaterial as BOZ can simply refuse to lend the banks the money.[38]

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[36] BOZ (Annual Reports, passim) mentions the success that the National Credit and Savings Bank appears to have each year in mobilizing savings.

[37] Although, as mentioned above, excess liquidity in the economy may also be an explanatory factor.

[38] Lending by BOZ to the banks has not been common. BOZ lent K54 million in 1974 in response to the decline in liquidity experienced by the banks caused by the large amount of private sector credit that year. In 1981 BOZ loaned K68 million to the banks in response to high credit demand.

Table 4.8

Prices, Exchange Rate and Interest Rates

	CPI '75= 100	%ch CPI	SDR /K	$ /K	Bank Rate %	Tbill Rate %	Sav. Rate %	Loan Rate %
66	0.58	10	1.4	1.4	4.5	3.8	3.0	6.5
67	0.61	5	1.4	1.4	5.0	4.4	3.5	7.0
68	0.67	11	1.4	1.4	5.0	4.5	3.5	7.0
69	0.69	3	1.4	1.4	5.0	3.3	3.5	7.0
70	0.71	3	1.4	1.4	5.0	3.1	3.5	7.0
71	0.75	6	1.29	1.4	5.0	3.4	3.5	7.0
72	0.79	6	1.29	1.4	5.0	4.0	4.0	7.5
73	0.84	7	1.29	1.55	5.0	3.8	4.0	7.5
74	0.91	8	1.27	1.55	5.0	4.0	4.0	7.5
75	1.0	10	1.33	1.55	5.0	4.0	4.0	7.5
76	1.19	19	1.09	1.26	6.0	4.4	6.0	8.25
77	1.42	20	1.09	1.32	6.0	4.4	6.0	8.25
78	1.66	16	0.98	1.27	6.5	4.5	7.0	9.5
79	1.82	10	0.98	1.29	6.5	4.5	7.0	9.5
80	2.03	12	0.98	1.25	6.5	4.5	7.0	9.5
81	2.31	14	0.98	1.13	7.5	6.0	7.0	9.5
82	2.6	12	0.98	1.08	7.5	6.0	7.0	9.5
83	3.11	20	0.78	0.66	10.0	7.0	8.0	13.0
84	3.73	20	0.46	0.45	14.5			

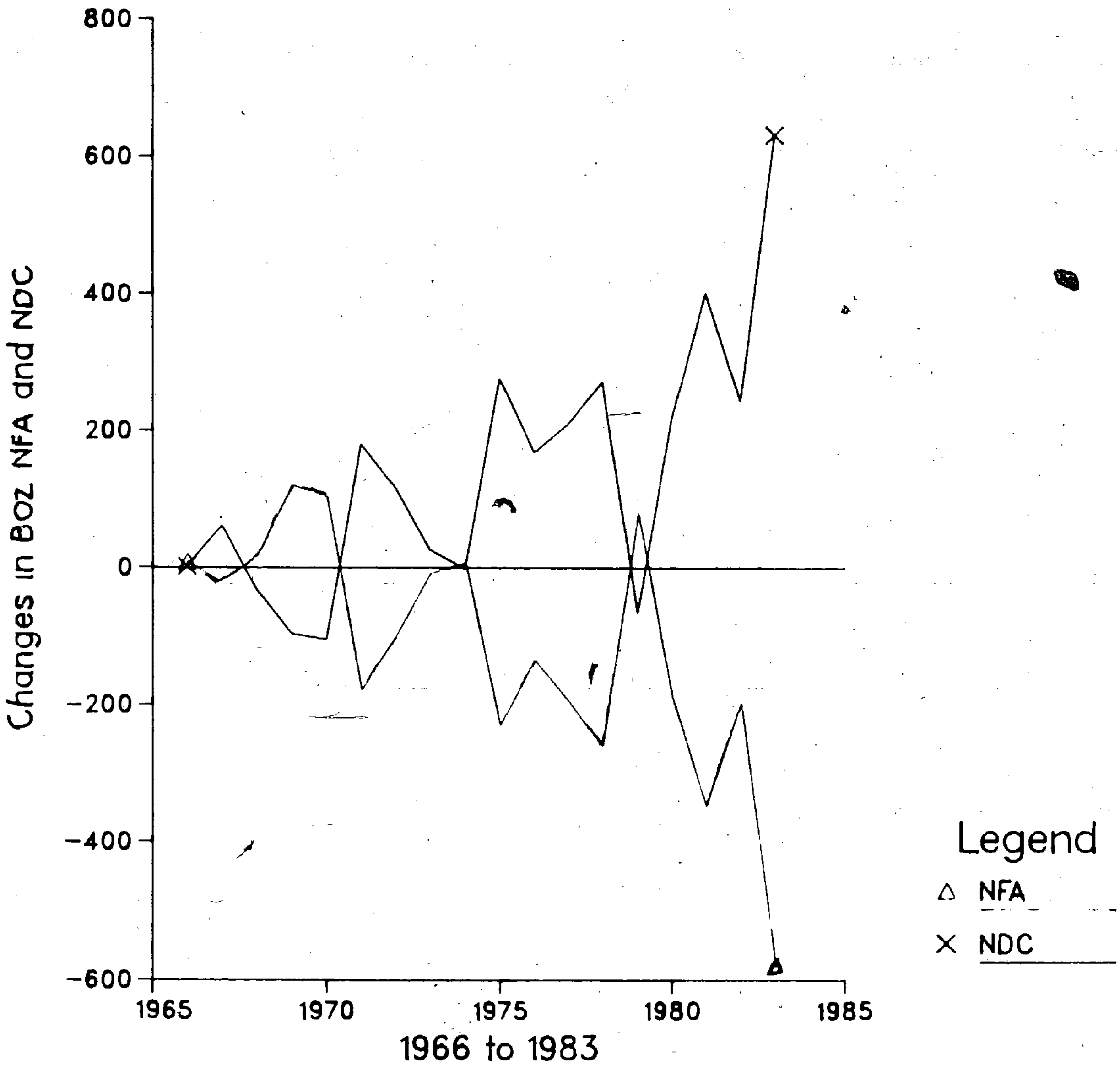
Source: BOZ Annual Reports, IFS, MDS;
Note: - Exchange Rates are end of period

4.6 Summary and Conclusions

In this chapter, the behaviour of real income, the balance of payments, money and credit, prices, interest rates and the exchange rate were outlined. The picture hopefully will provide a clue as to the forces affecting the demand for real balances. The behaviour of the economy at first sight seems quite complex with various different variables reacting to each other. Zambia appears to have incurred numerous shocks, in the form of government and monetary authority actions (monetized budget deficits, credit squeezes and various other monetary measures, import and exchange restrictions, nationalization measures, price control measures, devaluation, and Zambianization for example), and in the form of external shocks (UDI, transportation problems, OPEC oil price hikes, fluctuating copper prices, drought, the Angolan civil war, and the Zimbabwean war).

At first glance it might be surprizing if, despite all these events, one could still derive a stable money demand function with only a few key explanatory variables. However, Table 4.5 above suggests a strong relationship between the net foreign assets and the net domestic assets of the monetary authority. This would suggest that money market disequilibrium created by a change in domestic credit is corrected by changes in expenditures which induce monetary flows into or out of the country. This suggests a stable money demand function. This relationship can be seen very clearly in Figure 4.1. There is clearly a potential for empirically identifying a 'good' money demand function.

FIG 4.1
CHANGES IN BANK OF ZAMBIA NET FOREIGN ASSETS AND NET DOMESTIC CREDIT



As a summary I will attempt to provide a plausible explanation for the behaviour of real per capita balances in terms of the various events in the Zambian economy. Such an explanation may help to identify a money demand function. Per capita real balances are depicted in Table 4.9 and Figure 4.2. I am assuming that the demand for nominal balances responds proportionally to changes in the price level, so that the demand for real balances is unaffected by the price level. The realism of this assumption can be assessed later.

Real per capita balances grew steadily from 1965 to 1968. Table 4.1 suggests that rising per capita incomes are a reason for this. Per capita real M2 balances continued to grow in 1970 despite a fall in income,. This is probably due to monetary policy-induced repatriation of mining company foreign exchange proceeds, and the uncertainty over nationalization. At first sight it would seem difficult to model this in demand terms. However, M1 balances declined until 1972, which appears to track the decline in per capita incomes, except for 1972, when per capita income rose. The 1972 credit squeeze may be a factor here, and this might be difficult to model in a money demand function. Movements in M1 and M2 money balances then run parallel until 1975. The correspondence with per capita incomes is not close. Incomes rose in 1974, but per capita money balances fell. The liquidity shortage that year may be a factor, perhaps reflected by rising inflation as credit grew rapidly.

1975 was a crisis year - the Angolan war and associated transportation difficulties, and the collapse in copper prices. Per capita M1 balances rose while incomes fell. Inflation may have been a factor, but the large increase in liquidity was probably also relevant. The fall in per capita M2 balances may be partly due to rising inflation while interest rates stayed constant. However, the uncertainty associated with intensified exchange controls may have been a factor, which would be difficult to model. Per capita M1 balances fell in 1976, reflecting perhaps rising inflation and higher interest rates. Higher interest rates may explain the rise in per capita M2 balances, although import controls and high liquidity may be a factor, which may be difficult to model.

Per capita M1 and M2 balances then fell every year except 1979 and 1982. Falling per capita incomes may be one explanation, as well as rising interest rates and inflation. The years 1978 and 1979 are difficult to explain. The IMF program may be a factor. The large increase in M2 per capita balances in 1982 may reflect the massive increase in credit to government that year.

In summary, the foregoing casual analysis suggests that there may be plausible explanations for changes in real per capita balances each year in terms of a few key variables that reflect a complex of economic events. It appears that it may be easier to do this in terms of M1 balances than M2 balances, as the latter appear to respond directly to various economic shocks than via key economic variables to a greater extent than M1 balances. These surmises will be tested more formally in Chapter 5.

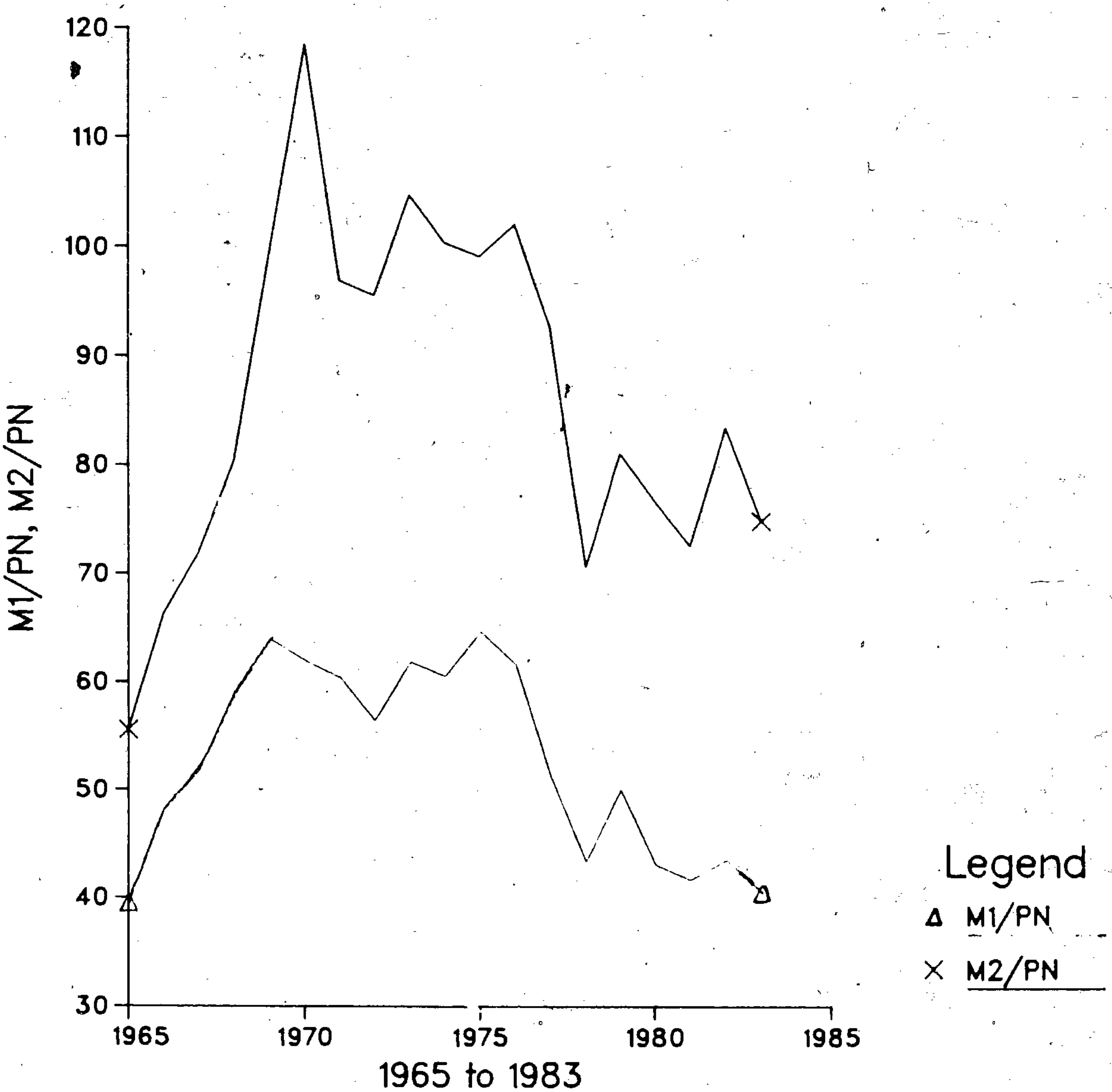
Table 4.9

Real per Capita Money Balances
(Kwacha)

Year	Per Capita Real M1	Per Capita Real M2
65	39.5	55.5
66	48.0	66.3
67	51.7	71.9
68	59.1	80.4
69	64.0	99.4
70	62.0	118.5
71	60.4	96.9
72	56.4	95.6
73	61.9	104.7
74	60.5	100.4
75	64.7	99.1
76	61.7	102.0
77	51.2	92.6
78	43.3	70.6
79	50.0	81.1
80	43.0	76.7
81	41.1	72.6
82	43.2	83.5
83	40.5	74.9

Note: - per capita real M1 is nominal publicly held currency plus demand deposits divided by the CPI times population. The figures are from the tables in this chapter;
- per capita real M2 includes time and savings deposits.

FIG 4.2
REAL PER CAPITA M1 AND M2 BALANCES



CHAPTER 5

MONEY DEMAND IN ZAMBIA

The recurring theme of the monetary approach is that money demand should be a stable and predictable function of a small number of key variables. The purpose of this chapter is to attempt to derive such a function for Zambia.

The last section of Chapter 4 took a preliminary look at the money demand function, based on the information provided earlier in that chapter. The first section of this chapter takes this investigation further by analyzing the performance of the income velocity of circulation. In Section 5.2 a money demand function is derived using the combination of variables that seems to explain money demand the best. The model is tested for different components of money, including base money. This enables us to determine which element of money is most stable. It also enables us to analyze the stability of money multipliers, and hence the stability of the money supply process. The results of this chapter therefore foreshadow Chapter 6.

5.1 The Velocity of Circulation

The Polak model, discussed in Chapter 2 above, assumes a constant velocity of circulation. However, this assumption is not necessary for the monetary approach if it can be shown that velocity is a stable and predictable function of certain variables. Friedman (1969), in his restatement of the Quantity Theory, suggests that money demand, and therefore velocity, is a function of: a) the nominal return on bonds (rb); b) the nominal return on equities(re); c) the expected rate of change in a price index, reflecting changes in the yield of durable goods relative to money ((1/P)dP/dt); d) the ratio of human to non-human wealth, reflecting the relative yield on human capital (w); e) expected income, reflecting total wealth (Y); f) tastes and preferences and any other factors (u). In symbols, assuming homogeneity of degree 1 in prices and nominal incomes:

$$\lambda M = f(\lambda P, rb, re, (1/P)(dP/dt), w, \lambda Y, u)$$

$$= \lambda f(P, rb, re, (1/P)(dP/dt), w, Y, u)$$

Assuming $\lambda = 1/P$

$$M/P = f(r_b, r_e, (1/P)(dP/dt), w, Y/P, u)$$

Assuming $\lambda = 1/Y$

$$M/Y = f(rb, re, (1/P)(dP/dt), w, P/Y, u)$$

$$= 1/v(rb, re, (1/P)(dP/dt), w, Y/P, u)$$

so that

$$Y = v(rb, re, (1/P)(dP/dt), w, Y/P, u) M$$

Because of data problems most studies restrict the explanatory variables to income (or a measure of 'permanent income') and a measure of the opportunity cost of holding money (e.g. Deaver, 1970; Diz, 1970; IMF, 1977; Frenkel and Johnson, 1976).

In Zambia, the velocity of circulation, by any definition, has not been constant, as Table 5.1 below shows.

Table 5.1

Velocity of Circulation

	V1=GDP/M1	V2=GDP/M2
65	9.3	6.6
66	8.1	5.8
67	7.9	5.6
68	6.6	4.6
69	7.2	4.7
70	6.8	3.6
71	5.9	3.7
72	6.7	4.0
73	6.6	3.9
74	7.1	4.3
75	4.9	3.2
76	5.0	3.0
77	5.1	2.8
78	5.7	3.5
79	5.2	3.2
80	5.5	3.3
81	6.1	3.5
82	5.2	2.7
83	5.4	2.9

Source: IFS

Notes - money figures are year-end;
- M1 is publicly held currency plus demand deposits;
- M2 is M1 plus quasi-money.

Velocity fell significantly between 1965 and 1968. Given Friedman and Schwartz' work (1963), and various studies cited by Bordo and Jonung (1981), this is to be expected given the rising per capita incomes during this period and increasing monetization of the economy. Bordo and Jonung (1981 and 1984) suggest, however, that, because increasing incomes and increasing monetization tend to be highly correlated, estimated income elasticities may be biased upwards, if 'monetization' variables are omitted.[39] When they include 'monetization' variables (such as the number of bank offices per capita) in money demand equations the income elasticities fall below unity, which is in accordance with Baumol's (1952) inventory-theoretic view of the transactions demand for money. However, growth in incomes may be overstated, as measured by official statistics. Harvey (1977) suggests that estimates of income in the non-monetized sector tend to be too low. Estimates of income growth may therefore be too high if they partially reflect commercialization of village life, and subsequent recording of income where it was not adequately recorded before. The upwards bias in income elasticity caused by the omission of 'monetization' variables may be offset by a downwards bias caused by the possible overestimation of percentage income growth.

Bordo and Jonung point out that increasing financial sophistication in an economy may counteract the monetization effect after a while. With more banking offices, greater ease in withdrawing cash, increasingly lower chequing charges, and the development of other financial intermediaries, people may start to economize more on their cash holdings. In Zambia, other

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[39]Johnson (1971) and Laidler (1985) point out that Friedman and Schwartz' estimate of an income elasticity of 1.8 is biased upwards, though for different reasons.

financial intermediaries came into existence in the early 1970s (see Section 4.5), which may partly explain the rise in velocity after 1970. Moreover, the rise is larger for V1 than for V2. As Bordo and Jonung (1981) point out, this makes sense, as people will try to economize on non-interest bearing deposits first.

Increases in the rate of inflation can be expected to increase velocity if the inflation is anticipated, and as people try to hold a lower portion of their income in money balances. However, if increases in inflation rates are associated with increases in uncertainty and instability people might want to hold more precautionary balances in liquid form. Increases in interest rates will also induce people to economize on non-interest bearing balances. It might be thought that expected inflation should not be considered separately as it should be reflected in the nominal rate of interest. However, in Zambia, interest rates have been pegged and so have not been adjusted to reflect inflation (or have only been adjusted very slowly). Also, people may substitute interest-bearing money for non-interest bearing money, even if the real rate of interest is negative, and inflation appears to make the holding of real assets a better alternative to holding money. Real assets and financial assets are not perfect substitutes in Zambia, as the latter are much easier to acquire and have much greater liquidity.

As Table 5.1 shows, V1 increased sharply in 1969. This could be a reaction to the sharp increase in inflation in 1968. The rise in V1 in 1974, and the slow increase after 1970, could also be partly due to rising inflation.

However, there is one other explanation of the rise in V1 in 1969 that should be taken into account. There was a sharp rise in income in 1969 (see Table 4.3). This was explained in Chapter 4 by a sharp increase in copper sales, because of stockpiling in previous years, and by a sharp rise in the terms of trade. If the increase in income was perceived as temporary then people would not necessarily adjust their desired money balances upwards. As Friedman and his students discovered (1969), velocity tends to rise during business cycles, even though it may fall secularly. If people adjust desired money balances to wealth, as Friedman posits, rather than current income, then people will spend most of an increase in current income, if it is transitory or unexpected. Velocity rises as a result.

V1 reverted to its 1968 level in 1970. This might suggest an upward revision in permanent income in response to the large 'unexpected' increase in income in 1969, and a corresponding upward revision in desired balances. Real incomes fell sharply in 1970. If this was unexpected then, using Friedman's theory, people would adjust their desired balances downwards by a smaller proportion than the decrease in income, thus providing another reason for V to fall. One reason for the sharp downturn in income in 1970 was the Mufulira mining disaster, which was clearly unexpected. Incomes continued to fall in 1971. This may have been perceived as a cyclical downturn, which may account for the continued decline in V1.

V2 changed little in 1969, but fell sharply in 1970. There was a sharp rise in the ratio of time and savings deposits to demand deposits that year. It is difficult to explain this on the basis of interest rates, as these showed little change. The main reason for this was the repatriation of mining company foreign exchange holdings as a matter of government policy, and the political uncertainty relating to prospective nationalization. Another possible reason is that the commercial banks agreed, in 1971, to compete to a greater extent. There may have been more competition among the banks to attract these deposits, which carry lower legal reserve ratios.

From 1971 to 1974 both V1 and V2 rose, except for 1973 when they were stationary. As real income rose sharply in 1972, the behaviour of V in 1973 could be attributed to a rise in desired real balances in response to a perceived increase in real income, which put downward pressure on V. This was offset, however, by a large rise in real incomes (adjusted for changes in the terms of trade) in 1973, which may have been unexpected, and by increasing inflation rates.[40] The rise in velocity in 1972 can be attributed to the large rise in incomes that year, which may have been 'unexpected' or transitory, and also to the credit squeeze that year. The rise in velocity in 1974 could be attributed to both a rise in transitory income and to rising inflation. The rise in spending, unmatched by an increase in desired money balances, was reflected in the banking system by a decline in liquidity. This was reflected by the decline in the ratio of liquid assets, over and above minimum reserve requirements, to total deposits, which declined from 25% in 1973 to only 4% in 1974. [41]

Both V1 and V2 fell sharply in 1975. Real incomes, adjusted for the terms of trade, fell by 25% because of the sharp fall in the terms of trade. If the decrease in income was perceived to be cyclical, and therefore transitory, then desired money balances would fall by less than the fall in income, explaining the fall in V. Import and exchange restrictions were intensified in 1975, so that people were unable to 'externalize' much of the excess money balances they were holding. People therefore built

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[40] For instance, the Rhodesian border closure was not as detrimental in its effects as expected, and the rise in copper prices may have been higher than expected.

[41] BOZ refers to this as 'actual liquidity', which means liquid assets that can readily be used to satisfy depositor's demands. There is also 'formal liquidity', which includes minimum required reserves. The total liquidity ratio fell from 53% in 1973 to 34% in 1974, close to the minimum allowable liquid assets ratio of 28%.

up liquid balances in their bank deposits. This could be construed as an upward shift in the money demand function. The large increase in credit expansion to government that year may also have contributed to excess money balances, that could not entirely be eliminated by the end of the year (see PR, 1979).

V2 did not decline as much as V1. Holdings of quasi-money actually declined marginally. A possible reason for this is the increase in the inflation rate. Deaver (1970) shows that a rise in the cost of holding liquid assets due to inflation will have a greater effect on interest-bearing deposits, assuming interest rates are constant, than on non-interest bearing deposits. This is because the cost of holding interest bearing deposits is partly offset by interest payments. A given increment in the cost of holding liquid assets is added to a smaller base, producing a greater percentage increase.[42] Another possible explanation is that the instability of 1975 may have created uncertainty and doubt. People may have wanted to hold their money in the most liquid form available, that is cash. There is evidence of this. The ratio of publicly held cash to demand deposits rose by 7%, while the ratio of cash to total deposits rose by 25%. Another reason for this may be the large decline in the black market exchange rate (see Picks Currency Year-book),

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[42]Let Y be the cost of holding cash. Then Y-i is the cost of holding interest bearing deposits. If K is the cost of holding cash relative to quasi money, then:

$dK/dY = -i/(Y-i)^2$, which is negative.

reflecting an excess demand for foreign currency, itself a function of the intensified restrictions, excess liquidity and a fixed exchange rate. This may have induced people to increase holdings of cash to make it easier to participate in the black market (and because of the need to provide more local currency per unit of foreign exchange).

V1 increased steadily from the end of 1975 to the end of 1978. Real income, apart from a small increase in 1976, declined, which may account for some of the trend. Another reason is probably the rise in interest rates in 1976 and 1978 which caused people to economize on their holdings of non-interest bearing deposits. Rising inflation could have caused people to switch from interest-bearing to non-interest bearing deposits. However, this effect does not seem to have been as powerful as the effect of increasing interest rates. A further reason for the sharp rise in 1978 may be the credit squeeze in that year. Enterprizes ran down their deposits in order to finance their operations. This was reflected by a sharp decline in the 'actual liquidity' ratio to 20% from 50% the previous year.

V2 declined between 1975 and 1977. This is the mirror image of V1 reflecting the rise in interest rates. V2 rose in 1978, probably in response to the credit squeeze.[43]

Both V1 and V2 declined in 1979. One reason may have been the easier credit policy, which allowed people to rebuild money balances. Another reason may be excess balances that people did not have time to eliminate by the end of 1979. Both M1 and M2 increased rapidly in 1979 mainly as a result of an increase in foreign assets. Inflation declined, which may also account for some of the decrease.

Both V1 and V2 increased in 1980 and 1981. Real income rose slightly, particularly in 1981, which may explain part of the increase if it was perceived to be transitory. This may be the case for 1981, when there was an unexpectedly good harvest. As was the case in 1974, there was a large demand for credit by the private sector. The increase in V was reflected by a decline in the 'actual liquidity ratio' from 33% to 13%. Inflation accelerated again, which may have caused people to reduce their money holdings per unit of income. Interest rates increased, which may explain why V2 rose by less than V1.

Both V1 and V2 fell sharply in 1982. One reason may be a revision upwards of permanent income, in response to the increase in 1981. This may have caused people to increase their stock of desired balances even though current income did not

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[43]Another possible reason for the rise in V in 1978 was the stricter enforcement of the 100% reserve requirement on deposits required against imports (see BOZ Annual Report, 1978).

change (it actually fell). Another reason may be a large increase in money supply that year as a result of an increase in domestic credit in excess of the fall in foreign assets. People may not have had time to adjust their actual holdings to their desired level.

V1 and V2 both rose in 1983. This may reflect the lagged adjustment of actual to desired balances from the year before, rising interest rates, rising inflation, and perhaps the increase in income that year. This was probably unexpected, as it derived almost entirely from a 33% increase in the terms of trade.

In summary, it is clear that there are many influences affecting velocity, and therefore money demand. Incomes, prices interest rates, policy measures, and other various events and shocks all seem to play a role. People appear to adjust money balances to expected or permanent incomes, rather than solely to current income. People's expected income may be based at least partly, on previous actual income. The measure of income they adjust to is therefore a mixture of current and past incomes. Similarly, people may adjust money balances to inflation and interest rates only after a time lag. Finally, there may be a time lag between the adjustment of actual balances to desired balances. For example, it may take more than one period for an excess demand or supply of money to be eliminated.

5.2 Estimation of Money Demand

My first task was to estimate a 'good' money demand function for M1. I chose this aggregate rather than M2. Quasi-money might be affected differently by the explanatory variables (and might have different explanatory variables). The coefficients in an M2 equation might therefore be harder to interpret than for an M1 equation.

I experimented with four different definitions of income:

a) Real GDP

This is simply the measure of physical final output as given in the official statistics.

b) Real GDP adjusted for the Terms of Trade (1)

Caves and Jones (1977) define a change in real income to consist of two components - the change in physical output and a measure representing the loss of purchasing power caused by an increase in the relative price of imports. In symbols:

$$\Delta y = \frac{x\Delta Px}{p} - \frac{m\Delta Pm}{p} + \Delta gdp$$

Dividing by y,

$$\frac{\Delta y}{y} = \frac{x\Delta Px}{py} - \frac{m\Delta Pm}{py} + \frac{\Delta gdp}{y}$$

Multiplying and dividing the first two components on the RHS by
Px and Pm respectively, gives,

$$\frac{\Delta y}{y} = \frac{X\Delta Px}{YPx} - \frac{M\Delta Pm}{YPx} + \frac{\Delta gdp}{y}$$

where y is real income adjusted for terms of trade, the first two expressions on the right hand side represent the terms of trade adjustment, gdp is real GDP, Px and Pm are the prices of exports and imports respectively, Y is nominal income, p is the implicit price deflator for real income (not real GDP), and X and M are nominal exports and imports respectively.

c) Real GDP adjusted for the terms of trade (2)

In equations relating real money balances to real income, real balances are usually calculated by deflating money balances by a price index in order to obtain the purchasing power of money balances. An index representing the domestic prices of goods, such as the Consumer Price Index, is usually used. From the Quantity Theory expression, MV = Y, it is evident that the same price deflator should be used for nominal income as for nominal balances. I tried a measure of real income, by deflating nominal income by the consumer price index. This will give a different measure than from the physical measure of output, which is obtained by deflating the value of output by the price of that output. An approximation of the price of domestic output might be the CPI, but this is clearly not a good approximation for the price of export goods, particularly when those goods are not greatly used in the country of origin. If the CPI rises faster than the price of export goods, then real income will be lower than the physical measure of output. As changes in the CPI will to some extent reflect import price changes, this scenario would reflect falling terms of trade. This is only a rough approximation as the deflator for each good will be similar to, but not necessarily equal to the CPI

d) Real Income adjusted for the Terms of Trade (3)

The official Zambian statistics (Monthly Digest of Statistics) include a measure of real income adjusted for changes in the terms of trade. They do not define this, and I found I could not replicate the adjustments. However, I have included this in the empirical work to see how it compares with the above.

I also experimented with per capita real GDP and income as well as the aggregate values. As discussed in Chapter 3 per capita GDP is theoretically more appropriate if it is suspected that the income elasticity is different from unity. If aggregate money balances are used as an explanatory variable, then, theoretically, population should be included as a separate explanatory variable. Assuming a proportional relationship between population and money balances the parameter should be unity if per capita gdp is the explanatory variable, and unity minus the estimated income elasticity if aggregate gdp or income is the explanatory variable. However, in practice one can probably omit the population variable, when estimating the demand for money balances in aggregate terms. This is because actual population in developing countries is not usually known with any great accuracy, and is often estimated by extrapolating along a trend line. A population variable is more likely, therefore, to represent a time trend or some other trend, such as increasing monetization. I found that adding population to the right hand side of the equation for M1 did not add significantly to the explanatory power of the equation. Neither did it diminish the estimate of the income elasticity, as it might have done had the variable represented a 'monetization' trend. I therefore decided to omit it (saving one degree of freedom) from the equation.[44]

Finally, I experimented with different definitions of permanent variables. Some researchers use adaptive expectations models, whereby the change in the expected variable adjusts by a

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[44] To test whether measured population is fitted along a trend line in Zambia I estimated the following equation:
$LnPOP = 1.28 + 0.02959t$
where the intercept term is the log of population in the first year, and 2.959% is the estimated annual population growth rate. As expected this fits the official data very well for most years. In later years the equation tends to underestimate actual population , but the statisticians seem to have corrected this by recording zero population growth in 1981.

constant fraction of the change in the actual variable (e.g. PR (1979) in their study of Zambia). One problem with this procedure is that a lagged endogenous variable appears on the right hand side of the equation, and the error terms are correlated (through a moving average process). The estimated coefficients are inconsistent. Also, the same adjustment process is arbitrarily assumed for each explanatory variable. PR (1979) acknowledge that this may not be correct.

Another method is to use a weighted average of present and past values of the explanatory variables. This implies that people change their desired money holdings with a time lag. An advantage of this method is that one has greater freedom to experiment with different adjustment processes for different explanatory variables.[45]

I decided to use the second method, experimenting with different weights to obtain the best fit. For real income I used

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[45] If there are measurement errors in the explanatory variable, a weighted average of the present and past values will introduce a moving average term into the error structure, as with the adaptive expectations mechanism. This can be allowed for by using established computer routines. However, if there are measurement errors the coefficient estimates are inconsistent, regardless of any averaging one does. Regardless of whether there are measurement errors the coefficients are inconsistent when estimated within an adaptive expectations framework. On balance, from the econometric point of view, it seems best to opt for the weighted average method of estimating permanent income. From the rational expectations point of view the weighted average method makes better theoretical sense, as one is not constrained into using information that is several periods old, as the adaptive expectations mechanism does.

an average of the current and previous years' figures. It seems implausible and irrational that people would use information that is more than one year old in order to form expectations.

I experimented with adaptive expectations models (and partial adjustment models, which are similar), but did not achieve more satisfactory results. In the Appendix I describe these models, and present some of the results I obtained from them.

Price controls introduce a complication in the measurement of expected inflation. Excess demand together with price controls implies that actual prices may have been changing at different rates than official prices, which have only been raised after long time lags. While people may react to inflation with a lag, an average of this period's and last period's price level may be inappropriate for deriving a measure of expected inflation if the observed CPI lags the actual cost of living. The current rate of inflation, or an average of the current and the next year's inflation, or next year's inflation may be more appropriate as the explanatory variable.

I estimated the equation in real terms, that is by deflating money balances by the CPI. [46] This assumes that the

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[46]This raises the question as to whether the measured CPI is the appropriate deflator to use in order to derive real money balances. I decided to use the measured price level as the deflator in order to be consistent with the implicit GDP deflator which uses measured prices. Also, the measured price level appears to fit the homogeneity hypothesis well, as discussed on this page.

demand for nominal balances moves in proportion to the price level. Laidler (1985) discusses this assumption in detail. He says that a large number of studies have demonstrated the accuracy of this assumption. The proposition has support from micro-theory, namely that it is relative prices that matter. To test the assumption, however, I ran a regression of nominal balances on prices and the other variables in the M1 money demand function and obtained a coefficent on price that was not significantly different from 1. The coefficient was very close to zero when I ran a real money demand equation with the price level on the right hand side. This also demonstrates the homogeneity hypothesis.

I used annual data rather than quarterly data. Although quarterly data provides more degrees of freedom it also presented problems. Income is only available on an annual basis. I experimented with proxies for quarterly income. Following PR (1979) and Genburg (1976) I estimated quarterly real income using industrial and mining output as benchmarks. However, this did not produce satisfactory results. One reason is that the correlation between the two is not good. On an annual basis the correlation coefficient is only 0.67. For some years the direction of change of annual GDP is different from that of industrial output. The index for industrial output does not cover all companies, just the larger ones. Also, GDP includes agricultural activity, whereas this is excluded from the index for industrial output.[47]

I also used a quarterly interpolation of GDP. This gave better results than using industrial and mining output as a proxy. The results were much closer to those obtained by PR. However, both the inflation and income coefficients were insignificant, contrary to PR's results. Estimating the model over the whole period, the inflation coefficient became significant, but the income coefficent was still insignificant.

PR (1979) showed that prediction errors tended to be higher on a quarterly basis than on an annual basis, indicating that

[47]I attempted to replicate PR's results, using their proxy for quarterly GDP, and using their adaptive expectations formulation. . However, I found my results tended to be different, sometimes substantially, from their's. The estimate of long run income elasticity was only 0.27, much lower than the value of 1 they achieved, and the coefficients for both income and inflation were insignificant. When I estimated their model for the whole period (rather than for 1966 to 1975 as they do) the income elasticity was the wrong sign and insignificant. I also tried verifying their equation for time and savings deposits. Unlike them I found the inflation coefficient to be insignificant. The income coeffient was insignificant which agreed with their results. I also tried to replicate their equation for base money demand. Although I was able to reproduce the sign and magnitude (significant) on the inflation variable, I could not do the same for the income variable. The measurement of the income variable seems to be a problem.

Another possible reason why my results were differerent is that I did not separate demand deposits of the mining companies as they did, as I did not have the requisite information for the whole period (only 9 years of data are available for mining company deposits out of a sample of 18). However, PR found that their prediction errors were little different from the errors arising from the estimation of total demand deposits. This is probably not the reason for the discrepancy therefore. Separation of mining company time and savings deposits might make a larger difference, but information on such deposits is not available.

quarterly errors tended to be offsetting. The larger errors for the quarterly data reflect the problems with finding a proxy for income, and probably the difficulty in stipulating a suitable adjustment mechanism. As they did not have enough data when they did their study they were restricted to using quarterly data. This thesis has the luxury of more data points. I therefore decided to stick with the annual data.

There is the problem of how to treat the lag in the adjustment of actual balances to desired balances. A partial adjustment mechanism could be used, whereby the change in actual balances adjusts by a constant fraction of the change in money demand. I decided not to use any adjustment mechanism, at least in the preliminary phase of identifying the best model. This is because the specification of the adjustment of desired balances to changes in the explanatory variables simultaneously reduces the gap between estimated and actual balances.[48]

I did not include any explanatory variables showing the effect of government policies or external events on money demand. Differences between actual and estimated values would indicate the difference that such factors would make. I did not include any institutional variables as Bordo and Jonung (1981) do. One reason was that I did not have any reliable data to

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[48]The equations for the partial adjustment and adaptive expectations formulations are identical, apart from the error term (Kennedy, 1979).

measure such variables. Another reason was that there may be an offsetting bias, mentioned earlier, in that the process of monetization tends to exaggerate the true growth of real income.[49]

Finally, I considered the question of identification and simultaneous equations bias. As the supply of money is partially determined by the (exogenous) component of the money base it would seem implausible that the parameters in the money demand function could not be distinguished from the money supply function. However, if real income, prices and interest rates are not exogenous variables in the economic system they might be affected by the availability of money. An increase in domestic credit might affect real incomes and prices. In Zambia it is unlikely that real output is determined by the availability of real money balances. An exogenous increase in nominal balances (an increase in the domestic component of the money base, for example) will soon be drained out the economy through increased imports of intermediate inputs, except for extra money people wish to hold in response to increased incomes. If there are import controls, prices will probably rise instead as people

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[49] I included population as an explanatory variable in a preliminary run. This variable is in effect a time trend, as discussed earlier. If monetization also occurs along a trend then this might be captured by the population variable. However, the coefficient was insignificant. The estimate of the income elasticity remained the same. I therefore decided to omit the variable for the regressions described below.

dispose of the excess nominal balances until the former level of real balances is restored - that is, real balances are demand -determined. Real output in Zambia is basically not demand -determined within the economy. More important factors are probably external demand, and, in the case of agriculture, the weather. As an experiment I regressed the explanatory variables in the money demand function on nominal and real money balances, and compared the results with regressions of nominal and real balances on each variable in the money demand function. The results were considerably worse for the 'money supply' equations, in the sense of much lower coefficients, t values and F values, particularly in the case of real income and expected inflation. The danger of simultaneous equations bias does not appear to be great.

Table 5.2 shows the results of a preliminary exercise to isolate the best model, without attempting any refinements on expected income and prices. The actual rate of inflation was used. Expected income was arbitrarily assumed to be the simple average of the current and previous year's income. The best results were obtained using real gdp unadjusted for changes in the terms of trade.

TABLE 5.2

ESTIMATED MONEY DEMAND EQUATIONS - M1

Dep Var	y - N	y⁺ - N	y	y⁺	int Rate	P - P_{-1}	R^2	DW	F	Meth
a) Real GDP										
M/PN	1.36				-0.02	0.014	0.7	2.27	15.1	OLS
	(5.1)				(-0.2)	(0.02)				
M/PN	1.65				0.004	0.36	0.87		40.3	GLS
	(8.0)				(0.05)	(0.71)				
M/PN		1.34			-0.13	0.29	0.85	2.18	32.4	OLS
		(5.9)			(-1.7)	(0.62)				
M/PN		1.45			-0.13	6.51	0.93		77.9	GLS
		(5.72)			(-2.03)	(0.51)				
M/P			1.43		-0.22	-0.1	0.78	2.7	23.0	OLS
			(7.5)		(-2.06)	(0.16)				
M/P			1.61		-0.29	0.44	0.94		100.6	GLS
			(16.4)		(-5.8)	(1.34)				
M/P				1.37	-0.3	0.33	0.81	2.47	24.7	OLS
				(7.3)	(-3.9)	(0.78)				
M/P				1.41	-0.33	0.57	0.93		80.1	GLS
				(15.2)	(-8.0)	(2.19)				
b) Real Income Adjusted for Terms of Trade (1)										
M/PN	0.74				0.05	0.13	0.62	1.56	10.5	OLS
	(4.2)				(0.43)	(0.16)				
M/PN		0.81			-0.02	0.53	0.8	2.12	23.1	OLS
M/P			0.88		0.16	0.26	0.64	1.84	11.4	OLS
			(5.25)		(1.47)	(0.32)				
M/P				0.94	0.06	0.66	0.68	2.24	13.0	OLS
				(6.05)	(0.77)	(1.16)				

TABLE 5.2 (cont.)

c) Real Income Adjusted for Terms of Trade (2)

M/PN	0.93				0.27	0.67	0.41	1.15	5.2	OLS
	(2.43)				(1.13)	(0.63)				
M/PN		1.27			0.41	0.74	0.73	1.93	16.6	OLS
		(3.72)			(1.82)	(1.15)				
M/P			1.3		0.32	1.2	0.52	1.71	7.4	OLS
			(4.1)		(2.5)	(1.19)				
M/P				1.33	0.28	0.82	0.64	2.1	10.9	OLS
				(5.6)	(3.1)	(1.3)				

d) Real Income Adjusted for Terms of Trade (3)

M/PN	0.36				-0.02	-0.03	0.23	0.58	2.76	OLS
	(1.0)				(-0.1)	(-0.23)				
M/PN		0.6			-0.001	0.67	0.53	0.94	7.5	OLS
		(1.36)			(0.003)	(0.64)				
M/P			0.84		0.31	0.71	0.19	0.93	2.5	OLS
			(2.1)		(1.9)	(0.5)				
M/P				1.21	0.26	1.48	0.29	1.45	3.3	OLS
				(3.0)	(2.0)	(1.49)				

Notes:
- all variables are in natural logarithms;
- figures in brackets are t values;
- M is M1, N is population, P is the CPI, y is real GDP or real income, y^+ is expected income or GDP, (defined as the simple average of this period and last period's income or GDP);
- the interest rate is represented by the rate on savings deposits in commercial banks;
- the sample period is 1966 to 1983;
- Terms of Trade Adjustment (1) refers to the Caves and Jones (1980) method of adjustment;
- Terms of Trade Adjustment (2) is nominal income deflated by the consumer price index;
- Terms of Trade Adjustment (3) is the official Zambian Government adjustment, as reported in the MDS.

This may seem surprizing, given that transactions balances are held on the basis of the purchasing power of money, for which terms-of-trade adjusted real income is a better proxy. One possible reason is that real output may be a better proxy for permanent income than terms-of trade adjusted income. The latter tends to fluctuate far more than output, because of the changes in the terms of trade, and probably reflect transitory changes to a greater extent than 'permanent' changes. There may still, however, be a time lag between changes in output and changes in desired money balances, which can be captured by using a measure of permanent output.

The Caves and Jones formula for adjusting for the terms of trade worked the best, followed by the variable obtained by deflating nominal income by the consumer price index. Using the Zambian Government's measure produced very bad results.

Using aggregate values of real balances produced better F values than using per capita values in the case of physical output. However, using per capita values for the first version of terms of trade adjusted income produced better F values than for aggregate values. The estimated coefficient on the interest rate variable (proxied by the bank savings deposit rate) had the expected negative sign in the case of real GDP, but was usually the wrong sign in the case of real income. The interest rate coefficients were much larger, with higher t values, when the equations were estimated in aggregate terms rather than per capita terms.

The coefficients for inflation were generally positive and only rarely significant. The positive coefficient is puzzling and also contradicts the findings using quarterly data. One reason could be that people shift out of quasi-money into other forms of money as a result of inflation (see earlier footnote on Deaver's (1970) finding), given the rate of interest. As will be seen later the estimated inflation coefficient in the case of quasi-money is negative. In the short term, on a quarterly basis, there may be a negative correlation because people have not had time to adjust desired real balances to rising prices. If prices rise faster than money balances in the short term then real balances fall. Other reasons for the positive coefficient are discussed later.

Income elasticities varied between 1.34 and 1.61, using real GDP and per capita GDP as the income variable. This would confirm the common expectation (e.g. PR (1979)) that income elasticities are greater than one). Using 'expected' output did not appear to make much difference. Income elasticities greater than one were also obtained for the second version of terms of trade adjusted income. As would be expected, (because of the large transitory element in this measure of income) the size of the elasticity, and its degree of significance, was higher for the 'expected' variable. The income elasticities were less than one for the other versions of terms of trade adjusted income, but again they were higher using the 'expected' variable.

The DW statistics tended to show negative serial correlation using OLS. I used generalized least squares to correct for this.

I then took the best looking equations to see which fitted the data best on a year-to-year basis. It is invalid to compare R^2 when the dependent variables are different (see Kennedy, 1979). Instead I used the mean percentage square error of the residuals to compare the goodness of fit between different equations.

The best fit appeared to come from the equation in Table 5.2 where real money balances are a function of expected real income, the interest rate, and the current rate of inflation, using generalized least squares to correct for autocorrelation. Errors over 5% occur in four years only:- 1972 (-5.2%), 1978 (-12.4%), 1979 (13.1%) and 1981 (-8%). A minus sign means an estimated demand for money greater than actual money supply. It is noteworthy that events of particular monetary significance occurred in these years. In 1972 there was a credit squeeze (as referred to in Chapter 4), such that there was excess demand for money balances which presumably was not satisfied by the end of the year. 1978 and 1979 were the years of the IMF Standby program. In 1978 monetary restraint actually caused money supply to fall. However, predicted money demand fell by much less. The excess demand was not eliminated by year-end. In 1979 estimated money demand underpredicted actual money supply by almost exactly the same amount as the over prediction the previous year. Predicted money demand fell, but money supply rose. This reflects the lagged adjustment of actual to desired balances from the year before, and also the improved liquidity situation in a year when real GDP fell. 1981 was also the start of another IMF program. The overprediction of money demand is harder to explain, as the policy of credit restraint did not work. The overall credit ceiling was broken.

IMF programs may cause adjustment coefficients to change, so that the period of adjustment is shortened, relative to that implied by the model. It is also possible, as PR (1979) suggest, that IMF programs cause a change in expectations or confidence, such that the money demand function shifts, or expectations of the explanatory variables change. For example, an IMF program is usually expected to be deflationary. People may expect incomes to fall, and may revise their desired money balances accordingly. This means that last year's income receives a lower weight. This could be one reason for the large overprediction in 1978.

Likewise in 1979 the economic situation looked much healthier, partly because of the large increase in copper prices. The government and BOZ announced that credit to the private sector would be much easier. This may have prompted people to revise upwards their desired money balances, and to ignore the information conveyed by events in the previous year. In 1981, people may have also revised their desired balances downwards, expecting deflation, and not expecting the favourable harvest that caused the credit ceiling to be broken.

The model shows that in most years, even when liquidity built up very rapidly as in 1975 and exchange and import restrictions were intensified, the errors are reasonably small. This indicates that money market equilibrium tends to be attained within a year. [50]

The next step was to try and refine the M1 equations further, using real output as an explanatory variable. First, I added a dummy variable representing the exchange restrictions that were intensified in 1976. The dummy took the value of 1 for 1976 onwards, and 0 for earlier years. PR (1979) adopted this procedure for their quarterly model, and obtained a significant coefficient. However, I obtained an insignificant coefficient. One reason may be that the dummy that PR used acted as a proxy for the increase in interest rates in 1976.

I experimented with different weighted averages of current and the previous period's GDP. The best results were weights of 0.5 in each period.

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[50]As noted by Prais (1977), the use of end of the year stock data and annual average flow data already implies an adjustment lag.

If the interest rate reflected expected inflation there would be less justification for having both variables. One test of whether it is justifiable to include both variables is to run the regression without one of the variables. If the variables are highly collinear, then the t values on the included variable should increase significantly (the explanatory power that was common to both variables will be allocated solely to the included variable). High collinearity would indicate that interest rates reflected expected inflation. When the inflation variable was dropped, using the equation of best fit from Table 5.2, the R^2 only marginally declined (to 0.89). The t value on the interest rate coefficient changed only marginally. When the interest rate was dropped, however, the R^2 dropped dramatically to 0.5, and the coefficient on inflation became negative but insignificant. This shows that there is a degree of collinearity, and that the inflation rate is acting to some extent as a proxy for the interest rate. However, the degree of collinearity is not very high.[51] This indicates that there is at least justification for including the interest rate variable. As the inflation variable adds to the explanatory power of the equation, and is justified theoretically, there is good cause for including it as well (as Aghlevi and Khan (1977) do, and as Laidler (1985) says is justified when interest rates are

[51] The correlation coefficient between the two variables is about 0.65.

regulated).

I experimented further by substituting the average of this period's and next period's inflation rates, for the current period inflation rate. As explained earlier, this is justified by the existence of price controls, excess demand, and the lag between the adjustment of official prices and increases in unofficial prices. The fit improved marginally.[52]

The next step was to estimate demand equations for all different components of money. This exercise is necessary for the purposes of determining the most stable and predictable money demand function, and for examining the stability of the money and credit multipliers (see Chapter 6).

I assumed that the same model applies to each component of money (as does Diz, (1970)). The results are tabulated in Table 5.3, and are discussed below:

Currency

All coefficients were significant. The R^2 and the MPSE were much lower and higher respectively than for M1. The income elasticity was 1.52, which is slightly higher than for M1. The coefficient for inflation was positive. A possible explanation is increasing uncertainty and instability, which caused people to want to be as liquid as

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[52]As expected, a regression using an average of the current and previous period's inflation rates produced a worse fit.

possible. In times of goods and foreign exchange shortages people might want to hold extra amounts of cash so as to have quick and ready access to scarce goods and black market foreign exchange when they become available. Wilford (1979) found that currency holdings increased relative to demand deposits as inflation increased and attributes this to increased uncertainty. Another explanation, discussed under 'Demand Deposits', is that the opportunity cost of holding money for transactions purposes increased faster for demand deposits, because of increasing chequing charges, than for currency, prompting a switch to the latter.

There were large residuals in 1969, 1970 and 1971. These might be related to the quality of the agricultural sector, which is not included in the model. If the harvest is good, agricultural incomes are high. Farmers tend to hold a greater proportion of their money balances in currency, than urban dwellers. Therefore currency holdings can be expected to increase relative to what the model predicts. This may account for the overprediction in 1970 (a bad harvest), and the underprediction in 1971 (a very good harvest). Future research could use a proxy variable to account for this (such as the number of bags of maize harvested).

Diz (1970) experimented with a variable proxying the distribution of income, namely the share of income going to labour. His hypothesis was that the higher this ratio, the greater the demand for currency by the public, as wage earners would be less likely to hold money in banks. He obtained a significant coefficient. I tried the same test, but was unable to obtain a significant coefficient. One reason may be that the period of very large wage increases in Zambia (the late 1960s) coincided with Zambianization of the currency. People who had not previously used banks may have been persuaded to open bank accounts when they exchanged old for new notes (they may have also distrusted the new currency).[53]

I also added a dummy proxying exchange rate restrictions, but this did not improve the fit significantly.

Bank Reserves

Commercial Bank Reserves were hypothesized to depend on the legal reserve ratios for the different classes of deposits as well as the variables in the basic model. One could reason that it is not necessary to include these extra variables as the amount of reserves demanded depends

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[53] Harvey (1977) raises this point.

on the level of deposits (which depends on the demand for them), and the opportunity cost of holding reserves. However, if there was no legal reserve ratio, the banks might hold fewer reserves than implied by the legal requirement.[54] I have therefore included them.

The estimated equation produced a very high R^2 of 0.99. The MSPE was relatively (to M1) high at 73. Errors were over 10% in 1974 and 1975. The underprediction in 1974 may be due to the liquidity squeeze in that year, caused by rapidly rising credit. Excess reserves fell to zero. The overprediction in 1975 is, conversely, due to the very large liquidity build-up that year.

The income elasticity was very high - nearly 2 - and highly significant. As expected, the interest rate coefficient was negative, and was significant. The inflation rate coefficient was negative and verged on significance at the 5% level. This may seem surprizing, given the positive coefficient in the currency equation. Banks, however, are presumably not so concerned with the need for quick access to scarce goods and foreign exchange. Also, unlike consumers, there is no other liquid asset that has a lower opportunity cost. The coefficient on the legal reserve ratio for demand deposits was positive, as

[54] There is evidence of this in Zambia. In some years - 1974, and 1981 onwards - excess reserves fell to zero.

expected, and significant. The coefficient for the reserve ratio on time and savings deposits was negative and significant. This is a little hard to explain as one would expect a positive sign. One reason could be that the ratio was only changed once over the period, thereby allowing insufficient variation to allow a meaningful coefficient to be estimated.

Base Money

As base money includes bank reserves the legal reserve ratios were included as arguments. A high R^2 of 0.98 was attained, along with a good (comparable to M1) MPSE of 34. The income elasticity was 1.34, comparable to that of M1. The interest elasticity was significant. The inflation elasticity was significant and positive. The positive coefficient in the currency equation outweighed the negative coefficient in the bank reserve equation. The coefficient for the reserve ratio on demand deposits was the expected sign, but just below significance at the 5% level. The coefficient for the other ratio was positive and insignificant. The reversal of signs from the bank reserve equation may reflect the instability of the coefficient resulting from lack of variation in the data.

It is interesting to note that the MPSE for base money is less than half of the MPSE for the components of base money. This indicates that that the residual errors are partially offsetting.

The only large errors (over 10%) were in 1970 and 1971. The errors in estimating M1 in 1978 and 1979 and 1981 were therefore not attributable to base money.

Demand Deposits

The R^2 was 0.87, while the MPSE was 68.4. As with M1, the largest errors were in 1978 and 1979 and 1981 (over 10%). Errors were also large (between 5 and 10%) in 1967, 1968, 1972, and 1976. As mentioned earlier 1972, 78, 79 and 81 were years of major monetary policy events. The income elasticity was 1.25, or slightly lower than for M1. The interest rate coefficient was significant and had the expected sign. The inflation rate coefficient was negative and very insignificant. This may seem puzzling at first as the coefficient on currency is positive. A possible reason is that chequing charges have gone up with inflation, with the result that the opportunity cost of holding demand deposits has risen faster than the opportunity cost of holding cash. Given a need to hold money for transactions purposes, this might explain the move into currency. Another reason, referred to above, may have been the desire to be as liquid as possible, given the economic uncertainties and shortages.[55]

M1

The results of this equation have already been discussed. The equation is marginally different from the one in Table 5.2, as the inflation variable measures 'expected' inflation rather than the current rate of inflation.

Quasi-Money

The equation for quasi-money produced an R^2 of 0.88, and a high MSE of 320, indicating large residuals. Errors were well over 10% in most years. The income elasticity was very high, and highly significant, indicating that this form of money is more of a luxury good than the other forms. The interest rate coefficient was negative and almost zero. This may seem surprizing given the increase in interest rates over the period, the rise in the ratio of time and savings deposits to demand deposits, and the highly significant negative coefficients on the interest rate variable in the previous equations. A possible reason

[55] From what I remember of my experience in Zambia bank charges were both high and increasing. Holding transactions-related money in savings accounts was impractical and undesirable given the withdrawal notice required, and the negative real interest rates. There were therefore definite incentives for holding cash.

is that higher interest rates have at times been associated with government -initiated credit squeezes, that have induced businesses to run down their time and savings deposits.

The coefficient on inflation is negative (as expected) and approaches significance at the 5% level.

The income elasticity is very different from that obtained by PR (1979) who obtained an insignificant coefficient. PR were themselves surprized by their result.

The demand for this component is clearly more unstable than for the other components of money. One reason could be that people switched back and forth between the banks and other financial intermediaries. However, the evidence does not support this. [56] A more plausible reason is that the stock of quasi-money tended to reflect the shocks hitting the economy. People and businesses would add to their balances during times of excess liquidity and intensified foreign exchange restrictions, and destock during credit squeezes. There was a particularly large destocking in 1978.

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[56] The major reason for this to happen would be if interest rate differentials were continually fluctuating. This was not the case in Zambia. Interest rates rose very slowly. Rates in the other financial institutions tended to lag behind those in the banks.

M2

The demand equation for M2 produced an R^2 of 0.96, and an MPSE of 62. The income elasticity was almost 2. The interest rate coefficient was negative and significant, reflecting the dominating effect of the non-interest bearing elements of money. The inflation rate coefficient was negative, but insignificant, reflecting the opposing forces of inflation on currency and on time and savings deposits. The only error over 10% was in 1978 (20%).

Judging from the above, the demand for M2 is appears to be less predictable than the demand for base money and M1. This is of policy interest.

TABLE 5.3

DEMAND EQUATIONS FOR EACH COMPONENT OF MONEY

a) Currency(Curr)

$$Curr = -6.4 + 1.5GDP^{+} - 0.42i + 2.74(P/P_{-1})^{+}$$
$$(-3.9) \quad (6.5) \quad (-3.6) \quad (3.6)$$
$$R^2 = 0.81 \quad SEE = 0.08 \quad MPSE = 71.6 \quad F = 18.8$$

b) Bank Reserves (R)

$$R = -12.3 + 1.94GDP^{+} - 0.48i - 0.44(P/P_{-1})^{+} + 1.32rs1 - 0.22rs2$$
$$(-11.5) \quad (14.4) \quad (-4.0) \quad (-1.35) \quad (4.1) \quad (-1.74)$$
$$R^2 = 0.94 \quad SEE = 0.06 \quad MPSE = 54 \quad F = 266$$

c) Base Money(B)

$$B = -5.8 + 1.34GDP^{+} - 0.44i + 0.79(P/P_{-1})^{+} + 0.59rs1 + 0.03rs2$$
$$(-6.8) \quad (12.6) \quad (-4.3) \quad (2.2) \quad (1.9) \quad (0.25)$$
$$R^2 = 0.98 \quad MPSE = 34 \quad SEE = 0.048 \quad F = 267$$

d) Demand Deposits(DD)

$$DD = -3.4 + 1.25GDP^{+} - 0.3i - 0.018(P/P_{-1})^{+}$$
$$(10.3) \quad (-6.2) \quad (-0.05)$$
$$R^2 = 0.87 \quad MPSE = 68.4 \quad SEE = 0.066 \quad F = 38$$

e) M1

$$M1 = -3.9 + 1.35GDP^{+} - 0.33i + 0.70(P/P_{-1})^{+}$$
$$(14.9) \quad (-9.0) \quad (2.65)$$
$$R^2 = 0.94 \quad MPSE = 30 \quad F = 90 \quad SEE = 0.049$$

f) Quasi Money(QM)

$$QM = -17.7 + 3.2GDP^{+} - 0.01i - 1.73(P/P_{-1})^{+}$$
$$(9.2) \quad (0) \quad (-1.6)$$
$$R^2 = 0.88 \quad MPSE = 320 \quad F = 41 \quad SEE = 0.16$$

g) M2

$$M2 = -8.0 + 1.98GDP^{+} - 0.2i - 0.24(P/P_{-1})^{+}$$
$$(16.9) \quad (-4.2) \quad (0.70)$$
$$R^2 = 0.96 \quad MPSE = 62 \quad F = 124 \quad SEE = 0.06$$

Notes: - GDP and inflation variables are in 'expected' form;
- equations were estimated using GLS, for 1966-83;
- i is the interest rate on bank savings accounts.

Diz (1970), in his study of Argentina's monetary experience, also estimates demand equations for the different components of money. It is interesting to compare his results with mine. Diz obtains 'permanent' income elasticities of 3.1 (1.52) for publicly held currency, 1.6 (1.25) for demand deposits, and 0.8 (3.2) for time and savings deposits. He does not estimate a demand equation for bank reserves.[57] My estimates are in parentheses for comparison. His estimates for the interest rate elasticity are 0.2 (-0.42) for currency, -0.2 (-0.3) for demand deposits, and 0.15 (0) for time and savings deposits. His estimates for the 'expected' inflation rate elasticity are -1.8 (2.74) for currency, -1.35 (-0.018) for demand deposits, and -8.7 (-1.73) for time and savings deposits.

There are clearly major areas of disagreement. His estimates of income elasticity are much higher than mine for currency and demand deposits, and much lower for time and savings deposits. Diz' results are a little puzzling, as one would expect the 'permanent' income elasticity to be higher, the 'wider' the definition of money. As an economy grows people will tend to use cash less and bank deposits more. As their savings grow with income (that is, as their wealth increases) they will be more likely to use time and savings deposits as a repository for their wealth. Macesich (1970) also posits the income

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[57] Instead, he estimates an equation for the bank reserve ratio. This is discussed further in Chapter 6.

elasticity of bank deposits to be greater than that of currency. Perlman (1970) finds income elasticities to be lower for currency than deposits for a cross-section of countries.

My income elasticities may seem puzzling as, according to my theory, the income elasticity of demand deposits should be higher than for currency, whereas it is lower. It may be the case that the currency coefficient is biased upwards because of an omitted variable that is correlated with income. Such a variable may capture a trend, such as an increasing ratio of currency to demand deposits. I tested this by reestimating the equation with population as a variable. This should capture both population, which theoretically should be in the equation anyway, and is fitted along a trend, and any other trend. The income elasticity fell to 1.12. The population coefficient was 2.7, and highly significant. If population was proportional to money demand and there was no other trend the coefficient would be unity.

As growth in currency demand has been at the expense of demand deposits one might suspect that the income elasticity of demand deposits in Table 5.3 is biased downwards. I reran the equation with a population variable. The income elasticity rose to 1.46. The coefficient on population was 1.1, reflecting mainly the effect of population itself.

These results probably explain why population did not make any difference to my original M1 equation, prompting me to omit it. The biases on the currency and demand deposit income elasticities cancelled each other out. I also checked the other money components. The alternative specification made little difference to bank reserves. The income elasticity for base money fell to 1.18. As with currency the interest elasticity rose significantly to nearly -1. The income elasticity for quasi money fell to 2.4, reflecting a strong 'monetization' trend. The interest rate became more negative, as did the inflation coefficient. The income elasticity for M2 fell to 1.71. The equations are shown in Table 5.4.

The rise in the interest rate coefficients are disturbing. Laidler (1985) cites various studies showing the interest rate elasticity to vary between 0.15 and 0.4, which is consistent with my original estimates. Also of concern was a large rise in the COND values in the equations, suggesting that the X'X matrix was approaching singularity. This makes the coefficients very susceptible to changes in sample size and specification.

Diz obtains a positive interest elasticity for the demand for currency. He admits that this is contrary to his expectations. He attributes this to 'complementarity' between the two forms of money, but does not explain the reason for this. His estimate of the interest rate elasticity for demand deposits is the same sign and magnitude as mine. He obtains a significant positive interest elasticity for time and savings deposits, which I do not.

Table 5.4

Alternative Specification of Money Demand Functions

a) Currency

$$Cur = \underset{(-3.3)}{-5.5} + \underset{(4.0)}{1.12(y/N)} - \underset{(-3.4)}{0.93i} + \underset{(3.43)}{2.03\Pi} + \underset{(6.17)}{2.69pop}$$

R^2=0.91 F=44 SER=0.07 MSPE=44

b) Base

$$Base = \underset{(-7.8)}{-7.1} \underset{(8.7)}{+1.18y} \underset{(-4.5)}{-0.98r} \underset{(0.42)}{+0.17\Pi} \underset{(3.4)}{+1.26rs1} \underset{(-1.9)}{-0.28rs2} \underset{(6.9)}{+2.2pop}$$

R^2=0.99 F=205 SER=0.045 MSPE=26

c) Bank Reserves

$$Bkrs = \underset{(13.3)}{-14.45} + \underset{(12.3)}{2.04y} \underset{(-2.38)}{-0.61r} - \underset{(-1.66)}{0.83\Pi} + \underset{(3.7)}{1.69rs1} - \underset{(-2.04)}{0.38rs2} + \underset{(5.7)}{2.19pop}$$

R^2=0.99 SER=0.056 F=277 MSPE=60

d) Demand Deposits

$$Ddep = \underset{(4.0)}{-5.2} + \underset{(6.9)}{1.46y} - \underset{(-1.13)}{0.17r} - \underset{(-0.04)}{0.018\Pi} + \underset{(4.0)}{1.11pop}$$

R^2=0.86 F=28 SER=0.07 MSPE=65

e) M1

$$M1 = \underset{(-4.6)}{-4.69} + \underset{(8.2)}{1.36y} \underset{(-3.2)}{-0.37r} + \underset{(1.94)}{0.57\Pi} + \underset{(6.8)}{1.53pop}$$

R^2=0.93 F=58 SER=0.05 MSPE=31

Table 5.4 (Cont.)

f) Quasi-Money

$$QM = -15.6 + 2.4y - 0.76r - 2.45\Pi + 4.69pop$$
$$(-4.6) \quad (4.3) \quad (-1.85) \quad (-2.37) \quad (6.1)$$

R^2=0.89 F=37 SER=0.16 MSPE=42.4

g) M2

$$M2 = -7.8 + 1.71y - 0.48r - 0.55\Pi + 2.62pop$$
$$(6.4) \quad (8.7) \quad (-3.6) \quad (-1.6) \quad (10.3)$$

R^2=0.96 F=98 SER=0.06 MSPE=58

Notes

- variables are in natural logarithms;
- income and inflation are in expected form;
- y is in per capita terms;
- equations estimated by GLS;

Diz has a much higher inflation elasticity for demand and time and savings deposits compared to mine. His coefficients are significant in contrast to mine. Diz' high inflation coefficients probably can be explained by the much higher, and more entrenched, rates of inflation in Argentina, compared with Zambia. His inflation elasticity for currency is opposite in sign from mine. I outlined a plausible reason for a positive inflation elasticity for currency in Zambia above.

5.3 <u>Forecasts of Money Demand</u>

The final exercise in this chapter was to simulate money demand for the different components from 1976 on. The model was run for the years up to the period immediately before the period to be predicted. The rationale for this is that a policy maker who has to make a decision for a particular year only possesses information on the parameters of the model up to that year. For a valid forecast to be made he can only use those parameters. As the principal practical application of the monetary approach to the balance of payments lies in the forecasting of a balance of payments outcome, given a predicted money demand and a selected change in domestic credit, the ability to forecast money demand is important. A key part of PR's (1979) study follows the same procedure, with the same objective. I am assuming the explanatory variables are the same for each year, which is not necessarily true. However, to estimate different models for each year would have been very time-consuming. The point of the exercise is to test the stability of the money demand function. If the prediction errors show that the model structure is changing over time this indicates that the function is not stable, and that the practical usefulness of the monetary approach to the balance of payments is limited.[58]

The exogenous variables take on their actual values in the simulations. In reality these would also have to be forecasted, introducing further scope for forecast error. However, this is a problem in any kind of forecasting, and is not a drawback specific to the monetary approach.

The simulations are shown in Tables 5.5 to 5.11 below.

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[58] The equations described in Table 5.3 are used for the simulations, partly because of suspicions attached to the high interest rate elasticities and the higher COND values shown in Table 5.4.

TABLE 5.5

FORECASTS OF PUBLICLY HELD CURRENCY
(Kwacha, millions)

Year	Actual	Predicted	Error	%Error
1976	101.9	124.5	22.9	22.5
1977	83.2	95.5	12.3	14.7
1978	79.1	67.2	-11.8	-15.0
1979	69.5	69.1	-0.4	-0.6
1980	74.4	70.3	-4.1	-5.5
1981	81.2	76.3	-4.9	-6.0
1982	80.1	82.5	2.4	3.0
1983	76.8	85.5	8.7	11.4
Root Mean Squared Percentage Error (RMSPE)				19.6
Mean Absolute Error			8.4	
Standard Deviation			6.8	

TABLE 5.6

FORECASTS OF COMMERCIAL BANK RESERVES
(Kwacha, millions)

Year	Actual	Predicted	Error	%Error
1976	73.4	68.1	-5.3	-7.2
1977	73.0	92.9	19.9	27.2
1978	63.2	63.2	72.1	8.9
1979	67.5	63.0	-4.5	-6.6
1980	62.4	59.2	-3.2	-5.1
1981	61.4	65.8	4.4	7.2
1982	65.3	66.6	1.3	1.9
1983	62.0	59.0	-3.0	-4.8
RMSPE				19.5
Mean Absolute Error			14.2	
Standard Deviation			22.5	

Note - values are in real terms.

TABLE 5.7

FORECASTS OF BASE MONEY
(Kwacha millions)

Year	Actual	Predicted	Error	%Error
1976	175.2	183.1	7.9	4.5
1977	156.2	162.1	8.9	5.7
1978	142.2	134.9	-7.3	-5.2
1979	137.0	129.8	-7.2	-5.2
1980	136.9	131.8	-5.1	-3.6
1981	143.6	141.0	-2.6	-1.8
1982	145.9	146.0	-0.1	0
1983	138.8	141.1	2.3	1.6
RMSPE				6.5
Mean Absolute Error			5.2	
Standard Deviation			3.0	

TABLE 5.8

FORECASTS OF DEMAND DEPOSITS
(Kwacha Millions)

Year	Actual	Predicted	Error	%Error
1976	215.0	195.3	-19.7	-9.2
1977	188.4	201.4	13.0	6.9
1978	157.6	179.4	21.8	13.8
1979	213.1	151.8	-61.3	-28.7
1980	176.6	171.0	-5.6	-3.2
1981	160.5	180.7	20.2	12.6
1982	181.7	184.8	3.1	1.7
1983	176.0	176.5	0.5	2.7
RMSPE				21.0
Mean Absolute Error			18.2	
Standard Deviation			18.0	

TABLE 5.9

FORECASTS OF M1
(Kwacha millions)

Year	Actual	Predicted	Error	%Error
1976	316.9	321.3	4.4	1.4
1977	271.6	309.1	37.5	13.8
1978	236.6	250.0	13.0	5.5
1979	282.6	219.7	-6.3	-22.3
1980	250.8	237.8	-13.0	-5.2
1981	239.8	262.2	22.4	9.4
1982	260.7	266.8	6.1	2.3
1983	252.8	260.5	7.7	3.1
RMSPE				16.8
Mean Absolute Error			13.8	
Standard Deviation			10.4	

TABLE 5.10

FORECASTS OF QUASI MONEY
(Kwacha millions)

Year	Actual	Predicted	Error	%Error
1976	187.6	127.6	-59.8	-32.0
1977	215.0	201.7	-13.3	-6.2
1978	146.5	226.5	80.0	54.6
1979	173.7	152.1	-21.6	-12.4
1980	191.3	163.1	-28.2	-14.7
1981	179.5	185.3	5.8	3.2
1982	199.8	186.5	-13.0	-6.5
1983	211.7	194.3	-17.4	-8.2
RMSPE				38.9
Mean Absolute Error			29.9	
Standard Deviation			26.1	

TABLE 5.11

FORECASTS OF M2
(Kwacha millions)

Year	Actual	Predicted	Error	%Error
1976	524.4	455.8	-68.6	-13.1
1977	491.0	497.2	6.2	1.3
1978	386.0	479.1	92.9	24.1
1979	458.2	379.6	-78.6	-17.2
1980	447.1	395.5	-51.6	-11.5
1981	423.2	440.3	17.2	4.1
1982	503.3	454.3	-49.0	-9.7
1983	467.3	443.2	-24.1	-5.2
RMSPE				21.0
Mean Absolute Error			48.5	
Standard Deviation			30.8	

The tables show that the RMSPE is lowest for base money, by a long way, and highest for M2. Although currency and bank reserves individually have RMSPEs close to that of M2, the errors appear to be offsetting, so that the errors for base money are low. Percentage prediction errors for currency range from 23% to -6%. For bank reserves the errors range from 27% to -7%. For base money, the errors are all under 6% in absolute terms, ranging from 5.7% to -5.2%.

The largest errors for all components are generally in 1978 and 1979, the years of the IMF program. The error for Quasi Money is particularly large in 1978, and appears to account for the very high RMSPE relative to other components.

The structure of the errors do not reveal any systematic under or over prediction. One can conclude that the structure of the money demand functions has not changed over time.

In conclusion, the demand function for base money would appear to be far more sound for the purposes of policy making than the other functions. The average error and the variance are both small. If the errors are random, then one can predict with 95% confidence that one might be plus or minus K15 million out on one's prediction. For M1 this range becomes plus or minus K30 million, and for M2, plus or minus K80 million. These figures are in real terms. In today's prices the figures should be multiplied by four. Even in the case of base money the error in predicting the balance of payments might be K60 million, which is quite large.

5.4 Summary and Conclusions

Section 5.1 discussed the behaviour of the velocity of circulation. It appeared that it could be explained in terms of traditional money demand arguments, such as income and the opportunity cost of holding money. In Section 5.2 I estimated a function for M1, using measures of permanent income, interest rates and expected inflation as arguments. Permanent income was proxied by a simple average of this period and last period's real GDP. Expected inflation was proxied by an average of this and next period's inflation rate, on the basis that measured prices lag behind actual prices as a result of price controls. The savings rate on bank accounts was used to represent the interest rate. I experimented with terms of trade adjusted income. However real GDP explained money demand better, perhaps because it represents permanent income better. Equations estimated in per capita terms did not perform as well as those in aggregate terms.

The fit I obtained for M1 was quite good. The income elasticity was well over one, as expected (because of monetization effects). The inflation coefficient was surprizingly positive, perhaps reflecting uncertainty and instability. The interest rate coefficient was negative, as expected, and significant. Major residuals occurred in years of major policy disturbance, particularly 1972, 1978, 1979 and 1981. The largest errors were in 1978 and 1979, which were the IMF standby agreement years. One suspects that IMF programs have the effect of changing the way expectations are formed and adjustments are made.

I then assumed that the same model would hold for the other components of money. Good fits were obtained for base money, and demand deposits. Quasi-money could not be explained nearly so well. The reason seems to be that it serves as a buffer against shocks to the economy. During years of high liquidity it builds up, and is run down during years of low liquidity, the most notable example being 1978.

The equations for currency and bank reserves both have sizeable errors. However, they appear to be offsetting, as the base money function has much smaller errors.

The signs and magnitudes of the coefficients are generally plausible. Major exceptions were the high income elasticity of currency demand, and the positive inflation elasticity on currency. The latter could be explained by uncertainty and instability in the economy, and a desire to be as liquid as possible during times of scarcity of goods and foreign exchange. Transactions on the black market for both these items require cash. Another factor was that rising chequing charges were increasing the opportunity cost of holding transactions balances on demand deposits relative to currency. The omission of these trends might be partly responsible for the high income elasticity on currency. Reestimating the equation with a trend variable (population) considerably reduced the income elasticity. Similarly, reestimation of the demand deposit equation increased the income elasticity.

The income elasticity for quasi-money seemed very high (over 3). This suggested that it might include a trend variable representing 'monetization', which would be highly correlated with income. Inclusion of the population variable (which represents a trend) reduced the income elasticity to 2.4.

In Section 3 I produced forecasts of the different elements of money for the years 1976 to 1983. As it is absolute changes in net foreign assets we are interested in I calculated the mean absolute prediction error and the variance of the error. The lower the error the smaller the error in predicting the balance of payments for a given change in domestic credit, and the money multiplier. The errors were lowest for base money and the highest for M2. This should be of interest to policy-makers. However, even in the case of base money the errors in today's prices could be quite large (K60 million). There is still plenty of room for reducing the error. However, this might be difficult without a far more precisely specified money demand function. In a world of changing government policies, changing expectations, and various external shocks it may be difficult to formulate a more precise function. However, given the many shocks that Zambia has experienced it is a great source of encouragement that the errors are not considerably larger.

CHAPTER 6

MONEY SUPPLY IN ZAMBIA

In order to explain changes in net foreign assets in terms of monetary factors it is necessary not only to explain changes in money demand but also the control the monetary authority has over the creation of money and credit. If the monetary authority cannot control its domestic assets, or predict the effect on total credit of a change in its domestic assets, it will have problems in attaining a balance of payments target, even it can accurately predict demand for the liabilities of the banking system. The purpose of this chapter is to analyze the control the Zambian monetary authorities has over its domestic assets, and how well it can explain the multipliers which determine the total change in domestic assets. Changes in money supply or domestic credit can come about through changes in the money base, and/or changes in the money or bank credit multipliers.

The money supply and bank credit supply process is first described in general terms. In particular, the derivation of the money and credit multipliers is presented. The institutional framework within which the Zambian banking system operates, and the monetary actions of the Bank of Zambia are discussed in the second section, in order to assess the degree of control that the central bank has over base money. The actual behaviour of the multipliers are presented in the third section. In sections four and five explanations are sought for the behaviour of the elements of the multipliers, and an attempt is made to predict their behaviour. Considerable use is made of the results of the last chapter. The last section presents some conclusions as to the explainability of the money supply process in Zambia.

6.1 The Money Supply Process

By definition the money supply process can be written as:

$$Mo = mH$$

where Mo is money supply, m is the money multiplier, and H is the money base (high powered money). After total differentiation this can be written as:

$$dMo = mdH + Hdm + dmdh$$

Dividing through by Mo produces the following:

$$\frac{dMo}{Mo} = \frac{dH}{H} + \frac{dm}{m} + \frac{dmdH}{mH}$$

H is defined as commercial bank reserves plus currency held by the public - C + R. These are assets of the banks and the public, and liabilities of the central bank.[59] Most of the bank

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[59] Strictly speaking, government deposits are also part of central bank liabilities. They can be switched to and from the commercial banks by the central bank in order to induce a deposit contraction or expansion. This potential instrument of monetary control has not been used in Zambia. Government deposits are therefore treated as negative domestic credit to government.

reserves are usually kept at the central bank, and are used for facilitating inter-bank clearings. Some of the reserves are kept at the commercial banks in the form of notes and coins, and foreign exchange. Commercial bank holdings of foreign exchange are usually shown as a separate item from reserves, but are essentially the same as they can be cashed in at the central bank for reserves. The source of high powered money comes from domestic credit extended by the central bank (usually to the government), and foreign assets, and 'other assets minus other liabilities.'[60]

The central bank can try to exert control over the supply of high powered money through varying its domestic credit to customers, and varying 'other assets minus other liabilities'.[61]

As well as being able to control at least part of the supply of high powered money the central bank can influence the demand by placing minimum reserve requirements on bank reserves, and varying these requirements. It can also influence demand by placing or removing constraints on deposit (and credit) creation by the banks. If it considers that deposit expansion is proceeding too quickly it can (apart from altering reserve

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[60] This includes items such as loans to the banks, 'special deposits' levied by the central bank on the banks and other organizations, physical assets, and the equity of the central bank.

[61] In practice the government's financing requirements may mean the surrender of control over high-powered money, but in principle the central bank has control.

requirements) impose special deposits, which has a similar effect to raising reserve requirements, or it can raise the required ratio of liquid assets to deposits, or, in some countries, including Zambia, it can impose credit ceilings on the banks. It can also raise the discount rate to act as a disincentive to banks borrowing extra reserves from it. It can sell government bonds to the public and to the banks. In the latter case there is a problem in that the bonds can be sold back again at any time, in exchange for reserves, and perhaps induce an unwanted credit expansion. Also, money supply will rise by the amount of excess reserves the banks use to purchase the bonds. This is better than the multiple expansion that would occur if they were bought by the central bank. In both cases the central bank may have difficulties in selling new or existing government debt unless it can vary its price.

The money multiplier is not within the direct control of the monetary authority. The size of the multiplier is determined by a mixture of the behavioural actions of the commercial banks and the public, and the policy actions of the central bank. The money multiplier can be viewed in two ways. First, it is the ratio of M1 to base money, or M2 to base money. If the demand for these different elements of money can be explained and predicted on the basis of well-defined demand functions, then the multiplier can also be predicted. The results of the last chapter can simply be used. Second, it is the ratio of the ratios of different components of money. It may be more accurate to predict the numerator or denominator of these ratios, or the ratios as a whole, than to predict M1, M2 and base money.

Using the second method, the M1 multiplier can be derived as follows:

Letting C = currency held by the public
R = commercial bank reserves
D = demand deposits
T = time and savings deposits
c = ratio of currency to demand deposits
r = ratio of bank reserves to demand deposits

then,

$$\frac{M1}{H} = \frac{C + D}{C + R}$$

which, after multiplying and dividing by D becomes

$$\frac{M1}{H} = \frac{c + 1}{c + r}$$

Alternatively, bank reserves can be defined as the sum of reserves required on demand deposits, time and savings deposits, and excess reserves. Letting t be the ratio of time and savings deposits to demand deposits, and rd, rt and re be the required reserve ratios of demand deposits and time and savings deposits, and the excess reserve ratio respectively, the multiplier, after manipulation, can be written as:

$$\frac{M1}{H} = \frac{c + 1}{c + rd + rtt + re(1+t)}$$

The second method is more complicated than the first - there is an additional variable to explain. However, the reserve -demand deposit ratio in the first method may be not so easy to explain as it is influenced not only by rd, but also by rt, re and t.

The M2 multiplier is defined as:

$$\frac{M2}{H} = \frac{C + D + T}{C + R}$$

There are also various ways of writing this. Letting c_1 and r_1 be the ratios of currency and bank reserves to total demand and time and savings deposits respectively, then

$$\frac{M2}{H} = \frac{c_1 + 1}{c_1 + r_1}$$

Another version is:

$$\frac{M2}{H} = \frac{c + t + 1}{c + r_1(1+t)}$$

Or

$$\frac{M2}{H} = \frac{c + t + 1}{c + rd + rtt + re(1+t)}$$

Finally,

$$\frac{M2}{H} = \frac{c + t + 1}{c + r}$$

The definition one chooses to use depends on the accuracy with which the numerator and denominator of the component ratios, or the ratios themselves can be explained and predicted.

An alternative way of examining the controllability of the money supply process is to examine the relationship between the money base and commercial bank credit. From a policy point of view this relationship is relevant as domestic credit is the policy instrument. Rather than impose a ceiling on total credit the authorities can just place a ceiling on the credit expansion of the monetary authority and, with the use of information on the credit multiplier and money demand, predict a balance of payments outcome. The credit multiplier can be written as:

$$\frac{BC}{H} = b$$

Unless commercial bank credit can be explained independently it is necessary to estimate b through estimating its components. It may be possible to explain the demand for bank credit to some extent through the same variables as in the money demand function. However, it probably would not be easy to obtain a good equation because of factors such as 'animal spirits', changing government policies, intermittent credit ceilings, and differential responsiveness of credit demand to different sources of income (e.g. agriculture versus mining). The multiplier can be derived in terms of its component ratios as follows:

$$\frac{BC}{H} = \frac{D + T - NFA - (OA - OL) - R}{C + R}$$

Dividing and multiplying by (D+T),

$$\frac{BC}{H} = \frac{1 - f - e - r_1}{c_1 + r_1}$$

where: - f is the ratio of net foreign assets (NFA) to total deposits;
- e is the ratio of 'other assets less other liabilities' to total deposits;
- other symbols as previously defined.

Alternatively, dividing and multiplying by demand deposits and letting f_1 and e_1 be the ratios of NFA and (OA-OL) to demand deposits respectively, the credit multiplier can be written as:

$$\frac{BC}{H} = \frac{1 + t - f_1 - e_1 - r}{c + r}$$

r and r_1 could also be decomposed further into rd, rt and re.

The differences between this and the money multiplier are the terms f and e. It may be difficult to explain these ratios on the basis of behavioural relationships as is possible for c and r. f is partly determined by the banks and partly by the central bank - how much foreign exchange it allows the banks to keep. The same goes for e. For the purposes of empirical testing it is probably easier to treat both these variables as exogenous, so that predicted values are actual values. The variables to be explained are then the same as in the money multiplier.

6.2 Institutional Framework

IMF (1971) contains a brief description of the monetary system in Zambia (also see Harvey, 1977).

The Bank of Zambia was founded in 1964 under the legislation of the Bank of Zambia Act. Prior to 1964 there was no independent monetary authority in Northern Rhodesia, as the country was part of a monetary union using the Rhodesia and Nyasaland Pound. There are five commercial banks, all but one of which are foreign-owned. In addition there are a number of specialized financial intermediaries, which comprise about 30% of total financial assets.[62]

The BOZ has always possessed the traditional arsenal of instruments at the disposal of central banks, as described in the last section. It also has the power to ration foreign exchange, to regulate how much foreign exchange the commercial banks and other organizations and individuals are allowed to keep for their own purposes, and to prescribe sectoral ceilings on commercial banks' loans and advances. Its powers to conduct open market operations are not limited legally, but are limited practically by the lack of a market, apart from the commercial banks and other financial institutions.[63] Its powers of moral

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[62] See Chapter 4.5

[63] The lack of a market is partly a result of a reluctance to allow interest rates to be determined by market forces. Harvey (1977) notes, however, that BOZ has tried to encourage companies to hold marketable debt. For instance, the government- owned financial non-bank intermediaries were encouraged to buy government debt rather than simply deposit assets at BOZ. The hope was that the creation of a debt market would encourage foreign-owned companies to invest their liquid assets in government debt rather than overseas.

moral suasion are high, mainly because of the limited number of commercial banks. It can influence the composition of bank lending between government and the private sector, and the composition between economic sectors. Together with the government it has a strong measure of control over the allocation of foreign exchange between economic sectors.

In 1968 the powers of BOZ over credit and foreign exchange allocation were considerably toughened, as part of the 'Mulungushsi' reforms.[1] It was decreed that no non-Zambian (wholly or partly) companies could obtain credit from the banks in excess of their equity without the permission of BOZ. As this applied to most companies BOZ was able to directly control credit allocation to much of the economy. Another purpose was to induce foreign owned companies to bring funds into the country and retain a larger proportion of their profits to finance their operations. [2]

Since 1968 BOZ has frequently made use of its instruments of control. In 1969 and 1970 it called special deposits from the

[1]The major reforms were the nationalization of the mining companies and several other large companies.

[2]One apparent reason for the reform was that BOZ had insufficient monetary control because banks could easily satisfy credit demand by obtaining funds from their overseas head offices. C. Harvey (1971) says this reason was invalid because of the reluctance of head offices to become net lenders. As Harvey also mentions, it is doubtful whether the BOZ could have had much influence over credit allocation prior to 1968 because of the high degree of liquidity in the economy (as mentioned in Chapter 4, section 1 above).

mining companies (K25 million and K68 million respectively) in order to stem the build-up of liquidity resulting from a large balance of trade surplus and the repatriation of the foreign exchange proceeds of the mining companies. In 1971 it released these in response to much lower copper prices and a growing demand for credit. In 1972 it unleashed a battery of measures designed to restrict bank lending to the private sector, channel existing financial resources to the Government (to avoid 'inflationary financing of the budget deficit' (BOZ Annual Report, 1972)), and improve the balance of payments. The measures were in response to a deteriorating balance of payments situation, increasing bank lending to the private sector, and a deteriorating government budget position.[66].

The immediate effect was a large decline in banks' actual liquidity to 7% in July, versus 14% earlier in the year.[67] The

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[66]The measures were (see BOZ Annual Report, (1972)): a) Raising of minimum reserve ratios from 8% to 12% for demand deposits and from 3% to 8% for time and savings deposits; b) Increase in minimum liquidity ratio from 25% to 28%; c) The percentage of liquid assets which could be held by each bank in the form of bills of exchange and promissory notes was restricted to 10%, whereas there was no limit previously. d) Long-term government securities could count as liquid assets, while external balances ceased to be eligible for such classification; e) Borrowing by companies was limited according to their debt/ equity ratios. The permitted ratios were 1:1 for Zambian companies and 1:2 for foreign controlled companies

[67]Actual liquidity is liquidity that is readily available to meet cash requirements - they comprise notes and coins, actual cash balances, and Treasury bills. Formal liquidity consists of minimum reserve requirements, bills of exchange, promissory notes, local registered stocks and items in transit.

banks had to sell a large part of their treasury bills to BOZ in order to raise the cash. Banks also reacted to these measures by reducing their net foreign assets (by K8 million), reducing lending to the private sector, and borrowing from other banks and BOZ. The reduction in net foreign assets of the banks helped to finance the balance of payments deficit and also helped to avert a larger decline in net foreign assets of BOZ.

In 1974 a number of measures were enacted:

a) The amount of foreign exchange available for imports was greatly increased, in response to high copper prices; b) Companies were directed to finance imports locally instead of abroad, to take advantage of much lower interest rates. This induced a large increase in domestic credit. Another reason for this was that imports had to be paid for at shipment, again to avoid high interest charges. This increased the need for bridging finance. It also induced a short term capital outflow; c) The large demand for credit, combined with a large budget surplus, drastically reduced banks' actual liquidity to only 4% from about 25%, and brought the total liquidity ratio to close to the legal ratio of 28%. To avoid a credit crunch, BOZ released special deposits (about K20 million) and advanced about K50 million to the banks; d) Near the end of the year BOZ ordered that import finance should be obtained from overseas again, in response to the rapidly deteriorating balance of payments situation; e) BOZ started a 'counter-finance' scheme whereby it lent money to the banks, which in turn lent it to the mining companies, while they awaited the proceeds of their exports from overseas customers. This helped to inject liquidity into the economy.

In 1975 payments arrears started to accumulate. The BOZ ordered importers to place the local currency equivalent of imports on special deposit at the banks, while foreign exchange was awaited. The asset counterpart had to be held in Treasury bills.[68] In 1976, BOZ tried to reduce liquidity by increasing the minimum reserve requirement on demand deposits from 12% to 15%. It kept the requirement on time and savings deposits the same as an incentive for banks to persuade people to hold their money balances in interest-bearing and less liquid deposit accounts, in the hope that this would reduce excess demand pressures. Interest rates were also increased as a further inducement. The exchange rate devaluation of 20%, via an increase in prices, helped to mop up some of the excess supply of money. However, BOZ lending to government and the mining companies made it hard for BOZ to control money supply.

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[68]Thus, if the objective of import deposits was to prevent liquidity building up in the economy, it didn't succeed as the government merely reinjected it back into the system.

In 1978, a further 10% devaluation helped mop up excess money balances. Interest rates were again raised. Neither the minimum reserve ratio nor the liquidity ratio were changed. However, it was recognized that the Treasury bills held by the banks as the counterpart to import deposits represented a potentially dangerous source of new demand for goods, if they were to be cashed in to satisfy credit demand. Therefore BOZ directed that they be consolidated under BOZ - in effect there was a 100% reserve requirement against import deposits.

After the 1978-1980 IMF program there was little attempt at monetary control until 1983. Credit to government was restricted during the short-lived 1981 IMF program. However, credit to the private sector increased so much that the total credit ceiling was exceeded. The BOZ facilitated this by advancing about K70 million to the banks, so that they would not fall under the liquid assets ratio.

In 1983, a new IMF program led to more active monetary policy, via a 20% devaluation and subsequent depreciation, and a large increase in interest rates. However, by 1984 BOZ was finding it difficult to maintain control because, once again, of large government budget deficits. At the end of 1984, BOZ ceased making purchases from the IMF. The very latest development has been the inauguration of an 'exchange auction'. This led to a 55% depreciation of the kwacha against the dollar in the first week of October, 1985.

In conclusion, monetary policy was quite active until 1975. Since then, it has been subordinate much of the time to the financing requirements of the government and the mining companies, which has made it very difficult for it to regulate liquidity in the economy, and therefore to respond to incipient balance of payments pressures. Prior to 1975 this was easier as budgetary and balance of pressures were not so pressing. Also, ample foreign exchange reserves enabled liquidity to drain out of the economy automatically in response to demand pressures. Once these reserves were depleted the liquidity was locked up in the economy. BOZ would have found it easier to control its domestic assets if there had been a market for government debt. Deregulation of interest rates might have facilitated this, but this did not occur. Given budgetary requirements, raising minimum reserve requirements would not have helped much as the budget deficit would have pumped liquidity back into the system.

However, notwithstanding the above, the central bank, in principle, can control its domestic assets, given agreement with the government on control over the budget deficit. IMF programs recognize this by setting limits on central bank extension of credit to government.

6.3 Description of Behaviour of Money and Credit Multiplierss

Tables 6.1 and 6.2 below decompose the changes in M1 and M2 into changes in base money and changes in the money multiplier.

TABLE 6.1

DECOMPOSITION OF ANNUAL CHANGES IN M1

Year	%ch. M1	Diff.	%ch. Base	%ch. Mult.	%ch. Inter.
66	32.9	-8.5	24.4	6.7	1.6
67	24.5	1.7	26.2	-1.1	-0.3
68	25.6	-3.4	22.2	2.8	0.6
69	12.7	-3.5	9.2	-3.1	0.3
70	15.4	6.3	21.7	-4.4	-1.0
71	7.2	-1.6	5.6	1.6	0.1
72	1.0	19.1	20.1	-16.1	-3.2
73	14.3	0.9	15.2	-1.5	-0.2
74	12.7	3.8	16.5	-3.2	-0.5
75	10.5	0.2	10.7	0.02	0
76	25.0	4.7	29.7	-3.8	-1.13
77	14.2	-1.1	13.1	1.1	0.14
78	-1.9	7.5	5.6	-6.9	-0.38
79	11.9	-7.5	4.4	6.6	0.29
80	10.8	0.5	11.3	1.3	0.12
81	12.7	4.0	16.7	-4.4	-0.74
82	10.1	4.4	14.5	-4.3	-0.62
83	17.0	2.2	19.2	-1.8	-0.34.
Mean	14.3	1.7	15.6	-1.4	-0.2
St. Dev		6.2		5.3	
66-75					
Mean		1.5		-1.23	
St. Dev		7.4		6.2	
73-83					
Mean		1.8		-1.48	
St. Dev		4.0		3.65	

It is clear that most of the changes in M1 are accounted for by changes in base. The mean increase in M1 was 14.3% versus a mean increase of 15.6% in base. However the differences between the annual percentage changes have a high variance, implying a changing multiplier, as also reflected in the fifth column. If one made the extreme assumption (as P&R (1979) do) that growth rates were normally distributed, one could predict that the growth of M1 will vary between 14% slower and 11% faster than base 95% of the time - a large margin of error. However, such an assumption seems unrealistic in light of the results of the previous chapter, and in view that the means and variances are very different for different sub-periods. Table 6.2 shows the decomposition of M2.

TABLE 6.2

DECOMPOSITION OF ANNUAL CHANGES IN M2

Year	%ch. M2	Diff	%ch. Base	%ch M2mult	%ch. Inter.
66	28.7	-4.3	24.4	3.2	0.8
67	25.6	-0.6	26.2	-0.5	-0.1
68	18.8	-3.4	22.2	-2.8	-0.6
69	18.4	9.2	9.2	8.4	0.8
70	25.0	3.4	21.7	2.8	0.6
71	10.8	5.3	5.6	5.0	0.3
72	7.0	-13.1	20.1	-10.9	-2.2
73	13.3	-1.9	15.2	-1.6	-0.2
74	20.4	3.9	16.5	3.3	0.6
75	-4.5	-15.2	10.7	-13.8	-1.5
76	25.7	-4.0	29.7	-3.1	-0.9
77	24.4	11.3	13.1	10.0	1.3
78	-0.3	-5.9	5.6	-5.6	-0.3
79	7.6	3.2	4.4	3.0	0.1
80	18.9	7.6	11.3	6.9	0.8
81	7.5	-9.3	16.7	-7.9	-1.3
82	19.3	4.8	14.5	4.2	0.6
83	22.0	2.8	19.2	2.4	0.5
Mean	16.0	-0.12	15.6	0.18	-0.04
St. Dev		7.4		6.6	
1966-75					
mean		0.8		-.66	
St. Dev		7.9		7.0	
1973-83					
mean		0.25		-0.2	
St. Dev		7.8		7.0	

As with M1 the mean growth of M2 is almost the same as that of base money. The mean growth rate of M2 is higher than M1, reflecting the growth of time and savings deposits. Of interest is the higher variation of the multiplier. The fluctuations appear, also, to be more random. The variances are very similar for the two sub-periods.

The M1 multiplier declined over the whole period at an average annual rate of 1.5%. However, it increased from 2.26 to 2.53 between 1965 to 1969. Table 6.3 shows that the currency-demand deposit ratio was the same in 1969 as 1965 (it rose, then declined). The explanation lies in the reserve-demand deposit ratio, which fell from 0.24 to 0.18.[69] The reason may be the high liquidity of the banks at independence, and the strong demand for credit in the ensuing years as a result of strong economic growth.

The multiplier fell by 16% in 1972. One reason for this was a rise in the reserve-demand deposit ratio following the large rise in legal reserve requirements in that year. Another reason was a rise in the currency-deposit ratio of 22%. As Keran (1970) notes, a credit squeeze will tend to cause the currency-deposit ratio to rise as companies economize on deposits, and because they hold a large proportion of total deposits. After 1972 the M1 multiplier declined in most years, with a lower variance than in earlier years. There was a large negative swing in 1978, followed by a large positive swing in 1979. Both reserve and currency ratios rose in 1978 and both fell in 1979. The reason for the rise in 1978 is probably the credit squeeze that caused companies to economize on deposits. In 1979, credit ceilings for the private sector were relaxed. Very high copper prices may

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[69]From Section 6.1 the M1 multiplier was defined as $(1+c)/(c+r)$. Also, $\delta m/\delta c = (r-1)/(c+r)^2$, which is < 0.

have induced some optimism. As a result bank lending and demand deposits increased rapidly, probably causing the downward shift in the ratios.

The decline in the M2 multiplier was very small over the whole period. However, the variance was greater than the M1 multiplier. As the algebra in Section 6.1 shows the difference in the variability in the two multipliers lies in the ratio of time and savings deposits to demand deposits. Tables 6.3 and 6.4 below show that t has a greater variability than c or r. The standard deviation of percentage changes in c and r are 11.5 and 13.1, compared to 15.9 for t.

A possible reason why the link between time and savings deposits and base money is more volatile than the link between base and M1 is deposit switching between banks and other financial institutions because of interest rate differentials. This seems unlikely as rates were rarely changed and tended to move in tandem (or with a slight lag). An examination of the statistics of the National Savings and Credit Bank and the National Building Society does not reveal wide fluctuations in deposits. A more likely reason is switching between demand deposits and time deposits in response to such factors as interest rates, incomes, inflation and exchange and import controls.

The M2 multiplier increased by 18% between 1965 and 1971, with all the increase coming after 1968. The lack of change before 1969 can be ascribed to the fall in the reserve ratio (the ratio of reserves to demand deposits) being offset by a decline in the ratio of time deposits to demand deposits.[70] From 1969 to 1971 there was little overall change in c. t rose from 0.6 to 0.84, in response to the repatriation of mining company foreign exchange proceeds but r remained virtually the same, so that the multiplier increased.

The M2 multiplier dropped sharply in 1972, reflecting the 1972 credit squeeze, and the rise in minimum reserve ratios. The drop was not as great as for the M1 multiplier. This can be ascribed to a rise in t. One reason for this was, according to BOZ (Annual Report, 1972), the abolition of an inter-bank agreement that had prevented interest rate competition. Interest rates rose by a quarter of a percentage point. Another reason may be that building society rates did not change, causing an influx of funds into time deposits. The M2 multiplier dropped very sharply in 1975 (by 13%), whereas the M1 multiplier was unchanged. The main reason was a large (29%) fall in t which

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[70] Using the last definition of the M2 multiplier in Section 6.1, then:
$\delta m/\delta t = (c+r) - \delta r/\delta t(c+1+t)/(c+r)^2$. If $\delta r/\delta t$ is ≤ 0 then $\delta m/\delta t$ is ≥ 0. If $\delta r/\delta t > 0$ then $\delta m/\delta t$ is < 0 if $(c+r)$ is $< \delta r/\delta t(c+1+t)$. Whether $\delta r/\delta t$ is $\geq$ or ≤ 0 depends on the differential reserve requirements on the two kinds of deposits. If the reserve ratio for time deposits is lower than for demand deposits then the effect on the multiplier of a rise in t is ambiguous. A rise in t caused by a rise in time deposits causes a rise in r if demand deposits change very little. If a rise in t is accompanied by a fall in demand deposits then r will fall.

produced only a small change in r. One reason forthe fall in t could be the rise in the rate of inflation that year (the rationale for this was explained in the last chapter), unaccompanied by a rise in interest rates. Other reasons are perhaps intensified exchange controls, combined with an excess demand for foreign currency, reflected by a fall in the black market rate (also reflected by an increase in the currency ratio, particularly the ratio of currency to total deposits, which rose by 25%).

The M2 multiplier rose by 10% in 1977. The main reason was an increase of 21% in the t ratio. This was probably in response to higher interest rates, and higher liquidity in the economy, combined with intensified exchange and import controls. There were sizeable decreases in the M2 multiplier in 1978 and 1981. These were partly caused by a combination of larger c and r. These, as discussed earlier, can all be explained, in part, by companies and individuals economizing on deposits, particularly demand deposits, during periods of tight credit. Another reason is a fall in t. As suggested in Chapter 5 time and savings deposits seem to act as a buffer stock (i.e. as precautionary balances). While it is possible to economize on demand deposits to some extent during a credit squeeze, there is a limit as balances for transactions needs have to be kept.

Tables 6.3 and 6.4 show the behaviour of the multiplier components, to illustrate the discussion above.

TABLE 6.3

MONEY MULTIPLIER COMPONENTS

Year	c	%ch. c	r	%ch. r
1965	0.36	NA	0.24	NA
1966	0.36	-0.23	0.21	-15.00
1967	0.42	16.70	0.18	-13.86
1968	0.38	-8.11	0.18	2.47
1969	0.35	-8.60	0.19	1.41
1970	0.31	-11.92	0.24	27.86
1971	0.36	18.59	0.20	-16.61
1972	0.45	24.23	0.26	30.73
1973	0.42	-8.36	0.28	9.35
1974	0.43	4.34	0.30	5.27
1975	0.46	6.45	0.28	-4.38
1976	0.46	-1.34	0.32	10.88
1977	0.42	-8.31	0.33	3.53
1978	0.44	5.58	0.37	14.45
1979	0.40	-9.17	0.34	-8.63
1980	0.38	-4.50	0.35	3.18
1981	0.47	22.94	0.34	-4.73
1982	0.48	1.28	0.37	9.04
1983	0.48	1.70	0.38	3.30
Mean		2.3		3.2
St. Dev		11.5		13.1
Growth rate	1.7		2.5	
1966-1975				
Mean		3.3		2.7
St. Dev		13.0		16.6
Growth Rate	2.5		1.6	
1973-1983				
Mean		0.96		3.8
St. Dev		9.3		7.2
Growth Rate	1.3		3.1	

Notes - c is the ratio of currency to demand deposits;
- r is the ratio of bank reserves to demand deposits.

Source: - IFS.

Table 6.3 shows that c grew over the period, but grew faster during the first sub-period. The average change was 2.3%, but was much lower in the second sub-period. The reserve ratio also grew. For both ratios the variance is much larger than the mean. However, this thesis has indicated that there may be sound economic reasons for these fluctuations.

TABLE 6.4

MONEY MULTIPLIER COMPONENTS (2)

Year	c_1	%ch. c	r_1	%ch. r_1	t	%ch. t
1965	0.21	NA	0.15	NA	0.69	NA
1966	0.22	3.98	0.13	-11.75	0.60	-13.47
1967	0.25	13.49	0.11	-15.98	0.64	7.33
1968	0.25	-0.61	0.12	10.82	0.52	-19.26
1969	0.22	-13.28	0.12	-3.76	0.60	15.77
1970	0.18	-19.72	0.14	18.34	0.74	22.91
1971	0.20	12.69	0.11	-22.05	0.84	14.59
1972	0.22	12.48	0.13	18.44	1.04	23.17
1973	0.21	-5.97	0.14	12.19	0.99	-4.68
1974	0.20	-4.09	0.14	-3.55	1.17	17.99
1975	0.25	25.69	0.16	13.24	0.83	-29.01
1976	0.25	-1.71	0.17	10.44	0.84	1.20
1977	0.21	-16.23	0.16	-5.58	1.01	21.04
1978	0.21	2.85	0.18	11.34	1.07	5.65
1979	0.21	-3.86	0.18	-2.96	0.95	-11.86
1980	0.18	-11.64	0.17	-5.22	1.10	16.86
1981	0.23	25.96	0.16	-1.36	1.05	-4.71
1982	0.21	-7.86	0.16	-1.18	1.27	20.25
1983	0.20	-4.02	0.16	-2.48	1.41	11.59
Mean		0.45		1.05		5.3
SD		13.2		11.7		15.9
Growth rate	-0.3		0.4		4.1	
1965-75						
Mean		2.5		1.6		3.5
SD		13.9		14.9		18.8
Growth Rate	1.8		-0.7		5.4	
1973-83						
Mean		-0.08		2.3		4.0
SD		13.7		7.7		15.7
Growth Rate	-0.5		1.3		3.6	

Note: - c_1 is the ratio of currency to total deposits;
- r is the ratio of bank reserves to total deposits;
- t is the ratio of time and savings deposits to demand deposits;

Source: IFS.

Looking at Table 6.4, c_1 stayed virtually the same over the whole period, reflecting an increasing t. It grew slowly during the first sub-period, but then declined slowly. The fluctuations were greater than for c, probably because of the fluctuations in t. r_1 changed only marginally during the period. It grew slowly during the first sub-period, then declined slowly.

The t ratio showed a higher annual average percentage change and variance than the other components.

The above exercise shows the changes in the individual components in the multiplier. It is also possible to specify approximately the contribution of changes in each component to changes in the multipliers. I conducted this exercise using the methodology developed by Friedman and Schwartz (1963). The results are in Tables 6.5 and 6.6. [71]

The formula used by Friedman and Schwartz is:

$$db = \ln b_1 - \ln b_0 - \ln(b_1+p_0) + \ln(b_0+p_0)$$

$$dp = \ln(1+p_1) - \ln(1+p_0) - \ln(b_0+p_1) + \ln(b_0+p_0)$$

$$dbdp = -\ln(b_1+p_1) + \ln(b_1+p_0) + \ln(b_0+p_1) - \ln(b_0+p_0)$$

b = ratio of deposits to bank reserves

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[71] Diz (1970) and PR (1979) use another method. The change in the multiplier can be approximated by totally differentiating the function: $m = f(c,r,t)$, so that:
$dm = \delta m/\delta c \cdot dc + \delta m/\delta r\ dr + \delta m/\delta t\ dt +$ Interaction terms.
Diz obtains the interaction term as a residual. As P&R (1979) note, for finite changes in the multiplier the average of the partial derivatives over two periods can be used. Some of the partial derivatives are evaluated in earlier footnotes in this chapter.

p = ratio of deposits to currency held by the public.

This exercise was carried out for both the M1 and M2 multipliers. For the M1 multiplier the ratios were expressed in terms of demand deposits. For the M2 multiplier, the ratios were expressed in terms of total deposits (thus avoiding the term t). [72]

Table 6.5 shows that the contribution of the currency ratio to changes in the M1 multiplier (dp) offsets to some extent the contribution of the reserve ratio (db). This happened in 11 out of the 18 years, but has been less the case over the last 8 years. The mean and variance of the contribution of the currency ratio has been somewhat higher than that of the reserve ratio.

The degree of offsetting is less in the case of the M2 multiplier. Only in 50% of the cases is the contribution of the reserve ratio the opposite sign of the contribution of the currency ratio. Again most of these cases were in the earlier years. As was the case with the M1 multiplier the contributions of both ratios strongly reinforced each other in 1972. The mean and variance of the contributions is similar except for the second sub-period, when the contribution of the currency ratio fluctuated more. As with the M1 multiplier, the variances in the contribution of the ratios is much greater than the means.

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[72] This formula is an approximation only. The last column in Tables 6.5 and 6.6 show actual changes in the multiplier. In some years the difference between actual and approximation is quite large.

Possible reasons for changes in the ratios were alluded to earlier, and will be discussed in more detail below.

TABLE 6.5

CONTRIBUTIONS TO CHANGES IN THE M1 MULTIPLIER

Year (1)	%ch. dp (2)	%ch. db (3)	%ch. dbdp (4)	Sum= 2+3+4 (5)	Actual %ch. M1mult. (6)
1965	NA	NA	NA	NA	NA
1966	7.36	0.18	0.02	7.56	6.81
1967	4.57	-5.80	-0.45	-1.68	-1.34
1968	-0.58	3.56	-0.04	2.95	2.72
1969	-0.49	3.73	-0.03	3.21	3.16
1970	-7.51	5.67	-0.70	-2.54	-5.16
1971	6.90	-5.71	-0.66	0.52	1.50
1972	-8.83	-8.60	1.30	-16.14	-15.90
1973	-4.79	2.89	-0.27	-2.16	-0.74
1974	-1.88	-1.22	0.05	-3.05	-3.24
1975	1.69	-1.70	-0.06	-0.07	-0.14
1976	-4.07	0.26	-0.02	-3.83	-3.66
1977	-1.28	2.46	-0.07	1.12	1.00
1978	-5.42	-1.45	0.16	-6.70	-7.08
1979	3.53	2.49	0.20	6.22	7.16
1980	0.95	1.11	0.02	2.09	-0.41
1981	0.79	-5.20	-0.08	-4.49	-3.44
1982	-4.62	-0.51	0.05	-5.08	-3.82
1983	-1.44	-0.43	0.01	-1.85	-1.89
Mean	-0.8	-0.5	-0.05		
SD	4.6	3.9	0.4		
1966-75					
Mean	-0.4	-0.7	-0.08		
SD	5.6	4.8	0.6		
1973-83					
Mean	-1.1	-0.3	-0.02		
SD	3.1	2.4	0.1		

Notes: - db, dp and dbdp are defined above, in terms of ratios of demand deposits to currency amd bank reserves;
- M1 multiplier is publicly held currency plus demand deposits divided by base money.

TABLE 6.6

CONTRIBUTIONS TO CHANGES IN THE M2 MULTIPLIER

Year	%db	%dp	%dbdp	SUM= 2+3+4	Actual %ch. M2mult
(1)	(2)	(3)	(4)	(5)	(6)
1965	NA	NA	NA	NA	NA
1966	5.69	-1.39	-0.11	4.19	3.44
1967	5.58	-5.89	-0.46	-0.77	-0.45
1968	-2.99	0.38	-0.02	-2.62	-2.80
1969	1.18	6.99	0.12	8.29	8.40
1970	-4.07	10.85	-0.60	6.18	2.76
1971	8.70	-4.70	-0.55	3.46	4.97
1972	-5.05	-6.17	0.42	-10.80	-10.88
1973	-5.70	2.84	-0.22	-3.08	-1.64
1974	1.48	1.95	0.04	3.47	3.34
1975	-5.09	-9.46	0.67	-13.88	-13.75
1976	-3.93	0.50	-0.03	-3.47	-3.10
1977	2.37	7.12	0.25	9.75	9.97
1978	-4.11	-0.93	0.05	-4.98	-5.56
1979	0.77	1.47	0.02	2.26	3.04
1980	4.09	4.46	0.27	8.82	6.86
1981	0.03	-8.64	-0.00	-8.61	-7.93
1982	-0.56	3.35	-0.03	2.77	4.17
1983	1.07	1.55	0.02	2.65	2.36
Mean	-0.03	0.24	0		
SD	4.3	5.6	0.32		
1966-75					
Mean	-0.03	-0.46	-0.07		
SD	5.3	6.35	0.4		
1973-83					
Mean	-0.87	0.38	0.095		
SD	3.3	5.1	0.23		

Notes:
- db, dp and dbdp are as defined earlier, in terms of ratios of total deposits to currency and bank reserves;
- M2 multiplier is defined as M2 divided by base;

Bank Credit

A similar analysis of changes in commercial bank credit is provided below in Table 6.7. Changes can be expressed as:

$$dBC/BC = dH/H + db/b + dbdH/bH$$

where BC is commercial bank credit, H is high powered money, and b is the bank credit multiplier, defined as the ratio of bank credit to base.

TABLE 6.7

DECOMPOSITION OF ANNUAL CHANGES IN BANK CREDIT

Year	%ch. BC	Diff.	%ch. Base	%ch. BC Mult.	%ch. Inter.	%ch. BC Mult.1
66	42.1	15.1	27.3	11.7	3.2	11.1
67	15.4	-8.4	23.8	-6.3	-1.6	-6.1
68	28.8	7.7	21.1	5.9	1.2	17.2
69	24.8	8.9	15.9	8.1	1.3	0.4
70	11.5	14.2	-2.7	14.5	-0.4	13.4
71	17.8	-8.0	25.4	-6.1	-1.5	-11.5
72	14.6	-4.5	19.1	-3.1	-0.7	-8.3
73	12.8	-3.2	16.0	-3.2	-0.5	-2.1
74	31.3	27.2	4.1	26.5	1.1	8.3
75	0.6	-36.1	36.7	-26.5	-9.7	-20.0
76	17.4	-1.8	18.9	-1.0	-0.2	0.5
77	21.2	14.5	6.7	13.1	0.9	15.7
78	-13.5	-19.5	5.9	-18.3	-1.1	-21.8
79	52.4	46.4	6.0	44.3	2.6	-0.6
80	4.9	-6.7	11.6	-6.1	-0.7	33.7
81	18.3	-1.3	19.4	-1.2	-0.2	-21.4
82	33.6	19.1	14.5	16.7	2.4	41.2
83	7.4	-6.3	13.7	-5.6	-0.8	-10.2
Mean		1.9		3.5		2.2
St. Dev		17.9		16.4		17.7

Notes: - commercial bank credit consists of credit to the private sector and government. It excludes the counterpart of payments arrears, which were invested in Treasury bills before being transferred to BOZ in 1978.
- The last column reflects the inclusion of 'other assets minus other liabilities' in bank credit.

Comparing Table 6.7 with Tables 6.1 and 6.2 it is clear that the bank credit multiplier fluctuates more than the M1 and M2 multipliers. The standard deviation is 16.4 compared to 5.3 and 6.6 for the M1 and M2 multipliers respectively. However, there is some sort of a pattern to the variations. The multiplier tends to rise when bank credit is increasing, although this is not obvious every year. In 1974, bank credit expanded considerably. This caused a fall in the reserve ratio (excess reserves fell to zero), and an increase in the bank credit multiplier. In 1975 the multiplier fell in response to a large decline in lending to the private sector, which caused a large rise in excess reserves, and a rise in the reserve ratio. The large increase in the currency ratios that year also contributed to the fall in the multiplier. In a similar manner, the fall in the multiplier in 1978, and subsequent rise in 1979 can be attributed to the credit program of those two years. The large increase in credit in 1982 may explain the increase in the multiplier in that year.[73]

If domestic credit is defined to include 'other assets less other liabilities' (which eliminates the 'e' term in the multiplier), the annual changes in the multiplier change considerably. However, the mean and the variance change very little (this is shown in the last column of Table 6.7).

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[73]The credit multiplier was defined in section 6.1 in terms of its component ratios. The change in the multiplier due to a change in the reserve ratio (r) can be written as:

$$\delta b/\delta r = (f + e - c - 1)/(c + r)^2$$

where the symbols are as defined in Section 6.1.This will normally be negative as f and e are normally small. The change in b due to a change in the currency ratio can be written as:

$$\delta b/\delta c = (r + f + e - 1)/(c+r)^2,$$

so that the sign is ambiguous.

The credit and money multipliers have the c and r terms in common (plus the t term under an alternative definition of b). In order to explain the credit multiplier the terms f and e must be explained in addition. This may be hard as simple behavioural hypotheses such as can be formulated for the elements of c and r are not so easy to derive for f and e. Both are subject to portfolio and policy influences.

Table 6.8 below shows net foreign assets and 'other items net' as a fraction of demand deposits and total deposits.

TABLE 6.8

RATIO OF 'OTHER ITEMS NET' AND NET FOREIGN ASSETS OF COMMERCIAL BANKS TO DEPOSITS

Year	OIN / Demand Deps.	OIN / Total Deps.	NFA / Demand Deps.	NFA / Total Deps.
65	16.1	10.4	10.3	6.7
66	16.0	10.5	10.4	6.8
67	17.5	11.1	5.7	4.2
68	27.8	18.8	-1.7	-1.2
69	20.5	13.1	3.2	2.0
70	20.9	12.1	10.3	6.0
71	15.1	8.2	0	0
72	8.2	4.3	-7.6	-3.8
73	9.0	4.9	-6.6	-3.5
74	-17.0	8.9	-6.3	-3.2
75	-2.8	-1.6	-8.7	-5.0
76	0	0	-7.5	-4.0
77	9.8	1.7	-12.7	-5.9
78	-3.8	-2.0	-7.9	-4.1
79	-55.1	-30.3	9.7	5.3
80	-7.4	-3.6	-12.4	-6.0
81	-51.8	-24.5	6.9	3.2
82	-17.8	-7.7	-14.8	-6.4
83	-26.0	-11.8	-2.3	-1.1
Mean	0.7	1.1	-1.8	-0.4
St. Dev	23.6	12.8	8.6	4.7

Source: Table 4.5 above.

Notes: - OIN are 'other items net', that is, 'other assets' less 'other liabilites'. They differ from the official figures in that they exclude payments arrears, which are instead assumed to be foreign liabilities of the monetary authority. They include: balances held at Zambian banks, 'other assets', amounts owing to BOZ and other banks, bills payable, and 'other 'liabilities'.

- total deposits are demand deposits plus time and savings deposits;
- figures are year-end.

Clearly the variance of the ratio of OIN to deposits, particularly demand deposits, is very high. There is a pattern, however, in that the ratio is positive prior to 1974, and mainly negative thereafter, reflecting the predominance of non-monetary liabilities. Unfortunately, the official figures do not provide a detailed breakdown of the composition of the individual items under OIN. Therefore, explanations for the annual changes in the ratio are bound to be fairly hazardous.[74] As these items in the balance sheet are presumably under the control of the banks and BOZ it seems justifiable to treat 'e' as an exogenous variable, which can simply be subsumed under bank credit. Table 6.7 shows that the variance of the changes in the multiplier under this broader definition is only marginally higher than the narrower definition.[75]

The ratio of NFA to deposits has a much smaller variance, particularly for total deposits. The ratios are generally very small. Not surprizingly, the ratio is predominantly negative after the early 1970s.

It would appear to be difficult to explain the behaviour of f as there is no obvious behavioural hypothesis that would do

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[74] One reason for the change to negative ratios after 1973 may be the introduction of the export finance scheme, whereby the BOZ lent money to the banks, which in turn was lent to the mining companies as a bridging loan prior to the arrival of export receipts. The large negative item in 1981 can be attributed to advances by BOZ to the banks.

[75] In which case, the multiplier becomes : $(1 - f - r)/(c + r)$.

the job. It might be possible to explain the numerator and denominator separately. The denominator can be explained in terms of demand equations, as was done in the last chapter. It is difficult to explain the behaviour of NFA separately as the BOZ determines the extent to which the banks are allowed to retain foreign exchange proceeds, rather than surrender them to BOZ. One could attempt to explain net foreign assets in a reserve flow equation (as outlined in Chapter 2, and discussed further in Chapter 7). However, this is impossible if bank credit is an endogenous variable as it is necessary to know the bank credit multiplier, which is what one is attempting to explain in the first place. There is also still the problem of the interdependence between NFA and bank reserves.[76] Therefore it is impossible to explain NFA as a separate item. As the amount of NFA that the authorities allow the banks to hold is largely a policy decision, it is best, for the purposes of research, to treat the predicted values as the actual values.

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[76]The bank balance sheet can be written as:

$$\Delta NFA = \Delta D - \Delta BC - \Delta R$$

where D is total deposits, BC is bank credit, including OIN, and R is reserves. Letting BC = bH, substituting for H, and assuming the change in the supply of deposits equals the change in demand, the equation, after some manipulation, is:

$$\Delta NFA/b + \Delta NFA_1 = \Delta D/b - \Delta DC - \Delta R/b - H_{-1}\Delta b/b,$$

where ΔNFA_1 is the NFA of the monetary authority, and ΔDC is the domestic credit of the monetary authority. One cannot explain total NFA without knowing b, and one cannot explain b without explaining first what f is.

6.4 Estimation and Forecast of Multipliers

The purpose of this section is to find behavioural reasons for changes in the money and credit multipliers. This boils down to an analysis of the behaviour of the currency and reserve ratios. It will be remembered from the literature review in Chapter 3 that P&R (1979) suggested that research attempting to explain changes in the multiplier components would be useful.

A good example of research into money multipliers can be found in Diz (1970), in his study on the monetary experience of Argentina. He sets up a simple model to explain changes in the reserve ratio (which was the largest determinant of changes in the multiplier). The model incorporates 'the policy influences of the monetary authorities as well as the reaction of banks to certain variables which affect their decision to hold reserves.'

An important determinant of reserve ratios is the legal reserve ratios on different classes of deposits. Diz explains the holdings of excess reserves in terms of demand and supply. In terms of demand, his hypothesis is that the demand for excess reserves is a function of the opportunity cost of holding reserves - in terms of the foregone yield on interest earning assets that could be substituted for reserves - and of the composition of deposits. Deposit composition influences banks' expectations of clearing drains. As time and savings deposits require longer withdrawal notice one can hypothesize that the excess reserves ratio will be lower the higher the ratio of time and savings deposits to demand deposits.

In terms of supply, Diz' hypothesis is that the central bank may alter the supply of reserves to the banks. The central bank could accomodate a change in demand for reserves by injecting or withdrawing reserves to and from the system. Alternatively it could allow market forces to bring about the change in supply. For example, if bank liquidity is running low because of high credit demand, the central bank could inject more reserves into the system, rather than allow a credit squeeze to develop. Diz proxies this variable by the rate of change in bank reserves. [77]

Diz allows for the possibility of adjustment lags, or banks basing their behaviour on 'expected' variables, by using moving averages of rates of change in reserves, deposit composition, and of the opportunity cost of holding money. Treasury bill rates are used to represent opportunity costs. In symbols, his model is:

$$r = f(r_l, d, i, (1/R)(dR/dt), S, u)$$

where

r = aggregate reserve ratio

r_l = legal reserve ratio

d = ratio of demand deposits to time and savings

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[77] Bolnick (1981) also uses this variable, only in the context of a lag between a change in reserve flows and a change in lending.

deposits

i = actual or expected opportunity cost of holding reserves

(1/R)(dR/dt) = actual or expected flow of total reserves

S= dummy variable representing seasonal factors

u = other possible influences

Diz obtains fairly good results in his empirical tests. One problem that he does not emphasize is that d is not an exogenous variable (nor, for that matter, are the other variables, except the legal reserve ratios), as the numerator and denominator are determined by demand influences. If one used the predicted values instead of the actual values of d the residual errors in estimating r would be higher.

Diz then explains the currency ratio and d by first explaining the demand of the numerator and denominator of these variables, and comparing the coefficients. For example, he concludes that an increase in permanent income will cause a decrease in the ratio of currency to demand deposits as his estimated income elasticity for demand deposits is higher than for currency. In this way he accounts for the actual movements in the ratios quite well.

Keran (1970) discusses possible reasons for changes in the currency ratio in Japan. He notes that the ratio increases during periods of tight money. The reason is that businesses tend to economize on their money holdings when money is tight. As they hold most of their money holdings in bank deposits, and their relative (to individuals) shares of deposits and currency are high and low respectively, bank deposits will tend to fall relative to currency when money is tight.

Wilford (1979) explains in casual terms the changes in the currency ratio in Mexico. Until 1970, there was a downward trend, reflecting factors such as expansion of the banking system, increased confidence in the banking system, and higher educational levels. After 1970 the trend was upwards, reflecting an increased inflation rate and increased instability.

In this section I will utilize Diz' approach by developing and testing a reserve ratio model. This requires a certain leap of faith, as the ratio of time and savings deposits and the rate of change of reserves are taken as given. However, it allows the estimation of a quarterly model (as the data for all the variables is available), and gives an idea of what the errors are. Following this I use the results of chapter 5 to estimate the currency ratios, the ratio of time and savings deposits to demand deposits, and, for comparison, the reserve ratios. I then estimate the multipliers. I also use time series analysis to estimate the ratios.

Given that the money multipliers are simply ratios of deposit-inclusive money to base money, it may seem unnecessary to analyze the component ratios. However, it could be the case that the errors in estimating the component ratios are less than the errors in estimating deposit-inclusive money and base money. This possibility alone justifies the exercise. In the case of the bank credit multiplier it is necessary to explain the component ratios.

I experimented with both reserve ratios (that is, the ratio of reserves to demand deposits, and the ratio of reserves to demand and time and savings deposits).[78] The first model I tried was a regression of the ratio of reserves to demand deposits on the explanatory variables in the Diz model. An explanation of the expected signs is appropriate. An increase in the Treasury bill rate would increase the opportunity cost of holding reserves, and this would tend to lower reserves for any given demand deposits. Counteracting this, however, a rise in the T-bill rate (proxying other interest rates) might prompt a shift from demand deposits to TS deposits. TS deposits carry a lower reserve requirement, so that total reserves would fall, but not as fast as demand deposits as reserves still have to be held against TS deposits. Therefore the net effect is indeterminate.

[78] It may seem questionable to use the ratio of reserves to demand deposits as a dependent variable, as reserves can vary against demand deposits not only because of changes in the legal reserve ratio on demand deposits and desired excess reserves against demand deposits, but also because of changes in the legal requirement on time and savings deposits (TS deposits), changes in the level of TS deposits, changes in the ratio of TS deposits to demand deposits, and changes in excess reserves held against TS deposits. However, these factors are explanatory variables, and can simply be included in the equation.

If the effect on the holding of excess reserves against demand deposits outweighs the effect on the ratio of TS deposits to demand deposits, (T/D ratio) then the coefficient will be negative.

The sign on the T/D ratio is also indeterminate. If T/D rises but total deposits remain the same then demand deposits must fall. This would cause the reserve ratio to rise as reserves still need to be held against TS deposits. Against this, desired excess reserves might fall as the probability of sudden clearing drains diminishes with a rise in the T/D ratio. Also, if T/D is rising because TS deposits are rising faster than demand deposits then total reserves will rise faster than demand deposits, causing the ratio to rise. In practice one would expect a positive sign.

Both the legal reserve ratios should have positive coefficients. The rate of change of reserves should obviously have a positive coefficient.

In addition to the explanatory variables in Diz' model I added the rate of inflation. The reasons for using both interest rates and expected inflation as measures of opportunity cost were discussed in Chapter 5. One might expect a differential effect on reserves and deposits, as bankers may be less susceptible to money illusion and be quicker at adjusting their money holdings than holders of demand deposits. Bankers may also be less prone to 'uncertainty' factors than the public. People may also increase their holdings of demand deposits relative to TS deposits as a result of an increase in the inflation rate. A negative coefficient would therefore be expected.

The results of the regression are shown in Table 6.9 below:

TABLE 6.9

ESTIMATES OF RATIO OF BANK RESERVES TO DEMAND DEPOSITS

Variable	Coeff Estimate	Stand. Error	T Stat.	Diagnostics
LRSRT1	0.022	0.002	9.8	R^2 = 0.94
LRSRT2	-0.006	0.003	-2.41	F = 183.4
TD	0.104	0.02	6.6	SER = 0.018
ATB	-0.002	0.003	-0.64	DW = 1.97
DCPI	-0.002	0.001	-1.76	COND = 35.8
D2BKRES	0.002	0.0003	7.2	MAPE = 5.19
CONSTANT	-0.04	0.011	-3.5	MSPE = 0.48

Definitions

LRSRT1 - legal reserve ratio on demand deposits;

LRSRT2 - legal reserve ratio on time and savings deposits;
TD - ratio of time and savings deposits to demand deposits;
ATB - average of this period and last period's T-bill rate;
DCPI - current inflation rate;
D2BKRES - average compounded growth rate of bank reserves over the last 2 periods:
= $((((BKRES/BKRES_{-2})^{**}0.5)-1)*100)$
SER - Standard Error of Regression
COND - conditionality - measures singularity of X'X matrix
MAPE - Mean Absolute Percentage Error
MSPE - Mean Square Percentage Error(adjusted for n-k-1 degrees of freedom)

Note : - sample period from 1966 3 to 1983 4

Apart from the coefficient for inflation and the interest rate the coefficients were all significant at the 5% level. The inflation coefficient had, however, the expected sign. The TD coefficient was positive, indicating that any decline in the excess reserve ratio did not exert a strong enough influence to outweigh the effect of a rising TD ratio. The coefficient on the legal reserve ratio for time and savings deposits was negative. This is difficult to rationalize. One problem is that the ratio was only changed once (in 1972), so that there may not have been sufficient variation in the data to produce a meaningful statistic. The percentage residuals were usually under 10%, although they were much larger in 1970 and 1980.The repatriation of foreign exchange proceeds by the mining companies in 1970, and the placement of much of these in time deposits may account for the large residual.

I used a shorter sample period (1966-1977) to test for the stability of the coefficents. The t-value for the LRSRT1 was much lower at 5.1, although the coefficient value itself showed little change. LRSRT2 became insignificant at -0.3, reflecting the instability of this coefficient. The TD and ATB coefficients hardly changed. The t value of the inflation coefficient fell (in absolute terms) from -1.75 to 0.64. This may reflect the unimportance of inflation as an explanatory variable until inflation began to accelerate in the late 1970s. The coefficient on D2BKRES increased slightly. The R^2 showed little change. I also tested the data on another sample period, 1971 to 1983. There was little change from the results of the full sample. The ATB coefficient changed signs and remained insignificant. However, it will be remembered that the sign on this is indeterminate. The T/D coefficient changed very little but the t value fell from 6.6 to 3.5.

Testing the data for other periods made little difference to the major coefficients (LRSRT1, TD, D2BKRES). One can conclude that the major parameters are fairly stable for different time periods, and that therefore the model is stable.

The low t values for inflation and the interest rate might reflect collinearity between the two. However, the simple correlation between ATB and the rate of inflation was very low, indicating this was not a problem. If there was high collinearity then adding the T-bill rate to the equation would have had a large effect on the t statistic for inflation. However, the effect was small.

As per Bolnick (1981) I experimented with changes in bank credit to the private sector as an explanatory variable. The rationale is that an increase in bank credit reduces the excess reserves. For example, excess reserves declined to virtually zero in 1974, and after 1979, concomitant with a rapid increase in private sector credit. However, the coefficient on the variable was insignificant at the 5% level. The reason is probably that companies economize on their deposits during an expansion, when credit is becoming tight. The effect on the reserve ratio is therefore ambiguous. As a substitute for bank credit I used imports as an explanatory variable, given that credit is often used for imports. However, the coefficient was insignificant. The variable would not be expected to perform as well as credit, as imports are often financed by overseas credit.

A possible reason for the low t value on the interest rate coefficient is collinearity between this variable and the TD variable. When the TD variable was omitted from the regression the ATB variable was significant (and positive). When the TD variable was added the ATB ratio became insignificant. The collinearity reflects a common upward trend, as higher interest rates have been associated with higher TD ratios.[79] It was worthwhile adding the ATB ratio as it improved the DW significantly, and lowered the MAPE.

The legal reserve ratio on demand deposits appears to be the most important determinant of the reserve ratio. Using LRSRT1 alone as an explanatory variable I obtained an R^2 of 0.84.

I used the same explanatory variables for the ratio of reserves to total deposits. An increase in the Treasury bill rate would be expected to lower desired excess reserves, which would lower the overall ratio. An increase in the TD ratio would be expected to lower the ratio because of the lower reserve requirement on TS deposits.[80]

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[79] The simple correlation between ATB and TD was 0.7.

[80] If the TD variable changed only because of changes in the T-bill rate then there would be little justification for including it as a separate variable. However, other variables

The sign on the inflation coefficient might be more difficult to determine than in the case of the ratio of reserves to demand deposits. This is because (as discussed in the last chapter) people may adjust their TS deposits downwards with an increase in inflation.

The results of estimation of the model are shown in Table 6.10 below.

TABLE 6.10

ESTIMATION OF RATIO OF BANK RESERVES TO TOTAL DEPOSITS

Variable	Coeff. Estimate	St. Error	T Value	Diagnostics
LRSRT1	0.011	0.001	8.9	R^2 = 0.87
LRSRT2	-0.0023	0.0015	-1.58	F = 79
D2BKRES	0.0011	0.00015	7.22	DW = 1.64
TD	-0.015	0.009	-1.7	SER = 0.01
DCPI	-0.0009	0.0007	-1.43	COND = 35.9
ATB	-0.0019	0.0017	-1.11	MAPE = 5.5
CONST	0.042	0.006	6.7	MSPE = 0.544

Definitions: - see Table 6.9.
Note: - Reserve ratio is the ratio of bank reserves to time and savings deposits, plus demand deposits.
- Sample period is 1966 3 to 1983 4.

The signs were generally as expected. The coefficients for LRSRT1 and D2BKRES were highly significant. The coefficient on LRSRT2 was again negative, as in the first model, but insignificant at the 5% level. The coefficients on TD and ATB

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[80] (cont'd) influence the TD ratio as was shown in Chapter 5.

were both insignificant at the 5% level. This reflects collinearity between these two variables. The coefficient on inflation was insignificant. As was expected, however, the t value was lower than that in the first model. Adding domestic credit (or imports) did not improve the fit of the model.

The residuals were less than 10% in most quarters (58 out of 71). Errors over 10% occurred in 1967, 1970, 1972, 1977 and 1980.

The mean square error was slightly higher in the second model than in the first. On this basis I decided to use the ratio of reserves to demand deposits for the purposes of predicting the money and credit multipliers. Using the same procedure as in Chapter 5 I ran the model for each year from 1976 onwards and simulated the reserve ratio for the following year (under the assumption that a policy maker would only know the parameters of the model up to the previous year). The results are printed in Table 6.9 below. Although some of the prediction errors are over 10%, the errors tend to offset each other, so that the average annual errors are much smaller. The largest annual average error is -6.2%. The lowest error is -0.1%. The average error over the seven years was -1.6% which is very low. It is interesting to note that the largest errors occur in 1978 and 1979, the years of the IMF program. Possible reasons for this were discussed in chapter 5

TABLE 6.11

SIMULATION OF RESERVE RATIO, 1977 to 1983

Year		Actual	Simulated	Error	%Error
1977	1	0.295	0.306	0.011	3.7
	2	0.299	0.305	0.006	2.0
	3	0.29	0.307	0.017	5.9
	4	0.341	0.326	-0.02	-5.8
Average					1.45
1978	1	0.313	0.323	0.01	3.2
	2	0.315	0.293	-0.022	-7.0
	3	0.314	0.301	-0.013	-4.1
	4	0.363	0.302	-0.061	-16.8
Average					-6.2
1979	1	0.346	0.317	-0.029	-8.4
	2	0.361	0.322	-0.039	-10.8
	3	0.318	0.31	-0.008	-2.5
	4	0.294	0.307	0.013	4.4
Average					-4.32
1980	1	0.327	0.327	0	0
	2	0.277	0.308	0.031	11.2
	3	0.434	0.364	-0.07	-16.1
	4	0.324	0.343	0.019	5.9
Average					0.25

Table 6.9 (cont.)

Year		Actual	Simulated	Error	%Error
1981	1	0.32	0.277	-0.043	-13.4
	2	0.305	0.311	0.006	2.0
	3	0.358	0.354	-0.004	-1.1
	4	0.362	0.351	-0.011	-3.0
Average					-3.9
1982	1	0.344	0.337	-0.007	-2.0
	2	0.329	0.333	0.004	1.2
	3	0.344	0.368	0.024	7.0
	4	0.341	0.346	0.005	1.5
Average					1.9
1983	1	0.356	0.353	-0.003	-0.8
	2	0.363	0.354	-0.009	-2.5
	3	0.356	0.358	0.002	0.5
	4	0.334	0.342	0.008	2.4
Average					-0.1

Note: - Reserve ratio is defined as the ratio of bank reserves to demand deposits.

The disadvantage of this method is that the ratio of TS deposits to demand deposits and the change in bank reserves is not known, but also have to be explained. In Chapter 5 demand equations were estimated for different elements of money, and each element was forecast for a number of years. It would be interesting to compare the predictions of the reserve ratio in Table 6.11 above with the ratio of the predictions of bank reserves and demand deposits from Chapter 5. This is done in Table 6.12 below.

TABLE 6.12

COMPARISON OF RESERVE RATIO PREDICTIONS
Ratio of bank reserves to demand deposits

Year	Prediction Error (1) %	Prediction Error (2) %
76		2.9
77	1.5	19.9
78	-6.2	1.4
79	-4.3	27.3
80	0.25	-1.9
81	-3.9	-4.2
82	1.9	0.6
83	-0.1	-4.8
Mean	-1.87	5.2
RMSPE	3.3	12.2

Notes: - Prediction Error (1) is taken from Table 6.11 above. Figures are annual average.
- Prediction Error (2) is taken from Tables 5.6 and 5.8 above. Figures are year-end.

It is clear that the mean prediction error is significantly greater when the numerator and denominator are estimated separately. The variance of the error is also much greater. This is not surprizing, however, given the assumed exogeneity of the change in reserves and the TD ratio in the first column. The average prediction errors in the second column are very similar.

I then compared the actual currency and TD ratios with those implied by the simulations of the numerator and denominator of these ratios in the last chapter. The comparisons are tabulated below in Table 6.13. Clearly the prediction errors are high and variable, and are generally higher and more variable than the individual elements, with the exception of the ratio of TS deposits to Demand Deposits ratio. Repeating the figures from Chapter 5 the average prediction error for currency was 3.1%, with a standard deviation of 12.4. The average prediction error and standard deviation for demand deposits were -0.43% and 13.8 respectively, and the average prediction error and standard deviation for TS deposits were -2.8% and 25.3 respectively.

The ratio of currency to total deposits has a higher prediction error and a higher variance of these errors than the ratio of currency to demand deposits. This can perhaps be expected as demand deposits are a closer substitute for currency than total deposits. One typically will decide how much cash to hold in relation to demand deposits than to total deposits. Again, it is interesting to note the large, and virtually offsetting errors in 1978 and 1979. The advent of the IMF program probably caused companies and individuals to economize on deposits. Likewise the ratio was underpredicted in 1981, the year when a new IMF program was initiated. The ratio of TS deposits to demand deposits was overpredicted in 1978 for the same reason. However, there was an overall tendency towards underprediction in the case of the latter ratio.

TABLE 6.13

ESTIMATED MULTIPLIER COMPONENT RATIOS

a) Currency - Demand Deposit Ratio

Year	Actual	Predicted	Error	%Error
76	0.47	0.64	0.17	36.1
77	0.44	0.47	0.03	6.8
78	0.50	0.37	-0.13	-26.0
79	0.33	0.46	0.13	39.4
80	0.42	0.41	-0.10	-2.4
81	0.51	0.42	-0.90	-17.6
82	0.44	0.45	0.01	2.3
83	0.44	0.46	0.02	4.6
Mean				5.4
RMSPE				22.1

b) Currency - Total Deposits Ratio

Year	Actual	Predicted	Error	%Error
76	0.25	0.39	0.14	56.0
77	0.21	0.24	0.03	14.3
78	0.26	0.17	-0.09	-35.0
79	0.18	0.23	0.05	27.8
80	0.20	0.21	0.01	5.0
81	0.24	0.21	-0.03	-12.5
82	0.21	0.22	0.01	4.8
83	0.20	0.23	0.03	15.0
Mean				9.4
RMSPE				26.9

TABLE 6.13 (cont)

c) Time and Savings Deposits - Demand Deposits Ratio

Year	Actual	Predicted	Error	%Error
76	0.87	0.65	-0.22	-25.3
77	1.14	1.0	-0.14	-12.3
78	0.93	1.26	0.33	35.5
79	0.82	1.0	0.18	22.0
80	1.08	0.95	-0.13	-12.0
81	1.12	1.03	-0.09	-8.5
82	1.10	1.01	-0.09	-8.2
83	1.2	1.10	-0.10	-8.3
Mean				-2.1
RMSPE				19.0

Notes: Figures are taken from Tables 5.5 onwards in Chapter 5.

As the purpose of this exercise is to predict the multiplier, the next step is to compare predictions of the different multipliers by dividing the predictions for M1 and M2 by the predictions for base money and comparing these to the predictions one would obtain from using the predictions of the components of the money multiplier.

Table 6.14 below shows the predictions and prediction errors for the M1 and M2 multipliers obtained from the predictions of M1, M2 and base money. Table 6.15 shows the same for the M1 and M2 multipliers derived from the multiplier components. I tried all the various definitions (see section 6.1) and used the ones with the lowest standard deviation of prediction errors. The lowest standard deviation was obtained using the ratio of reserves to total deposits, and the ratio of currency to demand deposits.[81]

The standard deviation of the absolute prediction error of the M1 multiplier was 0.11, using the method of calculation in Table 6.14, and 0.1, using the method in Table 6.15. One would have slightly more confidence in predicting the M1 multiplier by predicting the component ratios than by predicting M1 and base money. However, in either case, the confidence limits are wide.

The standard deviation of the absolute prediction errors for the M2 multiplier were 0.36, using the method in Table 6.14, and 0.18 using the method in Table 6.15. The second method produced continual underprediction, except for 1981. One can conclude that it is better to predict the components of the multiplier than M2 and Base (it will be remembered from Chapter 5 that the prediction errors for M2 were high, because of the large errors in predicting TS deposits). However, the range of confidence in predicting the M2 multiplier is still wide.

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[81] The standard deviation was, however, only marginally lower than when the ratio of reserves to demand deposits was used - 9.1 versus 9.2, in the case of the M1 multiplier and 9.5 versus 9.6 in the case the M2 multiplier. The variability was significantly higher when the ratio of currency to total deposits was used - not surprizing, given the much higher variability of the prediction errors of this ratio than in the case of the currency -demand deposits ratio.

TABLE 6.14

PREDICTIONS OF THE MONEY MULTIPLIERS, DERIVED FROM PREDICTIONS OF M1, M2 and BASE MONEY

a) M1 Multiplier

Year	Actual	Predicted	Error	%Error
76	1.81	1.75	-0.06	-0.03
77	1.74	1.91	0.17	9.6
78	1.66	1.85	0.19	12.0
79	2.06	1.69	-0.37	-17.8
80	1.83	1.80	-0.03	-1.4
81	1.67	1.86	0.19	11.4
82	1.79	1.83	0.04	2.1
83	1.82	1.85	0.03	1.4
Mean			0.14	2.2
RMSPE				9.3
Standard Deviation			0.11	

b) M2 Multiplier

Year	Actual	Predicted	Error	%Error
76	2.99	2.49	-0.5	-16.7
77	3.14	3.07	-0.07	-2.3
78	2.72	3.55	1.31	48.0
79	3.34	2.92	-0.42	-12.4
80	3.27	3.0	-0.27	-8.2
81	2.95	3.12	0.17	5.8
82	3.45	3.11	-0.34	-9.8
83	3.4	3.14	-0.26	-7.6
Mean			0.42	-0.4
RMSPE				19.3
Standard Deviation			0.36	

Notes: - M1 multiplier is M1 divided by base;
- M2 multiplier is M2 divided by base.

TABLE 6.15

PREDICTIONS OF THE MONEY MULTIPLIERS, DERIVED FROM THE MULTIPLIER COMPONENTS

a) M1 Multiplier

Year	Actual	Predicted	Error	%Error
76	1.81	1.69	-0.12	-6.6
77	1.74	1.62	-0.12	-6.9
78	1.66	1.82	0.16	9.6
79	2.06	1.71	-0.35	-17.0
80	1.83	1.91	0.08	4.4
81	1.67	1.83	0.16	9.6
82	1.79	1.81	0.02	1.1
83	1.82	1.82	0	0
Mean			0.13	-0.73
RMSPE			0.10	9.1
Standard Deviation				

b) M2 Multiplier

Year	Actual	Predicted	Error	%Error
76	2.99	2.36	-0.63	-21.1
77	3.14	2.71	-0.43	-13.7
78	2.72	2.16	-0.56	-20.6
79	3.34	2.89	-0.45	-13.5
80	3.27	3.19	-0.08	-2.5
81	2.95	3.16	0.21	7.1
82	3.45	3.07	-0.38	-11.0
83	3.40	3.20	-0.20	-5.9
Mean			0.37	-10.2
RMSPE				14.4
Standard Deviation			0.18	

Notes: - M1 multiplier is derived as: $(c+1)/(c+r_1(1+t))$, where symbols are as defined as in Section 6.1;
- M2 Multiplier is defined as: $(c+1+t)/(c+r_1(1+t))$;

In summary, the M1 multiplier appears more predictable than the M2 multiplier. This is encouraging, as we saw in Chapter 5 that one can explain and predict M1 more accurately than M2. Therefore it is the M1 multiplier that we would want to use in predictions of Balance of Payments outcomes. However, the confidence limits for making the predictions are very wide under any definition. How much this matters from the point of view of making balance of payments predictions remains to be seen in Chapter 7. Finally, the last two tables show that there is not much to choose between the method in Table 6.14 or that in Table 6.15, although using the components of the multiplier for prediction seems more accurate.

Credit Multiplier

Balance of payments equations can be written either using money multipliers or using bank credit multipliers (see Chapter 7 below). The multiplier that one chooses for analysis partly depends on how accurately the behaviour of the multiplier can be explained.

I conducted the same exercise for the credit multiplier as for the money multipliers above. 'Other Items Net' are assumed to be part of domestic credit for reasons explained earlier. I tested different definitions of the multiplier. The standard deviation of the prediction errors were all much the same. Rather surprizingly perhaps (in view of the higher prediction error of the currency-total deposits ratio than the currency-demand deposits ratio), the lowest standard deviation was obtained using the ratios of currency and reserves to total deposits. It is evident, however, that the variation of the errors is much higher than in the case of the M1 multiplier, although lower than for the M2 multiplier. However, the main discrepancy is in in 1978, when there is an overprediction of 43% (for the same reasons as for the overprediction of the M2 multiplier in Table 6.14 above). If this is netted out then the variability falls considerably. The results are listed in Table 6.16 below.

TABLE 6.16

PREDICTIONS OF THE CREDIT MULTIPLIER

Year	Actual	Predicted	Error	%Error
76	1.98	1.42	0.56	-28.3
77	2.29	1.83	-0.46	-20.0
78	1.79	2.59	0.77	43.0
79	1.78	1.76	-0.02	-1.1
80	2.38	2.35	-0.03	-1.2
81	1.87	2.05	0.18	9.6
82	2.64	2.26	-0.38	-14.4
83	2.37	2.22	-0.15	-6.3
Mean			0.32	-2.3
St. Dev			0.25	21.9
RMSPE				22.0

Notes:
- Bank Credit includes 'Other Items Net';
- the bank credit multiplier is defined as: $(1 - f - r_1)/(c_1 + r_1)$ where symbols are defined as in Section 6.1;
- the values for f (the ratio of net foreign assets to total deposits) are actual values, for reasons explained earlier in this section.

Time Series Analysis

An alternative method of predicting components of the multiplier is to predict the ratios as a function of the past behaviour of these ratios. If changes in the ratios have not been purely random, then they will have a pattern. Time series analysis can be used to isolate the non-random elements of these changes - specifically, the moving average and autoregressive elements. If the correct time series model can be identified it may be possible to obtain reasonably accurate forecasts for short periods ahead.

I used monthly data to derive time series models for the currency ratios and the reserve ratios.[82]

The best model for the currency-demand deposit ratio seemed to be a first order moving average model with a seasonal component. The seasonal component arises in the third quarter of every year, reflecting payments to farmers for the harvest, and preparations for the upcoming planting season (also see BOZ Annual Reports, passim). The estimated model was:

$$C/D = -0.37a_{t-1} - 0.22a_{t-13}$$
$$(5.0) \qquad (-2.93)$$

MSE = -0.008 (t values in brackets)

where C/D is the currency-demand deposits ratio, a is the

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[82] Meaningful results can only be obtained with long time series. Pankratz (1983) says that 50 observations are the minimum. However, much longer series are needed if the model contains a seasonal component.

random error, and MSE is the mean square error.

The residuals just passed the Q test at the 5% level.[83] However, the residuals showed that there was a considerable amount of white noise, with the difference between actual and estimated values often exceeding 10%. Ex-ante forecasts for 1983 all showed considerable underprediction, with the highest error being -15% and the average error being -7.8%. However, the standard deviation of the prediction errors was 5.2%, which is significantly lower than the results obtained above. However, the period of analysis only covers one year, and it does not follow that similar errors would be obtained in other years.

To test for the stability of the model I reestimated the model using only post-1975 data (the original sample used 1967-82 data). The coefficients were hardly changed, although the t values were a little lower and the MSE was higher (at 0.0085). The autocorrelation function of the residuals indicated only white noise. The ex-ante forecast errors for 1983 were very similar.

The predicted and actual values of the currency-demand deposits ratio are tabulated below in Table 6.17.

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[83]I first took first differences to eliminate non-stationarity in the data. Analysis was conducted using the BMDQ2T program.

TABLE 6.17

PREDICTIONS OF THE CURRENCY-DEMAND DEPOSITS RATIO, USING TIME SERIES ANALYSIS

Month (1983)	Actual C/D	Predicted C/D (1)	Predicted C/D (2)	%FE (1)	%FE (2)
Jan.	0.48	0.459	0.459	-4.4	-4.4
Feb.	0.489	0.461	0.461	-5.7	-5.7
March	0.494	0.449	0.449	-9.1	-9.1
April	0.488	0.443	0.444	-9.2	-9.0
May	0.446	0.447	0.447	0.2	0.2
June	0.455	0.436	0.438	-4.2	-3.7
July	0.477	0.447	0.448	-6.3	-6.1
August	0.514	0.441	0.442	-14.2	-14.0
Sept.	0.506	0.435	0.437	-14.0	-13.6
Oct.	0.511	0.449	0.449	-12.1	-12.1
Nov.	0.519	0.444	0.444	-14.5	-14.5
Dec.	0.436	0.437	0.439	0.2	0.7
Average Error				-7.8	-7.6
St. Dev				(5.2)	(5.3)

Notes: - C/D is the ratio of currency to demand deposits. F/E is forecast error;
- (1) uses data from 1967 to 1982 for estimation of the model, and (2) uses data from 1975 to 1982.

Although the model has a seasonal component, it clearly does not capture the seasonal variation in the data. The model underpredicts by a much greater amount during the months August-November.

Time series analysis is a time consuming process, and is just as much an art as a science. I have therefore not pursued any further analysis. The purpose of this exercise is more to show the possibilities of this kind of analysis, particularly for short term forecasting. [84]

6.5 Analysis of the Behaviour of the Multiplier Components Over Zambia's History

Although, from the policy point of view, the forecasting of multipliers is clearly a somewhat hazardous exercise, it is interesting, as Diz does (Diz, 1970) to attempt to explain the historical behaviour of the multiplier components.

Reference is made to Table 5.3, where the estimated equations for the different elements of money demand are presented.

The estimated and actual values of the multiplier component ratios are graphed in Figures 6.1 to 6.5. The figures are discussed in turn:

a) Ratio of currency to demand deposits (C/D)

The actual C/D ratio rose at first, and then fell sharply from 1967 to 1970. It then followed an upward trend, with downturns in 1973, 1977, 1979 and 1982. The estimated coefficients of the demand functions for currency and demand deposits (see Chapter 5) imply that the C/D ratio should react

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[84] I also conducted similar analysis on the ratio of bank reserves to total deposits. I fitted a model with a first order non-seasonal AR component, a 12th, 24th and 36th seasonal AR component, and a second and third order MA component. However, I was unable to attain an acceptable Q statistic. The residuals were frequently over 20%. The model was probably incorrectly specified.

negatively to income and interest rate changes, and positively to inflation rate changes. From 1966 to 1969 income rose steadily, while interest rates rose only slightly. The inflation rate fell at first, then accelerated, and then fell again in 1969 and 1970. One would consequently predict a falling ratio for these years. The pattern is only approximately captured by the estimated ratio. As mentioned in Chapter 5, one factor not captured by the model is the agricultural harvest. A good harvest tends to increase the currency ratio. The harvests in 1966 and 1967 were good, which may account for the increase in the currency ratio in those years. As also mentioned in Chapter 5, Zambianization of the currency may explain the greater than estimated drop in the currency ratio in 1968-69. The upward trend in the ratio to 1976 is captured. However, the ratio rises far more quickly between 1970 and 1972 than is explained by the model. This may have something to do with the uncertainty and instability arising from the balance of payments problems of 1971 and 1972, and perhaps the credit squeeze of 1972 (although the model captures this - the estimated ratio rises significantly in 1972). The good harvest in 1971 is also a factor.

The sharp downturn in 1973 is not predicted by the model. It could be a reaction from the economizing on deposits that took place in 1972. As Keran (1970) notes, the ratio is likely to increase during economic downswings and decrease during upswings. 1973 was a year of upswing. The model does not capture the large rise in 1978. The reason for the upturn must be the credit squeeze associated with the IMF program (plus the expectational effect of such a program). It is difficult, empirically, to capture this effect. The reason for the sharp downturn in 1979 is the reverse of this effect

The upward trend after 1979 is generally captured. However, the sharp rise in 1981 is not captured. Again, this was a year of an IMF program. Although the credit constraint turned out not to be binding, the program might have engendered an expectational effect. A more significant factor may be the good harvest that year.

b) Ratio of Currency to Total Deposits

From the elasticities estimated in the last chapter, one would expect this ratio to decline with real income and interest rates, and to increase with inflation. Given the actual behaviour of these variables one would expect a decline in the 1960s. Figure 6.2 shows that the estimated ratio captures the movement of the actual ratio quite well (after allowing for the harvest and the Zambianization of the currency, as referred to in a) above.[85] One would expect little change in the ratio in

[85] Note that Diz would predict the opposite, based on his implausible ranking of income elasticities. The above would seem to confirm the expectation that the income elasticity of time and savings deposits is larger than that of currency.

the early 1970s, followed by a rise in the mid-1970s as inflation accelerated and income fell. The estimated ratio captures the actual reasonably well after 1970. The fall from 1976, at least, is predicted by the rise in interest rates. The rise in 1978 and fall in 1979 is not predicted and must be a function of the IMF program. After 1978-79 inflation accelerated again. However, interest rates also rose. Given little change in income one would expect little change in the ratio. The estimated ratio followed the trend quite well with the exception of 1981 - an IMF program year, and a good harvest year.

The apparent closer fit of this currency ratio to the actual than for the currency ratio in (a) may seem inconsistent with the results of the forecasting exercise above, when it was shown that the broader currency ratio had a higher forecasting error. This may be because the forecasting errors were in percentage terms, whereas here they are in absolute terms.

c) <u>Ratio of Time and Savings Deposits to Demand Deposits</u>.

Using Table 5.4 this ratio would be expected to rise with real income and to fall with inflation. The effects of interest rates are a little ambiguous. Using Table 5.3 - without the population coefficient - the ratio would be expected to rise. The opposite effect is predicted from Table 5.4. Overall, however, one would expect the ratio to rise to 1969-70, and then to fall in 1971. After 1971 the ratio would be expected to follow a general upwards trend consistent with rising interest rates, but moderated by declining real incomes after 1974, and rising inflation.

The estimated path follows the actual path approximately (see Figure 6.5). The general upward trend is captured. The estimated ratio does not capture the very large increase in the early 1970s. This is perhaps because of the liberalizing of interest rate competition in 1971 by the banks, and also the desire by the mining companies to keep their repatriated foreign exchange proceeds in the bank, rather than spending them. The fall in 1972 is not captured. This reflects the credit squeeze in that year, and the resultant economizing on time deposits by companies. .

The fall in 1978 is not predicted - the IMF factor again.[1] The reason for the fall in 1979 is probably because of the fall in income that year. This is captured by the model in 1980, implying that the adjustment lag built into the model may be too long. This may also account for the discrepancy in 1983. Real output rose in 1983, but the model is still reacting to the decline in 1982.

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[1] It may also have something to do with the closing of the loophole in arrears arrangements, whereby not all import deposits were being frozen effectively, and also with the consolidation of arrears under BOZ.

d) Ratio of Bank Reserves to Demand Deposits

This ratio would be expected to rise with increases in income, and fall with increases in interest rates and inflation. The ratio would therefore be expected to rise until 1970, then fall and then rise to 1975-76 (income rose in 1976). There should also be rises in 1972 and 1976 in response to increases in the legal reserve ratios. After 1976 there should be a downwards trend, moderated by upward movements in response to increases in incomes in 1981 and 1983, and a downtrend in inflation in 1978 and 1979.

Figure 6.3 shows that the estimated path follows the actual path quite well. The paths are very similar until 1974, when the actual reserve ratio drops far more steeply than implied by the model. The reason may be the tight liquidity arising that year from rapidly expanding credit, in response to the policy directive that imports be locally financed. Decreasing liquidity as a result of expandingprivate sector credit may be the reason for the sharper than estimated fall in 1979 and 1980.

e) Ratio of Bank Reserves to Total Deposits

This ratio would be expected to fall or stay constant with increases in income (the income elasticity for reserves falls roughly midway between the income elasticities for demand deposits and TS deposits). It would be expected to fall or stay constant with interest rates, and to stay constant or rise with inflation. One would therefore expect the ratio to change little from 1965-72. In 1972 it should rise with the rise in the legal reserve ratios. It would then stay constant until 1976, when legal reserve ratios were raised again. Rising interest rates in 1976, 1978 and 1983 might have caused downturns in the ratio.

Figure 6.3 shows that the estimated reserve ratio roughly approximates the actual ratio. The increase in 1968 and 1969 was not captured. As the ratio of reserves to demand deposits was roughly as predicted this implies that the ratio of reserves to TS deposits was much higher than predicted. This is partly because the actual TD ratio was much lower than predicted.

The discrepancies in 1978, 79 and 1981 are probably a result of the IMF programs, for reasons outlined earlier.

In summary, the estimated ratios that appear to correspond best to the actual ratios are the currency-total deposits ratio and the bank reserves-demand deposits ratio. This is not very helpful in deriving the best estimate of the multiplier, as there is no definition of the multiplier that uses these two ratios alone. These results are also contrary to the results of the earlier forecasting exercise where the other currency and reserve ratios performed better. However, whichever ratios one uses, there are obviously significant errors in explaining and forecasting the ratios, and therefore the multipliers.

There are several possible reasons for the errors. First, estimation of the true coefficients is difficult, given the short time series, and the limited variability in the explanatory variables. Second, there is the difficulty of capturing the effects of exogenous or policy-induced shocks, such as credit squeezes, IMF programs, and exchange and import restrictions, and the increases in uncertainty and the effects on expectations that these factors cause. Third, there are the problems associated with using annual data, when reactions of changes in 'desired' variables to the explanatory variables may take place over longer or shorter periods, and/or adjustment of the actual values of the dependent variable to desired values may also take place over a different time period. Moreover, the speed of adjustment may change over time, partly as a result of exogenous shocks. Finally, there are difficulties in measuring 'expected' values of the explanatory variables, particularly when the basis for forming these expectations may change over time.

However, on a more positive note, it is clearly possible to provide plausible reasons for the discrepancies, even if it is difficult to capture discrepancies in the model (one exception being the harvest variable, which should be included in the currency variable.

FIG 6.1
ESTIMATED AND ACTUAL RATIO OF
CURRENCY TO DEMAND DEPOSITS

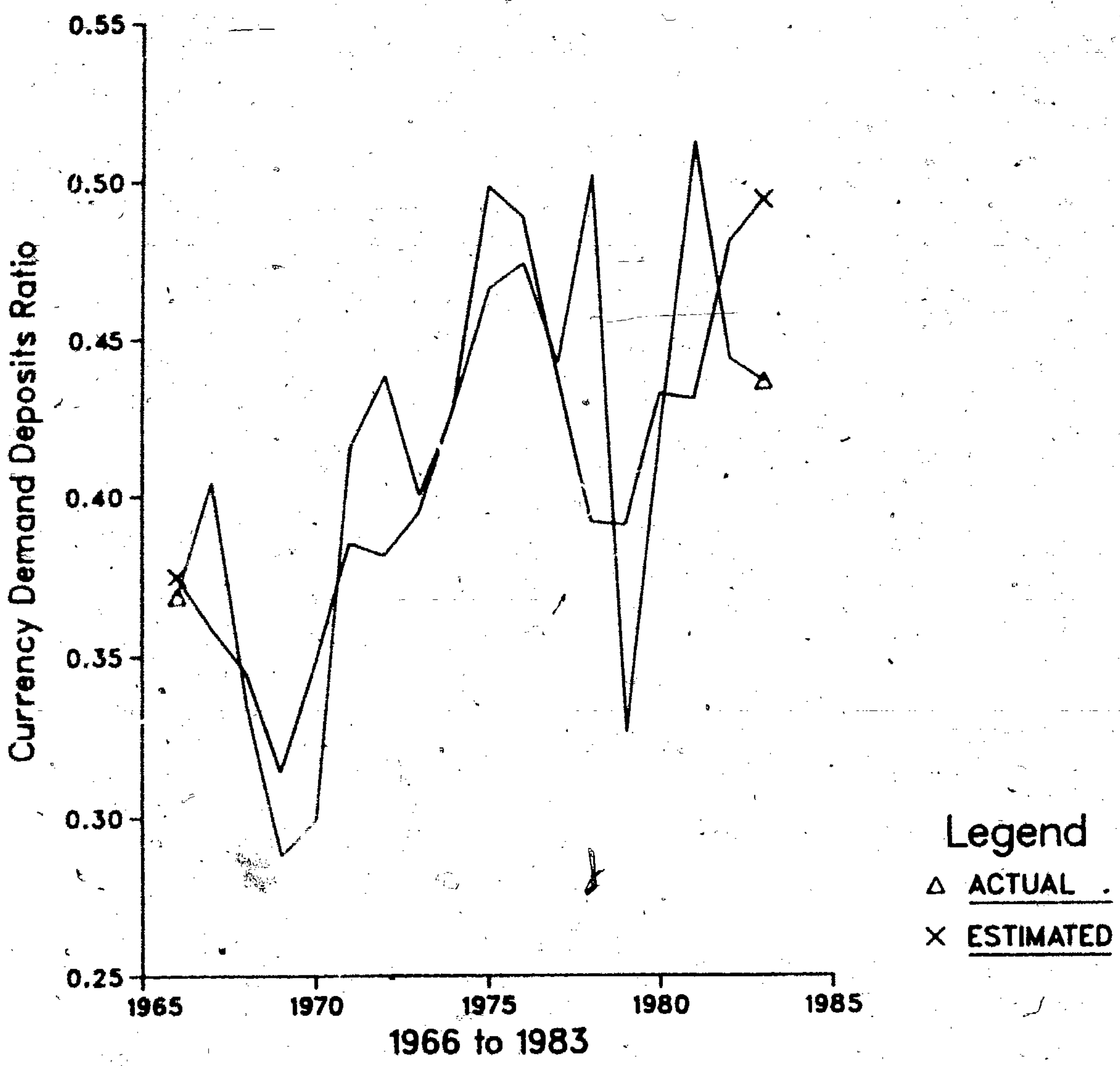


FIG 6.2
ESTIMATED AND ACTUAL RATIO OF CURRENCY TO TOTAL DEPOSITS

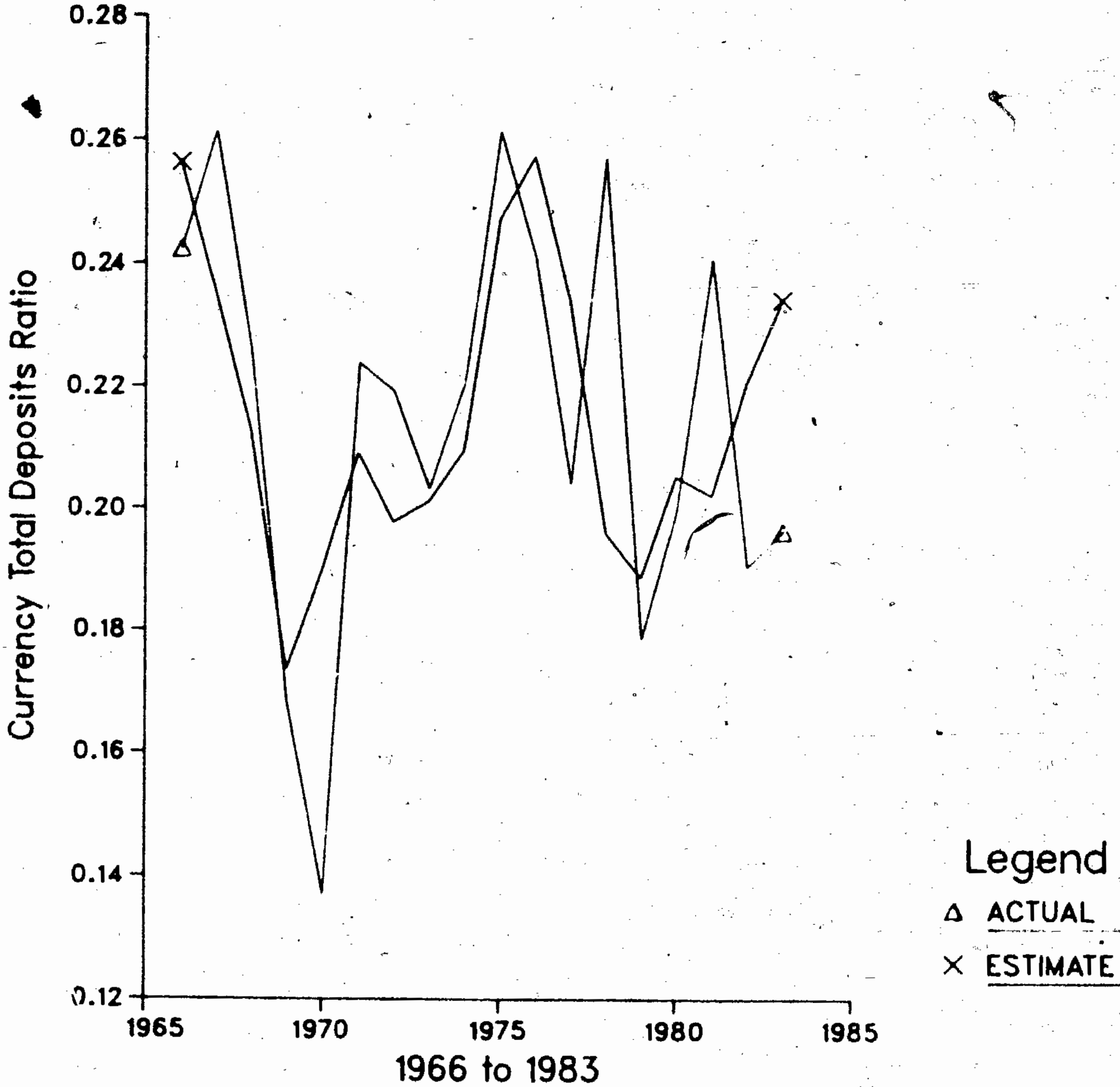


FIG 6.3
ESTIMATED AND ACTUAL RATIO OF
BANK RESERVES TO DEMAND DEPOSITS

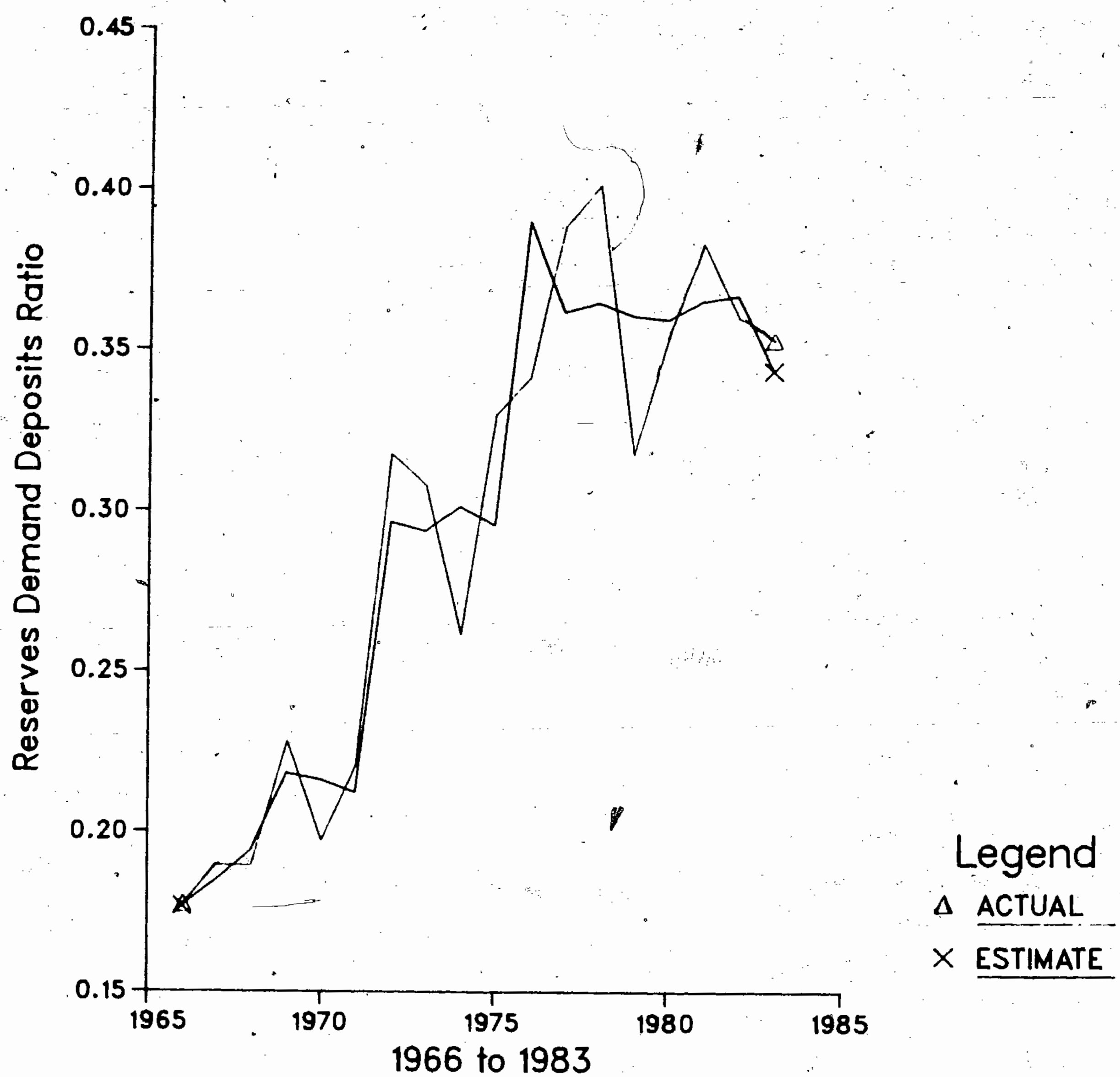


FIG 6.4
ESTIMATED AND ACTUAL RATIO OF
BANK RESERVES TO TOTAL DEPOSITS

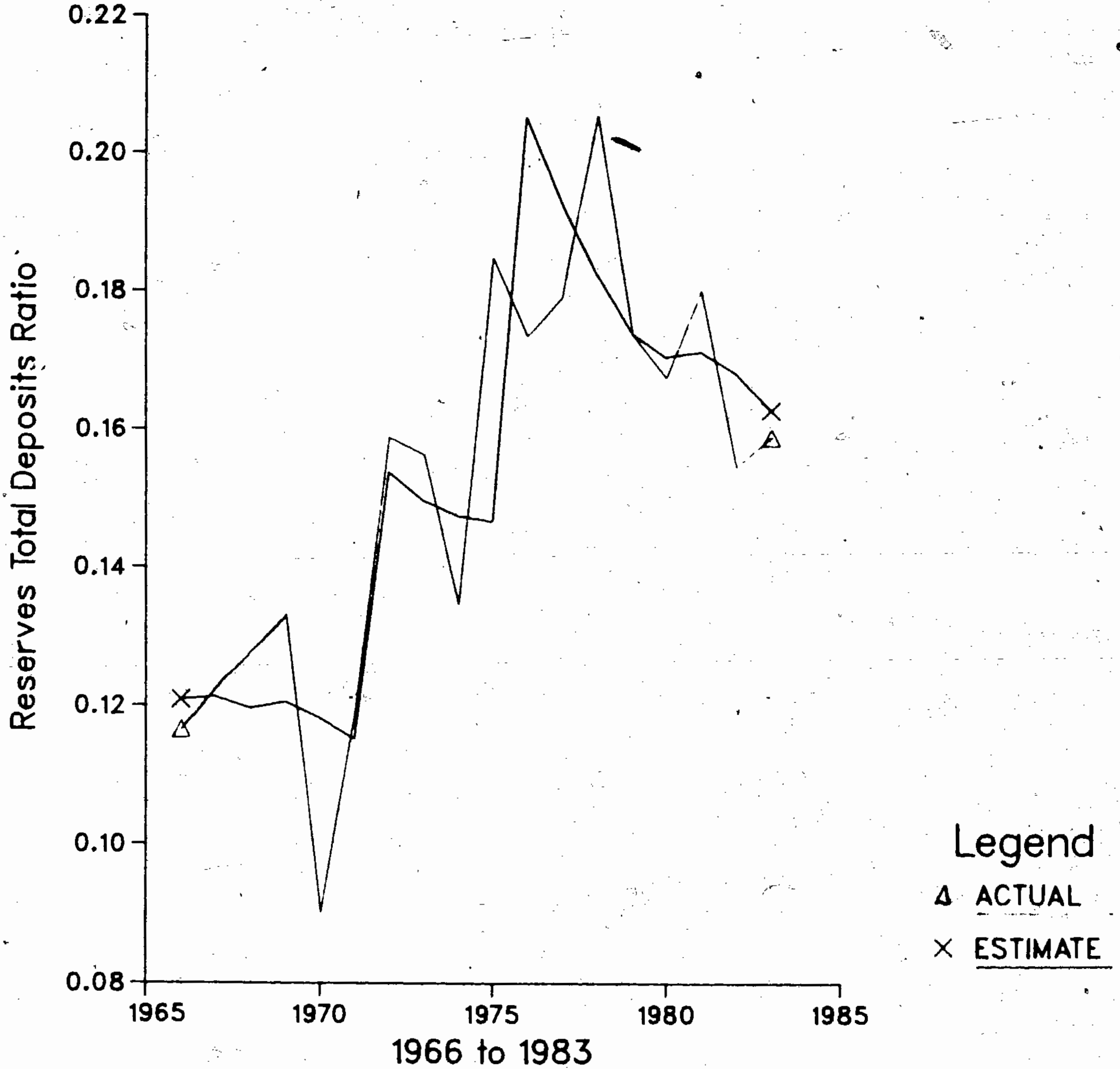
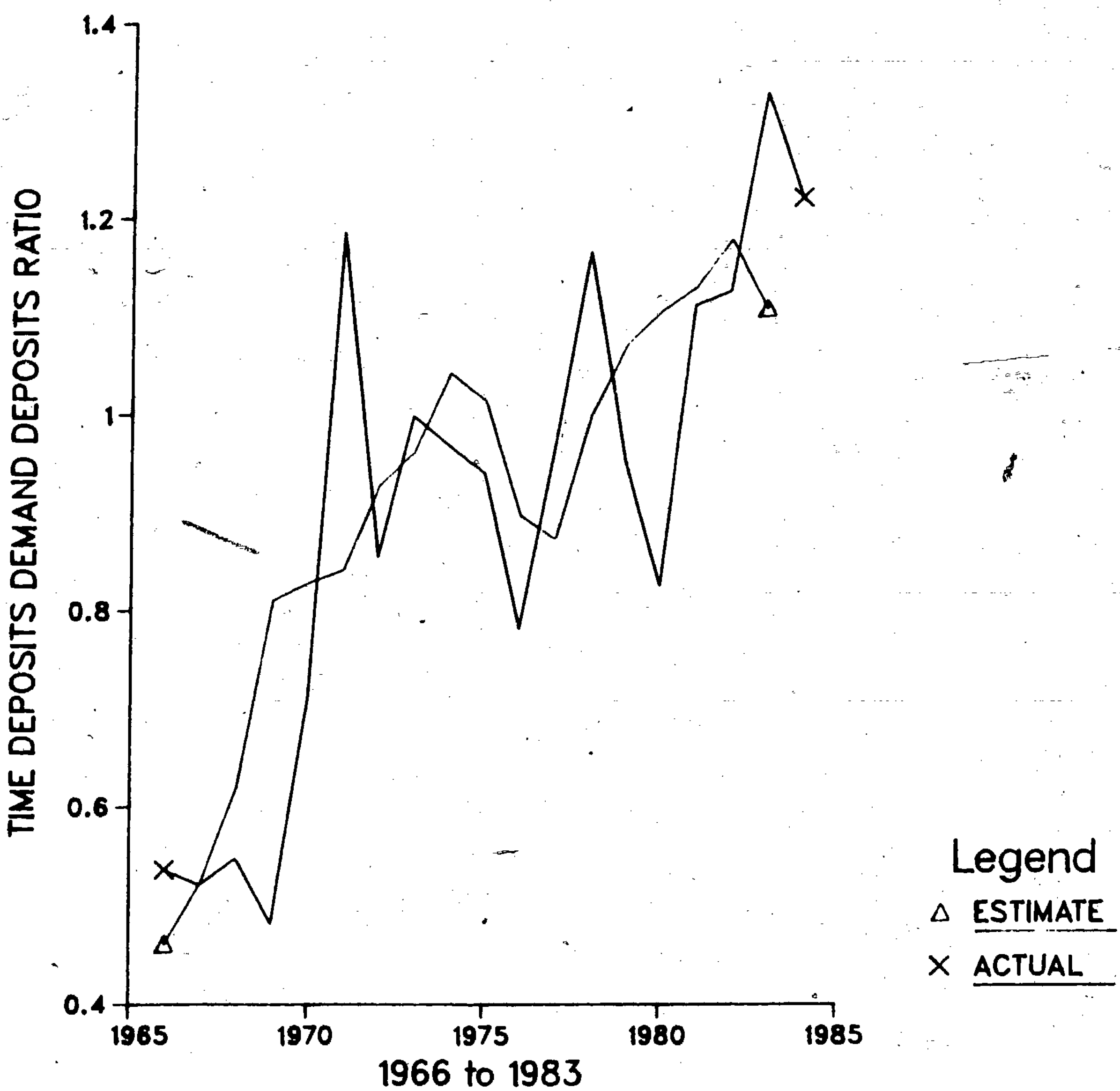


FIG 6.5
ESTIMATED AND ACTUAL RATIO OF TIME AND SAVINGS DEPOSITS TO DEMAND DEPOSITS



6.6 Summary and Conclusions

The purpose of this chapter has been to analyze the controllability and predictability of the money supply process in Zambia. The reason for this analysis is that control over the domestic assets of the central bank and knowledge of how these may affect bank credit and deposits is important if a given balance of payments target is to be attained, given an estimated money demand function.

The first section outlined the money supply process, showing the links between base money and money supply and credit. The second section outlined the institutional setting in Zambia, and the actions which BOZ has taken to regulate liquidity and the balance of payments. By regulating liquidity, expenditure can be controlled, and therefore so can the balance of payments. The prime example of its actions was in 1972, when it enacted a host of measures in order to decrease liquidity and arrest a declining balance of payments situation. However, since 1975 its ability to exert control has been diminished mainly as a result of the government's budgetary requirements. The system of regulated interest rates was probably one factor preventing it from exerting control as it was unable to undertake significant open market operations to offset the increase in liquidity generated by large budget deficits (or to sell new government debt to the public). Import and exchange controls also hampered its efforts, as they prevented liquidity from draining out of the country. However, as IMF packages indicate, the central bank can in principle control the growth of its domestic assets.

The third section described the fluctuations in the money and credit multipliers, and decomposed these into fluctuations in the component ratios, and measured the effects of each of these on changes in the multiplier. The variations do not appear to be totally random, indicating that they can be explained to an extent. This is not surprizing given that the multiplier consists of ratios of different elements of money. In Chapter 5 it was shown that it was possible to explain the demand for these with a measure of confidence.

The fourth section analyzes formally the changes in the multiplier components, making use of the results from Chapter 5. Predictions of the multipliers were marginally better using predictions of the component ratios than predictions of base money and deposit-inclusive money. The prediction errors were lowest for the M1 multiplier, and highest for the M2 multiplier. The variances of the prediction errors are such that the confidence limits for predicting the multipliers are quite wide. However, there appeared to be reasons for the errors, often relating to policy and external shocks.

I estimated a separate reserve ratio model, developed by Diz (1970), using quarterly data. This tracked the data and predicted the future quite well. The main disadvantage with it is that some of the explanatory variables are really endogenous, in particular the ratio of time and savings deposits, to demand deposits and the rate of change of bank reserves. I also experimented with time series analysis using monthly data to forecast the currency demand-deposits ratio. However, this met with mixed success.

The fifth section discussed the differences between the actual and estimated values of the multiplier component ratios, derived from the results of chapter 5, in order to examine more closely the size and nature of the errors. Errors appeared to be smallest for the currency-total deposits ratio, and the reserves-demand deposits ratio. It was encouraging that these ratios tracked the historical data quite well. Further refinements in the demand functions for each component would add to the ability to explain the performance of the ratios. However, this may be difficult given the difficulty of modelling the effects of policy shocks and of specifying adjustment lags. The 'harvest' factor appears to be a variable that could be built into the currency demand equation.

The results of this chapter and chapter 5 are needed to produce explanations of Zambia's balance of payments performance. This will be the subject of Chapter 7.

CHAPTER 7

THE BALANCE OF PAYMENTS IN ZAMBIA

The purpose of this chapter is to combine the results of the last two chapters into an estimation of Zambia's balance of payments in terms of money demand and money supply. In the first section the methodology for doing this is discussed in terms of the reserve flow model that was described in Chapters 2 and 3. The second section produces some empirical results using the reserve flow model. The reserve flow equation is directly estimated by regression analysis, using three definitions of money (M1, M2 and Base) and the specification of the money demand function developed in Chapter 5. The actual values of Zambia's balance of payments are then compared with the estimated values. The reserve flow equation is then indirectly estimated by plugging in the estimates of the demand for money and the money multiplier (from Chapters 5 and 6) in the equation. Finally, the balance of payments is forecast, on an ex-ante basis, for the years 1977 to 1983, using different definition of money. The third section provides a summary and conclusions.

7.1 Balance of Payments Models

As discussed in Chapter 2 there are two basic kinds of balance of payments models. The first (for example, the Polak and Rhomberg models) assumes that income is endogenously, and simultaneously, determined along with the balance of payments variable. The main disadvantage of these models is that little attention is paid to the specification of the money demand function. Also, there is little to differentiate this model from an income -determination model, with the result that it is harder to focus on the monetary aspects of the balance of payments.

The second kind of model - the reserve flow model - takes the explanatory variables in the money demand function as 'given', and concentrates on the accurate specification of the money demand function. It is the second kind that is discussed below.

There are two classes of the reserve flow model. In the first one, described in (a) below, the net foreign assets of the monetary authority is the dependent variable. In the second class, described in (b) below, the net foreign assets of the entire banking system is the dependent variable.

a) <u>Change in NFA of the Monetary Authority</u>

Given that

$$H = F + D$$

where H is base money, F is the NFA of the monetary authority, and D are the domestic assets of the monetary authority (including 'Other Items Net'), then

$$mH = mF + mD = Ms$$

where m is the money multiplier, and Ms is money supply. Writing the equation with mF on the left hand side, lagging by one period and expressing in first differences, adding and subtracting mF_{-1} on the LHS, adding and subtracting mD_{-1} on the RHS, and equating ΔMs with ΔMd produces the following equation:

$$m\Delta F = \Delta Md - m\Delta D - \Delta m(D_{-1}+F_{-1})$$

so that,

$$\Delta F = \Delta Md/m - \Delta D - H_{-1}\Delta m/m \quad (7.1)$$ [87]

This can be estimated directly by regressing ΔF on the RHS variables, and specifying ΔMd in terms of the money demand model developed in Chapter 5. The estimating equation is therefore:

$$\Delta F = b_0 + b_1\Delta Md/m - b_2\Delta D - b_3H_{-1}\Delta m/m$$

Substituting the variables specified in the money demand function discussed in Chapter 5, the following is obtained:

$$\Delta F=b_0+b_1a_1\Delta y/m+b_1a_2\Delta i/m+b_1a_3\Delta\Pi/m+b_1a_4\Delta P/m+b_2\Delta D+b_3H_{-1}\Delta m/m+error$$

If the money demand function is correctly specified and the money market is in flow equilibrium the coefficients on the domestic credit and the money multiplier variables should be equal to minus unity, and b_1 should equal unity. The error term will then contain only white noise. The money demand function may be correctly specified in the sense that the correct explanatory variables are included. However this need not necessarily imply money market equilibrium if there are random

[87] Alternatively, taking the total differential,

$$mdF + Fdm = dMd - mdD - Ddm, \text{ so that}$$

$$dF = dMd/m - dD - Hdm/m$$

Dividing through by H, multiplying and dividing dF/H by F, and doing the same to dD/H by D, yields the following:

$$(F/H)dF/F = dMd/Md - (D/H)dD/D - dm/m,$$

which is in rate of growth form. This is the same as taking logarithms of mH = m(F+D), and totally differentiating. The coefficients represent elasticities.

or policy-induced disturbances. For example, it may take more than one time period to eliminate an excess supply of money caused by an increase in domestic credit. Foreign reserves will therefore not adjust in the same period by the full amount of the increase in domestic credit. [1]

The money market may be in equilibrium in the sense that the true $\Delta Md = \Delta Ms$. If, however, the money demand function has been incorrectly specified, then there will be a non-random error in the estimating equation. If this is correlated with the domestic credit variable the coefficient on that variable will be biased (see Helliwell, Gylfason, and Frenkel, 1980). There may therefore be two sources of error in the estimation of the model. One source of error may arise if the money market is not in equilibrium at the end of the period. The other source may arise if the money demand function is

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[1] To see this formally (as also shown in Chapter 2), one can postulate the following formulation which allows for slow adjustment of excess money supply to an initial disequilibrium.

$\Delta Ms - \Delta Md = \beta(\Delta D - \Delta Md)$

If $\beta = 0$ then adjustment is instantaneous. A rise in domestic credit causes an excess supply of money which is immediately eliminated by a corresponding fall in reserves (assuming no change in money demand), so that excess money supply at the end of the period is zero. If $\beta = 1$ then there is no adjustment, and the excess money supply is unchanged at the end of the period. The actual fall in reserves per time period is therefore equal to $(1-\beta)$ times the initial excess supply of money:

$\Delta F = (1-\beta)\Delta Md - (1-\beta)\Delta D$

In terms of the estimating equation in the text, the term $(1-\beta)$ then becomes part of the coefficients to be estimated. The long run coefficients in the money demand function can then be estimated directly from the estimate of the b_2 coefficient.

misspecified. When the equation is estimated the two sources of error are combined, and it is not possible to separate the two.

The model can also be estimated indirectly by first estimating the money demand function and the multiplier and then inserting the estimates into the reserve flow model. As discussed in Chapter 2, Aghlevi and Khan (1977) do this. By adopting this method one is implicitly constraining the coefficients on the domestic credit and money multiplier variables to be minus unity (that is, one is assuming money market equilibrium). If this assumption is correct, then any error in estimating the balance of payments stems from a mispecification of the money demand function or random errors in the money demand function. If this assumption is incorrect, then the error in estimating the balance of payments is again the combination of the two errors mentioned in the last paragraph.

One way of separating these two potential errors is to first estimate the model directly, that is by regressing ΔF on the variables in the equation above. If the coefficient on domestic credit and the money multiplier is minus unity one can then assume that the money market is in equilibrium and that any errors in estimating the balance of payments are random residual errors arising from the estimation of the part of the equation relating to money demand. This can then be verified by estimating the money demand function, and the multiplier, and then substituting into the reserve flow equation. This method also has the advantage that the multiplier can be treated (correctly) as an endogenous variable, whereas in the first method actual values of the multiplier are used. As shown in the second section the estimated coefficient on the domestic credit coefficient was insignificantly different from minus unity. This allowed the use of the second method.

One problem with using the first method (that is, regressing directly) is that the results may be hard to interpret if domestic credit and the money demand variables are highly correlated. There may also be simultaneous equations bias if the change in F affects domestic credit, the multiplier, or the variables in the money demand function.[89] Also, as the variables determining the multiplier are the same as the ones determining money demand it is impossible to identify separately the money demand and multiplier coefficients, unless one, incorrectly, assumes the multiplier to be exogenous. Given these hazards, there are advantages to estimating money demand and the multiplier separately.

Whether to estimate the model in first difference or rate of change form partly depends on one's objectives. The absolute change in NFA should be of more interest, particularly from the policy view-point. The monetary authority's balance of payments

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[89]The danger of bias is still present if one estimates the money demand function separately. As discussed in Chapter 5 there is reason to believe that simultaneous equations bias is not a serious problem in the Zambian situation.

objective is usually to reach a desired stock of NFA (usually expressed as a legal minimum function of a number of months of imports). An x% change in F does not convey nearly as much information with regard to this objective as an x dollar change. A statistical problem is that percentage changes can be very misleading when the numbers are near to zero and are changing from positive to negative and vice versa.[90]

Whether the demand for M1 or M2 is used in the model depends on the stability of the demand function. Obviously, the M1 multiplier is used in the model if M1 is the money aggregate used.

Another way of expressing the model is to forget about the multiplier altogether, and to express the change in F as a function only of the demand for base money and domestic credit of the monetary authority (as P&R (1979) suggest):
Given the monetary authority's balance sheet:

$$H = F + D$$

and first differencing, and assuming that $\Delta Hd = \Delta Hs$ (the change in demand for base money equals the change in supply), then

$$\Delta F = \Delta Hd - \Delta D \qquad (7.2)$$

or, in rate of change form,

$$(F/H)\Delta F/F = \Delta Hd/H - (D/H)\Delta D/H$$

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[90] A change in NFA from 0 to some other number is a percentage change of infinity, for example. In Zambia, both NFA and domestic credit were at very low levels in some years, and both switched from positive to negative and vice versa.

Adding the money multiplier appears to complicate matters unnecessarily, if the demand for base money can be predicted with greater accuracy than the demand for deposit-inclusive money and the elements of the multiplier (which, from the analysis in Chapters 5 and 6 appears to be the case for Zambia).

b) <u>Change in the Net Foreign Assets of the Banking System</u>

Given the balance sheet of the banking system

$$Dp + C + R = F + D + R$$

where R is commercial bank reserves, C is publicly-held currency and Dp represents commercial bank deposits, then

$$C + Dp = F + D, \quad \text{or}$$
$$Ms = F + D$$

F can be subdivided in the NFA of the monetary authority (Fm) and the NFA of the commercial banks (Fb). D can similarly be subdivided into Dm and Db. Therefore

$$Fm + Fb = Ms - Dm - Db$$

Letting $Db = bH = b(Fm+Dm)$, where b is the credit multiplier,

$$Fm + Fb = Ms - Dm - bFm - bDm$$

Lagging one period, taking first differences, and adding and subtracting bDm_{-1} and bFm_{-1} on the RHS

$$\Delta Fm + \Delta Fb + b\Delta Fm = \Delta Md - \Delta Dm(1+b) - \Delta b(H_{-1})$$
$$\Delta Fm(1+b) + \Delta Fb = \Delta Md - \Delta Dm(1+b) - H_{-1}\Delta b$$

so that

$$\Delta Fm + \Delta Fb/1+b = \Delta Md/1+b - \Delta Dm - H_{-1}\Delta b/1+b \quad (7.3)$$

If $\Delta Fb = 0$ (for example, the commercial banks surrender all foreign exchange to the central bank), then the expression explains NFA of the monetary authority only. If the commercial banks hold all the foreign exchange, then ΔFm disappears from the left hand side.[91]

It is impossible to obtain an expression for the change in total NFA on the left hand side, independent of the term (1+b). This is because b contains the ratio of Fb to deposits. It is only possible to obtain an expression for the change in NFA of the central bank, which can be done by taking $\Delta Fb/1+b$ to the RHS, and treating ΔFb as exogenous. To put it another way, one cannot obtain a separate estimate for ΔFb in terms of money or deposit demand and the credit multiplier. In order to know the credit multiplier, the ratio of bank NFA to deposits (f) has to be known. Unless f can be independently explained the demand for deposits and Fb have to be explained separately. However, this cannot be done as the size of Fb is constrained by the other items in the balance sheet, one of which is bank credit, which is a function of the bank credit multiplier. If f is known independently then ΔFb can be estimated directly from an estimate of bank deposits (which can be estimated in terms of income and opportunity cost, as in Chapter 5). If the credit multiplier is more stable than the money multiplier, and the demand for money more stable than the demand for base money, the equation can then be used to estimate the net foreign assets of

[91] The same result can be obtained by total differentiation:

$$dFm + dFb = dMd - dDm - bdFm - Fmdb - bdDm - Dmdb$$

After manipulation this becomes:

$$dFm + dFb/1+b = dMd/1+b - dDm - Hdb/1+b$$

the monetary authority. However, it is very difficult to estimate f independently in terms of behavioural variables, and it usually ends up being treated as an exogenous variable.

7.2 Estimation of the Balance of Payments in Zambia

As mentioned in the last section, the first task was to estimate the reserve flow model directly by regressing ΔF on the right hand side variables in equation (7.1) above.

I first used M2 as the money demand variable, using the model specified in Chapter 5.[92] There is the problem that the multiplier must be treated as an exogenous variable, which is invalid. The test therefore shows how well the balance of payments can be explained, assuming that the money multiplier is known.

The results of the estimation are set out below in Table 7.1.

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[92] That is, the change in money demand was specified as a function of changes in expected income, expected inflation, the interest rate and the price level. The differences between the function estimated in that chapter, and the one in the reserve flow equation above are that money demand is specified in nominal terms and the coefficients represent absolute rather than percentage changes, and therefore are not in elasticity form.

TABLE 7.1

ESTIMATION OF M2 RESERVE FLOW MODEL

Variable	Coeff. Estimate	St. Error	T Value	Diagnostics
Constant	1.73	3.98	0.44	R^2 = 0.999
MDERGDP	0.31	0.11	2.84	F = 1343.3
MDASRATE	-33.4	17.6	-1.90	SER = 10.5
MDEPACPI	8.5	3.1	2.8	COND = 17.4
MACPI	369.3	183.5	2.01	DW = 2.74
HPMUL2	-0.012	0.21	-0.06	
DABZDC1	-0.986	0.05	-21.75	

Notes:

- MDERGDP = change in expected real GDP divided by M2 multiplier;
- MDASRATE = change in savings account rate divided by M2 multiplier;
- MDEPACPI = change in expected inflation divided by M2 multiplier;
- MACPI = change in price level divided by M2 multiplier:
- HPMUL2 = change in money multiplier multiplied by last period's high powered money and divided by this period's M2 multiplier;
- DABZDC1 = change in net domestic credit of BOZ, including 'other items net'.
- DW is the DW statistic for the OLS regression. This model was estimated using generalized least squares, correcting for serial correlation.

The closeness of fit, as measured by R^2, is very good. The coefficient for real income is significant and has the expected sign. It is not comparable with the coefficient in the money demand function estimated in Chapter 5, which is in log form and assumes constant elasticities. It is not possible to derive real money balance elasticities with respect to the variables in the money demand function in the way it is formulated in equation

7.1 above.[93] The sign for the change in the multiplier is negative, as expected, but the magnitude is almost zero. The sign for the change in domestic credit is almost exactly -1, and is highly significant. This indicates that an increase in domestic credit is almost completely leaked out of the economy within a year. This indicates great stability in the money demand function, as an increase in money balances, via an increase in domestic credit, is spent, and not hoarded. Excess money balances have a direct effect on expenditure. [94]

As mentioned in Section 7.1 above, coefficients of minus unity on the domestic credit and money multiplier variables indicate that money market equilibrium is restored within the same time period as the increase in domestic credit and/or the money multiplier. The figures in Table 7.1 show this is not strictly the case, as the coefficient and the t value on the money multiplier variable are almost zero, indicating that a change in the money multiplier hardly exerts any influence on foreign assets. It is not clear why the coefficient is so low when the estimated coefficient on domestic credit is as hypothezized. I decided to ignore this anomaly on the basis

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[93] The assumption of constant elasticities in money demand models is unrealistic for income, if variables proxying monetization are not included in the equation.

[94] There was no problem with multicollinearity between the RHS variables. A correlation matrix showed little correlation except, as might be expected, between domestic credit and prices.

that, in practice, fluctuations in the money multiplier, and the consequent effects on foreign assets, are very small in relation to the changes in domestic credit and their effects on foreign assets.

Table 7.2 shows the differences between the estimated and actual balance of payments. The errors are generally very small, except for 1967 to 1969. They are much smaller than if only the change in domestic credit had been used to estimate the change in net foreign assets (except for 1967 to 1969 - see the last column of Table 7.2). This indicates that the equation is picking up the influence of changes in money demand on the balance of payments.

TABLE 7.2

ESTIMATED AND ACTUAL BALANCE OF PAYMENTS (M2)
(Kwacha millions)

Year	Actual ΔNFA	Estimated ΔNFA	Error	Actual ΔNFA -ΔNDC
66	7.9	9.9	2.0	21
67	-21.6	-47.3	-25.8	-11
68	13.6	44.2	30.6	11
69	121.0	100.5	-20.6	10
70	103.6	110.2	6.6	-10
71	-179.3	-173.2	6.1	19
72	-99.5	-105.8	-6.3	-18
73	-8.6	-12.4	-3.8	-16
74	7.5	19.7	12.2	5
75	-229.1	-236.7	-7.6	-47
76	-133.0	-133.9	-0.9	-34
77	-194.0	-192.8	1.2	-15
78	-259.6	-253.5	6.1	-12
79	80.7	70.3	-10.4	13
80	-187.4	-182.4	5.0	28
81	-346.6	-345.9	0.7	55
82	-195.0	-203.8	-8.8	47
83	-579.1	-562.5	16.6	53
Mean Absolute Error			9.6	24
Mean Square Error			165	810

The same exercise was then repeated using the M1 multiplier, and assuming an M1 money demand function. The coefficient estimates and the actual and estimated changes in net foreign assets are presented in Tables 7.3 and 7.4 below.

TABLE 7.3

ESTIMATION OF M1 RESERVE FLOW MODEL

Variable	Coeff. Estimate	St. Error	t Value	Diagnostics
Constant	2.87	3.63	0.79	$R^2 = 0.999$
MDERGDP	0.2	0.08	2.47	F = 1131
MDASRATE	-16.02	11.1	-1.44	SER = 11.2
MDEPACPI	4.7	1.75	2.68	COND = 12.7
MACPI	187.0	79.9	2.34	DW = 2.84
HPMUL1	-0.07	0.2	-0.34	
DABZDC1	-0.98	0.04	-25.3	

Notes:

- HPMUL1 = change in M1 money multiplier divided by multiplier;
- other definitions are the same, except that M refers to the M1 money multiplier.
- GLS was used to correct for first order serial correlation.

TABLE 7.4

ESTIMATED AND ACTUAL BALANCE OF PAYMENTS (M1)
(Kwacha millions)

Year	Actual ΔNFA	Estimated ΔNFA	Error
66	7.9	11.1	3.2
67	-21.6	-44.2	-22.6
68	13.6	44.2	30.6
69	121.0	105.7	-15.3
70	103.6	113.3	9.7
71	-179.3	-174.6	4.7
72	-99.5	-100.8	-1.3
73	-8.6	-10.0	-1.4
74	7.5	19.1	11.6
75	-229.1	-241.2	-12.2
76	-133.0	-135.8	-2.8
77	-194.0	-190.9	3.1
78	-259.6	-259.5	0.1
79	80.7	69.6	-11.2
80	-187.4	-184.5	2.9
81	-346.6	-350.3	-3.7
82	-195.0	-197.2	-2.2
83	-579.1	-566.0	13.1
Mean Absolute Error			8.4
Mean Square Error			138.0

The average error is similar to that in the M2 model. The variance of the error is significantly lower. This demonstrates that it is better to use the M1 demand function rather than the M2. I also estimated the balance of payments using the demand for base money estimated in chapter 5. The results are presented in Tables 7.5 and 7.6.

TABLE 7.5

ESTIMATION OF BASE MONEY RESERVE FLOW MODEL
(Kwacha millions)

Variable	Coeff. Estimate	St. Error	t Value	Diagnostics
Constant	2.49	3.9	0.64	R^2 = 0.998
DERGDP	0.09	0.03	2.93	F = 1207
DASRATE	-23.4	8.74	-2.68	SER = 10.4
DEPACPI	0.87	1.15	0.76	COND = 13.5
DACPI	100.4	41.2	2.44	DW = 3.09
DALRSRT1	10.9	5.3	2.06	
DALRSRT2	-7.8	4.4	-1.77	
DABZDC1	-0.96	0.03	-29.1	

Notes:
- DALRSRT1 = change in legal reserve ratio on demand deposits;
- DALRSRT2 = change in legal reserve ratio on time and savings deposits;
- other variables are as defined in Table 7.1, except the multiplier component is excluded.

TABLE 7.6

ESTIMATED AND ACTUAL BALANCE OF PAYMENTS (Base)
(Kwacha millions)

Year	Actual ΔNFA	Estimated ΔNFA	Error
66	7.9	15.0	7.1
67	-21.6	-46.3	-24.8
68	13.6	43.5	30.0
69	121.0	109.5	-11.6
70	103.6	109.8	6.2
71	-179.3	-172.3	-7.0
72	-99.5	-99.4	0.1
73	-8.6	-15.8	-7.2
74	7.5	17.03	9.6
75	-229.1	-245.1	-16.0
76	-133.0	-121.9	11.1
77	-194.0	-200.9	-6.9
78	-259.6	-255.6	4.1
79	80.7	70.5	-10.2
80	-187.4	-184.8	2.6
81	-346.6	-347.3	-0.7
82	-195.0	-196.3	-1.3
83	-579.1	-571.8	7.3
Mean Absolute Error			9.1
Mean Square Error			142

The results are similar to the other models. The MSE is slightly higher, but the magnitude of the residuals is much the same for each year. The interest rate coefficient is negative and significant, (in contrast to the other models where it is insignificant). The inflation coefficient is insignificant but the right sign. The reserve ratio on demand deposits has the expected sign and is significant. The other reserve ratio has a negative sign and is insignificant (although nearly significant at the 5% level). The sign on this was also negative in the estimation of the base money equation in Chapter 5.

The result is a little surprizing, as a lower MSE for Base money would have been expected, based on the results in Chapter 5.

The next exercise was to estimate the balance of payments by plugging the estimated values of money demand and the multipliers into the reserve flow equation, instead of estimating the equation directly. The multiplier becomes - realistically - an endogenous variable. This assumes monetary equilibrium, an assumption which is justified by the results obtained when the regression model was run directly.

The model was estimated using both definitions of deposit-inclusive money, and base money. The equations in Table 5.3 were used to produce estimated values. The analysis in Chapter 6 showed that a more accurate estimation of the money multipliers could be obtained by estimating the component ratios of the multiplier than the ratio of deposit-inclusive money to base money. The analysis in the last part of Chapter 6 showed that the currency-total deposit ratio and the reserve-demand deposits ratio could be estimated better than the other ratios. However, as there is no multiplier configuration using these two ratios alone, I used the currency -demand deposit ratio instead (which was calculated by estimating the demand for the numerator and denominator, and then forming the ratio). Finally, the actual value for base money lagged one period was used in the analysis (as it is lagged, it is already 'known').

The results of the estimation of the models are shown in Tables 7.7, 7.8 and 7.9, and Figures 7.1, 7.2 and 7.3. The results are very satisfying, perhaps surprizingly so, given the errors in predicting money demand and the multipliers in Chapters 5 and 6. The errors are very small, both in absolute terms, and relative to the actual figures, except in 1967 and 1968. The results are very comparable to the ones obtained by running the model directly. The MSEs are marginally higher, which is to be expected, given that the multiplier is exogenous in the direct estimation.

There is little to choose between the three models. The base money model however has a lower MSE. A comparison of the residuals indicates that in most years the base money model produced lower residuals than the other models, including practically every year after 1972. The base money errors were much bigger in 1972 and 1975 only. This shouldnot be surprizing, given the greater accuracy with which base money was fitted in Chapter 5, and given the extra potential error arising from the estimation of the multiplier. One might conclude, as PR (1979) do, that the base money model could command more attention in formulating financial programs.

The multiplier part of the model only produces very small figures. Any error in estimating the multiplier will only have a marginal effect on the estimate of the balance of payments. The importance attached to multiplier analysis has probably been overstated in this thesis.

TABLE 7.7

INDIRECT ESTIMATION OF THE BALANCE OF PAYMENTS (M2)
(Kwacha millions)

Year	Actual ΔNFA	Estimated ΔNFA	Error
67	-21.6	-50.8	-29.2
68	13.6	44.8	31.2
69	121.0	109.3	-11.8
70	103.6	111.1	7.8
71	-179.3	-181.7	-2.4
72	-99.5	-94.2	5.4
73	-8.6	-16.4	-7.8
74	7.5	20.2	12.8
75	-229.1	-247.9	-18.8
76	-133.0	-109.4	23.6
77	-194.0	-196.9	-2.9
78	-259.6	-261.6	-2.0
79	80.7	69.6	-11.2
80	-187.4	-189.5	-2.1
81	-346.6	-340.1	6.5
82	-195.0	-188.2	6.8
83	-579.1	-567.8	11.4
Mean Absolute Error			10.8
Mean Square Error			200.0

Notes:

- the estimation is based on the model:
  $\Delta Fm = \Delta Md/m - H \cdot \Delta m/m - \Delta Dm$
  where ΔMd refers to M2, m is the M2 multipler; H is base, Fm is the NFA of BOZ, and Dm are the net domestic assets of BOZ;
- m is defined as: $(c + 1 + t)/c+r$
  where c is the currency-demand deposit ratio, t is the TD ratio, and r is the reserve-demand deposits ratio.
- the estimation was carried by estimating the components separately, and substituting into the model.

TABLE 7.8

INDIRECT ESTIMATION OF THE BALANCE OF PAYMENTS (M1)
(Kwacha millions)

Year	Actual ΔNFA	Estimated ΔNFA	Error
67	-21.6	-51.5	-29.9
68	13.6	44.2	30.7
69	121.0	109.4	-11.7
70	103.6	111.2	7.7
71	-179.3	-181.5	-2.2
72	-99.5	-93.5	6.0
73	-8.6	-15.9	-7.3
74	7.5	20.6	13.1
75	-229.1	-248.0	-18.9
76	-133.0	-110.2	22.8
77	-194.0	-197.1	-3.1
78	-259.6	-260.6	-0.9
79	80.7	69.5	-11.2
80	-187.4	-192.0	-4.6
81	-346.6	-337.9	8.7
82	-195.0	-188.4	6.6
83	-579.1	-569.8	9.3
Mean Absolute Error			10.8
Mean Square Error			200.0

Notes:
- the model is the same as in Table 7.7, except that ΔM1 and the M1 multiplier are substituted in the relevant places for Δ M2 and the M2 multiplier;
- the M1 multiplier is estimated as:
  $(c+1)/c+r$
  where the symbols are as defined as in Table 7.7

TABLE 7.9

INDIRECT ESTIMATION OF THE BALANCE OF PAYMENTS (Base)
(Kwacha millions)

Year	Actual ΔNFA	Estimated ΔNFA	Error
67	-21.6	-52.6	-31.0
68	13.6	42.7	29.1
69	121.0	108.0	-13.0
70	103.6	110.6	7.1
71	-179.3	-180.6	-1.3
72	-99.5	-83.8	15.7
73	-8.6	-13.9	-5.3
74	7.5	19.2	11.7
75	-229.1	-251.3	-22.3
76	-133.0	-120.5	12.5
77	-194.0	-191.5	2.5
78	-259.6	-257.9	1.7
79	80.7	74.0	-6.7
80	-187.4	-190.1	-2.7
81	-346.6	-345.8	0.8
82	-195.0	-190.0	5.0
83	-579.1	-570.4	8.7
Mean Absolute Error			9.9
Mean Square Error			183.4

Notes:

- the model is: $\Delta Fm = \Delta Hd - \Delta Dm$
  where Fm and Dm are as defined in Table 7.7, and Hd is the demand for high powered money, estimated separately and then plugged into the equation.

FIG 7.1

ESTIMATED AND ACTUAL CHANGES IN BANK OF ZAMBIA NET FOREIGN ASSETS: M2 MODEL

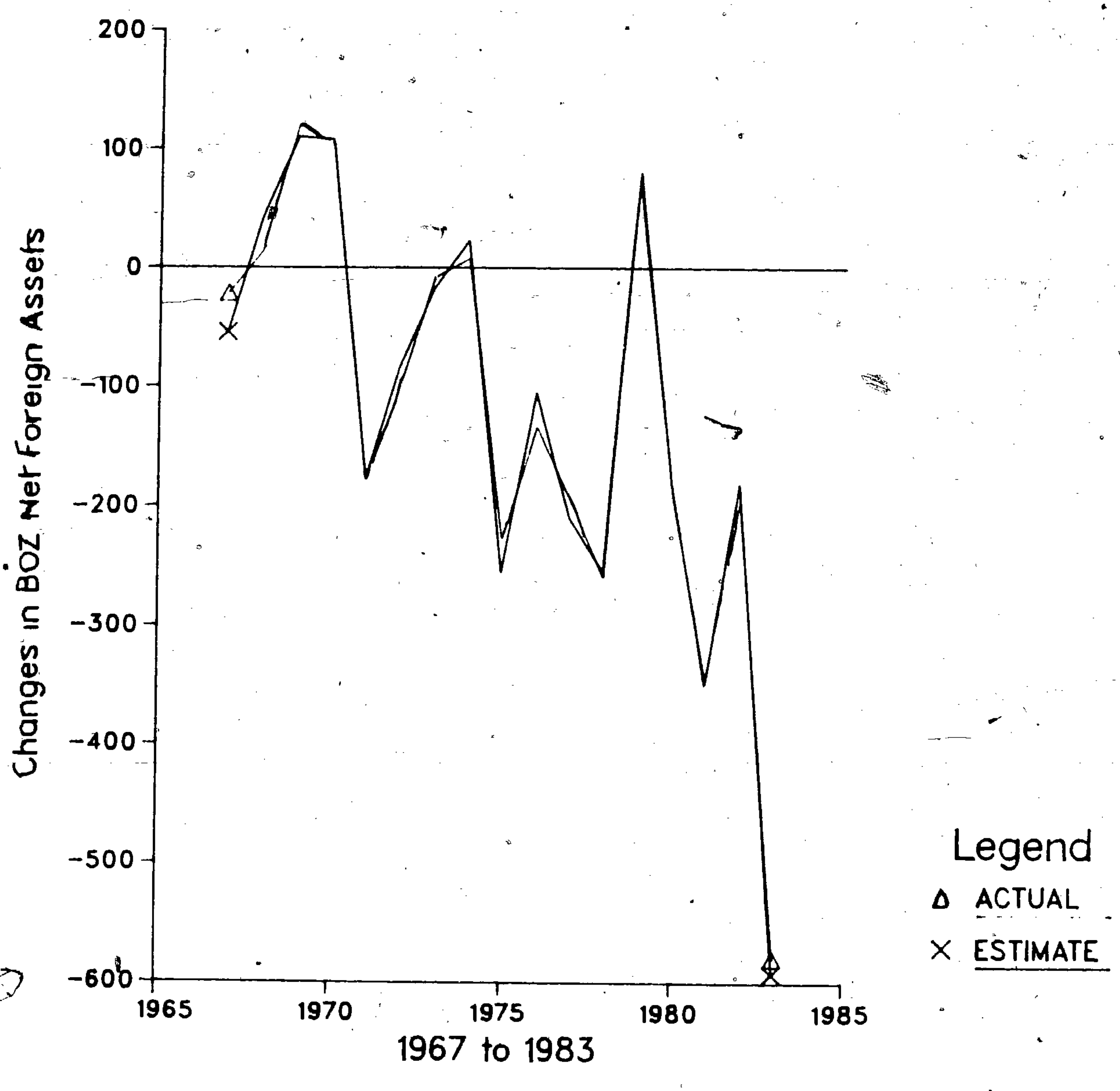


FIG 7.2
ESTIMATED AND ACTUAL CHANGES IN BANK OF ZAMBIA NET FOREIGN ASSETS: M1 MODEL

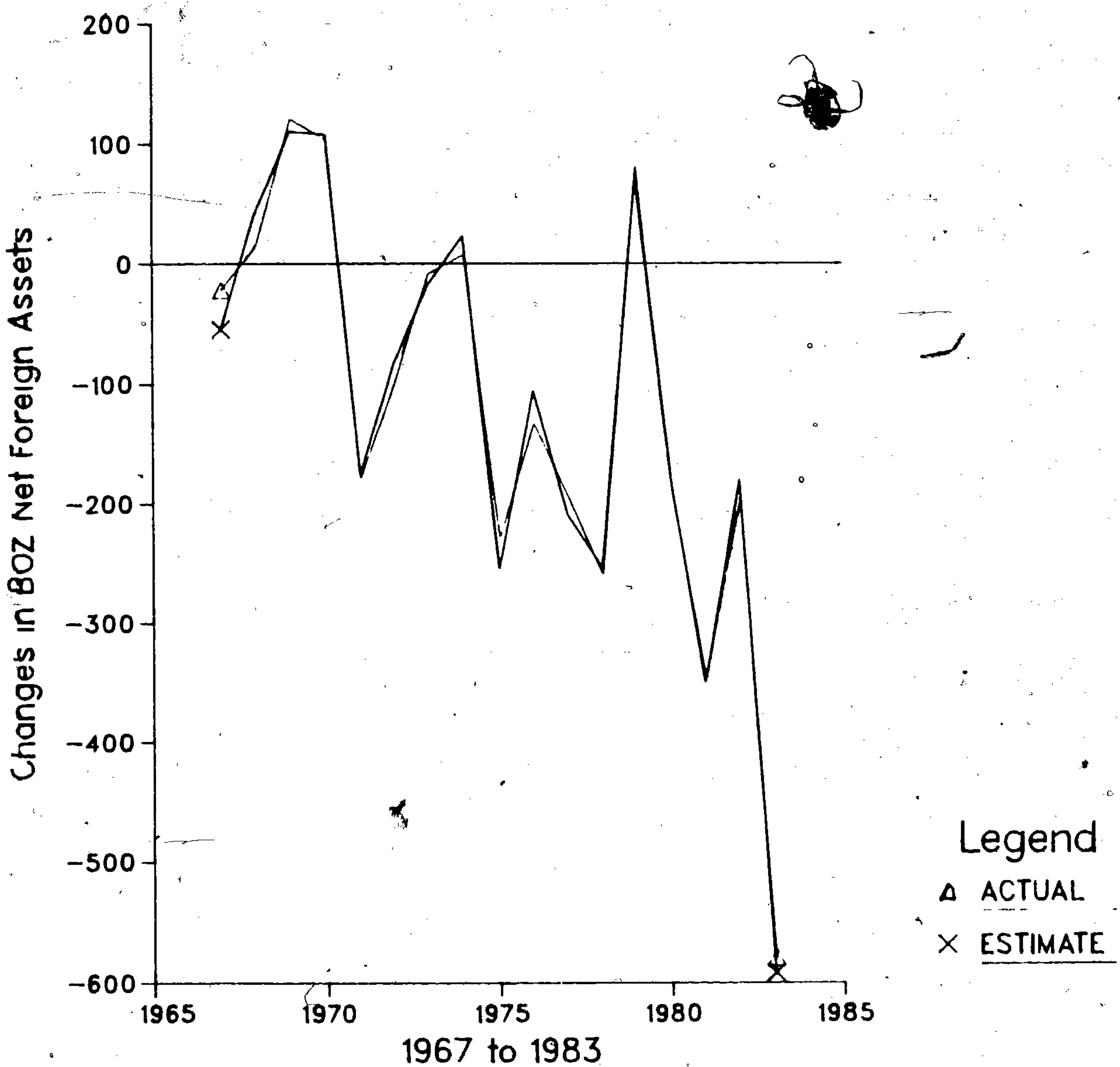
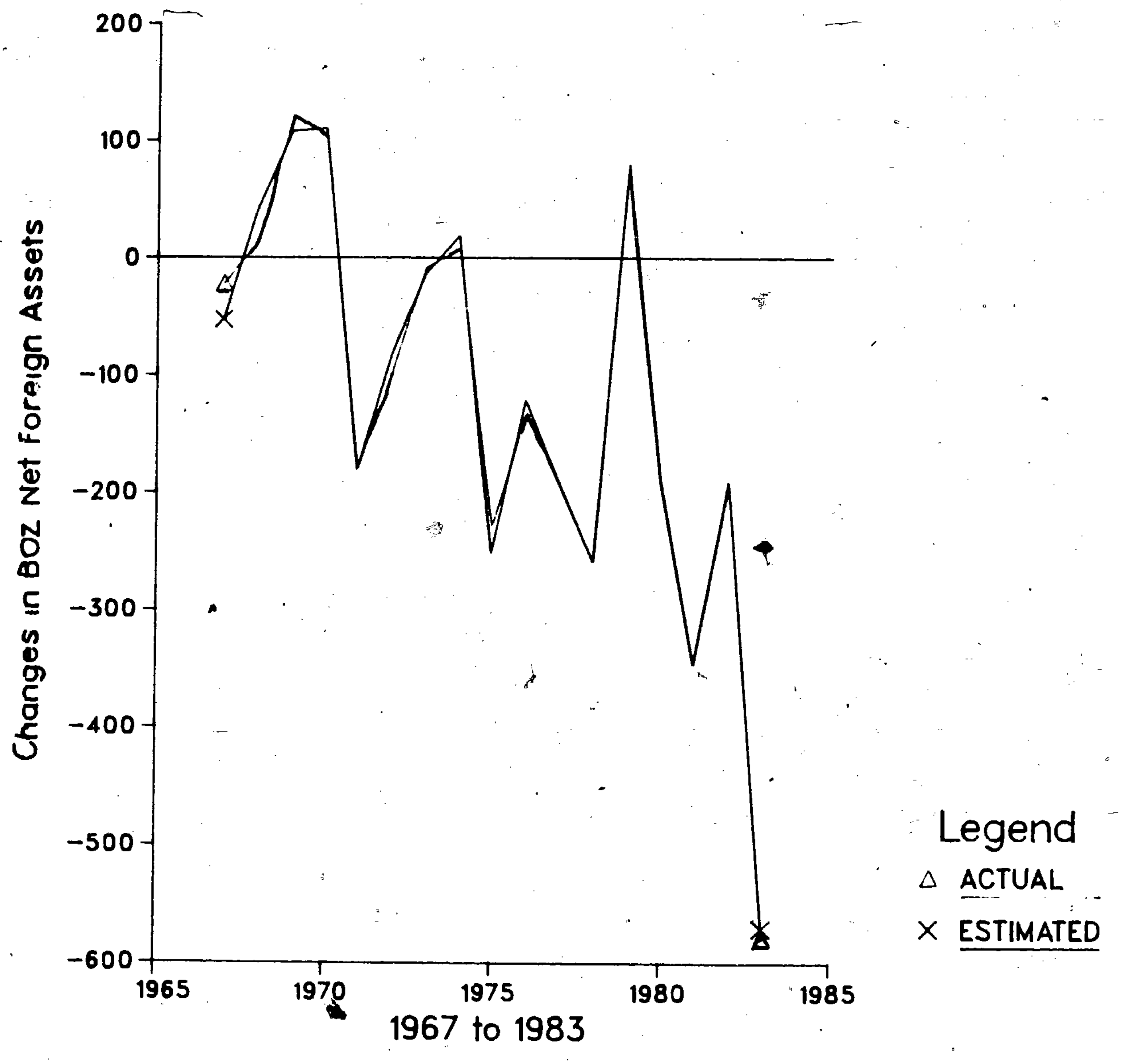


FIG 7.3
ESTIMATED AND ACTUAL CHANGES IN BANK OF ZAMBIA NET FOREIGN ASSETS: BASE MODEL



7.3 Forecasting of Balance of Payments

The last exercise is to predict the changes in the net foreign assets of the monetary authority by using the simulated values of money demand and the money multipliers that were obtained in chapters 5 and 6. The money multiplier predictions are derived from the money multiplier components rather than the ratio of deposit-inclusive money to base money, as the variance of the errors in the former is lower than in the latter, as shown in Tables 6.12 and 6.13 above. In conducting the simulations it is assumed that the previous years' values are the actual values.

The results are shown in Table 7.10. They are quite revealing. Using the demand for base money function to forecast the change in NFA produces far more accurate results than using the demand for deposit-inclusive money functions. In turn, the demand for M1 function is considerably more accurate than using the demand for M2 function. The error variance for M2 is actually greater than if the change in net domestic credit alone had been used to predict the balance of payments. However, the main source of error lies in the very inaccurate forecast of both the demand for M2 and the M2 multiplier in 1978. The base money model does not predict the best in all years. The M2 model predicts the best in 1983, and the M1 model predicts the best in 1981 and 1982. On the average, however, there is less chance of making a sizeable error using the base money model. The reason is that the demand for base money is more stable than the demand for deposit-inclusive money, and also there is no need to predict the multiplier, thereby eliminating another source of error.

Another way of forecasting the changes in the NFA of the monetary authority would have been to use the credit multiplier model. However, Chapter 6 showed that the variance of the errors in predicting the credit multiplier were higher than for the M1 and M2 multipliers. Therefore there was little point in such an exercise.

TABLE 7.10

FORECAST OF THE CHANGE IN NFA OF THE MONETARY AUTHORITY
(Kwacha millions)

a) M2 model

Year	Actual ΔNFA	Forecast ΔNFA	Error	Actual ΔNFA - ΔNDC
76	-133	-113	20	34
77	-194	-157	37	15
78	-260	-129	131	12
79	81	71	-10	13
80	-187	-213	-26	28
81	-347	-358	-11	55
82	-195	-188	7	47
83	-579	-580	-1	53
Mean Absolute Error			30.4	32
Mean Square Error			2484	1315

b) M1 Model

Year	Actual ΔNFA	Forecast ΔNFA	Error
76	-133	-116	17
77	-194	-145	49
78	-260	-266	6
79	81	65	-16
80	-187	-212	-25
81	-347	-347	0
82	-195	-194	1
83	-579	-569	10
Mean Absolute Error			15.5
Mean Square Error			464

TABLE 10 (cont.)

c) Base Money Model

Year	Actual ΔNFA*	Forecast ΔNFA	Error
76	-133	-124	9
77	-194	-186	8
78	-260	-271	-11
79	81	69	-12
80	-187	-198	-11
81	-347	-353	-6
82	-195	-193	2
83	-579	-573	6
Mean Absolute Error			8.1
Mean Square Error			76.0

Note:
- the models are defined in Tables 7.7, 7.8 and 7.9. The predicted values of the multipliers are taken from Table 6.15. The predicted values of the demand for M2, M1 and base money are taken from Tables 5.11, 5.9 and 5.7 respectively, and substituted into the models. The actual values of the previous year are used. Actual values are used for domestic credit.

7.4 Summary and Conclusions

The results of this chapter show quite conclusively that research into money demand functions can pay off in terms of better understanding of the balance of payments. Although I could not develop a money demand function that could explain every variation in money balances, I was able to obtain acceptably small errors. I was able to obtain much better predictions of the balance of payments outcome than through predictions using the change in net domestic credit alone.

As direct estimation of the reserve model showed, changes in domestic credit of the monetary authority virtually have an inverse one to one correspondence with changes in net foreign assets of the monetary authority (see also Fig. 4.1 in Chapter 4). This shows in itself the stability of the money demand function in that excess money balances are directed towards expenditure. It also shows that monetary equilibrium tends to be restored within the same time period as the disturbance to the equilibrium created by an increase in credit.

The results show that the demand for base money function performs the best in predicting the balance of payments, while M2 performs the worst. This supports Paljarvi and Russo's contention that base money demand functions should receive more attention.

Finally, it seems that the emphasis placed upon estimating the multiplier may have been misplaced. In the first place errors in estimating the multiplier have only a very small effect on the balance of payments. In the second place knowledge about the multiplier is irrelevant if the base money demand function is used.

In summary, the results are very encouraging. They show that it is possible to derive sound demand functions based on a few key variables in places such as Zambia which has suffered a multitude of shocks and upheavals. This study demonstrates the usefulness of monetary research in developing countries, and hopefully will point the way to more similar research in Africa.

APPENDIX

EXPECTATIONS AND ADJUSTMENT MODELS

The measure of expected income used in Chapter 5 was a weighted arithmetical average of this and last period's income. The measure of expected inflation used was the average of this and the next period's inflation rate.

A more traditional measure of expected income and inflation can be formulated by means of the adaptive expectations assumption (AE)(see Johnston, 1972; Maddala, 1977; Kennedy, 1979; Laidler, 1985; and Attfield, Emery and Duck, 1985). It is assumed that expectations are updated each period by a fraction of the discrepancy between the current observed value of the variable and the previous period's. This implies that the expected future value of a variable can be measured by taking an exponentially weighted average of current and past values of that variable.

Letting y^+ represent expected income in natural logs,

$$y^+ - y^+_{-1} = \lambda(y - y^+_{-1}) + e$$

By back substitution we obtain

$$y^+ = \lambda y + \lambda(1-\lambda)y_{-1} + \ldots\ldots\ldots + \lambda(1-\lambda)^n y_{-n}$$

This can be built into the money demand function as follows:

$$m = a_0 + a_1(\lambda y + (1-\lambda)y^+_{-1}) + a_2(\lambda\Pi + (1-\lambda)\Pi^+_{-1}) + e \quad (1)$$

Lagging one period, multiplying by $(1-\lambda)$ and subtracting from

(1) gives the following expression.

$$m = a_0\lambda + (1-\lambda)m_{-1} + a_1\lambda y + a_2\lambda\Pi + a_3r - a_3(1-\lambda)r_{-1} + (e-(1-\lambda)e_{-1}) \quad (2)$$

There are both theoretical and econometric problems with the adaptive expectations model. On the theoretical side the model is too mechanistic and 'irrational'. From the behavioural point of view it seems implausible that a person's measure of permanent income should be affected by values of income several periods back (even though, under the exponential weighting system, the influence is small). Second, if the past value of the variable has always been rising or falling, then the expectation will always be short of or above the current value, leading to systematic forecast errors. If people were rational they would change their method of forming expectations until systematic errors were zero. However, the AE hypothesis does not allow any mechanism for changing expectations. The λs are assumed to be constant.

Third, the model assumes that people do not take current information, such as changes in government policy, and the occurrence of other shocks, into account when forming their expectations. Fourth, the model assumes that expectations concerning real income and inflation are adjusted with the same speed. As PR (1979) mention, 'there is no a priori reason for assuming that these expectations are formed analogously'. However, if the assumption is not made the model loses its simplicity.

Assuming different λs we get:

$$m = a_0\lambda_1 + (1-\lambda_1)m_{-1} + a_1\lambda_1 y + a_2\lambda_2\Pi + a_2(1-\lambda_2)\Pi^*_{-1} - a_2(1-\lambda_1)\Pi^*_{-1} + a_3 r - a_3(1-\lambda_1)r_{-1} + (e-(1-\lambda_1)e_{-1}) \quad (3)$$

We cannot get an expression eliminating the lagged expected inflation variable. Instead the distributed lag formulation has to be substituted, the estimation of which is difficult, because of the loss of degrees of freedom and the problems associated with multicollinearity.

Econometric problems arise because equation (2) contains both a lagged dependent variable and a moving average error term. Asymptotic bias arises because the lagged dependent variable is contemporaneously correlated with the autocorrelated disturbance (see Kennedy, 1979). However, it is possible to overcome the problem by assuming the error pattern is autoregressive, and then conducting GLS (see Johnston,1972). A computer package can do this automatically (the procedure is to lag equation 2 by one period, multiply through by ρ, and subtract from equation 1). The estimated equation is non-linear, as the terms $(1-\lambda+\rho)$ and $\rho(1-\lambda)$ appear as the coefficients of m_{-1} and m_{-2} respectively. The coefficients still suffer from small sample bias. One problem is the creation of yet another RHS variable, losing another degree of freedom, when one has already been lost in arriving at equation (2). This is particularly serious for the bank reserves and the base money equation, which have the legal reserve ratios as extra variables. A further problem is multicollinearity between the variables that are not in 'expected ' form. There may also be multicollinearity between the two lagged endogenous variables. If second order autocorrelation was assumed, this problem (and the degrees of freedom problem) would be worse, as there would be a third lagged endogenous variable.

The model I used in Chapter 5 is also admittedly ad-hoc. It does not allow for any change in expectations- forming mechanisms. However it simple and plausible. I do not think it is any more ad-hoc than the AE model, and is, I believe, more plausible. It recognizes that peoples' perception of permanent income may take time to adjust, particularly if income fluctuates unexpectedly. However, it is unlikely to take longer than one year to adjust. My model also allows for the potential of different expectations forming mechanisms for inflation and income. My method creates fewer potential econometric problems. There is precedent in the literature. For example, Zecher(1976) uses a 16 quarter weighted moving average of GDP to derive permanent income.

If permanent income was really specifed properly, it would take into account other factors apart from past values of income. However, it is difficult to specify the true 'rational expectations' process for arriving at expected income.

There may be time lags between the adjustment of actual to desired balances, for reasons of ignorance, inertia, and the costs of change. Following Johnston (1972) and Laidler (1985) one can assume (arbitrarily) that these costs are a quadratic function. By minimizing these costs with respect to real balances, one obtains:

$$m - m_{-1} = a(m^{*} - m_{-1})$$

where m^{*} is desired real balances, and replaces m on the LHS of equation 2. By substitution we obtain:

$$m = ab_0 + (1-a)m_{-1} + ab_1y + ab_2\Pi + ab_3r + ae$$

The error term is spherical, which (as well as the lack of a lagged interest rate term) distinguishes it from equation (2). This has fewer some econometric problems than the AE method as long as there is no autoregressive error structure in the residuals.

Laidler (1985) discusses difficulties with this method. He says that the theoretical basis is suspect. The theoretical basis for the transactions and the precautionary demand for money derive from the transactions costs that people face in adjusting money holdings. It does not seem valid to introduce a further type of adjustment cost. Second, the equation implies that nominal balances adjust simultaneously in reaction to price level changes in order to keep real balances constant. It is not obvious why this adjustment should be instantaneous, while the adjustment of other variables is not. Third, for the economy as a whole it is not clear what a means. If it means the adjustment of actual real or nominal balances to desired, then it is capturing the whole transmission mechanism in the economy, which is not what the equation was supposed to represent. If this is the case, however, then the equation is more of a supply function than a demand function.

As with the AE mechanism the adjustment parameter is assumed to be constant. This may not be the case, particularly during periods of economic upheaval and policy change.

In practice I found I did not need to use any kind of partial adjustment mechanism. The residuals in the equation estimated in Chapter 5 seemed sufficiently random that no adjustment process was called for. If there had been any systematic deviation of actual balances from desired balances then this might have indicated the need for a partial adjustment mechanism.

The PA and AE hypotheses can be combined into one equation. When the AE mechanism is substituted into the equation (4) the following is obtained.

$$m = a\lambda b_0 + (2-\lambda-a)m_{-1} - (1-a)(1-\lambda)m_{-2} + a\lambda b_1 y + a\lambda b_2 \Pi + a_3 b_2 r - a_3 b_3 (1-\lambda) r_{-1} + ae - (1-\lambda)ae_{-1}$$

It is not possible to identify directly the adjustment parameters unless constrained least squares are used, but the elasticities in the long run function can be identified. However, the problems that were mentioned earlier still apply.

The method loses valuable degrees of freedom.

As an experiment I ran the models outlined above to see how well they fitted the Zambian data. I first worked with M1, using annual data. I first tested the PA model.

The equation derived was (in logarithms):

$$m = -1.9 + 0.39m_{-1} + 0.76y - 0.012\Pi - 0.17r$$
$$(2.2) \qquad (2.03) \qquad (-.002) \qquad (-2.14)$$

R^2=0.83 F=22 COND=627 SER= 0.07 Method = GLS

This produced a long run income elasticity of 1.27, which is close to the elasticity derived in Chapter 5. The interest rate elasticity was also close. The inflation elasticity was the opposite sign from Chapter 5, and almost zero. The coefficient estimates are probably very unstable, as indicated by the very high COND estimate. However, the income and interest rate coefficients are at least consistent with those estimated in Chapter 5. The error structure revealed little autoregression, indicating that the model is a PA model rather than an AE model.

I also estimated the M1 equation by adding a population variable. The F and R^2 improved. However, COND value shot up. The equation showed significant first and second autocorrelation, for which I used GLS. The income elasticity fell to 0.97, and the inflation coefficient became positive, although insignificant. The interest rate elasticity rose to

-0.6.

I also estimated the AE model. When I estimated this without a population variable the income elasticity was about 1.3, or the same as under the PA model. The inflation coefficient was positive. The residuals showed significant correlation. However, when I estimated the model with a population variable the income elasticity fell to just over 1. The COND values reached very high levels, so one would be inclined to have little faith in the coefficient estimates.

When I tried both PA and AE combined I obtained an income elasticity of 1.36, which is the same as that achieved in Chapter 5. The equation had a very low F value.

I also tried these methods on quarterly data, for which they are perhaps more appropriate as a person would probably place greater weight on lagged incomes in forming income expectations. Using an AE model I obtained the following results:

$$m = -0.04 + 0.83m_{-1} + 0.18y - 1.3\Pi - 0.09r + 0.07_{-1}$$

(12.8) (1.44) (-3.4) (-0.5) (0.42)

R^2=0.89 F=115 SER=0.06 COND=338 Method=GLS1

This produced a long run income elasticity of 1.06, compared to 1.3 using annual data. The inflation coefficient is significantly negative, in contrast to the annual model. The interest rate elasticity, at -0.47, was similar to the result obtained in the annual model. I also estimated this equation using per capita income and population as explanatory variables. The income elasticity fell to 0.8. However, the equation was generally unsatisfactory because of the extremely high COND value (over 2000).

I estimated the model without a lagged interest rate, that is, as a PA model, and without adding the population variable (which, as explained in Chapter 5, serves as a trend variable). The income elasticity was about one. The inflation coefficient was negative and strongly significant. The interest rate remained insignificant (surprizingly, as the reason for its insignificance in the AE model seemed to be the multicollinearity with the lagged variable). The error structure showed little correlation, implying that the model is a PA rather than an AE model. This was confirmed when I estimated the combined PA and MA model with quarterly data (without the population trend variable). The income elasticity was 0.9, with (as in many of the cases above) an insignificant coefficient.

I also tried estimating the currency demand equation. Estimating this in aggregate terms produced very implausible results, with a negative income elasticity, and an implausibly high inflation elasticity. In chapter 5 the currency equation had worked well. Absurd results were also obtained when the equation was specified in per capita terms. However, when I tried the equation on quarterly data it worked much better. The income elasticity was 1.05, but the coefficient was insignificant.

Finally, I tested the base money equation using quarterly data (there were not enough degrees of freedom to use annual data). I used the AE model. However, the residuals showed very little autocorrelation, indicating that the PA model is probably the true one. The income elasticity was 1.08, much below the estimate in Chapter 5. However, judging from the results with M1 income elasticies tend to be lower using quarterly data . The interest elasticity was -0.34, which was much the same as in Chapter 5. The inflation coefficient was also much the same. The coefficients for the reserve ratios were the right sign but insignificant, probably because of multicollinearity.

In summarizing this appendix, the results obtained were acceptable for M1 using both quarterly and annual data, for currency, using quarterly data, and for base money using quarterly data. The income elasticities tended to be lower than those estimated in Chapter 5, except in the case of M1 using annual data. However, when a population trend variable was added to the M1 equation the income elasticity dropped significantly, whereas it made no difference in Chapter 5. The results do not indicate any superiority over the ones obtained in Chapter 5. The very high COND values obtained, particularly when the equations were specified in per capita income terms, lead one to be suspicious of the results. Also, the PA model, which seems to fit the data better than the AE model (based upon an examination of the residuals) is theoretically dubious (as Laidler(1985) discusses).

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