An Error Correction Approach to Modelling Demand For Money in Selected SADC Countries Under Structural Adjustment Programs

by

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TO MY FAMILY

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ABSTRACT

Since the early 1980's, a number of Southern African Development Community (SADC) countries have introduced economic and financial reforms under the auspices of Structural Adjustment Programs (SAPs). Recent developments in studies on demand for money point out that such changes may cause instability of the demand for money function and ultimately inhibit the efficacy of monetary policies. Furthermore, the application of classical and monetarist type demand for money models under these circumstances would be unsuitable. Error correction models (ECMs) are considered to be more appropriate.

This study reviews financial liberalization under SAPs and applies an error correction approach to model the demand for money in three SADC countries, namely, Malawi, Zambia, and Zimbabwe. Empirical results indicate that the demand for broad money has remained stable in Malawi and Zimbabwe whereas narrow money in both cases has become more unstable. In the case of Zambia, financial liberalization has had a destabilizing effect on the demand for both narrow and broad money. The empirical results are significant because they show the limitations of monetary policy under a changing financial environment and caution against undue reliance on monetary policy as a tool of macroeconomic management.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

The specification and estimation of the demand for money function has interested economists for decades. This is evidenced by the existence of numerous published studies on the subject. Recent economic and institutional developments challenge the relevance of monetary theories which have prevailed for some time. The significance of these recent developments is in itself a subject of controversy. In monetary theory, as is the case in many other areas of economics, economists differ on even the most fundamental issues which are concerned with the relevance and the actual impact of monetary factors on economic activity. Monetary theory offers variety of ideas which includes issues such as what constitutes the money supply, what determines the demand for it and what is the precise nature of the transmission mechanism by which given changes in monetary variables affect gross domestic product (GDP), prices, employment and the balance of payments. Following the classical tradition, Solow's (1956) model of long-run economic growth explains the rate of output growth in terms of total factor productivity, the rates of growth in both capital per worker and that of the labour force. Money supply is assumed to be neutral in the growth process. It could only explain nominal variables such as the price level and nominal exchange rates. Real business cycle theory of growth confirm the classical position and point out that monetary effects are transitory and that, in the long-run, they do not affect real variables. See, for example, Kydland and Prescott (1986) and Plosser (1989). Other theories disagree with the classical and real business cycle views. Friedman (1959) and the monetarist school believe that money exerts a significant influence in the economy. It can stimulate output growth, generate employment and cause inflation. For this reason, monetarists advocate the need for policy intervention in order to regulate the quantity of the money supply in accordance with stipulated rules. Details of the various theoretical approaches to money are described more extensively in the literature review section of this study.

Despite the controversies, many studies seem to agree that money exerts a significant influence on the economies of both developed and developing nations, either on nominal variables or on real variables, or on both. They show that the behaviour of money demand has important implications for the efficacy of monetary policy and therefore, a study of the demand for money function in a dynamic framework is fundamental in the quest for policies which can further macroeconomic objectives. The existence of a stable long-run relationship between real money on the one hand, and real income and nominal interest rates on the other, implies that it is feasible to achieve price stability by controlling the growth rates of either M1 or M2 or the monetary base, or for that matter, any relevant monetary aggregate defined according to the relative sophistication of the monetary sector. For this reason, the quantity of money needs to be regulated through the use of monetary policies by central banks. This issue is highly contested in economic theory.

The present study is empirical in nature in that a model of demand for money is specified and estimated taking into account recent developments in both monetary theory and econometric methodology. For purposes of empirical implementation of the model, data related to selected countries in the Southern African region are utilized.

1.1 Monetary policy and the demand for money

The use of monetary policy in macroeconomic stabilization of many developing Southern African countries implicitly indicates a belief in the importance of monetary factors in the economy. In the specific context of developing nations, international financial institutions are emphasizing, among other things, the need for fiscal and monetary restraint as part of the strategy to deal with chronic economic problems of poverty, unemployment, government indebtedness and balance of payments deficits. In order to determine the impact of monetary changes on the economy, and to evaluate the efficacy and relevance of monetary policy, it is imperative that we know the behaviour of the demand for money. There are theories within the classical school of economic thought which suggest that the demand for money is a stable function of income, wealth, prices and interest rates. They contend that, since the function is stable, the impact of monetary policy can be predicted with a reasonable degree of accuracy. However, if it is unstable, then the efficacy of monetary policy is difficult to determine. The controversy surrounding the whole issue of money and monetary policy hinges essentially on the question of stability of the demand for money function. Needless to say that in order to determine the stability of the function, the issues of specification and estimation are crucial.

This study focuses on the demand for money primarily because there is evidence of greater reliance on monetary policy as a macroeconomic tool and yet, in the context of many developing African countries, there is little research incorporating the recent theoretical and methodological issues raised concerning the behaviour of the demand for money. A majority of the few existing studies rely heavily on the more conventional approaches, as embodied in the classical and Friedman-type monetarist framework, which are now considered to have serious limitations.[1]

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[1] The theoretical approach used in that analysis is in the tradition of the quantity theory of money. The central theme of that theory is that there is a logical and

Ironically, the formulation and implementation of monetary policies in African countries appears to rely heavily on results based on the conventional approach.

This study, therefore, focuses on the specification and estimation of the demand for money function and includes three small open developing economies in the Southern part of Africa, namely, Malawi, Zambia and Zimbabwe. These countries are part of a ten member economic grouping known as the Southern African Development Community (SADC).[2] The choice of the three countries is based on their having experimented with economic reform programs, and also that relevant data were more readily available than other countries in the region. Although Tanzania had a longer experience with programs of economic reform, yet data limitations precluded it from our study. Other countries such as Botswana, Swaziland and Lesotho have fared better economically than the other members but they could not be included in our study as their programs of economic reform were introduced fairly recently. Since the mid-seventies, this region is undergoing some drastic changes on the

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empirically observable relationship between the stock of money and the level of income and prices. This is embodied in the Cambridge version of Fisher's equation : $M = kPY$ where M is the stock of money, P is the price level, Y is the volume of transactions or output and k is the proportion of income (PY) which is held as a cash balance.

[2] By the end of 1992, these countries consisted of Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe.

political, economic and social fronts. Political changes are taking place because of the transfer of power from colonial to democratically elected governments. Economic changes are occurring because of the shift from a more interventionist, mixed economy system to a less regulated market oriented economy. Social changes are inevitable because political and economic changes engender change in the entire fabric of society. These countries are currently pursuing economic liberalization[3] programs which are popularly known as Structural Adjustment Programs or SAPs. It is presumed that these developments would have a significant impact on the banking and financial sector by changing their environment. This has feedback effects on the behaviour of the velocity of circulation of money. Contrary to both the classical and monetarist theories, velocity of circulation of money may be highly volatile particularly in the face of rapid or drastic institutional and structural changes in the financial sector.

The literature survey in chapter 3 shows how, in the context of developed economies, there have been structural shifts in that function which have been attributed to the rapid pace of financial innovation. This implies that the demand for money function may not be stable, which, in turn,

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[3] The origin of this term is certainly not clear. However, it implies the " decontrol" of once heavily regulated markets so as to enable market forces determine the allocation of resources.

suggests that the policy impact of a change in monetary policy cannot necessarily be predicted with accuracy.

1.2 Demand for money - overview of the controversy

A review of some important studies which have been conducted on the demand for money will be made in chapter 3 to show the evolution of the theory and to evaluate the modelling of the demand for money function. The analysis will show that inspite of the existence and even popularity of some studies on the subject, notably Friedman (1959), Meltzer (1963), and Laidler 1966), the post 1973 economic events in many of the developed and some developing countries do not provide overwhelming support for the hypothesis that real money balances are predictably related to some scale measure such as income or wealth, and some measure of the opportunity cost of holding real balances. See Judd and Scadding (1982a). Rasche (1987), expanded the discussion to current developments. An underlying proposition in that analysis is the issue of stability of the velocity of circulation of money, the so-called velocity puzzle. The relationship between money and income basically describes the demand for money, and this is commonly represented by the income velocity of circulation. Empirical evidence shows that, contrary to the classical and monetarist theories, velocity is neither constant nor stable in all circumstances as evidenced by its secular tendency to rise during periods of tight money and to fall during periods of easy money. There are studies which appear to verify that income velocity, especially of M1 (the narrow definition of money), has drifted upward over time. See, for example, Nelson and Plosser (1982). Their study showed that M2 tends to move around an unchanged mean and this suggests that M2 and income are cointegrated.[4] However, Hallman, Porter and Small (1989, 1990) and Hafer and Jansen (1991), pointed out that the results for M2 appear to be sensitive to the sample period and how the test is performed. The absence of a cointegrating relationship between income and M1 and the presence of a cointegrating link between income and M2 implies that there is no stable long-run demand for M1 whereas there exists a stable long-run demand for M2. See, for example, Dickey, Jansen and Thornton (1991).

Debate on the dynamic aspects of the function focuses on the adjustment process by which the demand for money responds to changes in any of the independent variables cited above. It focuses on the process or mechanism of adjustment and whether or not this demand reaches equilibrium in the long-run. This challenges long-held views of rapid or instantaneous adjustment of short-run demand for money toward long-run equilibrium. Many time series studies

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[4] The concept of cointegration is explained in more detail in chapter 3. Basically, when a linear combination of a pair or a group of time series are stationary, then the variables are said to be cointegrated. See Engle and Granger (1987).

on the behaviour of the demand for money suggest that trends in the money market show evidence of short-run deviations from long-run equilibrium.

Hendry (1980) calls the marked departure from traditional methodologies, a "new econometric methodology"- an approach which provides a link between long-run trend relationships among economic variables and a system of short-run dynamic adjustment equations.

Hafer and Jansen (1991), also pointed out that a fundamental short-coming of conventional studies lies in their failure to provide a comprehensive analysis of the long-run or dynamic considerations. They argued that if there exists some linear combinations among the vector of key demand for money variables such as real money balances, real income, and interest rates, and that if these are cointegrated, then the demand for money can be estimated using models which yield more information than traditional approaches.

The new methodology effectively deals with the issue of exogeneity or endogeneity of variables. We recall that much of the debate between monetarists and Keynesians centres on the exogeneity of money. Friedman and Schwartz (1963, 1982) concluded that in the long run money "causes" income but not vice versa. From this causality pattern, they inferred that money supply was exogeneous. The conclusion that money "matters" for the determination of aggregate demand implies a close empirical connection between monetary fluctuations and the business cycle. These studies emphasize that over long periods of history and under a variety of institutional arrangements, nominal GNP moves in tandem with the nominal money supply and equivalently, velocity appears stable.

Whereas conventional specifications make the implicit assumption that causation runs from income, among other variables, to demand for money, critics have raised questions concerning the exogeneity or endogeneity of the variables used in specifying the demand function for money.

Tobin (1970) and Kaldor (1970) contested the money exogeneity proposition. They argued, instead, that money was demand determined, and therefore endogeneous. Sims (1972), using Granger's (1969) definition of causality, found evidence which he interpreted as supporting Friedman's proposition of money supply exogeneity.

Hendry (1980,1985), pioneered work on a new econometric methodology and used it to show that parameter instability prevailed in the US and British money demand functions and this was evidence of a spurious phenomenon due to incorrect specification. Granger and Newbold (1974) indicated that the log-levels of many economic variables are non-stationary and are therefore subject to the "spurious regression" phenomenon if the ordinary least squares (OLS) estimator is applied. Phillips (1986) further showed that the use of a log-level model generates spurious inferences because the usual t and F-test statistics do not have even a limiting distribution. Recent evidence by Ito (1989) questioned the appropriateness of the log-level specification since it exhibits a large shift, whereas log-first differences and error-correction specifications show little sign of instability. Thus, the main criticism of the specification of the demand for money function is based on the observation that the variables commonly used in these studies are non-stationary stochastic processes even in log-form. Estimation of the function using non-stationary data will lead to unreliable t-statistics, as the underlying time series would have theoretically infinite variances. In order to circumvent the problems described above, preference is accorded to the error-correction model (ECM). This is due to its " fair" features, in that it avoids the possibility of spurious correlations among strongly trended variables.It also ensures that the long-run relationship, which may be lost by expressing the data in differences to achieve stationarity, is captured by including the lagged levels of the variables on the right-hand side. The ECM also differentiates between short-run (first-differences) and long-run (lagged-level) effects. Finally, it provides a more general lag structure, which does not impose a specific structure on the model (Hendry, 1980).

There does not appear to be consensus on what definition of money would be appropriate since there are different classifications of money according to the liquidity characteristics of various deposits. For example, M1 relates to the most liquid form of bank liabilities, namely, currency and demand deposits. M2 includes the less liquid liabilities such as fixed deposits of banks.

Although most studies suggest the use of income and interest rates, differences exist on which interest rate should be used, i.e., whether the short or the long-term rate. With regard to the income variable, arguments centre on whether GNP or GDP should be used. Mankiw and Summers (1986) suggested that it is an empirically useful exercise to consider other scale variables such as personal disposable income, private spending, final sales, and domestic absorption. They even go further and point out that, on the basis of their empirical work, consumption expenditure rather than GNP outperforms all other aggregates in explaining the demand for money and that it was the most appropriate scale variable. Recently, a growing body of literature suggests that wealth could be a more relevant conditioning variable than income for broad money aggregates. See Adam (1991), and Barr and Cuthbertson (1991).

Another related issue concerns the choice of price index. For open developing countries, the CPI (consumer price index) is preferred to the GDP deflator. This is because the latter is constructed as a value-added deflator which includes exports, which domestic residents do not purchase, but excludes imports, which they do. The CPI on the other hand avoids this problem by including imports and excluding exports.

A survey of the literature suggests that not many studies have been conducted on the demand for money in SADC economies. And where these studies have been undertaken, questions have been raised about the econometric methodology applied. Adam (1992) noted the lack of dynamic analysis in the works of Pathak (1981), Darrat (1985) and Mwega (1990). He acknowledged, however, the relevance of the theoretically and methodologically sound study of money demand on the Sudan undertaken by Domowitz and Elbadawi (1987). That study estimates an error correction model which centres on the long-run proportionality between money and income and shows that in the short-run, domestic inflation and the U.S. dollar exchange rate are significant explanatory variables in demand for money. According to Adam (1992), a shortcoming of that study was that it was based around bivariate cointegrating relationships between money and income or money and financial wealth whereas more recent developments in the field indicate that multivariate cointegrating vectors spanning a larger number of variables including wealth, inflation and interest rates, would provide a fuller characterization of the long-run determinants of demand for money. Adam (1992) also noted that the few existing studies show a wide variation in their results, especially for the short-run behaviour of the demand for money function. His own study of the demand for narrow money in Kenya is useful as it makes use of a dynamic model following, among other studies, Granger (1986), Engle and Granger (1987), Hendry (1986), Banerjee et al.(1986, 1992), Johansen and Juselius (1990). These studies provide a useful basis to study the demand for money in the economies of the SADC region.

1.3 Purpose of the study

The purpose of this study is to revisit the demand for money in the context of the experiences of three SADC countries, namely, Malawi, Zambia and Zimbabwe. This is because there are no published studies specific to these countries except in the general context of demand for money in Africa. We intend to test recent specifications of the demand for money function which clearly depart from the early theories. This follows from a survey of the experience of developing countries in Asia which shows that it is possible that the structural adjustment programs which were put in place have probably influenced institutional developments in the financial sector, and therefore, the assumption of a stable velocity of circulation of money may not hold.

It establishes whether there exists an equilibrium long-run or cointegrating relationship between certain combinations of real money balances, real income, and interest rates. This is modelled along the lines of the study carried out by Johansen (1988) and Juselius (1990) who used Danish and Finnish data.

Such a study has implications for the nature and implementation of monetary policies, particularly during a turning point in the economic development of the SADC region under the structural adjustment programs.

Because there still exists some controversy regarding the question of what constitutes an appropriate measure of money, the study examines M1, M2 and the monetary base (MB). M3 is excluded because it has only been introduced in Zimbabwe in 1992 and is not used as a measure in Malawi and Zambia. We test whether there is a predictable relationship between each monetary aggregate and some measure of income. Also, since there does not seem to be consensus on the appropriate interest rate variable, (long-term versus short-term), this issue is also examined.

1.4 Organisation of the study

The study is organized as follows. Chapter 2 presents a historical discussion of the three SADC countries under study. It focuses on their economic character and reviews their implementation of SAPs. In particular, it describes the changes which have taken place in the banking and financial sector so as to lay the ground work for an important theme of this study, which is to show how changes in the institutional environment affect the demand for money function. Chapter 3 reviews the literature on the evolution of theories of the demand for money and provides a critical appraisal of the theoretical and empirical work in the field. Chapter 4 describes the research methodology and specifies the model. Chapter 5 presents and analyzes the empirical results of estimating an error-correction model of demand for money. Finally, Chapter 6 summarizes the findings and their policy implications.

CHAPTER 2

HISTORICAL BACKGROUND

2.0 Introduction

This chapter presents a summary of historical and macroeconomic developments in Malawi, Zambia, and Zimbabwe in order to draw attention to the context within which our study of demand for money is undertaken. The summary covers the period beginning with the late seventies and as much as data permit, up to 1992. Although there have been many significant economic developments in the region, it is the structural adjustment effort which is more relevant to this study. We review the circumstances that led to the introduction of SAPs and discuss their particular characteristic features, especially in relation to the banking sector.

The chapter is organized as follows. Section 2.1 is a brief overview of the SADC region. Sections 2.2, 2.3, and 2.4 present specific macroeconomic features of Malawi, Zambia and Zimbabwe respectively which have a bearing on the study.

2.1 Structural Adjustment Programs in the SADC region- the context

SAPS in the SADC region took centre stage particularly in the early 1980's as part of an overall strategy of market-based economic reform. Their main objective was to address the issues of chronic poverty and underdevelopment which were largely a reflection of the region's colonial legacy. Emerging "majority" governments embarked on a massive campaign to improve social infrastructure, social services such as education, health care, and public transportation which created a large public sector. Thus, "big government" was put in place in order to achieve rapid growth and development.

The growth in government soon led to fiscal imbalances which reflected largely in growing budget deficits. External imbalances also surfaced because of, among other things, overvalued currencies and falling export earnings due to heavy reliance on primary commodity exports whose prices were volatile on international markets. Falling commodity prices had a particularly adverse effect on Zambia whose mainstay was the copper industry . Zimbabwe's economy too has been equally vulnerable particularly because its exports were largely primary in nature - minerals and raw agricultural products. Fiscal imbalances, worsening external disequilibria, inflation, decline in GDP and growing unemployment, all contributed to an economic crisis of unparalleled magnitude. The basis for sustainable growth had been eroded. This necessitated a turn around in economic philosophy. Governments began to realize that the large number of public enterprises created were largely inefficient and costly as they pumped millions of dollars by way of subsidies. On the external front, they became concerned about the unduly heavy reliance on primary exports pointing out the need for diversification and promoting the development of manufacturing industries.

SAPS were not an entirely indigenous venture but were rather inspired by the International Monetary Fund. Consequently, the specific nature of policies designed for implementing reform closely resemble policies which have been applied elsewhere in developing countries of Asia and Latin America. The package is quite standard and focuses on the following aspects:

a) **Reduction in government spending.** This measure is aimed at reducing budget deficits by reducing central government spending and raising government revenues. Thus, it encourages the elimination of subsidies to public enterprises, cutting spending on social services, and even eliminating some departments or merging them with others.

b) **Liberalisation of all markets (resource, product and financial markets).** This aims to enhance the efficiency of the allocation of resources across all sectors. It entails removing all or most of the price controls put in place in earlier times. Such controls had led to shortages of commodities and the emergence of parallel markets.

c) **Devaluation of currency.** The perception is that most of these countries' currencies were artificially pegged at high rates and as a result, they incurred high costs in terms of low external demand for their products and huge import bills. The policy calls for the introduction of a market-determined exchange rate to replace the artificially overvalued currency. The removal of trade barriers is another aspect of this measure which is expected to encourage trade.

d) **Restrictive monetary policies.** McKinnon (1973) and Shaw (1973) demonstrated that in the 1970's the financial markets of most developing countries were repressed. This was evidenced by the existence of negative real deposit and lending rates of interest, restricted entry of new firms into the financial markets as well as capital controls. Critics argue that these policies caused some imperfections in the operations of the financial market. McKinnon (1988), argued that financial repression policies such as usury restrictions on interest rates, heavy reserve requirements on bank deposits, and compulsory credit allocations retard the growth of the banking system, fragment the capital market and reduce savings.

The aim of domestic financial liberalization and deregulation has been to rectify those anomalies so as to improve economic performance. This is expected to be achieved through the following measures: (i) removal of regulations and price distortions so as to channel savings into high-yielding risk-adjusted forms of investment (improved allocative efficiency); (ii) introduction of measures to encourage competition among financial institutions and thereby reduce costs of financial intermediation (higher operational efficiency); and (iii) improvements in the quantity and quality of financial products and services (dynamic efficiency).

Monetary policy has also targeted other important goals: reducing the inflation which has accelerated to double digit rates in the last ten years; boosting foreign exchange reserves; supporting the exchange rate policy; and accommodating the targeted expansion in real GDP.

The introduction of higher rates of interest is intended to boost savings and encourage financial intermediation. Monetary policy has also introduced measures to promote financial intermediation, as for instance, the privatization of banks, revision of bank legislation to allow easier entry into the banking sector, removal of quantitative controls on credit expansion, controls on credit to the government and public enterprises, removal of controls on bank deposits and lending rates as well as improvements in bank supervision. The improvement in ease of entry is intended to break the predominantly oligopolistic nature of banks which were fostered under earlier policy regimes.

Although monetary policies have taken on this increasingly prominent role in the macroeconomic management of African economies, their efficacy is still the subject of much debate. In short, the objectives of economic liberalization have been to enhance efficiency through greater reliance on market forces and to improve the effectiveness of monetary policy. This study is not concerned with the entire reform program, but rather on those aspects which pertain to financial liberalization.

2.1.1 Implications of SAPs for demand for money

There is some evidence in the literature which shows that the structural changes introduced under SAPs may change the economic environment and also influence the stability of the velocity of circulation of money. This is because financial liberalization tends to improve the quality of economic signals, expand the array of financial assets and reduce transaction costs. Increases in interest rates on bank deposits could lead to increases in reserve money multiplier related to broad money because of a shift from currency holdings to bank deposits, a decline in the effective reserve requirement ratio, and increased efficiency in the utilization of reserves by commercial banks. Theoretically, the liberalization of interest rates constitutes a structural shift that may affect the stability of the demand for money function. Tseng and Corker (1991), in a study of financial liberalization in Asian countries, pointed out the several ways in which financial liberalization can impact on the demand for money. The most important ones are discussed below:

a) Changes in interest rates on the various monetary aggregates (embodied in the different categories of deposits of financial institutions) may alter the existing patterns of economic returns as well as the riskiness of a range of financial assets which could prompt portfolio shifts. High real interest rates make financial assets relatively more attractive than saving in other forms such as real assets. Corsepius and Fischer (1988), in a study on Thailand, observed that higher interest-bearing assets in the organized or formal sector grew at the expense of real assets such as land and housing and/or informal financial assets. The IMF has conducted numerous studies in developing countries which showed a positive impact of financial liberalization on "financial deepening".[5] So, the impact of reform measures can be observed through the evolution of monetary aggregates.

b) When the central bank loosens its "tight" grip on the commercial banks and other financial institutions, this encourages competition and may reduce borrowing costs since

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[5] Financial deepening is the ability of a country's formal financial system to mobilise resources. This is usually evidenced by a decline in the narrow money supply (M1) and growth in the broader categories of money, i.e., quasi-money which consists of M2 or M3.

more resource mobilisation structures exist. More people may be inclined to open deposit accounts or borrow money on a more regular basis. Thus, policies aimed at reducing central bank controls may cause the demand for money to respond more rapidly to income and interest rate changes.

c) Expansion of the monetary sector leads to a broadening of new, and perhaps, more attractive assets leading to gradual portfolio shifts away from monetary assets. These shifts might occur independently of developments in income and interest rates. The returns on such new assets might become important determinants of demand for money.

In short, financial liberalization may result in gradual shifts in the level of money holding, as well as changes in the income and interest elasticity of demand for money.

The study by Tseng and Corker (1991) suggests that one useful way to identify such trends is to examine the behaviour of the velocity of circulation of different monetary aggregates over time. The monetary aggregates that one could look at are:

i) the ratio of broad money, M2 (currency plus demand and time deposits in the banking system,) to income. An increase in this ratio over time is indicative of growth in quasi-money balances.

(ii) the share of quasi-money in broad money. An increase in this ratio may be reflected in a downward trend in income velocity of broad money.

(iii) the ratio of narrow money, M1, to income. This ratio is generally more volatile than the ratio of broad money to income.

We also note that although the SAPs were different in timing, implementation as well as magnitude, they were largely similar in kind. For example, the use of restrictive fiscal and monetary policies, exchange controls, price deregulation for many commodities and services were features common to all SAPs. Another significant similarity in the adjustment programs were the financial sector reforms where liberalization of interest rates and the encouragement of competition were vigorously pursued.

Despite the similarities described above, the same cannot be said about their socio-economic effects. This is because the magnitudes of adjustment were different among the countries mainly due to the differences in the magnitudes of the economic crisis. The impact seemed to have been more severe in Zambia which had taken "heavier doses" of the IMF's medicine than the other two countries.

The negative social effects notwithstanding, it appears that adjustment had some positive effects, particularly in stimulating the much needed local and, to some extent, foreign investment. It also stimulated economic growth and decelerated the worsening trend in balance of payments deficits.

The next section reviews the circumstances of each country in more detail.

2.2 Macroeconomic Survey of three SADC countries

2.2.1 MALAWI

2.2.1.1 Introduction

Malawi is a small, landlocked country in the South-eastern part of Africa. Its population was approximately 8.8 million by mid-1991, growing at an average of 3.5 percent per annum, one of the highest population growth rates in Africa. With a GNP per capita of US$ 230 in 1991, the country is classified as low-income. Half of the population lives below the poverty line (IBRD, 1991). This is partly explained by its colonial legacy which has already been described.

The country has a narrow resource base which revolves around agriculture. For decades, this sector has provided economic sustenance for the bulk of the population, about 80 percent of whom live on the land. Prior to independence, the thrust of government economic policy was to invest heavily in this sector, to improve infrastructure and develop estate agriculture. Exports consisted mainly of raw agricultural products such as maize, rice, tea and tobacco.

Malawi became independent in 1964. For the first 15 years following independence, its economy experienced a boom in GDP growth - averaging 6 percent per annum and around 3 percent in per capita terms. According to Kaluwa, Silumbu, Banda and Chilowa (1992), the economic performance resulted from favourable policy and an economic environment which supported rapid expansion in export-oriented agriculture. Ironically, it is the export-orientation of this sector that was to be responsible for the impeding economic crisis of the late 1970's and the early 1980's. As a small, open economy, Malawi was vulnerable to the vicissitudes of international markets as well as the weather. Some economic analysts contend that the roots of Malawi's economic crisis lie in the early 1970's when the world experienced the first oil shock after the Organization of Petroleum Exporting Countries (OPEC) raised the price of oil during 1973-1974. In 1976, and for the first time since independence, the net foreign assets of Bank of Malawi turned negative. In 1976, the economy grew by 8.3 percent but by 1979, this had fallen to 3.3 percent (IBRD, 1991). In 1979, there was a further increase in the price of oil (second oil shock) and terms of trade continued to deteriorate. Over the period 1979-1981, the crisis deepened further as economic performance worsened. There was a drought over the 1979/1980 season which resulted in a poor maize harvest. The crisis was further compounded by the deterioration in the balance of payments. The ratio of the balance of payments (BOP) deficits to GDP rose from 7.1 percent in 1977 to 17.8, 24.8, and 22 percent in 1978,1979 and 1980 respectively. As if this was not enough, in 1981 there was a world-wide economic recession which many analysts attributed to the deflationary policies of the Reagan era in the United States. The period was marked by rising market interest rates which had a particularly negative effect on the economies of developing countries as interest payments on their external debt increased sharply. Other serious problems were the onset of external transportation problems arising from unrest in Mozambique and the subsequent closure of its main external trade routes through Mozambique. It had to re-route via Durban and this caused a sharp increase in transportation costs. Another problem was the massive influx of refugees from war-torn Mozambique. As a result of these problems, GDP growth declined as explained in the next section.

2.2.1.2 Key Macroeconomic developments

Tables 1 and 2 show some of the macroeconomic indicators during the period 1973-1990.

Table 1 Sectoral Performance of Malawian economy in selected years (% change)

	73-75	78-79	80-81	82-83	86-88	89-90
GDP growth	6.31	5.83	-2.92	3.82	2.30	.77
Terms of trade	-2.46	-17.48	-1.71	-4.40	-6.56	.29
Agriculture	1.48	3.05	-7.51	5.38	1.15	.03
Manufacturing	14.50	4.85	4.51	3.53	3.1	1.25

Source: Calculated from the IMF Financial Statistics, various issues.

Table 2 Sectoral Growth (as % of GDP)

	1980	1985	1990	1991	1992
Agriculture	37.2	36.6	33.2	34.8	28.3
Industry	19.2	18.7	20.2	19.5	21.8
Manufacturing	11.6	12.3	13.6	13.0	14.6
GDI/GDP	24.7	18.6	19.1	20.0	19.3
Exports/GDP	24.8	24.2	24.0	23.4	23.7
GDS/GDP	10.8	12.9	9.4	7.9	3.7
GNS/GDP	3.8	9.2	5.0	4.3	..
Current account/GDP	- 25.0	-13.2	-9.0	-11.1	-12.2
Interest payments/GDP	2.8	2.6	1.8	1.9	1.9
Total debt/ GDP	66.1	90.0	85.1	76.4	101.1
Total debt/exports	260.8	359.5	346.9	318.8	422.2
Consumer prices	..	10.5	11.8	12.6	23.1
	1980-85	1985-90	1990	1991	1992
GNP (Growth rate)	3.4	3.2	4.1	7.3	-7.3

Source: World Bank, Country Surveys, 1991.
Notes: GDI = Gross Domestic Investment
GDS = Gross Domestic Savings
GNS = Gross National Savings

The discrepancy between the rates of GDP and GNP could be explained by the role of overseas investments during the period but there was not much information to prove this point.

Table 1 shows a sharp decline in the GDP growth rate, particularly from the period 1978-1979 to the 1980-1981 period. A more dismal picture is portrayed by the terms of trade which declined by 17.48 percent over the period 1978-1979 and were negative for most of the 1980's. Growth rate of the agricultural sector declined from the high of 11.54

percent in 1976-1978 to 0.32 percent in 1987. Considering the pivotal position of this sector, this trend was cause for concern to policy makers.

Table 2 shows other useful indicators. The ratio of gross domestic investment to GDP fell slightly from 24.7 in 1980 to 20 in 1991 and that of exports of goods and services to GDP fell from 24.8 to 23.7 over the same period. The growth rate of the share of the agricultural sector in GDP decreased from 37.2 to 28.3 percent. There was a slight improvement in the share of industry which grew from 19.2 to 21.8 percent of GDP over the same period. Manufacturing too grew from 11.6 to 14.6 percent of GDP. However, there were some negative trends. The ratio of gross domestic savings to GDP fell from 10.8 in 1980 to 3.7 in 1992. The current account balance as a proportion of the GDP remained negative over most of the period. However, it improved from -25 in 1980 to -12.2 percent in 1992.

The last segment of Table 2 indicates trends in the growth of GNP.

The growth rate of GNP increased from 3.4 percent in 1980 to 7.3 percent in 1991. However, it fell drastically to a negative 7.3 percent by the middle of 1993. Analysts attribute this drop to the severe drought of 1992 which affected the entire SADC region.

According to Silumbu (1990), the Malawian authorities reacted swiftly to deal with the situation. For almost five years up to 1981, the deterioration in the economic condition was seen essentially as a temporary phenomenon which required demand restraint and tough financial measures. Consequently, economic policy in the early 1980 took the form of restrictive monetary policy. This included increases in interest rates, and for the first time, a redefinition and enforcement of a liquid asset ratio (LAR) of 25 percent, insurance directives to commercial banks to exercise utmost restraint in extending credit, and the pursuit of a selective credit in favour of priority sectors, mainly agriculture. The government also interpreted the worsening balance of payments situation as being caused by an excessive increase in domestic credit to the private sector particularly in 1978. Again the authorities responded by re-enforcing the 1976 restrictive credit measures which involved directives to commercial banks to reduce credit expansion to 1.5 percent per month and give selective priority to agriculture while reducing credit for the purchase of consumption goods and imported non-agricultural and non-essential intermediate goods. These measures were in force throughout 1979. On 10 August 1979, the Reserve Bank of Malawi (RBM) instituted a comprehensive credit policy package which was to reinforce the monetary measures taken earlier (RBM, 1979). This package, like the earlier one, entailed interest rate increases which, among other things, increased the LAR from 25 to 30 percent. However, it went beyond the first package by instituting new exchange control measures. These were meant to rationalize the allocation of foreign exchange reserves so as to limit the importation of goods to essential consumer and capital goods and also to stimulate the dwindling export sector.

Malewezi (1987), Ngwira (1988) and World Bank (1990), summing up the roots of Malawi's economic crisis, identified the following factors as the most important:

a) inefficiencies in the production sector as a result of price controls;
b) poor performance of the smallholder agricultural subsector due to an unfavourable pricing structure.
c) inefficient public enterprises due to unsystematic and wasteful investments;
d) a narrow export base comprising mainly of tobacco, tea, and sugar, all of which face adverse world market conditions;
e) the heavy import dependence of the industrial and energy sectors;
f) a generally weak system of incentives; and
g) an over-valued exchange rate.

These factors motivated the Malawian government to re-think its economic policy, and with the help of both the IBRD and the IMF embarked on a policy of economic reform under the auspices of the structural adjustment program.

2.2.1.3 Structural adjustment in Malawi

The aim of the structural adjustment in Malawi was to deal with the economic crisis which the country had experienced since the 1970's as described in section 2.1.1. It was designed to give incentives for the production of tradable goods so as to improve the external balance. It was also aimed at rationalizing government taxes and expenditures so as to keep the budget deficit within limits. Another objective was to strengthen key sectors and establish an environment within which a strong and positive economic growth could be achieved. The period 1979 to 1992 can be viewed entirely as a phase of structural adjustment. The government negotiated a variety of reform packages with both the IMF and the IBRD at different stages during the period in question. The packages were designed to address specific problems. For instance, the Malawi government entered into agreements with the IMF on stand-by agreements (SBA) geared towards balance of payments rehabilitation. The conditions attached to these were the standard ones requiring fiscal and monetary restraint as well as an active program to decontrol the economy by liberalizing prices in many markets.

Malawi's SAP began in October 1979 with the conclusion of the first stand-by agreement (SBA 1) of Special Drawing

Rights (SDR) 26.34 million with the IMF.[6] An SDR represents what a country can borrow from the IMF for the purposes of balance of payments stabilisation. The particular SDR negotiated in 1979 was aimed at reversing the unfavourable balance of payments trends in order to reconstitute foreign exchange reserves. To further strengthen the program, SBA 2 was concluded for the period May 1980 to March 1982. The target was to attain balance of payments equilibrium by the end of 1982. SBA 3 was concluded for the period August 1982-1983 and it was to boost the balance of payments.

Malawi's reform program dealt with a variety of issues, all linked in some way to the nature of economic problems which the country had experienced prior to change. One group of policies, popularly referred to as SAL 1 (Stand-by agreement line), included policy reforms involving producer prices, export diversification, reform of pricing of goods and services provided by parastatals[7], strengthening of economic planning and debt management. SAL 2 introduced other issues such as disinvestment from inefficient enterprises, estate extension services and the introduction of user charges for some social and departmental services. SAL 3 introduced an estate sector credit facility, phased

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[6] An SDR is the IMF's unit of account. It represents the amount by which a member country can draw from the Fund for purposes of balance of payments stabilisation.

[7] Parastatals are enterprises in which the government owns a majority of the shares.

elimination of the subsidy on smallholder fertilizer, completion of price decontrol program and tax reform. It also introduced partial liberalization of marketing and smallholder produce. Finally, the program adopted measures to liberalize the external sector, deepen the domestic financial sector and ease exchange control on imports in three phases ending in January 1991.

Over the three-year period of September 1983 to September 1986, the government negotiated another facility of SDR 100 million. The aim was to continue with restrictive demand management policies, improve domestic supply of goods and services, provide the base for economic growth, and wipe out the deficit.

Other targets of government policy were to increase real GDP average growth from 3.5 percent over three years rising from 2.5 percent in 1983 to 4.5 percent in 1986. On the balance of payments side, the aim was to reduce the deficit from 9.1 percent of GDP in 1982 to 5.4 percent in 1986. It was also to reduce the overall deficit of SDR 38.5 million in 1982 to a small surplus by the end of 1986 (IMF Survey, 1989).

In 1986, the government imposed a strict system of foreign exchange allocation to reduce the current account deficit over 1986 and 1987. The Malawi Kwacha (henceforth denoted as MK), the unit of currency of Malawi, was devalued against a trade-weighted basket of currencies. This was done in stages. There was a 7 percent devaluation in March 1990, a 15 percent devaluation in March 1992 and finally, a 22 percent devaluation in June 1992.

In 1987, the government prepared a 10 year comprehensive development strategy in order to address development problems and placed poverty alleviation as its top priority.

2.2.1.4 Structural adjustment and the banking and financial sector

The banking and financial sector also underwent some changes during the era of reform. These changes were both structural as well as policy-oriented. As happened in other post-colonial economies, Malawi's banks were nationalized through equity participation by corporations which included Malawi Development Corporation and Press Holdings. The foreign-owned banks were merged into the National Bank of Malawi thereby forming the Commercial Bank of Malawi. Thus, the financial sector was reorganized to facilitate the consolidation of the powers of the monetary authority over the sector and to accommodate Malawian equity participation in the sector. Another significant development was the introduction of the Treasury Bill (TB) and the Local Registered Stock (LRS), a medium to long-term government bond, to facilitate the financing of public sector programs.

As early as the period 1964-1975, monetary policy took an active stance. As Silumbu (1990) observed, monetary policy was characterized by two basic features. First, there was use of instruments of credit policy to curb domestic credit expansion. Second, exchange controls were used to deal with the balance of payments. The use of monetary policy continued during the reform period. Emphasis was on the allocative role of the financial sector. So, the focus was not so much on increasing the quantity of credit, but rather on ensuring that an appropriate price for scarce financial capital was in place. This was based on a sound economic premise that capital is a scarce commodity and should be priced accordingly. There was also the belief that positive real interest rates and a market-based interest-rate structure would stimulate financial savings. In this regard, therefore, financial sector reforms in Malawi took the following forms:

a) a program for moving towards market-determined interest rates;

b) reduction in statutory reserve and liquidity requirements;

c) removal of subsidized credits to priority sectors and assigning a portion of bank assets to particular sectors; and

d) the introduction of selective credit controls, i.e, channelling of credit to priority sectors, especially the export-oriented sectors.

These measures were clearly consistent with a desire to deregulate the financial sector and to allow the free market forces to allocate resources.

The impact of these reforms on the financial sector was remarkable. Generally, the volume of financial assets and liabilities grew over the period especially due to the interest rate increases. Also, the government was able to control excessive growth in the money supply and thereby curtail the inflationary spiral. The figures in Table 3 give a general picture of the monetary aggregates of the Malawian economy for selected years between 1981 and 1991.

Table 3 Monetary Aggregates: Malawi, 1981-1991 (millions of MK)

	1981	1983	1985	1989	1990	1991
DD	73.8	71.6	97.6	205.2	284.3	346.0
TS	126.7	165.0	217.5	434.7	475.0	566.7
DC	430.1	592.7	685.3	825.7	876.6	1059.0
M1	114.7	127.7	166.9	427.0	482.1	633.80
M1V	9.6	11.2	12.1	10.3	10.5	9.6
M2	126.7	165.0	217.5	434.7	475.0	566.7
M2V	8.7	8.7	9.2	10.1	10.6	10.8

Source: IMF, International Financial Statistics, various issues.
Notes:
DD = Demand deposits
TS = time and savings deposits
DC = domestic credit
M1 = currency in circulation plus demand deposits of banks
M2 = M1 plus quasi-money
M1V = velocity of circulation of M1 (nominal GDP/M1)
M2V = velocity of circulation of M2 (nominal GDP/M2)

Table 3 indicates that deposits grew quite rapidly between 1981 and 1991 by recording an increase of over 50 percent in the last two years of the period. Domestic credit more than doubled, rising from MK[8] 430 million in 1981 to MK 1 billion in 1991. This reflected an expanding economy which required more financial resources. Despite the restrictive monetary policies pursued during this period, both M1 and M2 grew steadily. Of particular interest are the trends in the velocity of circulation of these two monetary

[8] The Malawi Kwacha, MK, exchanged for US$ 0.23 at the end of 1992-a sharp decline from the 1980 rate of US$ 1.20 (International Financial Statistics, IMF, 1992).

aggregates. The velocities of circulation of M1 and M2 have fluctuated from year to year, with M1 velocity ranging from 9.6 in 1981 to 10.5 in 1990 and M2 velocity from 8.7 in 1981 to 10.8 in 1991.

Table 4 Real effective exchange rate (index 1980=100) and interest rates (%)

	1981	1985	1989	1990	1991
Exch.rate	99.8	97.7	96.9	93.8	94.1
Disc.rate	10.0	10.0	11.0	11.0	14.0
TB rate	9.0	11.0	12.3	15.7	12.9
Dep.rate	9.7	9.9	12.5	12.7	12.1
Lend.rate	18.5	18.3	18.3	23.0	21.0
Bank rate	9.3	10.3	11.5	11.5	11.5

Source: IMF, International Financial Statistics, various issues.
Notes: Exch. rate = real effective exchange rate of the Malawi Kwacha against the US$. Disc.rate = discount rate; TB rate = Treasury bill rate
Dep.rate = rate of interest on deposits; Lend.rate = lending rate.

Table 4 shows that interest rates remained fairly constant in the first half of the period.

But from 1985 to 1991, there were significant increases particularly in the treasury bill rate which rose from 12.3 percent in 1985 to 15.75 percent in 1991 and the discount rate which rose from 11 percent in 1985 to 14 percent in 1990. Lending rates also rose quite significantly from about 18 percent in 1985 to 23 percent in 1989, then declined slightly to 20 percent in 1991. The bank rate has, however, increased only slightly from 9.25 percent in 1981 to 11.5 percent in 1991. All these changes are in nominal terms.

Thus, the above analysis indicates that Malawi's banking and financial sector also experienced changes during the adjustment period. Noticeable and perhaps significant developments have been the rapid increases in the different types of deposits, the expansion of domestic credit, the growth of the velocity of both M1 and M2, and finally, the rather sharp rise in the various nominal rates in the latter half of the period under study.

2.2.2 ZAMBIA

2.2.2.1 Introduction

Of the three SADC countries under study, Zambia's experience was probably the most turbulent. From the boom period of the 1970's, Zambia's economy deteriorated to one facing one of the worst economic crises on the African continent. This compelled it to embark on a course of economic reform under the auspices of the IMF and the IBRD.

Zambia attained independence in 1964. At that time, it was one of the prosperous African countries. World Bank estimates indicate that its population in 1991 was approximately 8.3 millions. One of the colonial legacies was the undue heavy dependence on one sector, namely, mining and more specifically, the copper industry. In the early 1970's, this served the economy very well because world copper prices were high and Zambia experienced an economic boom. In 1970, copper and cobalt contributed 58 percent to government revenue, and mining as a whole accounted for 36 percent of GDP. The mining sector contributed approximately 85 percent of the country's exports (IBRD, 1991). Over the period 1965-1973, GDP grew at an average rate of 2.4 percent and this was largely derived from rapid growth of the mining sector.

Zambia's economic crisis began with the sharp decline in the world price of copper in 1975. The impact on the mining sector was dramatic. Mining's share of GDP fell by half and its contribution to government revenue also dropped sharply. The oil price shocks of the period 1973-1974, had an had adverse effect on Zambia which depended heavily on imports of oil. The crisis was exacerbated by the fall in copper prices from this period on. According to Gulhati (1989), the shift in terms of trade was one of the most severe for any developing country. It represented a real income loss (compared to the period before the oil shocks) and equivalent to 22.9 percent of GDP over the period 1975-1979, and 31.9 percent over the period 1980-1986.

One of the criticisms levelled against the post-independence government of Kaunda was its failure to diversify the Zambian economy so as to cushion it from the vicissitudes of international markets. The Zambian government had done little in concrete terms to promote the growth of other sectors which had some growth and income potential. Agriculture was one example. Although efforts were made to stimulate the manufacturing sector, unfortunately that sector relied heavily on the mining sector, especially copper. Consequently, the manufacturing sector was also adversely affected by the slump in copper prices.

Another feature of the pre-1980 period was the direction of government policy. In order to redress the effects of a colonial legacy, the government had increased its role in the economy. For example, it imposed quantitative controls over prices, imports and foreign-exchange allocation. Subsidies on social services were also introduced in order to protect the urban population from rising inflation. Later, it became evident that pursuit of such a policy could not be sustained especially with declining economic growth and deepening balance of payments crises.

2.2.2.2 Key macroeconomic developments

Table 5 presents the statistics of major macroeconomic aggregates of the Zambian economy for the period 1980-1991.

Table 5 Macroeconomic performance, Zambia 1980-1991

	1980	1985	1990	1991
GDI/GDP	23.3	14.9	15.3	13.5
GDS/GDP	19.3	15.4	14.6	12.1
Current a/c bal/GDP	-13.9	-16.4	-11.2	-14.1
Total debt/GDP	84.1	205.0	202.6	210.4
GDP: Production (% GDP)[9]				
Agriculture	14.2	13.1	18.2	15.7
Industry	41.3	42.0	45.3	47.2
Manufacturing	18.5	22.9	31.9	36.3
Balance of payments (millions of US$)				
Exports of goods	1609	911	1342	1165
Imports of goods	1765	936	1369	1221
Resource balance	-157	-25	-27	..
Current account bal	-505	-298	-106	1
Reserves(incl. gold)	206	201	201	186
Exch.rate (local/US$)	0.8	3.1	34.5	67.8

Government Finance: Share of GDP (%)

	1980	1987	1988	1989	1990
Current/account	-9.8	-8.0	-8.8	-7.7	-6.7

Source: IBRD, 1991.

[9] Shares of only three key sectors are reported. The balance of the GDP was generated by smaller sectors such as commerce and tourism.

Although the rate of growth of the three important sectors, agriculture, industry and manufacturing remained positive and on the increase, the picture of external balance was not so rosy. The current account balance as a ratio of GDP remained negative at an average of 13 percent. The overall resource balance continued to be negative for the entire period though the severity mitigated from US$ 157 million in 1980 to US$ 56 million in 1991. Also as a sign of the weakening external sector, reserves (including gold) remained low and almost stagnant at US$ 201 million, an amount hardly sufficient to sustain three months' imports of Zambia. The ratios of gross domestic investment and gross domestic savings to GDP declined steadily over the period. With regard to government finances, the entire period was characterized by a negative current account balance averaging 7.8 percent of GDP over the period 1980 -1991. The combination of poor domestic as well as external payments performance led the country to increase its external borrowing and by the end of 1991 total debt was US$ 6.7 billion, of which US$ 2.9 billion was multilateral and US$ 2.5 billion was bilateral. Excluding short-term debt, Zambia's external debt represented US$ 766 per capita and this was among the highest in the world (IBRD, 1991). The government, eager to obtain more assistance from donors, set new targets, for instance, to achieve a primary budget deficit of 2 percent of GDP by 1992 and full balance by 1993 and even a small surplus by 1994.

Another serious problem was that of inflation. By the end of 1991, this was running at the incredible rate of 100 percent. See IBRD, 1991.

The drought which hit the whole of Southern Africa in 1992 only compounded an already bad situation. The contribution of the agricultural sector to GDP growth declined by 25 percent.

2.2.2.3 Structural adjustment in Zambia

Structural adjustment in Zambia was motivated by a need to curb the deterioration in the external payments position, which as described above, was due to falling copper prices. It was also an effort to curb the negative impact this was having on GDP growth and overall macroeconomic performance. Thus, SAPs were aimed at stimulating economic growth by diversifying economic activity and improving the balance of payments. Another objective was to bring the pricing of public and parastatal enterprise finances to market-rates. This would entail removal of price controls and elimination of subsidies. Jones (1994) outlines a chronology of major policy agreements between the Zambian government and international financial institutions and provided the following guide:

1981-85: Attempted stabilization and limited stabilization was to be under an IMF Extended Fund Facility and then under a standby agreement.

1985-86: Elimination of food subsidies and auctioning of foreign-exchange.

1986-87: Temporary suspension of the program due to IMF dissatisfaction with the government's progress on reform.

1987-89: Decision by Zambian government to undertake its own reform effort under the Interim National Development Plan.

1989-91: Zambian government returns to the IMF adjustment program and breaks off again in September 1991 due to mass protests against its increases in food subsidies.

Efforts aimed at reform between 1981 and 1985 were largely unsuccessful because the government failed to meet performance targets set by IMF. These efforts are discussed briefly below.

When Zambia adopted its first SAP, it was for the period covering 1981-83. The government negotiated an Extended Fund Facility (EFF) of SDR 800 million.[10] More specifically, in 1981 interest rates were increased and agricultural producer prices were introduced. In 1982, the prices of fifty commodities produced or marketed by public enterprises were decontrolled. The Zambian Kwacha, the Zambian unit of currency, henceforth denoted by ZK, was

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[10] An Extended Fund Facility (EFF) permits the member country to borrow over and above the amount which is based on its quota.

devalued by 20 percent and thereafter was allowed to depreciate.

In 1983, the IMF gave another stand-by facility. As Gulhati (1989) indicated, the main targets were the reduction in the current account deficit by 10 percent in current prices. This involved a 13 percent reduction in imports and a 14 percent expansion in exports. There was to be a 20 percent devaluation of the ZK and the introduction of a flexible exchange rate. Effectively it was reduced by 35 percent. It was also aimed at reducing public expenditures, especially subsidies. There was to be a 10 percent ceiling on wage increases. Civil service salaries and employment were to remain at the same levels.

The government was not able to meet all these targets largely because copper prices continued to fall. When it failed to meet its targets for reducing payment arrears, the IMF suspended its stand-by facility. This was however, renegotiated in 1984. But in that year, the government failed yet again to meet the targets agreed upon at the renegotiation. For example, it was unable to reduce its current account deficits to target levels because the Paris Club which had agreed to restructure its external debt had imposed very high debt-service requirements (Gulhati, 1989). It was because of this that the program was suspended again in 1985. Thus, Zambia's initial efforts at adjustment had largely been unsuccessful.

The government could not allow the initial failure at reform to block any fresh attempts because the economy was not performing well.

After several unsuccessful efforts to reforming the economy undertaken in the late 1970's and early 1980's, Zambia adopted a comprehensive structural reform program in 1985 with the support of the IBRD and IMF.

Shortages of foreign exchange made it increasingly difficult to sustain imports of essential consumer and raw material goods. Labour unrest in the face of rising inflation was beginning to surface. But before agreeing to grant Zambia another stand-by facility, the IMF imposed further conditions particularly to deal with the foreign-exchange crisis. The government was required to liberalize the allocation of foreign-exchange. To this effect, foreign-exchange auctioning was introduced in October 1985. Under this system, foreign-exchange was made available at a weekly auction rather than administratively via an allocation system that had been ruled to be inefficient. Although businesses welcomed this move, there was fear that it would engender speculations with all the attendant negative effects on the economy. Import-licensing restrictions were dismantled and the tariff system was reformed so that a less protective structure emerged. The IMF was also keen to see a more liberal pricing system emerge. It called for price decontrols on all commodities and the removal of agricultural producer prices. It also wanted some streamlining and rationalization of government ministries and departments to avoid overlapping and duplication. It recommended the extension of user charges for cost recovery for public services such as health and education. A thorny issue was that the IMF pressed for increases of 113 percent and 75 percent respectively in the prices of fertilizer and fuel and for further moves towards positive real interest rates.

The period 1989-1991 can be viewed as a consolidation of earlier reforms. The general theme was the complete liberalization of prices by phasing out all remaining subsidies and decontrolling all prices except maize and maize flour.

2.2.2.4 Structural adjustment and the banking and financial sector

Reforms in the banking and financial sector were quite similar to what took place in Malawi. Under IMF reform packages, monetary policies were restrictive in nature. This was in order to curb excessive growth in the money supply and keep inflation, which was already running at three digit levels, at bay.

Bank interest rates on deposits and lending rates were liberalized and a system of daily auctions for Treasury Bills were introduced. Treasury bill rates rose from 25 to 35 percent. There was also an increase in the liquidity ratio and the minimum reserve requirements of commercial banks.

Table 6 Monetary Aggregates, Zambia 1981-1991 (ZK millions)[11]

	1981	1985	1989	1990	1991
DD	371.0	886.0	5695.0	7927.0	13166.0
TS	415.0	870.0	8778.0	11842.0	25984.0
DC	2269.0	7402.0	15328.0	19059.0	64521.0
M1	564.0	1231.0	7947.0	12543.0	22360.0
M1 V	5.3	5.2	7.5	9.0	..
M2	2990.0	659.0	8781.0	11847.0	25997.0
M2 V	7.2	6.3	6.8	9.5	..
Exch.rate	102.2	105.6	102.6	88.2	78.1
Disc.rate		7.510.0	..	..	47.0
TB rate	5.8	7.5	18.5	25.9	..
Dep.rate	6.7	7.0	11.4	25.7	..
Lend.rate	9.5	13.0	18.4	35.1	..

Source: IMF, International Financial Statistics, various issues.

Figures in Table 6 show a growing trend in deposits. Both demand and time and savings deposits increased steadily between 1981 and 1985. However, after 1985, there was a sharp increase in both kinds of deposits. Demand deposits rose from ZK886 million in 1985 to ZK 7.9 billion in 1990.

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[11] The Zambian Kwacha, ZK, exchanged at US$0.0028 at the end of 1992. Like the Malawi Kwacha, this was a sharp decline from the 1980 rate of US$ 1.2446. International Financial Statistics, IMF, 1992, p 597.

Time and savings deposits rose from ZK 870 million to ZK 11.8 billion during the same period.

Both M1 and M2 also rose quite sharply despite the adoption of some restrictive monetary policies under the adjustment program. The velocity of circulation of both M1 and M2 have been erratic.

With regard to interest rates, their growth remained fairly stable in the early part of the period. However, from about 1985, there were sharp increases. For instance, the discount rate rose from 14.5 percent in 1984 to 25 percent in 1985, 30 percent in 1986 and then by 1991, it had risen to 47 percent. The treasury bill rate rose sharply as well, from 13.2 percent in 1985 to 24.25 percent in 1986 and by 1990, it had risen to 25.92 percent. Lending rates rose from 18.6 percent in 1985 to 27.4 percent in 1986, and by 1990, had reached 35.1 percent, quite a marked increase.

Although data on the exchange rate of the ZK were incomplete, for the period 1981 to 1987 there was a consistent depreciation of the ZK and this was due to the decline in economic growth, worsening terms of trade and also due to deliberate IMF-inspired policies.

Thus, it is quite evident that structural adjustment must have impacted Zambia's banking and financial sector. This is evidenced by the sharp increases in interest rates, increases in the volume of different types of deposits, rapid expansion in domestic credit and noticeable variations in the velocity of circulation of monetary aggregates.

2.2.3 ZIMBABWE

2.2.3.1 Introduction

Zimbabwe is another SADC member country bordered by Botswana, South Africa and Zambia. According to IBRD estimates, at the end of 1990, it had a per capita income of US$ 690. Its population during the same year was approximately equal to 9.8 million with a growth rate of 2.8 percent per annum (IBRD, 1991).

Over the period 1890 to 1980, it was under the British colonial rule. Then from 1965 to 1979, it was under the illegal Unilateral Declaration of Independence (UDI) engineered by the Smith regime. We mention this development because it accounted for many of the developments which took place in the country after the attainment of independence. Despite the isolation of the country due to imposition of sanctions, the economy grew significantly during UDI. This is explained by the active involvement of the government in the economy. It maintained strong agriculture and mining sectors and diversified its production of manufactured products for the domestic market. It also developed a tightly controlled economic system, with a centralized administrative units to allocate foreign exchange, impose price controls and regulate private investment. However, the administration fostered a highly inequitable pattern of distribution. Economic power was vested in the hands of a minority white settler class. The indigenous population provided cheap labour for commercial farms mining, and the emerging manufacturing industries. The benefits of economic development largely accrued to a small segment of the population which controlled the economy. It was this fundamental inequity which led to "Chimurenga", the war of liberation, which resulted in the overthrow of the colonial regime in 1980.

At the time of its independence in 1980, the majority government inherited a strong economy. However, it still faced some fundamental problems. As stated above, there were serious anomalies in the distribution of wealth. Another problem was the deterioration of the physical infrastructure and the depletion of capital stock due to shortage of foreign exchange. There were also shortages of skilled manpower due to the emigration of white Zimbabweans and due to limited availability of indegenous skills du to past discriminatory policies in education. The new government did not make fundamental changes in control of the economic structure for fear of scaring away much needed foreign investment.

In 1981, the government unveiled its economic policy framework. The "Growth With Equity" statement spelled out how the government was going to foster the twin goals of achieving economic growth and at the same time ensuring a fairly equitable pattern of distribution of wealth. In order to attain economic growth, it increased foreign exchange allocation to key sectors for the importation of raw materials, spare parts and for the replenishment of worn-out equipment. At the ZIMCORD[12] conference in mid-1981, it invited various donor countries and agencies to contribute financial and material resources towards reconstruction and rehabilitation of the economy. It raised about Z$ 2.2 billion[13] in pledges, a small amount compared to the need. With available resources, the government embarked on an extensive program to rebuild infrastructure destroyed by the war. It invested heavily in road and railway construction.

In order to promote the equity goal, the government embarked on a program to expand education and health services to all parts of the country, with special focus on the rural sector where facilities were extremely inadequate. More schools and clinics were built, with added investment in teacher and medical personnel training institutions.

To improve the conditions of the working poor, it introduced a minimum wage for all sectors. Even though the

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[12] The Zimbabwe Conference on Reconstruction and Development (ZIMCORD) was a meeting organized by the Zimbabwe government to raise money for rebuilding the war-ravaged economy.

[13] The Zimbabwe dollar, hereafter referred to as Z$, exchanged for US$ 0.1824 at the end of 1992. At the end of 1980, the rate was US$ 1.5858. See International Financial Statistics, IMF, 1992. p 93

level of wages was still barely above the poverty datum line and although employers continued to flout these laws, the step represented a genuine effort to redress past imbalances in regards to the well-being of the poor.

Policies to stimulate economic growth were highly successful between 1980 and 1981 as Zimbabwe achieved a very high rate of economic growth - a yearly average of 10 percent. The bumper harvest of 1981 boosted this performance.

The introduction of minimum wages, the high rate of economic growth and general improvements in living standards created greater domestic demand for goods and services which resulted in severe inflationary pressures. However, an international recession at the end of 1981 threatened to reverse the early gains in economic growth. External imbalances began to surface and balance of payments pressures began to be felt as export earnings dropped and imports and services increased.

The deterioration in the external payments position is reflected in the increase in the current account deficit which rose from 2.5 percent of GDP in 1979 to 11.5 percent in 1981. Government increased its borrowing because ZIMCORD pledges came in trickles. This increased external indebtedness and increased debt-service payments at a time when, due to the international recession, there was a decline in export earnings.

For quite some time before it decided on a path of structural adjustment, the Zimbabwe government tried a variety of its own stabilization measures.

Over the period 1982-1989, the deterioration in the external payments position necessitated adjustment. The government designed a package which included a program to reduce the deficit on current account of balance of payments from 11 percent of GDP in 1981-1982 to near balance by 1987-1988. This was also going to be achieved through a system of foreign exchange allocation whereby imports were to be discouraged and exports promoted. To bolster the allocation system, a flexible exchange rate system was introduced. This led to an effective depreciation of the Z$ by about 35 percent between 1980 and 1989. Another instrument was to remove subsidies on most commodities, albeit in phases. This led to rising prices for foods, utilities and rail tariffs. These policies succeeded in controlling the deterioration in the balance of payments position.

2.2.3.2 Key Macroeconomic developments

Table 7 shows the trends in the Gross Domestic Production from 1973 to 1991.

Table 7 Sectoral share Gross Domestic Product, 1973-1991

	1973	1980	1989	1990	1991
Agriculture	13.8	13.1	12.8	14.4	16.9
Industry	36.6	36.3	34.0	32.2	31.8
of which manufacturing	22.1	23.3	23.1	22.2	22.1
GDS	27.4	15.8	19.5	19.2	17.5
GDI	25.4	18.8	17.3	19.2	22.4
(FI)	21.2	15.3	17.3	19.2	22.4
(Change in S)	4.2	3.5	0.0	0.0	0.0

Source: IBRD, 1991.
GDS-Gross Domestic Saving, GDI-Gross Domestic Investment.

Notes: FI = Fixed Investment

S = stocks

For the period 1980 to 1989, there is a slight deterioration in the sectoral shares in GDP. In addition, there is also a downward trend in the gross domestic savings and the gross domestic investment share up to 1989. However, the performance of the economy showed some improvement in 1990-1991.

Table 8 shows trends in government finances and balance of payments over the period 1980-1990.

Table 8 Government Finance and Balance of Payments, 1980-1990.

	1980	1987	1989	1990
Government Finance: Share of GDP (%)				
Current receipts ..		36.6	34.4	35.1
Current expenditures..		40.6	35.4	37.1
Current Budget Bal ..		-4.1	-0.9	-1.9
Balance of Payments (at current prices, US$ millions)				
Export price indx.	166.1	100.0	117.1	117.6
Import price indx.	136.0	100.0	112.9	128.6
Terms of Trade	122.2	100.0	103.7	91.5
Exports of goods	1612.0	1606.0	1935.0	1983.0
Imports of goods	1384.0	1537.0	1788.0	2018.0
Resource balance[14]	-109.0	222.0	147.0	-35.0

Source: IBRD, 1991.

The picture appears to be one of restraint with the shares of both current receipts and current expenditures in GDP declining from 1987 to 1991. The budget deficit actually declined every year, from a negative 4.1 percent of GDP in 1987 to a negative 1.9 percent of GDP in 1990. This could be attributed to the policies of fiscal restraint pursued as part of SAP.

As regards the balance of payments, both imports and exports have increased. The net effect has been a deficit for most of the period except for the period 1987-89. In fact, the deficit worsened in 1991. Whereas export-growth averaged 1 to 2 percent over 1990-91, import-growth

[14] Proxies trade balance.

increased by 27 percent over the same period. This was due to an increase in imports which was made possible by projects to attract foreign exchange. It could also have been caused by a 12 percent depreciation of the exchange rate of the Z$ in 1990 which was followed by a 30 percent depreciation in 1991.

2.2.3.3 Structural adjustment in Zimbabwe

A massive program of adjustment was necessitated by the cycle of low growth, declining fixed investment, stagnant formal employment and constrained foreign exchange availability. The growth rate in the 1990's averaged 5 to 6 percent against an expected 9 percent.

Adjustment was introduced under the auspices of a government program known as Economic Structural Adjustment Program (ESAP) 1990-95. The program focused on five key aspects, namely, investment promotion, fiscal reform, monetary policy and financial sector reform, trade liberalization and domestic deregulation.

The recovery of investment was emphasized because it is the basis for the success of the adjustment program. Under this program, investment is targeted to rise over 26 percent of GDP per year. In 1989, the government published a set of investment guidelines and an investment register and it also set up the Zimbabwe Investment Centre (ZIC). These measures were designed to facilitate the processing of investment projects. By July 1992, the centre had approved about 400 projects valued at Z$2.3 billion (Reserve Bank of Zimbabwe, 1992). In order to allay any fears of expropriation of private property, especially on the part of the foreign investor, the government signed an agreement to protect foreign investment interests in the country with the World Bank's Multilateral Investment Guarantee Agency and the United States Overseas Private Investment Corporation. It also acceded to international conventions on arbitration in the case of investment disputes.

Fiscal reforms under the program have been designed to achieve a reduction in the budget deficit to about 5 percent of GDP by 1994/1995. This is to release resources to support trade liberalization. To this end, using expenditure reduction as well as cost recovery measures in areas such as education and health, the government reduced its budget deficit from 10.7 percent of GDP in 1990/1991 to 7.2 percent of GDP in 1991/1992. Further curtailment of recurrent expenditures was to be achieved through a reduction of subsidies to public enterprises and a reduction in the size of the civil service.

Under trade liberalization, the objective was to overcome the effects of the historical protective and restrictive import control system which has, over a period of more than twenty five years, nurtured a monopolistic industrial production structure. The government adopted a selective and phased approach during which imports have been gradually put on Open General Import Licence (OGIL). This effectively makes imports much easier by avoiding the bureaucratic delays associated with the old administrative system which, among other things, made it difficult to obtain an import licence. The program is phased over five years to allow stronger sectors to benefit from the removal of constraints on their export performance.

A related measure has been the devaluation of the Zimbabwe dollar at various phases and, in recent years, authorities have allowed it to fluctuate as the market dictates. This move was adopted in order to minimize the external payments deficits by promoting exports and discouraging non-essential imports.

Another goal of the reform program is deregulation. The government has embarked on a program to reform the regulatory system in order to increase domestic competition and provide entrepreneurs with the freedom necessary to respond to the emerging market opportunities and pressures. The program encompasses the areas of investment approvals, price and distribution controls, labour and wage setting and other rules and guidelines which impede growth, particularly of the small-scale and informal sector activities. A Deregulation Committee was set up to rationalize the entire exercise. The price decontrol program has ensured the removal of controls on many except a few essential consumer goods. In the labour market, collective bargaining has replaced direct intervention in wage setting for all but farm workers and domestic employees. Furthermore, strict labour market regulations pertaining to hiring and firing and retrenchment which existed before have also been dismantled and streamlined.

2.2.3.4 Structural adjustment and the banking and financial sector

According to Moyana (1992), governor of the Reserve Bank of Zimbabwe at the time ESAP was introduced, the motivation behind reforms in the banking and financial sector have been to create an environment conducive to the mobilization of domestic savings and efficient allocation of such savings to support productive investment and allow economic activity to take place under stable price conditions. The anti-inflationary thrust of the bank's policy entailed the use of restrictive monetary policies.

Before December 1989, monetary and financial sector management was largely achieved through administrative controls on credit allocation and interest rate levels. Under the reform program, however, the bank relied on the market mechanism for efficient allocation of both financial and non-financial resources. Significant changes in the financial market were made such that most interest rates became market determined and indirect open market operations assumed a central role as a monetary policy instrument. Deposit and lending rates are now market-based whereas previously they were administered. Some interest rates have gone up by as much as 40 percent. Table 9 presents some macroeconomic data on important aspects of the economy. Evidence indicates very rapid growth in some types of deposits and domestic credit. Between 1985 and 1991, demand deposits grew by 205 percent; time and savings deposits by 74.9 percent and domestic credit by 164.3 percent; M1 by 192.7 percent and M2 by 100 percent.

With regard to the exchange rate, the Zimbabwe dollar has fallen drastically in relation to the US dollar. At the time of independence, the exchange rate was 1.3 US$ but by the end of 1991, it had fallen to the all-time low of 19 cents. The deterioration in the Z$ is a combination of policy intervention through successive devaluations as well as the ESAP policy of exchange rate liberalization.

Unlike the experience of Malawi and Zambia, interest rates in Zimbabwe have been stable for a longer period of time. However, there were sharp increases in 1991 when most rates increased by more than 50 percent.

As in the case of the other two countries, we also note that the velocities of both M1 and M2 have fluctuated from year to year. M2 velocity fluctuated more than that of M1 in different periods. The sharpest rise was between 1990 and 1991 when it rose from 6.5 to 10.5, an increase of about 62 percent. Statistics related to these monetary developments are presented in Table 9.

Table 9 Selected Monetary Indicators, Zimbabwe 1981-1991

	1981	1985	1989	1990	1991
DD	511.5	683.9	1287.2	1647.8	2089.2
TS	941.9	1151.9	2387.4	2509.0	2014.1
DC	1426.3	2319.4	4477.9	4822.8	6131.0
M1	678.8	1035.5	1905.1	2464.1	3030.4
M1V.	6.6	7.3	7.1	6.7	7.0
M2	720.6	1005.2	2387.4	2509.0	2014.1
M2V.	6.2	7.5	5.7	6.5	10.5
Exch.rate	1.3	0.6	0.4	0.4	0.2
Bank rate	9.0	9.0	9.0	10.3	20.0
TB rate	..	8.5	..	8.4	13.3
Lend.rate	..	17.2	13.0	11.7	15.5
Bond rate	..	13.3	14.0	15.2	17.3
Dep.rate	..	10.0	8.9	8.8	..

Source: IMF, International Financial Statistics, various issues.

Thus, the monetary statistics seem to indicate that reform measures have also affected the banking and financial sector. Different kinds of deposits as well as domestic credit have increased quite substantially. Interest rates, which for a long time remained almost constant, started to rise by significant amounts. Also significant to note are the fluctuations in the velocity of circulation of both the narrow and broad monetary aggregates.

Other important developments have been of an institutional nature. The government has opened up the financial sector to both domestic and foreign competition.

This is expected to stimulate competition in a sector which for a long time has been oligopolistic. A third discount house has been opened while a fourth building society and a fifth accepting house have been licensed, with additional entrants expected to offer more competition in all segments of financial activities. Furthermore, policy reforms to liberalize the financial markets have permitted the opening up of other specialized financial institutions aimed at providing financial resources, especially to the indigenous entrepreneurs so as to encourage them to play an active part in production, export and employment creation. The latest entrant in this respect is the Venture Capital Company of Zimbabwe which will make financial resources available to potentially viable projects on an equity basis. Once a project becomes viable, the entrepreneur would have the option to buy out the Venture Capital Company equity holding (Reserve Bank of Zimbabwe, 1992).

New financial instruments have emerged under the program. In 1992, Foreign Currency Denominated Accounts (FCDAS) were introduced with a view to facilitate further liberalization of the trade and exchange system and also to improve the economy's foreign currency reserves. These accounts essentially raise deposits and also make foreign exchange more readily available. Effectively, this has eliminated illegal dealings in foreign currency which have in the past distorted the pricing of this resource.

In order to encourage foreign investment on the stock exchange, foreign investors are now allowed to buy shares on the stock exchange up to a maximum of 25 percent of the issued share capital with a single investor acquiring a maximum of 5 percent per counter. The limits are imposed as part of the government's strategy to achieve greater local equity control, for political and economic reasons. Foreign investors are also allowed to invest a maximum of 15 percent of the total assets in Zimbabwean primary issues of bonds and stocks and all such investments qualify for 100 percent dividend remittance rights.

In addition to the above changes, a mechanism to review the legal framework within which these institutions operate has been set up. The review aims to remove any inhibitions to greater effectiveness of monetary policy implementation and to enable the financial sector to respond effectively to emerging opportunities and challenges.

2.3 Conclusion

This chapter has presented a summary of key historical and economic developments in the three SADC countries- Malawi, Zambia and Zimbabwe. Special attention is given to some similarities in their historical experiences, and particularly the way in which they influenced the region's political, economic and social character. It described the economic and political forces which led to the introduction of SAPs. The main argument was that colonial development created an economic system which impoverished the majority of people in the region and that the challenge to post-indepencence SADC governments was to remedy those past injustices by embarking on expansive reconstruction and rehabilitation programs to extend basic services like education and health care. Whereas some progress was made in that regard, there is no consensus among analysts that all those goals were achieved. The monocultural nature of the economies, hostile international market forces and to some extent, a corrupt bureacracy, made it difficult for these governments to continue on their equity-oriented development strategies. This necessitated a fundamental economic change from an interventionist approach to a market-oriented economic system. Initial efforts to transform the system required huge financial resources which these countries did not have. This led them to enter into formal adjustment programs under the auspices of the IMF and the IBRD. Access to various facilities of these institutions was granted but a number of conditions were attached. The restrictive fiscal and monetary policies were part of the deal.

We also noted how the reform programs also impacted on the financial sector. The easing of entry restrictions changed the character of this sector, creating room for greater competition and broadening the scope for domestic resource mobilization and also the emergence of a broader range of financial instruments. The liberalization of a wide range of interest rates was particularly significant for a sector which, for decades, had been "financially repressed". It was a move towards interest rates which better reflected the true scarcity value of capital. Higher deposit rates were introduced with the aim of stimulating deposit creation. Higher lending rates, whilst welcomed by the banking business, raised the cost of borrowing, and this is likely to hit small businesses the hardest. We also noted the significant expansion in all monetary aggregates and that these developments may also have affected the demand for money.

CHAPTER 3

LITERATURE REVIEW

3.0 Introduction

This chapter presents the evolution of the theory of the demand for money in order to provide a theoretical framework within which we develop our model. We present a summary of the conventional approach to modelling demand for money. This includes the classical, Keynesian and monetarist views. We describe the methodology embodied in cointegration and error correction modelling which is now increasingly being applied in demand for money studies.

3.1 A summary of the conventional approach to modelling demand for money

The conventional approach to explaining the demand for money originates from Fisher's (1911) equation of exchange which is given by the following identity:

$$MV=PT \quad (1)$$

where M = volume of money stock

V = velocity of circulation of money

P = the price level

T = volume of transactions, a proxy for the volume of output

Equation (1) represents a state of equilibrium. Classical theory used Fisher's equation of exchange to derive a theory of demand for money. By rearranging equation

(1), the demand for money (at equilibrium) is equal to some proportion of income which can be represented as:

$$M_d = kPT \quad (2)$$

where M_d denotes the demand for money, and $k = 1/V$, the reciprocal of the velocity of circulation. So, from the classical point of view, money was demanded for transactions and precautionary purposes and as equation (2) shows, the quantity demanded depended on income.

A fundamental assumption in the classsical theory is that V is stable. This forms the basis for the classical belief that the demand for money function is stable and predictable so that monetary policy could be used as an effective tool of macroeconomic management.

Keynes (1930,1936), added the interest rate, r, as one of the determinants of the demand for money. From his observations, he argued that the speculative motive for holding money was important. Thus, the Keynesian view is evident in the following demand function for money:

$$M_d = k(Y) + L(r) \quad (3)$$

where k is defined as above and L denotes the part of demand for money which is determined by interest rates, r. Furthermore, it is assumed that demand for money increases with income, Y, and decreases with rate of interest, r. Thus, we have $\delta M_d/\delta Y > 0$ and $\delta M_d/\delta r < 0$.

A number of studies which capture the Keynesian speculative motive use different categories of interest rate. Common examples are the return on government treasury bills (tb), and the yield on long-term government bonds (br).

Friedman (1961) and the Chicago School (associated with monetarism) included a larger range of explanatory variables in the specification of the demand function for money. Instead of current income, Friedman suggested that some measure of income which included all possible sources of income, current and future, be considered. Thus, the discounted present value of one's income constituted what he termed permanent income. Other variables to be included were expected price level changes and different rates of return on financial assets. Although the monetarist specification of the demand function for money includes more explanatory variables, their empirical work suggests that permanent income is the most significant variable. Following the monetarist tradition, numerous studies of the demand for money used a broad range of explanatory variables which are presented in the following equation:

$$M_d=\lambda_0+\lambda_1 P+\lambda_2 Y+\lambda_3 Ra+\lambda_4 Ro \quad (4)$$

where Ro is the own return on money, Ra is the return on alternative assets, P is the price level and Y is nominal income. In most studies, current income is used for Y, given the difficulty in measuring permanent income accurately. A priori, $\lambda_1 > 0$; $\lambda_2 > 0$; $\lambda_3 < 0$. In the case of the narrow definition of money (e.g., M1), the "own" return would be close to zero. In most models, λ_1 is expected to be close to one. The coefficient λ_4 is expected to be positive in the case of broad money which includes a sizable interest-bearing component.

Although conventional approaches may differ somewhat, the method of estimation is basically the same. Using time series data, the λ-parameters in equation (4), for instance, are estimated by the method of Ordinary Least Squares (OLS). Furthermore, as is evident in all the above specifications, single equations are estimated in a static and partial equilibrium framework.

3.2 Critique of the conventional approach to modelling demand for money

In recent years, research on monetary issues has grown to be more critical of traditional theories described in Section 2. The application of those models has not always yielded satisfactory or desired results. Questions have been raised about both the theoretical and methodological procedures of specification and estimation. Theoretical concerns include the specification of the demand for money function itself, some of the underlying assumptions of the models, the appropriateness of the variables included, and the measurement of those variables. In regard to empirical issues, there are a growing number of studies which question the hypothesis that real money balances are predictably related to variables such as income or wealth, and some measure of the opportunity cost of holding real balances. The argument centres on the forecasting power of traditional models.

According to Johnson (1966), the chief deficiency in the early formulations of the demand for money lay in the choice of explanatory variables. For example, he pointed out that the use of income, wealth and the rate of interest, variables which are interdependant, leads to errors in application because of the multicollinearity problem.

Another criticism is based on the implicit assumption that money holdings adjust instantaneously to desired levels following a change in prices, incomes and interest rates. Critics suggest that since demand may occur with a time lag, a partial adjustment framework in which a variable adjusts to its equilibrium value with a time lag, would be more appropriate although it is essentially a short-term demand model. They demonstrated that the short-run demand for money adjusted slowly toward long-run equilibrium. See Chow (1966) and Goldfeld (1973) for a detailed discussion of the partial adjustment framework.

A number of authors have pointed out the shortcomings of the partial adjustment formulation. Nickell (1985), was particularly critical of some of the methods used to model the adjustment process. For example, he was critical of the methods which attempted to capture the sluggish adjustment of money demand toward desired equilibrium holdings by assuming a partial adjustment in which a fixed proportion of the difference between desired and actual holdings diminishes each period. Nickell thought that this was overly restrictive because it assumes that adjustment costs and expectations can be captured in a very specific, simple fashion. He suggested the use of an error correction dynamic specification which is a more general, intertemporal version of partial adjustment in which expectations are based on the available information. We shall return to a discussion of the error correction model later.

Another shortcoming of the conventional approaches is the limited predictive power of the model, particularly because of a changing institutional environment within which money is generated. In countries like the United States, it was observed that the conventional Goldfeld-type specifications were estimated using data generated from the relatively tranquil economic period beginning in the early 1950's and ending in the early 1970's. Thus, conclusions about the predictive power of estimated demand for money functions was reasonable. However, as described in Gordon

(1984a), beginning in the mid 1970's, an apparent shift in the demand for money relationship was observed. The period after the 1970's was largely characterized by supply shocks, high and volatile inflation, and large and erratic swings in economic activity. Consequently, empirical money demand equations from the pre-1974 period could not be expected to describe the later period with the same precision. Hendry (1980, 1985) showed parameter instability in the US and British demand for money functions. His main criticism of the specifications of the standard demand function for money is based on the fact that the variables commonly used in these studies are non-stationary stochastic processes - even in log-form and are integrated of order one, i.e., I(1). In the context of SADC countries, there is no empirical study addressing this issue. However, because of the many economic changes introduced under the SAPs, the stability of the demand for money function cannot be assumed a' priori. In fact, it should be empirically determined.

Some authors are concerned about the role of shocks in determining the demand for money. This is an aspect which conventional theory does not take into account. Carr and Darby (1981), Cooley and LeRoy (1981) and Judd and Scadding (1982), and Rasche (1987), among others, formulated models which emphasized the role of money supply shocks and argued whether the estimated function should include a short-term or long-term interest rate and how to properly specify the dynamic adjustment of actual to desired money balances. They pointed out that sudden and drastic changes in the money supply exerted a different impact on demand for money than anticipated changes of a similar magnitude.

Hafer and Hein (1980), Fackler and McMillin (1983), and Gordon (1984a) all recommended that the conventional money demand specification should at least be considered in first-difference form. Following Granger and Newbold (1974), this practice is justified given the need to avoid correlation due to time trends in the variables involved.

Critics of first-difference specifications point out that the presence of a lagged dependent variable potentially complicates the interpretation of the estimated results.

An important dimension of dissatisfaction with the traditional models is their reliance on statistical or computational procedures which are considered invariant to the nature of the time series data used. This has led to innovations on dynamic specification and use of a variety of time series models. Modern macroeconomics recognizes that although time series analysis requires data to have finite variance, many economic time series are not stationary in their levels. A series is said to be stationary if

$$Y_t = \alpha Y_{t-1} + u_t \quad (5)$$

$|\alpha| < 1$ and that u_t has finite variance. The deviations from the mean are transitory and there is a tendency for the series to return to its mean value. Another way of putting it is that the value of the mean is time independent. If $|\alpha| > 1$, then the series is said to be non-stationary. In such a case, it has a variance which is asymptotically infinite; the series rarely crosses the mean (in finite samples). Innovations to the series are permanent. If $\alpha = 1$, then this a special case of the class of non-stationary series known as a random walk in which case equation (5) can be expressed as

$$Y_t = Y_{t-1} + \epsilon_t \quad (6)$$

to emphasize the idea that Y_t is highly dependent on its lagged values.

In practice, economic time series are described in terms of their order of integration. A non-stationary series will be differenced a number of times until it becomes stationary. A series is said to be integrated of order d if it has a stationary representation after differencing the series d times. In such a case, the series has d unit roots. We should point out here that there is controversy surrounding methods to test for the presence of unit roots in time series. This is discussed later in the chapter. The stationarity property of a series is denoted as $X_t \sim I(d)$. A random walk series represented in equation (6) is denoted I(1) and a stationary series as I(0). In general, the properties of I(1) series apply generally for all non-stationary series under the restriction that the series needs to be differenced at least once in order to make it stationary. But such differencing creates other problems, namely, that information concerning the long-term relationship between the series is lost and so there will be some misspecification if a regression is carried out using series which are not cointegrated (Hafer and Jansen, 1991).

Granger and Newbold (1974) and Hendry, (1980, 1985), have shown that most series used in money demand studies are not stationary. This poses a significant problem in applied work, the most notable of which is the spurious regression problem. This is a problem which arises where a regression using non-stationary series which are known to be unrelated, indicates that the series are correlated. In fact, this has been cited as the major weakness of conventional demand for money studies and the Goldfeld-type log-level specifications of the function. See Granger and Newbold (1974). Thus, relationships which appear to be statistically significant, may, in fact, be spurious. Phillips (1986) further showed that the use of a log-level model generates spurious inferences because the usual t and F test statistics do not have a limiting distribution. More recent evidence by Ito (1989) questioned the appropriateness of such a model once it exhibits a large shift.

Ironically, the spurious regression problem has been known since Yule (1926). According to Frisch (1934), this problem could be attributed to the multicollinearity among the variables in a regression. Frisch noted that using trended variables is likely to yield a significant intercorrelated relationship even when there is no real economic relationship. Because the spurious regression problem is a centrepiece in the debate on specification and estimation of demand for money, we illustrate it with an example from (Adam,1992). Suppose X and Y are two series which are known to be uncorrelated and generated by the following known processes:

$$Y_t = Y_{t-1} + u_t, \quad u_t \sim IID(0, \sigma^2_u) \quad (7)$$

$$X_t = X_{t-1} + v_t; \quad v_t \sim IID(0, \sigma^2_v) \quad (8)$$

where $E(u_t, v_t) = 0 \ \forall \ t$; $E(u_t, u_{t-j}) = E(v_t, v_{t-j}) = 0 \ \forall \ j$. Under these assumptions, X and Y are uncorrelated random walks. If Y is regressed on X, one would expect the estimates of β_0 and β_1 in the regression model:

$$Y_t = \beta_0 + \beta_1 X_t + \epsilon_t \quad (9)$$

would tend to zero as the sample size increases. The R^2 of the model would also tend to zero. However, evidence from Monte Carlo experiments suggests that despite the fact that the data series were constructed to be unrelated, (OLS) estimates of β_0 and β_1 have significant t and F statistics. Such a result occurs when both the Y and X series are not stationary meaning that they are both dominated by a trend component. As Adam (1992) put it, it is the correlation of this effect which biases the OLS regression and hence the correlation cannot be interpreted in the usual way between stationary series. A typical spurious regression has a very high R^2 (generally close to one) and a low Durbin-Watson (DW) statistic. Phillips (1986) proved that the DW statistic converges in probability to zero, and that the standard F and t tests are inappropriate when an equation contains non-stationary variables since there are no asymptotic critical values for these statistics.

One classic example of spurious regression is shown in Hendry (1980). Hendry regressed the logarithm of the consumer price index on the cumulative rainfall in the United Kingdom and found a strong positive statistically significant relationship between these variables. The t-statistics were extremely large and R^2 was equal to 0.98. However, the low DW statistic of 0.1 indicated that the relationship was obviously spurious. Granger and Newbold (1974) offered a more extensive discussion of the spurious regression problem. To deal with this problem, econometricians have to find a method which rejects spurious regression results but which will not, at the same time, reject genuine structural correlation between non-stationary series. Previously, some studies got rid of the non-stationarity of the data series by differencing before estimating economic models. Box-Jenkins (1970) techniques adopted this approach. Such an approach, however, removes much of the long run characteristics of the data (Pierce,1977 ; Hendry, Pagan and Sargan,1984 and Engle and Granger, 1987). Hendry (1986) pointed out that by analyzing only the changes in economic time series, all information about the potential long run relationship between the levels of the variables is lost. He suggested that cointegration be used to address the spurious regression problem.

3.3 Departure from " tradition"

3.3.1 The cointegration approach to demand for money

Engle and Granger (1987) have written extensively about cointegration. According to their analysis, the components of a vector of time series X_t are said to be cointegrated of order (d-b) denoted $X_t \sim CI(d-b)$, where components of X_t are either I(d) or I(b) where both d and b are equal to or greater than zero, and there exists a vector $\alpha \neq 0$ such that $Z_t = \alpha' X_t \sim I(d-b)$. The vector α is called the cointegrating vector. When variables are cointegrated, it is possible to test for the existence of a long run relationship among a group of economic variables. It means that the variables track each other over time and even though there may be deviations from the long run path, they only last for a finite time.

When there are cointegrated variables, the long run relationship is best represented by an error correction model. This model encompasses other dynamic specifications including the partial adjustment model. This model is described in more detail later in this chapter.

Time series modelling of demand for money has focused on the issue of stability of the velocity of circulation - the so called velocity-puzzle which has arisen from the observation that trends in the money market show evidence of short-run deviations from long run equilibrium (Miller,1990). Contrary to standard theories of money, a growing number of studies show that velocity is not stable, implying the existence of non-stationary time series on the relevant variables. Miller (1990) developed his argument using the classical quantity theory model. He noted that the relationship between money and income described the demand for money and that this was commonly represented by the income velocity of circulation. He too noted that velocity was unstable. Dickey, Jansen and Thornton (1991) also demonstrated that income velocity, using different measures of the money supply, namely, M1, M2, M3 and the monetary base, has drifted upward over time. That would tend to indicate that there is no long run equilibrium relationship between the two. Their analysis is particularly interesting in that it builds from Fisher's equation of exchange. This identity can be written in natural logarithms as:

$$lnM+lnV-lnP-lnT\equiv 0 \quad (10)$$

$$\ln M + \ln V - \ln P - \ln T = 0 \quad (10)$$

The above identity can be converted into an equation by making velocity a function of some pertinent economic variables. Because V is unobservable, a proxy, V^*, is used so that

$$\ln V^* = \ln V + \epsilon_t \quad (11)$$

where ϵ_t represents a random error. V^* is a function of one or more observed variables, other than income and prices, which are postulated to determine the demand for money. Hence, the identity in equation (10) can be rewritten as:

$$\ln M + \ln V^* - \ln P - \ln T = \epsilon \quad (12)$$

If the proxy for V is good, then $E(\epsilon) = 0$ and ϵ is stationary. The Fisherian equation of exchange basically postulated a long run relationship between money, velocity, prices and output. More technically, it postulated the existence of the cointegrating vector $\alpha = (1,1,-1,-1)'$; see Dickey, Jansen and Thornton (1991). Even if V^* can deviate from its true value, V, in the short run, it should converge to it in the long run. If V^* is a poor proxy for V, then it suggests that the long run demand for money could not be captured in any meaningful sense. Dickey, Jansen and Thornton (1991) used this analysis to examine the relationship between money and income. This relationship is commonly represented by the income velocity of money. In the equation of exchange, the demand for money can be expressed in real terms:

$$\frac{M_d}{P}=m_d=f\left(\frac{Y}{P},Z\right) \quad (13)$$

where m^d is real money demand, y is real income and Z is a vector of variables which determine it. If it is assumed that the demand for money is homogeneous of degree one in real income, equation (13) can be written as:

$$\frac{m_d}{y}=h(Z) \quad (14)$$

h(Z) is the reciprocal of the income velocity of circulation or the k in the Cambridge version of the quantity theory described in section 2. Since at equilibrium, $m_d = m^s$, (where m^s is money stock) equation (14) can be rewritten as:

$$\frac{m_s}{y}=h(Z) \quad (15)$$

So, h(Z) is observed as the ratio of the real money stock (m_s) to real income (y). The authors proceed to formulate h(Z) in terms of the different definitions of money, namely, M1, M2, M3, and the monetary base and obtain $h_1(Z)$, $h_2(W)$, $h_3(X)$ and $h_4(R)$ respectively. The vectors Z, W, X and R represent the other factors that influence demand for those aggregates. Thus, for instance, $h_2(W)$ denotes the velocity of circulation of M2 as a function of W where this vector represents factors such as interest rates on savings and other time deposits. $h_3(X)$ denotes the velocity of circulation of M_3 and the vector X includes interest rates on fixed term deposits. $h_4(R)$ denotes the velocity of circulation of the monetary base. The vector R includes all those factors which influence the reserve level of the monetary sector. The authors then studied movements in the various velocity measures to determine if any of them form cointegrating vectors. And if such vectors were found, that proves the existence of a long run equilibrium relationship between money demand and the variables which are expected to determine it, thus proving stability and predictability.

Nelson and Plosser (1982) showed that a broader definition of money moves around an unchanged mean, suggesting that there is a stable long run relationship among the broader monetary aggregates. Hallman, Porter and Small (1989,1990) and Hafer and Jansen (1991), pointed out that the results for M2 appear to be sensitive to the sample period and how the test was performed. Johansen and Juselius (1990), using Danish and Finnish data also demonstrated the importance of determining the existence of equilibrium relationships among the variables which determine the demand for money.

The above discussion shows current trends in modelling demand for money. First, tests for unit roots are carried out on the time series in order to determine if they are stationary or not. Second, if the series are non-stationary, there are test procedures to determine if any linear combinations of the variables under study are cointegrated. Third, if such a relationship is found, then the demand for money is estimated using an error correction procedure. In the following sections we summarize the literature on the test procedures and discuss the error correction model.

3.3.2 Brief survey : Unit root and cointegration tests.

3.3.2.1 Unit root tests

Theoretical advances on unit roots have been developed by, among others, Dickey and Fuller (1979,1981), Fuller, Hasza, and Goebel (1981), Sargan and Bhargava (1983), Said and Dickey (1984), Phillips (1987), Phillips and Perron (1988), and Perron (1988).

The Dickey Fuller (DF) test is based on the following data generating process:

$$y_t = \alpha y_{t-1} + u_t ; u_t \sim (0, \sigma^2) y_0 = 0 \quad (16)$$

The test examines deviations from the mean, Y_0.

Testing the order of integration in a series entails testing the value of the coefficient α in equation (16) to see whether it is significantly greater or less than unity in absolute value. If it is less than unity then the series is stationary; if it is greater than or equal to unity, then the y is said to have (at least one) unit root and is therefore non-stationary. The traditional procedure would use a t-test under the null H_0: $\alpha = 0$. However, if we were testing the null $H_0: \alpha = 1$, the test statistic is not distributed as a standard "t". To deal with this problem, Dickey and Fuller regressed the first difference of the variable y_t on a lagged value of y_t:

$$\Delta y_t = \rho y_{t-1} + \epsilon_t \quad (17)$$

The method tests the significance of ρ under the null hypothesis H_0 $\rho \geq 0$, i.e., $\rho = (\alpha-1) \geq 0$. If we cannot reject H_0: that $\rho \geq 0$ then we correspondingly cannot reject the null that $\alpha \geq 1$. In other words, if the null is accepted, then the series is non-stationary.

The Dickey Fuller method has a fundamental drawback. It is sensitive to the presence of drift and time trends in the regression (the inclusion of a constant and a time trend in the estimating equation). It necessarily assumes that the data generating process is an autoregressive process of order 1; i.e., AR(1) under the null. It is possible that the AR process may be of a higher order than 1. In that case, the autocorrelation in the error term will bias the test. The Augmented Dickey Fuller test (ADF) was designed to overcome this problem and, in fact, many studies on demand for money using the method of cointegration rely on this test for unit roots. The ADF is identical to the standard DF test but is constructed within a regression model of the form :

$$\Delta Y_t=\alpha_0+\alpha_1 Y_{t-1}+\sum_{j=1}^{p}\gamma_j\Delta Y_{t-j}+\epsilon_t \quad (18)$$

which has an intercept but no trend or as:

$$\Delta Y_t=\alpha_0+\alpha_1 Y_{t-1}+\alpha_2 t+\sum_{j=1}^{p}\gamma_j\Delta Y_{t-j}+\epsilon_t \quad (19)$$

which has both and an intercept and a trend.

ϵ

for t = 1,...,N is assumed to be Gaussian white noise. p is chosen to ensure that the errors are uncorrelated. Tests are then conducted in order to determine if $\alpha_1 = 0$; or $\alpha_1 = 1$; or $\alpha_1 > 1$. These tests include the z-test and the τ-test and are based on the relevant asymptotic theory. The z-test tests the null hypothesis that $\alpha_1 = 0$ in equation (18) based on the test statistic $T\hat{\alpha}_1$, where T is sample size. τ is a t-statistic to test the same null. Note that the t-statistic does not possess the usual t distribution. There are various Monte Carlo experiments which have generated the relevant critical values; see Dickey and Fuller (1981), Guilky and Schmidt (1989), and Davidson and MacKinnon (1993).

Although useful, the DF and ADF methods run into problems under certain circumstances. Phillips and Perron (1988) and Perron (1988), pointed out that the presence of a sudden change in the mean level of the series for a given time period may lead to misleading results on the existence of a unit root. For instance, the series may be stationary except for the change in the mean. The change may appear so big and sudden compared to the variability exhibited over the rest of the sample period that it may be desirable to isolate its effect and consider that particular period as an "outlier" event or as exogeneous (Perron,1990). Split samples may be used as a remedy but the problem is that they imply tests with low power. So it may happen that the unit-root hypothesis cannot be rejected using a full sample but not with a split sample, often because the smaller number of observations in the latter have a low power. Phillips and Perron (1988) designed test statistics that allow for the presence of a change in the mean of the series under both the null and alternative hypotheses. Their analysis was designed to remove a particular or sudden change from the noise function and introduce it in the deterministic part of the series. By a sudden change is meant that the event is so unique that it departs from a general historical pattern. This change is reflected in the time series as a discontinuity in the mean. This analysis has some relevance in the modelling of demand for money. When a central bank implements or changes monetary policy, such as under the SAPs in the SADC, such a discontinuity can occur. Box and Tiao (1975) term this change in monetary policy an "intervention". The Phillips-Perron method uses a non-parametric correction for serial correlation by first calculating unit roots from ADF type regressions (equations 18 and 19) and with p = 0. The authors describe some stochastic process, $w^*(r)$ on C[0,1], the space of all real-valued continuous functions on the interval [0,1]. The transformed statistics are:

$$Z(\hat{\alpha}) = T_1(\hat{\alpha}-1) - T_2(\hat{\sigma}^2 - \hat{\sigma}_e^2)/(2S^2) \quad (20)$$

where S^2 is the residual sum of squares from the regression of Y_{t-1} on a constant and a dummy variable. T_1 and T_2 are sub-sample sizes characterizing the pre and post-break point.

$$Z(t\hat{\alpha}) = (\hat{\sigma}_e/\hat{\sigma})\, t\hat{\alpha} - T(\hat{\sigma}^2 - \hat{\sigma}_e^2)/(2\hat{\sigma}S_e) \quad (21)$$

The limiting distribution of Z(αs) and Z(tα) form the basis of the critical values presented in Tables 3 and 4 of Perron (1988). The statistics are then transformed to remove the effects of serial correlation on the asymptotic distribution of the test statistic. These are presented in Table 1 of Perron (1988, pp308-9).

Perron (1988), designed two procedures to test the null hypothesis of a unit root, namely the "Additive-Outlier" and the "Innovational-Outlier" models. The first is an extension of the Dickey Fuller test. The regression equations are the same as (18) and (19), but without the intercept term, α_0. The test is for H_0: $\alpha = 1$, where α denotes the sum of the autoregressive coefficients. He showed that the limiting distribution of t_{α^*}, the t-statistic for α^*, an estimate of α, is the same when the innovational sequence in the no-intercept versions of equations (18) and (19) is an ARMA (p,d,q) process as when the following equation is used:

$$y_t = \alpha y_{t-1} + \epsilon_t, \quad (22)$$

The innovational-outlier model considers a regression similar to the ADF but with the added improvement of including a dummy variable to account for any structural discontinuity. Accordingly, a regression of the following type is considered:

$$y_t = \mu + \gamma DU_t + dD(TB)_t + \alpha yt-1 + \sum_{j=1}^{p} c_j \Delta y_{t-j} + v_t \quad (23)$$

Where the dummy variable $DU_t = 0$ if $t \leq TB$ and 1 otherwise. TB denotes the time period during which the break has occurred. This specification, according to Perron (1988), implies that the change in the mean of the series does not occur simultaneously, and its effect on the level of y_t depends on the dynamics of the process. Tests for the significance of $\alpha = 1$ are conducted in the same way as before.

3.3.2.2 Cointegration tests

The general procedure to test for cointegration involves the construction of test statistics from the residuals of cointegrating regressions.

With M time series, Y_{t1}, Y_{t2}, ...Y_{tm}, each of which is I(1), two cointegrating regression equations could be considered:

$$Y_{t1}=B_0+\sum_{j=2}^{M}B_jY_{tj}+u_t \quad (24)$$

Equation (24) does not contain a linear time trend variable. When there is a linear time trend variable, the regression equation will include β_1t, where t is a linear time trend variable.

To test for no cointegration, we have to test for a unit root in the estimated residuals $\hat{u}_t$. As outlined before, the ADF regression equation given below would be applied:

$$\Delta\hat{u}_t=\alpha_*\hat{u}_{t-1}+\sum_{j=1}^{p}\phi_j\hat{u}_{t-j}+v_t \quad (25)$$

The null hypothesis to be tested is that $\alpha_* = 0$. If the value of the test statistic is smaller than the critical value, then there is evidence of cointegration.

The literature, however, cautions against wholesale reliance on the ADF test to determine cointegration simply because this procedure is only applicable in situations where there is only one cointegrating relationship. It cannot determine the existence of multiple cointegrating relationships. A procedure developed by Johansen and Juselius (1984, 1990) was designed to handle multivariate cointegrating relationships. Since this procedure is followed on our study it is described in detail in chapter 4 where the model of the demand for money used in this study is developed.

If cointegrating relationships are established, then the demand for money can be modelled using the error correction approach.

3.3.3 The error correction model

3.3.3.1 Definitions and origins

An error correction model (ECM) is a special case of the autoregressive distributed (AD) model. See Hendry, Pagan, and Sargan (1985) for a classification of AD models. As discussed earlier, an ECM is based on the notion that when variables are cointegrated, there is a long run or equilibrium relationship between them. It is constructed from the residuals of an equilibrium relationship between variables which are known to be cointegrated.

Hendry (1980), interpreted the ECM as a reparameterization of the general autoregressive distributed lag (ADL) model or a dynamic linear regression (DLR) model. The literature on time series views such models as an effective way of characterising the dynamic multivariate interactions among economic variables. In other words, they are structural representations of dynamic adjustment towards some equilibrium about which economic theory can be informative.

Although it is considered to be a useful technique, there is no consensus as to what is the best representation of an ECM.

Basically, an ECM can be viewed as a model wherein a policy instrument adjusts in order to maintain a target variable close to its desired value. Phillips (1957), Hendry, Pagan and Sargan (1984), viewed the ECM as a reparameterization of the dynamic linear regression model in terms of differences and levels, or as a restricted form of a dynamic linear regression model, which imposes long run proportionality (linear homogeneity) among some regressors. Hendry and Sternberg (1981) viewed it as a generalization of the simple " partial adjustment mechanism". Nickell (1985) viewed it as a quasi reduced form derived from special cases of rational expectations models of intertemporal optimization which involve costs of adjustment. Engle and Granger (1987) interpreted ECM as a particular representation of a vector autoregression appropriate for cointegrated vectors.

Sargan (1964) used the ECM framework to model wage and price equations. Hendry (1985) also wrote extensively on ECMs.

Hylleberg and Mizon (1989) suggested that from their practical applications the error correction formulation provided an excellent framework within which it was possible to apply both the data information and the information obtainable from economic theory.

Other studies which apply the ECM framework to demand for money include those of Hendry and Richard (1982), Rose (1985), Baba, Hendry and Starr (1987) and Domowitz and Elbadawi (1987).

3.3.3.2 Specification of ECMS

As pointed out earlier, there is no unique way to represent an ECM. However, a review of some of the specifications reported in the literature, would yield an understanding of the principles behind them.

An ECM could be explained in a simple manner following Granger (1983) and Granger and Engle (1985).

The authors use the simple example of an OLS regression of a variable y_t on x_t, and this can be specified as:

$$y_t = \alpha x_t + \epsilon_t \quad (26)$$

Assuming the variables y_t and x_t are each I(1), and there is no drift or trend in mean, and if there exists a constant A, such that

$$z_t = x_t - Ay_t; \quad I(0) \quad (27)$$

then the two variables are said to be cointegrated and A is the cointegrating parameter and it will be unique.

Since z_t has different temporal properties from its components, y_t and x_t must have a special relationship. Both variables have dominating low-frequency or "long-wave" components, and yet z_t does not. Equation 27 may be rewritten as

$$x_t = Ay_t \quad (28)$$

In the words of Granger 1986), this equation can be considered a long-run or "equilibrium" relationship and can be interpreted as the extent to which the system x_t, y_t is out of equilibrium. z_t can be interpreted as an equilibrium error (that is, the distance that the system is away from equilibrium at any point in time).

Granger proposes that when such a cointegrating relationship exists between variables, then there always exists a generating mechanism which he calls "the error correcting form" and the change in each variable will best be explained by the lagged values of z_t and the lagged values of the changes in both y_t and x_t. In other words, the disequilibrium between actual and desired values in the dependent variable, represented by z_t, and when a cointegrating relationship exists, provides and important explanation of the variations in the dependent variable. It is this process which distinguishes the ECM and conventional models of demand for money specification.

Granger's perception of the error correction mechanism is represented in equations (29) and (30).

$$\Delta x_t = -\rho_1 z_{t-1} + lagged(\Delta x_t, \Delta y_t) + dB(\epsilon_{1t}) \quad (29)$$

$$\Delta y_t = -\rho_2 z_{t-1} + lagged(\Delta x_t, \Delta y_t) + d(B)\epsilon_{2t} \quad (30)$$

d(B) is a finite polynomial in the lag operator B so that $B^k x_t = x_{t-k}$. ϵ_{1t} and ϵ_{2t} are white noise residuals. The z_{t-1} terms in both equations are the error correction terms. Granger contends that the ECM should produce better short-run forecasts and will certainly produce long-run forecasts that hold together in economically meaningful ways.

Thus, it is evident from the work of Granger (1983) and Engle and Granger (1987) that the concept of the ECM tries to mimic the existence of a long-run equilibrium to which an economic system converges over time.

Equations (29) and (30) do not specify the lag length on the first-differences of the independent variables. One has to try different lag lengths and pick the one which ensures that the residuals are white noise.

The Engle and Granger view of the ECM has its limitations, basically that it cannot deal with the possible existence of multiple cointegration vectors. Thus, there are other ECMs whose specification accomodates this aspect. Juselius and Johansen's procedure described in more detail in chapter 4, can be viewed as an ECM within a multivariate cointegrating framework.

Thus, the actual specification of the ECM will depend on the nature of the cointegrating relationships between the variables and will be modified in light of several diagnostic tests. Chapter 4 discusses in more detail the specific ECM applied in this study.

3.4 Conclusion

The overview of empirical studies of the money demand function seem to indicate a clear departure from what one might call the traditional approach to the specification of the demand for money function. This refers to the single equation static formulation where current demand for money is modelled as a function of a few current variables such as income, prices and a range of interest rates. More recent literature has criticized the static nature of the model as well as the methodological flaws associated with undertaking OLS regression analysis when the time series data employed may not be stationary. Thus, recent studies formulate dynamic models of the demand for money using the methods of cointegration and error correction with a view to avoiding the spurious correlation problem and account for the effect of the time factor in the adjustment towards long run equilibrium.

In the light of this evidence from the literature, we study the demand for money function in selected SADC countries within the framework of cointegration and error correction.

CHAPTER 4

METHODOLOGY

4.0 Introduction

This chapter discusses the methodology of research used to estimate an error correction model (ECM) of demand for money for the three SADC countries under study.

As reviewed in the literature, in order to estimate a long run demand for money function within an ECM framework, one must carry out four important procedures. These are listed below:

a) Conduct univariate tests for unit roots. The objective of such an exercise is to determine the order of integration for each of the variables involved in the model.

b) Estimate cointegrating regressions in variables of the same order of integration, as determined in (a) by OLS.

c) Conduct multivariate tests for unit roots on the residuals of the cointegrating regressions. This is in keeping with the notion established in the literature that, although it may turn out that some of the series in (a) are not stationary, it is conceivable that some linear combination of them could be stationary. If that is the case, then a stable long run equilibrium relationship can be established.

d) Finally specify and estimate an error-correction model of demand for money. The following sections describe the procedures to estimate and test the various hypotheses related to the four steps outlined above.

4.1 Univariate tests for unit roots

In order to test for stationarity in a typical time series, we apply the conventional ADF test. However, because of some of the limitations of this method as described in chapter 3, we use the more recent Phillips and Perron (1988) test for

unit roots. These tests are performed on both the nominal and real values of the variables which the literature suggests as determinants of the demand for money.

For each country, there are ten nominal and seven real variables of interest. These are expressed in logarithms and listed below.

Variables used in unit root tests

Nominal variables

m1 = narrow money

m2 = demand deposits and currency in circulation

mb = currency in circulation plus reserves of the monetary banking sector at the central banks.

y = gross domestic product

tb = 3-month Treasury Bill rate, a proxy for short-term interest rates.

br = government yield or bond rate - a proxy for long-term interest rates

P = price level, proxied by the consumer price index (CPI).

v1 = (m1/y) = velocity of circulation of nominal m1

v2 = (m2/y) = velocity of circulation of nominal m2

v3 = (mb/y) = velocity of circulation of nominal mb

Real variables rm1, rm2, rmb, ry, rv1, rv2, rv3 are obtained by deflating nominal variables by the CPI.

For these variables, unit root tests are conducted on the log-levels, first-differences and where necessary, the second-differences of the log-levels in both nominal and real terms. Thus, for each country, we conducted 17 ADF test regressions. We also carried out 17 Phillips-Perron type regressions as this is considered to be a more powerful test. The next section presents the various hypotheses tested and the relevant test statistics.

4.1.1 Augmented Dickey-Fuller test

The ADF test is based on OLS regression of two equations. Equation (31) contains an intercept and no trend whereas equation (32) contains both an intercept and a trend. P is chosen such that the residuals, ϵ_t are uncorrelated.

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \epsilon_t \quad (31)$$

$$\Delta Y_t = \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \epsilon_t \quad (32)$$

Y_t represents a typical variable on which time series data are available. The first difference of the variable is regressed on its lagged values. The test statistics presented in Table 10 are used to test the significance of α_1 following White (1993, p.157).

The unit root hypothesis can be rejected if the t-statistic is smaller than the critical value. These critical values are provided by Davidson and MacKinnon (1993), Fuller (1976) and Dickey and Fuller (1981).

Table 10 Summary of hypotheses tested and the test statistics used in the ADF unit root tests

Model with intercept and no trend:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \epsilon_t$$

Null hypothesis	Test statistics
1. $\alpha_1 = 0$	z-test
2. $\alpha_1 = 0$	τ-test
3. $\alpha_0 = \alpha_1 = 0$	ϕ_1

Model with intercept and trend:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \epsilon_t$$

Null hypothesisTest statistics	
1. $\alpha_1 = 0$	z-test
2. $\alpha_1 = 0$	τ-test
3. $\alpha_0 = \alpha_1 = \alpha_2 = 0$	ϕ_2
4. $\alpha_1 = \alpha_2 = 0$	ϕ_3

Notes: The z-test is based on a test statistic denoted as $T\hat{a}_1$, where T denotes the sample size. The τ-test is a t-ratio test. ϕ_1 and ϕ_2 are F-test statistics to detect a unit root in a model with zero drift in equations (31) and (32) respectively, whereas ϕ_3 tests the case of non-zero drift.

4.1.2 Phillips-Perron unit root test

Perron (1988) suggests a method which circumvents the problems associated with the ADF test. His method uses the non-parametric test developed by Phillips (1987) and Phillips and Perron (1988). He argues that if a series is stationary about a linear trend and if this is not taken into account in the construction of a unit root test, there will be a high probability of type II error and clearly the power of the test will be poor. So, in order to accommodate for the possibility of a changing mean, they use a non-parametric correction for serial correlation. The method calculates unit roots based on the ADF equation described earlier but with p = 0. Newey and West (1987) provide a method to construct an estimate of the error variance from the estimated residuals of the cointegrating regression thus:

$$\frac{1}{N}\sum_{t=1}^{N}\hat{e}_t^2+\frac{2}{N}\sum_{s=1}^{l}w(s,l)\sum_{t=s+1}^{N}\hat{e}_t\hat{e}_{t-s} \quad (33)$$

The statistical explanation of this equation is provided in Phillips (1987) and Perron (1988).

The statistics are then transformed in order to remove the effects of serial correlation on the asymptotic distribution of the test statistic. In chapter two, we outlined this method as summarized in Perron (1988) and pointed out that it is based on the above ADF regression. It also presents the critical values for the transformed statistics.

Perron's method estimates the following regression by OLS, where x_t is a univariate time series. This is a model with an intercept and a time trend, denoted by the variable (t-T/2).

$$x_t=\kappa+\lambda(t-T/2)+\theta x_{t-1}+\epsilon_t \quad (34)$$

The sample size is T + 1 and ϵ_t may be serially correlated and heterogeneously distributed. Perron (1988) gives a more detailed set of assumptions concerning the error term.

So, in the context of this study, the test for unit roots using Perron's method involves setting up regression equations similar to equation (34). Table 12 presents the hypotheses tested and the relevant test statistics used. We adopt, with slight modification, the notation and formulation in Taylor (1993).

Table 11 Summary of hypotheses and test statistics in Phillips-Perron unit root tests: Model with an intercept and trend

$$x_t=\kappa+\lambda(t-T/2)+\theta x_{t-1}+\epsilon_t$$

Null hypotheses:	Test Statistics
H_{01}: $\theta = 1$	$Z(\alpha)$
H_{02}: $(\kappa, \lambda, \theta) = (0,0,1)$	$Z(t\alpha)_1$
H_{03}: $(\lambda,\theta) = (0,1)$	$Z(t\alpha)_2$

The relevant test statistics in this case are transformed versions of the standard t-test for H_{01} and of the standard F-statistic for H_{02} and H_{03} respectively. In Perron's work, the transformed statistics are denoted as $Z(\alpha)$ for the transformed t-statistic for H_{01} and $Z(t\alpha)$ for the transformed F-statistic for H_{02} and H_{03}.

Suppose results from estimating equation (34) do not lead to a rejection of the
unit root hypothesis, then greater power may be obtained by estimating the relationship:

$$x_t^* = \kappa^* + \theta^* x_{t-1}^* + \epsilon_t^* \quad (35)$$

This equation differs from equation (34) in that it does not have a trend and the asterisks on the parameters (κ, θ,) indicate that they are different from those in equation (34). Using the demand for money variables described earlier, we compute the OLS regression of equation (35), and test the hypotheses laid out in Table 12.

<u>Table 12 Summary of hypotheses and test statistics for the Phillips-Perron unit root tests: Model with an intercept and no trend:</u>

$$x_t^* = \kappa^* + \theta^* x_{t-1}^* + \epsilon_t^*$$

Null hypotheses:	Test statistics
H_{01}^*: $\theta^* = 1$	$Z(\tau_\mu)$
H_{03}^*: $(\kappa^*, \theta^*) = (0,1)$	$Z(\phi_1)$

So, if the null hypothesis ($H_0 2$) in equation (34) cannot be rejected, then one should use the transformed t and F-statistics, here denoted as $Z(\tau_\mu)$ and $Z(\phi_1)$ to test H_{01}^* and H_{03}^* respectively. This is valid if the drift term κ in equation (34) is zero since $Z(\tau_\mu)$ and $Z(\phi_1)$ depend on κ.

Following Dickey and Pantula (1987) we also test for higher order unit roots by applying the same tests to the data in first and second differences. The test procedures will be the same as the ones described above.

4.2 Testing for cointegration

In this section we describe the procedures followed in this study to test for cointegration.

4.2.1 The general framework

Most cointegration tests are based on tests for unit roots in single equation time series models. The literature separates the discussion of these tests into univariate and multivariate cointegration tests. Tests for cointegration in univariate models reduce to unit root tests of the DF and ADF type and these have been described in section 3.1.1. Fortunately, the same ideas generalize to the multivariate case. Thus, cointegration tests can be viewed as a natural extension of tests for unit roots in single equation time series models.

The general procedure involves the construction of test statistics from the residuals of a cointegrating regression. Such a regression may consist of any pair of variables or a group of them. The main objective of this study is to determine if there exists a linear combination among those variables which determine the demand for money.

Following the discussion in the literature review, cointegration tests can be performed within a bivariate or in a multivariate context. In the bivariate case, the cointegrating equations to be used are given as equations (31) and (32) in chapter three. Then both ADF and Phillips-Perron tests are conducted on the residuals to determine if a linear combination of the variables in question is stationary.

4.2.2 The ADF test for cointegration

This test is done in almost the same way as the univariate unit root test except that in this case, it is applied to the residuals of the cointegrating regression. Thus, equations (18) and (19) are estimated and the residuals are saved. Then, in each case, the first-differences of the residuals are regressed on their lagged values, where the lag length is chosen such that the error term is white noise. Equation (36) shows the cointegrating regression which is used to test various hypotheses concerning cointegration.

$$\Delta \hat{u}_t = \alpha_* \hat{u}_{t-1} + \sum_{j=1}^{p} \Phi_j \hat{u}_{t-j} + v_t \quad (36)$$

Table 13 shows the hypotheses to be tested in this case.

Table 13 Hypotheses tested to determine existence of cointegrating relationships: ADF test

Null Hypotheses	Test statistics
H_0: $\alpha_* = 0$	z-test
H_0: $\alpha_* = 0$	τ-test

The z and τ-tests (the appropriate "t-ratio" test) are used. If the test statistic is smaller than the critical value, then there is evidence of cointegration. Critical values are provided by Dickey and Fuller (1987).

ngle and Granger (1987) also suggest that values of R^2 and the D.W. statistic be used. In general, a high R^2 and a low D.W. statistic tend to indicate cointegration.

The Phillips-Perron test is performed on the residuals obtained from the equations (34) and (35) and the cointegration tests are based on regression of the residuals structured along the lines of equations (34) and (35). The appropriate transformed statistics presented earlier are used to test the null hypotheses of non-stationarity.

To determine if there may be more than one cointegrating vector involving a group of variables, we apply the procedure of Johansen and Juselius (1990). This is well summarized in Dickey, Jansen and Thornton (1991.) This method uses a maximum likelihood approach to construct the test statistics for the number of cointegrating vectors.This procedure is described in the next section.

4.2.3. The Juselius and Johansen procedure for testing for cointegration

The procedure developed by Johansen and Juselius (1990), described below, is chosen because recent Monte Carlo evidence by Gonzalo (1989) indicates that the maximum likelihood procedure for estimating and testing for cointegration relationships performs better than both the single equation and multivariate methods.

Consider the vector autoregressive (VAR) model

$$Y_t = C + \Pi_1 Y_{t-1} + \ldots + \Pi_k Y_{t-k} + \Phi D_t + \epsilon_t \quad (37)$$

where Π_j $(j=1,2,\ldots,k)$ is a $p \times p$ matrix; $Y_{t-1}, .Y_{t-2}, \ldots, Y_0$ are $p\times1$ vectors which are fixed. $\epsilon_1, \ldots, \epsilon_T$ are normal and identically and independently distributed p-component vectors with mean 0 and dispersion matrix Λ, i.e., they are n.i.d $(0, \Lambda)$. D_t are centred seasonal dummies which sum to zero over a full year. C is a $p \times 1$ vector of constants.

If C is non-zero, it suggests that the non-stationary process Y_t has linear trends with coefficients which are functions of C. The unrestricted parameters $(C, \phi, \Pi_1, \ldots, \Pi_k, \Lambda)$ are estimated using T quarterly observations from a VAR process. Thus the number of observations is Tp and the number of parameters is $p + kp^2 + 3p + p(p+1)/2$. Since quarterly observations are used, we count 3p coefficients for the three seasonal dummy variables in order to avoid the dummy variable trap.

The vector Y_t, like most macroeconomic time series, may be non-stationary. The model presented in (37) can be rewritten as:

$$\Delta Y_t = c + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots + \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi Y_{t-k} + \Phi D_t + \epsilon_t \quad (38)$$

where $\Gamma_i = -(I - \Pi_1 - \ldots - \Pi_i)$, (i=1,...,k-1),

and $\Pi = -(I - \Pi_1 - \ldots \Pi_k)$.

Y_t is stationary if Π is full rank. But if the rank(Π) = 0, then Π is a null matrix. This would imply that the level terms have no effect and a model in first differences would be appropriate.

If rank(Π) = r and $0 < r < p$, then there exist $p \times r$ matrices α and β such that $\Pi = \alpha\beta'$.

Although Y_t itself is not stationary, the cointegrating vectors in the matrix β have the property that $\beta' Y_t$ is stationary.

For any square matrix, the number of eigenvalues equals the order of the matrix. Thus the $p \times p$ matrix Π, as defined above, has p eigenvalues. We also recall that the rank, r, of a matrix is defined as the number of linearly independent rows or columns of the matrix. Since linear independence also implies the number of non-zero eigenvalues of the matrix, we have $r \leq p$. In equation (38), Π is a $p \times p$ matrix of rank $r \leq p$ and it can be written as $\alpha\beta'$where α and β are $p \times r$ matrices with rank r.

The general form of the null hypothesis for cointegration in the Juselius and Johansen procedure is to test the null hypothesis: H_0: $\Pi = \alpha\beta' = 0$ since we assume that some of the individual series in Π are themselves non-stationary. It should be emphasized that this hypothesis applies to any autoregressive process or order ≥ 1. The matrix Π provides information about the long run relationships between the variables in the data.

his means that there are r cointegrating vectors and equation (38) can be interpreted as an error correction model; see Engle and Granger (1987), Davidson (1986), and Johansen (1988a).

The Juselius and Johansen procedure entails finding the maximum likelihood estimate of α, for a given β in a higher order process. Their procedure may be summarized in the following steps as summarized by Muscatelli and Hurn (1990):

a) Regress ΔY_t on its lagged values and D_t:

$$\Delta Y_t = c + \Phi D_t + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi Y_{t-k} + R_{0t} \quad (39)$$

and compute the residuals, R_{0t}.

b) Regress Y_{t-k} on the lagged values of ΔY_t and the seasonal dummies, D_t:

$$Y_{t-k} = d + \Phi_k D_t + \Gamma_{k1} \Delta Y_{t-1} + \Gamma_{k2} \Delta Y_{t-2} + \ldots + \Gamma_{kk-1} \Delta Y_{t-k+1} + R_{kt} \quad (40)$$

and compute the residuals, R_{kt}.

c) Using the residuals from equations (39) and (40), i.e., R_{0t} and R_{kt}, construct the product moment matrices. These matrices are also referred to as squares of canonical correlations between the residuals of equations (39) and (40). These correlations can also be interpreted as covariance matrices and are given by the following equation:

$$S_{ij} = T^{-1} \sum_{t=1}^{T} \hat{R}_{it} \hat{R}'_{jt} \quad i,j = 0,k. \; (41)$$

d) Use equation (41) to find the cointegration vectors. These are found by solving the following determinantal equation:

$$|\lambda S_{kk} - S_{k0} S_{00}^{-1} S_{0k}| = 0 \quad (42)$$

where

$$S_{00} = T^{-1} \sum_{t=1}^{T} R_{kt} R'_{kt} \quad (43)$$

$$S_{ko}=T^{-1}\sum_{t=1}^{T} R_{ot}R'_{kt} \quad (44)$$

$$S_{kk}=T^{-1}\sum_{t=1}^{T} R_{ot}R'_{ot} \quad (45)$$

and $S_{k0} = S_{0k}'$.

Note that R_{0t} and R_{kt} are column vectors of residuals from the regressions described in steps 1 and 2.

The eigenvalues are denoted by the P × 1 column vector

$$\hat{\lambda}=(\hat{\lambda}_1,\ldots,\hat{\lambda}_p) \quad (46)$$

whereas

$$\hat{V}=(\hat{v}_1,\ldots,\hat{v}_n) \quad (47)$$

denotes the corresponding matrix of estimated eigenvectors. These are normalized such that:

$$\hat{V}'S_{kk}\hat{V}'=I \quad (48)$$

The r cointegrating vectors are given by the r most significant vectors, that is:

$$\beta=(\hat{v}_1,\ldots,\hat{v}_r) \quad (49)$$

and these form the basis of the tests for the null hypothesis of r cointegrating vectors.

To this end, there are at least two tests namely, the trace test and the maximal eigenvalue test. In the trace test, the null hypothesis is that the number of cointegrating vectors is r which is less than or equal to p, and is based on the following equation:

$$\Lambda_2(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1}) \quad (50)$$

T denotes the number of observations in the sample and ln is the natural logarithm operator.

The trace statistic tests the validity of the restrictions under which the maximum likelihood estimate of the cointegration vector is derived. It is based on the likelihood ratio test. It tests the null hypothesis that $r \leq p$.

The maximal eigenvalue test is based on the following formula:

$$\Lambda_1(r, p) = -T\sum_{i=r+1}^{p} \ln(1-\hat{\lambda}_i) \quad (51)$$

It tests the null hypothesis that $r = p$. Once cointegration is established, then an ECM can be constructed to represent the appropriate demand for money function.

In demand for money analysis, the vector Y_t may consist of such variables as of the log-levels of GDP (y), M1 (m_1), M2 (m_2) and v_1, the velocity of circulation of M1. If there exists some linear combination of the variables in Y_t, for example, $\beta' Y_{t0,}$ which is stationary, then cointegration exists. This would also imply that the combination $\beta' Y_t = 0$. We recall from the discussion in chapter 3, that the relationship depicted in this combination represents the long-run relationship among the time series. In the context of demand for money, we could, for instance, propose that the relation:

$$b_1 lnm_1 + b_2 lnv_1^{*} + b_3 lnp + b_4 lny = 0 \quad (52)$$

is stationary so that $(b_1, b_2, b_3, b_4)'$ is the cointegrating vector. Following Engle and Granger (1987), when cointegration exists as described above, then the relevant time series can be represented in an error correction vector autoregressive (VAR) form, thus:

$$A(L)\Delta Y_t = \alpha(\beta' Y_{t-1}) + \epsilon_t \quad (53)$$

A(L) is a matrix of lag polynomials and Δ is the first difference operator. α and β are matrices of appropriate orders and ϵ_t is a vector of i.i.d disturbances.

Thus, in this study, we pick those variables which are verified to be I(1) from the unit root tests described earlier. Then we use the Juselius and Johansen's test to determine if the variables are cointegrated. This is done by comparing the trace and the eigenvalue statistics with the corresponding critical values.

Table 14 presents the hypotheses to be tested for cointegration by using the procedure of Juselius and Johansen.

Table 14 Summary of Hypotheses and test statistics for the Johansen test for cointegration

Null hypotheses for the Trace Test	Test statistics
H_0: $r = 0$	Likelihood ratio
$r \leq 1$	
$r \leq 2$	
$r \leq p - 1$	
Null hypotheses for the Eigenvalue Test	**Test statistics**
H_0: $r = 0$	Maximal eigenvalue
H_1: $r = 1$	
or	
H_0: $r = 1$	
H_1: $r \geq 1 \leq p$	

Other hypotheses can also be set up for any pairs of r. The critical values for both the trace and eigenvalue tests were tabulated in Johansen and Juselius (1990, Tables A3 p-209).

If the null hypothesis cannot be rejected, this indicates that there is at least one cointegrating vector. If $r = 0$, this indicates that every possible linear combination in Π is non-stationary and therefore, there is no cointegration.

If $0 \leq r \leq p$, then there must exist some linear combinations which are stationary numbering between 1 and p. If r is less than p, there are r cointegrating vectors and (p-r) unit roots or nonstationary linear combinations. The quantity (p-r) is also referred to as " common trends." If r

determined by examining the significance of the sum of the coefficients in the regression of lagged changes in Y (X) on the change in X (Y). See Granger (1986), Engle and Granger (1987), and Miller and Russek (1990).

The exact specification of the error correction model in this study will depend on the results of cointegration tests since only those variables that are cointegrated can be involved in an ECM. However, for purposes of explaining the hypotheses to be tested in the context of an ECM, we borrow the general form of an ECM presented in Hendry, Pagan and Sargan (1985):

$$Y_t=\sum_{i=1}^{m_0} b_{0i}Y_{t-i}+\sum_{j=1}^{n}\sum_{i=1}^{m} b_{ji}Z_{j,-i}+e_t \quad (54)$$

where Y is an endogenous variable, Z_j are exogeneous variables in the sense of Engle, Hendry and Richard (1983), and e is a white noise error. In the case of a simple ARIMA model (1,1,1) of demand for money, we can consider Granger's ECM representation presented in chapter 3, namely

$$\Delta y_t=-\rho_2 Z_{t-1}+lagged(\Delta x_t,\Delta y_t)+d(B)\epsilon_{2t} \quad (55)$$

In the multivariate context of the Juselius and Johansen's procedure, the significance of the estimated parameters of the ECM are tested in similar fashion. The error correction mechanism in this case is actually represented by:

$$\Delta Y_t = c + \Phi D_t + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi Y_{t-k} + R_{ot} \quad (56)$$

4.4 Data

The study uses quarterly time series data for the period 1977.1 to 1991.4. Data sources include:

1. Various issues of International Financial Statistics, a publication of the International Monetary Fund.
2. Central bank publications (1975-1991) of the countries under study, namely, Bank of Malawi Statistical Bulletins; Bank of Zambia Economic Reports; and the Reserve Bank of Zimbabwe Quarterly Economic and Statistical Review.

Quarterly time series data were available for all the three countries included in this study except for GNP. Quarterly GNP data were interpolated from annual data using the method proposed by Diz (1970).

Shazam (Version 7.0) was used for the empirical implementation of the model used in this study.

CHAPTER 5

EMPIRICAL RESULTS

5.0 Introduction

This chapter reports the empirical results obtained from estimating and testing of the models presented in chapter 4. Accordingly, the econometric analysis consisted of the following procedures:

1. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were conducted on all relevant variables, both in levels and first and in some cases, on second differences in order to detect the presence of unit roots.
2. Results of the ADF and PP tests based on the residuals of the cointegrating regressions are presented for cases when $r \leq 1$.
3. Results of cointegration tests were reported in the multivariate case for $r > 1$. In particular, we report the results of tests based on the trace and eigenvalue statistics which were obtained from applying the Johansen procedure.
4. Depending on the outcomes of the unit roots and cointegration tests, appropriate error correction models of demand for both the narrow money and broad money were specified and estimated.
5. A battery of diagnostic tests were conducted in order to determine the appropriateness of the ECM. These tests included the Chow test for model stability, Jacque-Bera test

for normality of residuals, the Arch test for heteroscedasticity, and Ramsey's Reset test for model specification. For a description of these and other important diagnostic tests, see among others, Goldfeld and Quandt (1972), Harvey (1990), Godfrey, McAleer, and McKenzie (1988), Zarembka (1974), Breusch and Pagan (1979) and Pagan and Hall (1983).

5.1 Substantive Results: Malawi

5.1.1 Results of ADF unit root tests

Table 15 reports the results of the ADF tests on both the nominal and real variables and the modified t and F-statistics. Results indicated the presence of a unit root in the variables M1, MB, tb, br, v1, v2, and v3. The series Y, P and M2 did not show the presence of a unit root. Since the t-statistics were significant at the 10 percent level in all these cases, we concluded that the results suggest that most of the nominal variables were non-stationary. The finding of unit roots in the nominal velocity measures was significant in that it signalled that the velocity of circulation of M1, M2 and MB was not stable, at least according to the ADF unit root tests.

The ADF tests on real variables indicated the presence of a unit root in all variables rm1, ry, rm2, tb, br, rv1, rv2, and rv3. The t-ratio was significant at the 10 percent level for all of the series. It was also significant that velocity, even when measured in real terms, was found to be unstable since the null hypothesis of a unit root could not be rejected for rv1, rv2 and rv3.

On the basis of the ADF test on the level values of the nominal and real variables, we therefore concluded that the results were largely consistent with the recent theoretical arguments which contend that macroeconomic time series tend to be non-stationary. The failure to reject the null hypothesis of a unit root in all measures of velocity of circulation of money undermine a central tenet of classical and monetarist assumption that velocity is a fairly stable function.

TABLE 15

Unit Root Tests: Augmented Dickey-Fuller test on level series (Malawi)

Variable	Test Statistics			
	τ	ϕ_1	ϕ_2	ϕ_3
Nominal				
M1	0.604*	2.220	4.039	3.506
Y	2.448*	5.987*	7.156*	7.136*
M2	1.747*	6.679*	5.141*	2.418
MB	-8.300*	2.333	2.112	1.141
TB	-1.423*	1.026	1.071	1.601
BR	-2.266*	3.480	2.270	2.517
P	0.326*	5.342*	8.956*	6.349*
V1	-2.276*	2.595	3.429	3.638
V2	-2.094*	2.235	2.089	3.090
V3	-1.399*	1.084	1.273	1.803
Real				
rm1	-1.402*	1.023	1.803	2.660
ry	-1.244*	0.820	0.883	1.279
rm2	-2.430*	2.954	1.902	2.852
rmb	-2.571*	3.308	2.140	3.208
tb	-1.428*	1.026	1.071	1.600
br	-2.266*	3.480	2.270	2.517
rv1	-2.065*	2.131	1.768	2.652
rv2	-2.345*	2.757	1.820	2.725
rv3	-1.555*	1.490	1.620	2.141

Notes: Asterisk (*) means that the statistic is significant at the 10 percent level

It was necessary to carry out the ADF tests on the first-differences of those variables which were observed to be non-stationary. These tests enabled us to determine the order of integration of the various series.

Table 16 reports ADF test results on the first-differences of the series. In the case of the variables M1, Y, BR, we could not reject the null hypothesis of a unit root. But for the variables M2, MB, TB,P and V2, we rejected the null hypothesis of a unit root. Thus, we concluded that M2, MB, TB, P and V2 were I(1), since they became stationary after differencing once.

For those variables which were non-stationary even after first-differencing, we performed the ADF tests on their second-differences. These ADF tests on the second-differences of V1, V3, M1, Y and BR lead to a rejection of the null hypothesis of a unit root. So we concluded that these variables were I(2). Results of these tests were not reported as they were similar to the earlier ones.

With regard to the real variables, ADF tests on their first-differences show that we could reject the null hypothesis of a unit root for all the variables except for rv3. The ADF test on the second differences of rv3 led to the conclusion that the variable was I(2).

TABLE 16

Malawi: Augmented Dickey-Fuller unit root tests based on the first-differences of variables

Variable	Test Statistics			
	τ	ϕ_1	ϕ_2	ϕ_3
Nominal				
M1	-1.493*	1.271	1.130	1.539
Y	-0.637*	2.958	2.615	1.086
M2	-3.966	7.870	7.220*	10.823*
MB	-3.273	5.369	3.683	5.513
TB	-3.687	6.795*	5.300*	7.951*
BR	-2.109*	2.279	2.210	3.259
P	-3.022	4.672*	3.255	4.780
V1	-1.827*	1.679	1.080	1.611
V2	-4.358	9.501*	6.135*	9.198*
V3	-2.422*	3.180	3.363	4.780
Real				
rm1	-3.350	5.637*	3.797	5.669
ry	-2.460	3.031	2.549	3.817
rm2	-3.327	5.536*	3.602	5.402*
rmb	-3.051	4.772*	3.504	5.139*
rv1	-3.463	6.005*	3.928	5.883*
rv2	-4.131	8.533*	5.513*	8.267*
rv3	-1.823	2.205*	2.272	2.854

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.

5.1.2 Results of Phillips-Perron unit root tests

Due to the limitations of the ADF test mentioned earlier, the PP test was also performed on both the nominal and real variables, on levels and also on first, and where applicable, on second-differences. PP tests, in a number of cases, yielded different results from the ADF as expected. Results of this test are reported in Table 17.

Since the $Z(t\alpha)_1$ and the $Z(\tau_u)$ statistics were found to be statistically significant at the 10 percent level for the variables MB, TB and BR but were not in the case of M1, Y, M2, P, V1, V2 and V3. The results suggested that the former group of variables were not stationary whereas the latter group were stationary. Also, we could not accept the null hypothesis of a unit root in the case of rm1, rmb, rv1, rv2, but could not reject it in the case of ry, rm2, tb, br and rv3.

PP tests on the presence of a unit root in the velocity series, differed significantly from those of the ADF tests. The PP tests indicated that only rv3, the real velocity of circulation of rmb was unstable. The other measures were stable.

Further PP tests were applied on the first-differences of those variables which were determined to be non-stationary in levels.

TABLE 17

Malawi: Phillips-Perron unit root tests based on the levels of variables

Variable	Test Statistics				
	$Z(t\alpha)_1$	$Z(t\alpha)_2$	$Z(\tau\mu)$	$Z(\phi)_1$	$Z(\phi)_2$
Nominal					
M1	-1.221*	1.289	-3.793	5.296*	7.272*
Y	6.576*	0.652*	-0.765*	1.238*	29.666*
M2	-1.163	1.263	-4.361	6.862*	9.553*
MB	-1.941*	2.017	-2.856*	3.058	4.459
TB	-1.544	1.206	-1.156*	1.067	1.595
BR	-2.280	3.585	-1.651*	2.315	2.523
P	-0.485*	6.819*	-3.405	9.048*	6.277*
V1	-4.035	8.188*	-3.967	5.466*	8.197*
V2	-5.438	14.821*	-5.639	10.683*	15.996*
V3	-2.653	3.587	-2.399*	2.598	3.861
Real					
rm1	-3.859	7.488*	-3.971	5.356*	8.033*
ry	-2.187*	2.417	-2.249*	1.769	2.634
rm2	-4.329	9.398*	-4.279	6.138*	9.202*
rmb	-3.439	5.965*	-3.235	3.896	5.837*
rv1	-3.955	7.841*	-3.986	5.340*	8.009*
rv2	-5.499	15.138*	-5.495	10.087*	15.122*
rv3	1.885*	2.058	-1.388*	1.876	2.545

Notes: Asterisk (*) means that the statistic is significant at the 10 percent level.
$Z(t\alpha)_1$ denotes a t-ratio in the model with an intercept and no trend. $Z(t\alpha)_2$ is an F-statistic in the model with an intercept and no trend. $Z(\tau_\mu)$ is a t-ratio in the model with an intercept and trend and $Z(\phi)_1$ and $Z(\phi)_2$ are F-statistics in this model.

Table 18 reports the results of PP tests on the first-differences of both the nominal and real variables. With the exception of Y, we could not accept the null of a unit root. So we inferred that M1, M2, MB, TB, BR P, V1, V2, and V3 were I(0).

After applying PP tests to the second-differences of Y, we could not accept the null hypothesis of a unit root and therefore concluded that Y is I(2), since the series was differenced twice before stationarity was observed.

All real variables except rv3 were found to be I(1) and rv3 was I(2), i.e., we could not accept the null hypothesis of a unit root in the case of most of the first differenced real variable series.

Table 19 presents a summary of the order of integration established by the ADF and PP tests. There is a discrepancy between the results, and this is expected. This seems consistent with theoretical arguments presented earlier that the ADF test tends to reject the null hypothesis of a unit root less often than the PP test. We chose to rely on the PP test for subsequent tests for cointegration between the variables, again for the reasons presented in chapters 3 and 4, that the PP test uses modified statistics to handle "outlier" or exogenous events.

This does not necessarily make our ADF tests redundant. Many studies on demand for money seem to rely on these tests and by applying these tests alongside the PP tests, we demonstrate the need for a careful review of estimation procedure in constructing error correction models of demand for money.

From Table 19, the ADF test shows only Y, M2 and P to be stationary in levels, or I(0). In addition, most of the variables tested were I(1), and M1, BR, V3 and rv3 were I(2).

The PP test on the other hand, showed more variables to be stationary: M1, M2, P, V1, V2, V3, rmb, rv1, rv2. But MB, tb, ry, rmb were found to be I(1) and y and rv3 were I(2).

We used these results to form pairs of variables to test for cointegration. Engle and Granger (1987) suggest that the variables used for this test must be both I(1). Thus, from Table 19, we selected only those variables which were I(1) as the basis for the PP test on the residuals of the cointegrating regressions.

TABLE 18

Malawi: Phillips-Perron unit root tests based on the first-differences of variables

Variable	Test Statistics				
	$Z(t\alpha)_1$	$Z(t\alpha)_2$	$Z(\tau\mu)$	$Z(\phi)_1$	$Z(\phi)_2$
Nominal					
M1	-4.892	12.068	-4.799*	7.833*	11.687*
Y	-1.742*	1.619	-2.167*	1.909	2.782
M2	-6.297*	19.802	-6.182	12.772*	19.040*
MB	-4.798	11.606*	-4.792*	7.807*	11.648*
TB	-4.784	11.445*	-4.992	8.308*	12.463*
BR	-6.028	18.166*	-6.410	13.683*	20.525*
P	-6.985	24.416*	-7.025	16.477*	24.694*
V1	-4.035	8.188*	-3.967	5.466	8.197
V2	-5.438*	14.821	-5.639	10.683*	15.996*
V3	-2.653	3.587	-2.400*	2.598	3.861
Real					
rm1	-5.782	16.185*	-5.693	10.844*	16.185*
ry	-6.124	18.757*	-6.065	12.270*	18.404*
rm2	-7.042	24.745*	-6.928	15.982	23.965*
rmb	-5.051	12.864*	-5.067	8.655*	12.894*
rv1	7.001	24.482*	-6.889	15.777*	23.619*
rv2	-8.413	35.277*	-8.278	22.749*	34.118*
rv3	-2.098*	2.726	-2.283*	2.637	3.429

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.

TABLE 19

Malawi: Order of integration of time series

Variable	Order of integration	
	ADF	**PP**
Nominal		
M1	I(2)	I(0)
Y	I(0)	I(2)
M2	I(0)	I(0)
MB	I(1)	I(1)
TB	I(1)	I(1)
BR	I(2)	I(1)
P	I(0)	I(0)
V1	I(2)	I(0)
V2	I(1)	I(0)
V3	I(2)	I(0)
Real		
rm1	I(1)	I(0)
ry	I(1)	I(1)
rm2	I(1)	I(1)
rmb	I(1)	I(0)
rv1	I(1)	I(0)
rv2	I(1)	I(0)
rv3	I(2)	I(2)

5.1.3 Cointegration tests

Bivariate cointegration regression results (based on Phillips-Perron tests)

Table 20 reports the results of the PP tests on the residuals of bivariate cointegration regressions of variables which were I(1) as selected from Table 19. The argument as pointed out in chapter 3 is that even if series may be nonstationary by themselves, I(1), some linear combination of them may be stationary, which would suggest that in the long run, the series move to some equilibrium. We tested the null hypothesis of non-stationarity by determining if the modified t-statistic, $Z(t\alpha)_1$ was significant at the 10 percent level. If the null hypothesis of non-stationarity could not be rejected, then it was concluded that the variables were not cointegrated. Following Engle and Granger (1987), we also report the R^2 and D.W. statistics as a high R^2 and a low value for the D.W. statistic indicate evidence of cointegration.

We found no evidence of cointegration between tb and br and between mb and br. In both cases, the $Z(t\alpha)_1$ statistic was significant at the 10 percent level so that the null hypothesis of non-stationarity could not be rejected. Furthermore, the R^2 values of 0.2177 and 0.3931 respectively, were low.

There was evidence of cointegration between rm2 and ry; rm2 and tb; rm2 and tb; and between ry and tb. In all these cases, the $Z(t\alpha)_1$ statistics were not significant at the 10 percent level so that we could not accept the null hypothesis of non-stationarity.

TABLE 20

Malawi: Phillips-Perron Tests on residuals of bivariate cointegrating regressions

Variable pair	Test statistics		
	$Z(\alpha)$	R^2	D.W
(tb, br)	-1.495*	0.218	0.273
(mb, br)	-2.387*	0.393	0.501
(rm2, ry)	-5.284	0.403	1.781
(rm2, tb)	-4.481	0.216	1.444
(rm2, br)	-4.591	0.542	1.476
(ry, tb)	-2.496	0.101	0.563

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.
The $Z(\alpha)$ statistic relates to the model with no intercept and no trend.

5.1.4 Multivariate cointegration tests

Table 21 reports the results of the Johansen procedure to test for the existence of multivariate cointegrating vectors.

We selected groups of I(1) variables from the PP test and applied the Johansen procedure. The procedure enabled us to derive the trace and the maximal eigenvalue test statistics.

With regard to the variables rm2, ry, tb and br, the likelihood ratio statistic (LR) for the trace test was significant for r = 0 (56.3900 against a critical value of 49.9250). The statistics for all other values of r were not significant. The maximal eigenvalue test showed the test statistic (λ) r = 1 to be significant. The null hypothesis of r = 1 was rejected in favour of r = 2. We could therefore conclude that there were at least two cointegrating vectors formed by these variables.

For the set of variables rm2, ry and tb, the trace test showed r = 0 to be insignificant but the maximal eigenvalue test statistic showed r = 0 to be significant. The null hypothesis of r = 0 was rejected in favour of r = 1. We therefore concluded that there was at most one cointegrating vector formed by the variables.

Finally, with respect to mb, tb and br, the trace test showed r = 0 to be significant and the maximal eigenvalue test showed that r = 0 and r = 1 were significant.

TABLE 21

Malawi: Multivariate cointegration tests based on the Johansen procedure

Variables: (rm2, ry, tb, br)

	Trace test			Maximal Eigenvalue test	
H_0	LR	crit.val	H_0	λ_{max}	crit.val
r=0	56.390*	49.925	r=0	27.493*	25.611
r≤1	31.646*	32.093	r=1	23.467*	19.796
r≤2	10.526	17.957	r=2	8.056	13.781
r≤3	3.276	7.563	r=3	3.640	7.563

Variables: (rm2, ry, br)

	Trace test			Maximal Eigenvalue test	
H_0	LR	crit.val	H_0	λ_{max}	crit.val
r=0	27.787	32.093	r=0	22.194*	19.796
r≤1	7.813	17.957	r=1	6.489	13.781
r≤2	1.973	7.563	r=2	2.190	7.563

Variables (mb, tb, br)

	Trace test			Maximal Eigenvalue test	
H_0	LR	crit.val	H_0	λ_{max}	crit.val
r=0	34.694*	32.093	r=0	20.356*	19.796
r≤1	16.374	17.957	r=1	15.756*	13.781
r≤2	2.193	7.563	r=2	2.473	7.563

Notes:
Asterisk (*) indicates that the statistic is significant at the 10 percent level.
LR = likelihood ratio statistic

The null hypothesis of r = 2 could not be rejected. We therefore concluded that there were at most two cointegrating vectors.

5.1.5 An error correction model of demand for money

Tables 22 and 23 show the results of estimating an error correction model of demand for the narrow money and broad money. Following the observation that there was a cointegrating relationship among the real variables, the ECM was specified in terms of real variables and mostly in first differences.

The results indicated that the change in the demand for real narrow money in Malawi was significantly determined by changes in real income and also by lagged values of the changes in real money. The estimated coefficient on the change in income had a positive sign as expected and the t-ratio was highly significant at the 10 percent level. The treasury bill and bond rates had the expected negative signs but were insignificant. The ECM for narrow money had a good fit as indicated by a number of diagnostic tests. The adjusted R^2 was 0.8822, which is quite high.

Table 23 indicates that changes in income and the lagged value of the change in real broad money were the most significant factors in explaining changes in real M2 i.e., rm2. The error correction term, EC_{t-1}, was also significant and had the right sign (-). This would suggest that changes in demand for money are significantly influenced by the discrepancy between target and actual values of demand for money. The interest rate variables had the correct signs but were insignificant. The ECM for changes in real M2 satisfied a number of diagnostic tests. The adjusted R^2 was 0.8719, which is quite high.

Chow tests for model stability were carried out. There was no evidence of a structural break in the case of broad money. However, for narrow money, four observations had an F statistic larger than the critical value F_c (11, 20) of 1.38. This provided evidence of a structural break, suggesting that the demand for narrow money was not a stable function.

TABLE 22

Malawi: An error correction model of demand for M1

$\Delta rm1_t$	=	$0.5604\Delta rm1_{t-1}$ (0.0751)	-	$0.1425\Delta rm1_{t-2}$ (0.1037)	+	$0.1891\Delta rm1_{t-3}$ (0.0648)
	+	$0.9306\Delta ry$ (0.2331)	-	$0.3855\Delta ry_{t-1}$ (0.1767)	-	$0.0091\Delta tb$ (0.0145)
	-	$0.1082\Delta br$ (0.0674)	-	$0.6263EC_{t-1}$ (0.1777)		

$\bar{R}^2$ = 0.8822
D.W = 1.7933
Akaike's FPE = 0.0046
Jacque Bera LM test $\chi_2(2)$ =0.6352
RESET (4) F[3,28] = 0.5456

Figures in parenthesis are standard errors.

TABLE 23

Malawi: An error correction model of demand for M2

$$\Delta rm2_t = \underset{(0.1535)}{0.0922} + \underset{(0.1037)}{0.4911\Delta rm2_{t-1}} + \underset{(0.0648)}{0.0675rm2_t}$$

$$+ \underset{(0.2453)}{1.1014\Delta ry_t} - \underset{(0.1848)}{0.4967\Delta ry_{t-1}} - \underset{(0.0153)}{0.0209\Delta tb_t}$$

$$- \underset{(0.0745)}{0.1084\Delta br_t} - \underset{(0.1397)}{0.8897EC_{t-1}}$$

$\bar{R}^2 = 0.8719$
D.W = 1.8561

Akaike's FPE = 0.0055
Jacque Bera LM test χ^2 (2) = 2.4647
RESET(1) [1, 33] = 1.0445
Glejser test χ^2(7) = 1.403
Harvey χ^2(7) = 1.010
ARCH χ^2 (1) = 0.0025

Figures in parenthesis are standard errors.

5.2 Substantive Results: Zambia

5.2.1 Results of ADF unit root tests

Table 24 reports the results of ADF tests on both the nominal and real variables related to Zambia. Results showed that the null hypothesis of a unit root could not be rejected for Y, TB, V1, V2 and V3 and could not be accepted for M1, M2, MB and P. Furthermore, we could not reject the null hypothesis of a unit root in all real variables except rv3.

As was the case for Malawi, we observed that the ADF tests suggested some evidence of unit roots in all nominal velocity measures and two real velocity measures.

TABLE 24

Zambia: Augmented Dickey-Fuller unit root tests based on the levels of variables

Variable	Test Statistics			
	τ	ϕ_1	ϕ_2	ϕ_3
Nominal				
M1	6.338*	20.541*	13.811*	20.263*
Y	1.299*	1.275	1.662	2.042
M2	5.299*	13.778*	9.428*	14.041*
MB	4.284*	10.624*	6.979*	9.056*
TB	-0.269*	1.431	2.022	1.554
P	4.040	8.378*	5.453*	7.967*
V1	0.277*	2.025	2.880	2.124
V2	-1.587*	1.535	2.670	3.700
V3	-2.300*	2.667	1.760	2.607
Real				
rm1	-1.159*	1.269	1.676	1.888
ry	-2.142*	2.399	1.616	2.323
rm2	-2.179*	2.572	2.424	3.433
rmb	-2.060*	2.227	1.444	2.065
rv1	-1.376*	1.308	2.297	3.052
rv2	-1.362*	1.315	1.555	1.935
rv3	-2.680	3.600	2.346	3.510

Notes: Asterisk (*) indicates that the statistic is significant at 10 percent level.

Given that most of the variables were found to be non-stationary, we performed the ADF unit root tests on the first-differences of the variables.

Table 25 reports the results of the ADF tests on the first-differences of nominal and real variables. The null hypothesis of a unit root could not be rejected in the case of M1, Y, M2, MB, P, and rv2. However, the null of a unit root could not be accepted for TB, v1, v2,v3, rv1, rv3, rm1, ry, rm2, and rmb.

Results suggested that TB, v1, v2, v3, rm1, ry, rm2, rmb, rv1, and rv3 were I(1).

ADF tests on those variables still non-stationary after differencing once, showed that M, Y, M2, MB, rv2 were I(2).

TABLE 25

Zambia: Augmented Dickey-Fuller unit root tests based on the first-differences of variables

Variable	Test Statistics			
	τ	ϕ_1	ϕ_2	ϕ_3
Nominal				
M1	0.517*	0.968	2.181	2.341
Y	2.487*	3.501	3.075	4.189
M2	0.103*	0.585	1.949	2.281
MB	0.461*	0.788	1.749	1.887
TB	-2.875	4.133*	2.797*	4.195
P	1.125*	1.647	1.948	1.862
V1	-4.014	8.076*	5.749	8.604
V2	-4.226*	8.940*	5.755*	8.623
V3	-3.078*	4.748*	3.083	4.616
Real				
rm1	-3.099	4.803	3.090	4.634
ry	-3.590*	6.445*	4.145*	6.217*
rm2	-2.889	4.174*	2.685	4.026
rmb	-3.122	4.875*	3.129	4.694
rv1	1.376*	1.308	2.297	3.052
rv2	-1.362*	1.315	1.556	1.935
rv3	-2.680	3.600	2.346	3.510

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.

5.2.2 Results of Phillips-Perron unit root tests

Table 26 reports the results of the PP tests on the levels of the variables. The null hypothesis of a unit root could not be accepted for M1, Y, M2, MB, P, V2, ry, rmb, rv3 and could not reject it for TB, V1, V3, rm1, rm2, tb, rv1 and rv2.

We also noted the significant result that according to the PP tests, there was no evidence of a unit root in all the velocity measures except rv3, a result which would suggest narrow and broad money velocity of circulation were stable but that velocity of circulation of the monetary base was not.

Table 27 reports the results of the PP tests on the first-differences of the variables. Results indicated that all real variables were I(1). Among the nominal variables, M1, M2, MB, TB were determined to be I(2).

After all the ADF and PP tests were conducted, we summarized the order of integration for all variables. These are reported in Table 28. The ADF indicated that M1, M2, MB, P and rv3 were I(0), Y was I(2), and that the rest were I(1). The PP-test results in some cases contradicted the conclusions derived from the ADF tests. The PP-tests indicated more variables to be stationary than the ADF tests. It indicated 9 out of the 19 variables were I(0), 2 were I(2). V1, V3, rm1, rm2, TB, rv1 and rv2 were I(1).

On the basis of the results, we selected those variables which were I(1) and performed cointegration tests. From the results, we could not find more than 2 variables which form a cointegration regression that would be consistent with money demand theory. For example, although rm1, rm2, and TB were all I(1) according to both tests, theoretically we could only pair up rm1 and TB or rm2 with TB. We could not include both rm1 and rm2 in a cointegrating regression with TB.

TABLE 26

Zambia: Phillips-Perron unit root tests based on levels of variables

Variable	Test Statistics				
	$Z(t\alpha)_1$	$Z(t\alpha)_2$	$Z(\tau\mu)$	$Z(\phi)_1$	$Z(\phi)_2$
Nominal					
M1	6.225*	29.782*	3.710	20.531*	20.158*
Y	34.862*	96.001*	19.014*	70.167*	67.067*
M2	6.616	32.277	4.182	22.140	22.723
MB	6.752*	34.405*	3.851*	22.700*	22.606*
TB	-0.366*	1.318	-1.751*	2.037	1.784
P	9.847	69.847*	5.861	45.292*	47.198*
V1	0.851*	1.024	-2.500*	2.579	3.159
V2	-2.244*	2.606	-3.844	5.001*	7.377*
V3	-2.716*	3.720	-2.678*	2.433	3.649
Real					
rm1	-1.986*	2.235	-2.803*	2.816*	3.967*
ry	-2.865	4.198*	-2.882*	2.839	4.194
rm2	-2.105*	2.421	-2.582*	2.361	3.331
rmb	-2.777	3.924	-2.772*	2.619	3.895
rv1	-4.847	-1.428*	-2.637*	2.576	1.875
rv2	-1.893*	1.978	-2.787	2.699	3.383
rv3	-3.038	4.660	-3.001	3.054	4.577

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.

TABLE 27

Zambia: Phillips-Perron unit root tests based on first-differences of variables

Variable	Test Statistics				
	$Z(t\alpha)_1$	$Z(t\alpha)_2$	$Z(\tau\mu)$	$Z(\phi)_1$	$Z(\phi)_2$
Nominal					
M1	-0.717*	0.737	-2.122*	2.441	3.163
Y	4.621*	18.241*	1.894*	11.882*	10.482*
M2	0.305*	0.653	-1.589*	2.116	2.557*
MB	-0.678*	0.693	-2.556*	3.108	4.162
TB	-9.353	43.604*	-9.205	28.110*	42.163*
P	-7.946	31.863	-8.424	24.526	36.391
V1	-5.248	13.846	-5.163	8.998	13.434
V2	-8.889	39.453	-8.736	25.446	38.137
V3	-4.777	11.430	-4.706	7.419	11.121
Real					
rm1	-5.524	15.263*	-5.442	9.885*	14.823
ry	-5.470	14.959*	-5.382	9.676*	14.514*
rm2	-7.153	25.601*	-7.045	16.563*	24.839*
rmb	-4.924	12.135*	-4.850	7.852*	11.777*
rv1	-5.272	13.912*	-5.203	9.039*	13.553*
rv2	-8.683	37.716*	-8.546	24.380*	36.552*
rv3	-4.716	11.153*	-4.650	7.241*	10.862*

Notes: Asterisk (*) indicates that the statistic is significant at 10 percent level.

TABLE 28

Zambia: Order of integration of time series

Variable	Order of integration	
	ADF	PP
Nominal		
M1	I(0)	I(2)
Y	I(2)	I(0)
M2	I(0)	I(0)
MB	I(0)	I(0)
TB	I(1)	I(2)
BR	-	I(1)
P	I(0)	I(0)
V1	I(1)	I(1)
V2	I(1)	I(0)
V3	I(1)	I(1)
Real		
rm1	I(1)	I(1)
ry	I(1)	I(0)
rm2	I(1)	I(1)
rmb	I(1)	I(0)
rv1	I(1)	I(1)
rv2	I(1)	I(1)
rv3	I(0)	I(0)

Thus, in the case of Zambia, we conducted bivariate cointegration tests. We did not carry out the Johansen procedure since there was no case for multivariate cointegration relationships among the variables.

5.2.3 Cointegration tests:

Bivariate cointegration regression tests

Table 29 reports the results of bivariate cointegration regressions for Zambia. Phillips-Perron tests were applied to the residuals of the cointegration regressions to determine if they were stationary.

The null hypothesis of a unit root was rejected in the case of the combination rm2 and TB because the τ-statistic was insignificant at the 10 percent level even though the R^2 of 0.607 was fairly high and the D.W. of 0.937 was quite low.

We concluded that rm2 and TB were cointegrated. We also rejected the null hypothesis of a unit root for the combination rm1 and TB since the τ-statistic was insignificant. We therefore concluded that the two variables were cointegrated.

The cointegration results suggested that one could construct an error correction model of demand for both narrow money and broad money with only one explanatory variable, namely TB, the treasury bill rate. Theoretically and practically this would be unsatisfactory as it presents serious problems of misspecification. See Green (1994) on specification errors.

A traditional estimation of demand for both narrow and broad money was attempted, in an effort to demonstrate the limitations of the conventional approach when there is evidence of non-stationarity in most of the series.

Given that some of the variables were nonstationary, an OLS model based on first-differences appeared to be a second-best option.

TABLE 29

Zambia: Phillips-Perron tests on the residuals of bivariate cointegration regressions

Variable pair	Test Results		
	$Z(\alpha)$	R^2	D.W
(rm2, tb)	-3.289	0.607	0.937
(rm1, tb)	-3.630	0.7244	1.024

The $Z(\alpha)$ results relate to the model with no intercept and no trend

5.2.4 OLS estimation of demand for money in Zambia

Results of this estimation are presented in Table 30 and 31.

OLS estimation of demand for narrow money was based on first-differences even though the variables were not cointegrated. This was simply because this turned out to have the best fit. The explanatory power of the model was quite high as reflected in a high adjusted-R^2 of 0.901. The model also satisfied a number of diagnostic tests. The estimated coefficients had the expected signs. Δry had a positive coefficient (1.042) and the t-ratio was significant at all levels of significance.

Although changes in real income explained most of the changes in narrow money, the estimated coefficient for the treasury bill rate was negative and insignificant, one can not rely on these results given the nonstationarity of the series, these could well be spurious results.

Results of conventional OLS estimation of M2 were not satisfactory even though we experimented with a variety of specifications.

Although the model had a high adjusted-R^2 and the estimated coefficients were of the right sign, and had at least one significant coefficient (income), the model failed to satisfy a number of diagnostic tests. The most notable was the high Jacque-Bera statistic (90.127), an indication of non-normality of the residuals. This violates one of the key assumptions and greatly reduces the usefulness of the model for making valid inferences.

Autocorrelation was another problem and efforts to correct for it were fruitless. For example, the model was also estimated in first difference form but we got a worse reading for the Jacque-Bera statistic.

Since cointegration results suggested that one could not construct an error-correction model, the application of a conventional model was equally invalid due to the findings of nonstationarity in the series.

The author had no answers for this dilemma. This may demonstrate the need for another model to capture the underlying the processes in the determination of demand for money in the Zambian case.

TABLE 30

Zambia: Results of OLS estimation of demand for M1

$$\Delta rm1_t = \underset{(0.0129)}{0.0163} + \underset{(0.0639)}{1.0426\Delta ry_t} - \underset{(0.0051)}{0.0071\Delta tb_t} + e_t$$

$\bar{R}^2 = 0.9011$
D.W = 2.0565
RESET(4) F[3, 36] = 1.0456
Jacque-Bera LM test $\chi^2(2) = 1.0542$
ARCH $\chi^2(1) = 0.0150$
Harvey $\chi^2(2) = 1.1480$
Glejser $\chi^2(2) = 1.706$

Figures in parenthesis are standard errors

TABLE 31

Zambia: Results of OLS estimation of demand for M2

$$rm2_t = \underset{(0.5405)}{-0.7859} + \underset{(0.1145)}{0.9229ry_t} - \underset{(0.0024)}{0.0181tb_t} + e_t$$

$\bar{R}^2 = 0.8981$
D.W = 1.0289
RESET(4) F[3, 36] = -1.7333
Jacque-Bera LM test $\chi^2(2) = 90.1272$
ARCH $\chi^2(1) = 0.0280$

Figures in parentheses are standard errors.

5.3 Substantive Results: Zimbabwe

5.3.1 Results of ADF unit root tests

Table 32 reports the results of the ADF tests on the levels of the variables. We rejected the null hypothesis of a unit root in the case of the nominal variables M1, Y, M2, MB, BR, V1, V2 and V3 and concluded that these variables were stationary. But we could not reject it in the case of BR and P. This was because the t-ratio was significant at the 10 percent level. We concluded that these two nominal variables were non-stationary.

We rejected the null hypothesis of a unit root for all real variables since the t-ratio was insignificant at the 10 percent level. We concluded that all real variables exhibited non-stationarity. Among other things, we observed that according to the ADF tests for unit roots, all real velocity measures were non-stationary, which would suggest instability.

Table 33 presents the results of the ADF tests on the first-differences of the series. The variables Y, MB, rm1, rv1 were found to be non-stationary in the first-difference and this was indicated by the significance of the t ratio at the 10 percent level. However, they were stationary in second-differences. All other nominal and real variables were stationary after the first-differencing.

TABLE 32

Zimbabwe: Augmented Dickey-Fuller unit root tests based on the levels of variables

Variable	Test Statistics			
	τ	ϕ_1	ϕ_2	ϕ_3
Nominal				
M1	3.415*	7.399*	5.010*	5.976*
Y	4.239*	9.515*	7.075*	10.068*
M2	3.661*	20.158*	15.872*	9.145*
MB	2.642*	3.999*	3.065	4.086
TB	-0.807*	-2.570	1.268	1.702
BR	1.724*	5.058*	4.140*	2.532
P	-1.436*	1.573	1.466	1.655
V1	-2.728	3.960	4.009	5.734
V2	-3.284	5.932*	5.321*	7.407*
V3	-1.945*	2.056	4.071*	5.906*
Real				
rm1	-1.743*	1.521	1.930	2.894
ry	-1.471*	1.087	1.168	1.747
rm2	-1.812*	1.680	1.398	2.058
rmb	-1.475*	1.091	1.653	2.474
tb	-0.807*	-2.570	1.268	1.702
br	1.724*	5.058*	4.140	2.532
rv1	-2.022*	2.051	2.123	3.187
rv2	-2.341*	2.938	1.935	2.709
rv3	-1.650*	1.363	1.495	2.242

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.

TABLE 33

Zimbabwe: Augmented Dickey-Fuller tests based on the first-differences of variables

Variable	Test Statistics			
	τ	ϕ_1	ϕ_2	ϕ_3
Nominal				
M1	-2.611	3.589	5.915*	8.645*
Y	0.603*	1.184	2.206	2.204
M2	-3.493	6.123*	10.183*	15.243*
MB	0.882*	1.026	-1.827	1.633
TB	-3.094	4.794	3.182	4.767
BR	-2.879	4.143	3.449	5.173
P	-3.040	4.627	2.981	4.466
V1	-5.319	14.147	9.331*	13.996*
V2	-4.093	8.394*	6.103*	9.134*
V3	-3.942	7.769*	5.106*	7.658*
Real				
rm1	-2.468*	3.055	2.115	3.164
ry	-3.004	4.512*	3.174	4.761
rm2	-2.869	4.116*	2.709	4.063
rmb	-3.181	5.063	3.548	5.318
rv1	-2.428*	2.954	2.007	3.004
rv2	-3.162	5.004*	3.222	4.828
rv3	-3.207	5.144*	3.503	5.252

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.

5.3.2 Phillips-Perron Tests

Phillips and Perron test results on the levels of the variables are shown in Table 34. We could not reject the null hypothesis of a unit root in the case of all variables except V1, V2, and V3 as shown by the significant $Z(t\alpha)_1$ ratios. Clearly, in sharp contrast to the ADF tests, the PP tests indicate that all nominal velocity measures were stationary.

All real variables were found to be non-stationary as indicated by significant the relevant statistics.

Table 35 reports the results of the PP tests on the first-differences of the variables. Except for Y, we could not accept the null hypothesis of a unit root for all nominal and real variables. We concluded that these variables were stationary.

TABLE 34

Zimbabwe: Phillips-Perron tests based on the levels of the variables

Variable	Test Statistics				
	$Z(t\alpha)_1$	$Z(t\alpha)_2$	$Z(\tau\mu)$	$Z(\phi)_1$	$Z(\phi)_2$
Nominal					
M1	1.605*	4.388	-1.212*	4.077*	3.166
Y	8.748*	10.507	4.129	75.122	41.532
M2	0.203*	2.302	-2.609	4.179*	3.886
MB	3.289*	14.284	0.153*	9.012*	5.450
TB	-1.473*	1.155	-2.246*	1.866	2.732
BR	1.552*	4.397	-0.347*	3.639	2.253
P	-1.490*	1.616	-1.912*	1.554	1.843
V1	-5.060	2.914*	-5.570	10.791*	16.121
V2	-3.291	5.952*	-3.871	5.452	7.622
V3	-3.416	5.863*	-4.753	7.816*	11.724
Real					
rm1	-1.807*	1.640	-2.121*	1.950	2.923
ry	-1.570*	1.741	-1.741	1.234	1.848
rm2	-1.860	1.772	-1.938	1.433	2.113
rmb	-1.570*	1.243	-1.967	1.691	2.532
rv1	-2.086*	2.189	-2.324*	2.165	3.242
rv2	-2.332*	2.919	-2.295*	1.914	2.674
rv3	-1.782*	1.600	-2.006*	1.597	2.395

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.

TABLE 35

Zimbabwe: Phillips-Perron tests based on the first-differences of the variables

Variable	Test Statistisc				
	$Z(t\alpha)_1$	$Z(t\alpha)_2$	$Z(\tau\mu)$	$Z(\phi)_1$	$Z(\phi)_2$
Nominal					
M1	-6.069	18.400*	-6.889	16.069*	24.092*
Y	0.642*	1.003*	-1.449*	2.759	3.227
M2	-7.144	25.522*	-7.661	20.205*	30.102*
MB	-5.580	15.564*	-7.117	16.962*	25.443*
TB	-5.713	16.340*	-5.740	11.012*	16.511*
BR	-4.368	9.522*	-4.814	7.744*	11.616*
P	-5.478	15.008*	-5.394	9.704*	14.554*
V1	-6.504	21.121*	-6.304	13.685*	20.517*
V2	-6.022	18.139*	-5.825	12.297*	17.966*
V3	-6.551	21.402*	-6.406	13.896*	20.840*
Real					
rm1	-5.777	16.690*	-5.781	11.247*	16.867*
ry	-5.305	14.073*	-5.328	9.462*	14.193*
rm2	-5.607	15.725*	-5.542	10.332*	15.494*
rmb	-5.430	14.747*	-5.463	9.991*	14.986*
rv1	-5.918	17.511	-5.886	11.657*	17.482*
rv2	-6.152	18.927	-5.982	12.236*	18.331*
rv3	-5.170	13.376	-5.159	8.904	13.355

Asterisk (*) indicates that the statistic is significant at the 10 percent level.

The order of integration determined by the two methods of testing for unit roots are given in Table 36. For reasons already explained, we noticed a discrepancy between the two and we chose to rely on the results of the PP test. According to this method, M1. M2, MB, TB, V1, V2, and V3 were I(0). BR and P were I(1) and Y was I(2). All real variables were determined to be I(1).

In contrast to the ADF tests, the results of the PP test suggested that all nominal velocity measures are stationary, from which we could infer stability. However, the PP test also showed that real velocity measures to be non-stationary.

5.3.3 Cointegration tests:

Bivariate cointegration tests

On the basis of the I(1) variables, we performed bivariate cointegrating regressions based on the PP test to determine the existence of cointegration vectors. The results of these tests are presented in Table 37. We rejected the null hypothesis of a unit root in the case of the combinations rm1 and ry; rm1 and TB; rm2 and ry; rm2 and TB. This was evidenced by the fact that the τ-statistic was insignificant at the 10 percent level. This suggested that these variable pairs were cointegrated. However, we could not reject the null hypothesis of non-stationarity in the case of the combinations rm1 and br, rm2 and br, and rmb and ry. This was because the relevant statistics were significant at the 10 percent level. We therefore concluded that these pairs of variable were not cointegrated.

Since there were many variables which were determined to be I(1), (Table 36), we decided to test for the existence of multivariate cointegration vectors in the series. As in the case of Malawi, we followed the Johansen procedure to determine the number of cointegrating vectors, the results of which are presented in Table 38.

TABLE 36

Zimbabwe: Order of integration of time series

Variable	Order of integration	
	ADF	PP
Nominal		
M1	I(0)	I(0)
Y	I(0)	I(2)
M2	I(0)	I(0)
MB	I(0)	I(0)
TB	I(1)	I(0)
BR	I(0)	I(1)
P	I(1)	I(1)
V1	I(0)	I(0)
V2	I(0)	I(0)
V3	I(0)	I(0)
Real		
rm1	I(0)	I(1)
ry	I(1)	I(1)
rm2	I(1)	I(1)
rmb	I(1)	I(1)
rv1	I(2)	I(1)
rv2	I(1)	I(1)
rv3	I(1)	I(1)

TABLE 37

Zimbabwe: Phillips-Perron tests on the residuals of bivariate cointegration regressions

Variable pair	Test results		
	Z(α)	R^2	D.W
(rm1, ry)	-5.307	0.957	1.352
(rm1, tb)	-4.321	0.636	1.175
(rm1, br)	-2.268	0.108	0.344
(rm2, ry)	-3.721*	0.955	1.038
(rm2, tb)	-3.554	0.555	0.958
(rm2, br)	-1.983	0.231*	0.299
(rmb, ry)	-2.125	0.148*	0.327

Notes: Asterisk (*) indicates that the statistic is significant at the 10 percent level.
The Z(α) statistics relate to the model with no intercept and no trend.

TABLE 38

Zimbabwe: Multivariate cointegration tests based on the Johansen procedure

Variables: (rm1, ry, tb , br)

Trace test			Maximal Eigenvalue test		
H_0	LR	crit.val	H_0	λ_{max}	crit.val
r=0	61.235*	49.925	r=0	30.278*	25.611
r≤1	33.984*	32.093	r=1	22.664*	19.796
r≤2	13.587	17.957	r=2	10.828	13.781
r≤3	3.841	7.563	r=3	4.268	7.563

Variables: (rm2, ry, tb, br)

Trace test			Maximal Eigenvalue test		
H_0	LR	crit.val	H_0	λ_{max}	crit.val
r=0	64.088*	49.925	r=0	40.293*	25.611
r≤1	27.824	32.093	r=1	18.364	19.796
r≤2	11.297	17.957	r=2	10.856	13.781
r≤3	1.526	7.563	r=3	1.695	7.063

Variables: (rmb, ry, tb, br)

Trace test			Maximal Eigenvalue test		
H_0	LR	crit.val	H_0	λ_{max}	crit.val
r=0	75.192*	49.925	r=0	47.963*	25.611
r≤1	32.024	32.093	r=1	21.721*	19.796
r≤2	12.475	17.757	r=2	12.964	13.781
r≤3	0.807	7.563	r=3	0.896	7.563

5.3.4 Multivariate cointegration tests

Table 38 reports the results of the trace and maximal eigenvalue tests obtained by executing the Johansen procedure. The tests were based on VAR of variables determined to be I(1) by the PP test. The table reports results with respect to three groups of variables.

1. rm1, ry, tb, br

The LR statistic was significant for $r = 0$ and $r \leq 1$. The null hypothesis of $r \leq 2$ could not be rejected. So we infered that there were at most two cointegrating vectors. The maximal eigenvalue test indicated the λ_{max} to be significant for the null hypotheses $r = 0$ and $r = 1$. However, it could not reject the null hypothesis that $r = 2$. We therefore concluded that there were at most 2 cointegrating vectors.

2. rm2, ry, tb, br

Both test statistics indicated that we could not reject the null hypothesis that there was at most one cointegrating vector.

3. rmb, ry, tb and br

Using the trace test, the null hypothesis of $r = 0$ could not be accepted in favour of $r \leq 1$. The eigenvalue test could not accept the null hypothesis of $r = 0$, $r = 1$ but it could not reject the null hypothesis of $r = 2$. This would lead one to conclude that there were at most two cointegrating vectors.

5.3.5 An error correction model of demand for money in Zimbabwe

Since the Johansen procedure indicated the existence of cointegrating vectors in some of the variables, we specified and estimated an error correction model of both the narrow and broad money. Tables 39 and 40 report the results of the estimated models.

For narrow money, the t-ratios on income and the lagged value of real money were significant. Both types of interest rates were found to be insignificant. The model had a fairly good fit, with an adjusted-R_2 of 0.874.

With regard to real M2, the t-ratios on income and the lagged-value of real money were found to be significant. Like in the other two countries, the interest rate variables were found to be insignificant.

Thus, changes in both the narrow and broad money were significantly determined by changes in real incomes and also by the lagged values of the changes in real incomes.

The insignificance of interest rates in demand for money could suggest the limited role of the speculative demand for money given the small size or the range of financial assets and more importantly a greater preference for saving in tangible wealth or assets.

TABLE 39

Zimbabwe: An error correction model of demand for M1

$$\Delta rm2_t = \underset{(0.0578)}{0.0067} + \underset{(0.0732)}{0.4976\Delta rm1_{t-1}} + \underset{(0.0268)}{0.0037rm1_{t-2}}$$

$$+ \underset{(0.0266)}{0.0038rm1_t} + \underset{(0.878)}{1.0628\Delta ry_t} - \underset{(0.0279)}{0.5308\Delta ry_{t-1}}$$

$$+ \underset{(0.0339)}{0.0097\Delta tb_t} - \underset{(0.0339)}{0.0289\Delta br} - \underset{(0.0960)}{0.5005EC_{t-1}}$$

$\bar{R}^2 = 0.9209$
D.W = 1.8081
RESET(4) F[3, 30] = 0.3003
Jacque-Bera LM test $\chi^2(2) = 2.1974$
ARCH $\chi^2(1) = 0.0830$
Akaike's FPE = 0.0035

Figures in parenthesis are standard errors.

TABLE 40

Zimbabwe: An error correction model of demand for M2

$$Drm2_t = \underset{(0.0937)}{0.0896} + \underset{(0.0610)}{0.1146\Delta rm1_{t-1}} + \underset{(0.0315)}{0.0309rm1_t}$$

$$+ \underset{(0.9053)}{0.9053\Delta ry_t} - \underset{(0.0308)}{0.0308\Delta tb_t} - \underset{(0.0396)}{0.0274\Delta br}$$

$$- \underset{(0.1757)}{0.5781EC_{t-1}}$$

$\bar{R}^2 = 0.8740$
D.W = 1.6976
RESET(4) F[3, 32] = 3.7265
Jacque-Bera LM test $\chi^2(2) = 2.5647$
ARCH $\chi^2(1) = 1.016$
Harvey -Collier recursive t-test(34) = -1.03
Harvey-Phillips het. test = 2.82.

Figures in parentheses are standard errors.

The Chow (1966) test for model stability was applied. Results showed evidence of a structural break in the case of narrow money. Six observations covering the period 1983-1984 had a Chow statistic larger than the critical value F_c (9, 24) of 1.92.

However, using the Chow test, there was no evidence of a structural break in the case of broad money. As observed in the case of Malawi, the results seem to suggest that the demand for narrow money is unstable whereas that of broad money is fairly stable.

5.4 Conclusion

The results reported in this chapter provided some useful information which helped us to evaluate the various hypotheses postulated in chapter 4.

The application of the ADF and the PP tests for unit roots established that in the three SADC countries, Malawi, Zambia and Zimbabwe, most of the univariate time series related to demand for money were non-stationary in levels. This was indicated by the modified t and F statistics which were significant at the 10 percent level. Although more variables were found to be stationary by the PP test, the finding that some series were non-stationary was a significant result which confirms the current views on the properties of macroeconomic time series.

Unit root tests provided important information which has some significance for the stability of the velocity of circulation of the different measures of money. Based on the PP test, we established that in the case of Malawi, all nominal velocity measures and rv1 and rv2 were stationary. However, the velocity of circulation of the real monetary base, rv3 was non-stationary. These results suggest that overall, velocity of circulation of money in Malawi is fairly stable. In the case of Zambia, except for V2 and rv3, all other velocity measures were non-stationary. This result indicates that velocity is unstable, which also implies instability in the demand for money. However, further testing was necessary to determine if there existed some linear combination of the velocity measures which was stationary. If this were the case, then, despite the non-stationarity of individual measures, we could still conclude on overall stability of the velocity of circulation. Theoretically, as argued in chapter 3, the intuition is that taken as group, the divergence of one variable in one direction could be offset by others moving in the opposite direction. Tests based on bivariate cointegration regressions of V1 and V3 indicated that the two were cointegrated so that we could infer stability. The same tests on rv1 and rv2 also suggested cointegration.

For Zimbabwe, all nominal measures velocity of circulation were found to be stationary. However, all real velocity measures were found to be non-stationary. Multivariate cointegration tests on rv1, rv2, rv3 were inconclusive even though bivariate tests on rv1 and rv2 and on rv2 and rv3 indicated that some cointegration existed, a factor which suggests that there is some stability.

Rather than just assume stability, as is the case with conventional models, we tested for stability of velocity of circulation using unit root tests.

There has been much debate about the reliability of unit root tests but by using at least two methods, both of which confirmed non-stationarity among some of the time series, we showed that there was some validity in the notion that most macroeconomic series tend to be non-stationary.

Other important results were on the bivariate and multivariate cointegration tests. These tests showed that although some time series are in themselves non-stationary, they may however be stationary when taken in combination with others. We found evidence of the existence of some significant cointegrating relationships among the series. However, this was the case with respect to Malawi and Zimbabwe. As argued earlier, this enabled us to apply an error correction approach to modelling demand for money. Following the theoretical survey presented in chapter 3, the existence of these cointegration relationships suggests the existence of some stable equilibrium demand for money over a period of time. Granger, (1986). We specified and estimated the demand for money in the case of Malawi and Zimbabwe. The ECMs has a good fit. They indicated a significant relationship between the demand for money and the income variable, its lagged values and also past values of the levels of demand for money and included an error correction term representing the adjustment mechanism. In both these countries where this model was applied, we found that income was the most significant variable which explained demand for both the narrow and broad money. The estimated parameters on the income variable were all in the neighbourhood of unity. This result is consistent with other studies. A study by Tseng and Corker (1991) on a group of some of the less developed countries in Asia indicated that for narrow money, the elasticity ranged from 0.67 to 1.79. For broad money, this ranged from 1.00 to 1.72. Their findings on interest rates showed negative but largely significant coefficients. The significance of the estimated coefficients could be a reflection of the countries' larger degree of monetization where economic agents prefer to hold their money in financial rather than non-financial assets.

In the case of Zambia, we found evidence of non-stationarity in some of the variables but did not find any significant cointegrating vectors. We could not therefore utilize an error correction methodology to model the demand for money. This implied the absence of a move to some stable equilibrium demand for money over time. Having failed to find any cointegrating vectors, we simply applied OLS to first-differenced data, to ensure that at least the regression would be rid of the spurious regression problem. However, this was only possible in the case of narrow money. OLS estimation of broad money in first-differences yielded a very poor fit, so we had to use the series in levels. This was highly unsatisfactory because of the problems related to the conventional specifications. This limits the usefulness of that particular result. We concluded that in the case of Zambia, the predictability of monetary policy was uncertain. This might have been partly caused by the poor quality of some of the quarterly data used in the estimation.

CHAPTER 6

CONCLUSIONS AND POLICY IMPLICATIONS

6.0 INTRODUCTION

The study was motivated by some concern (based on the experiences of some developing countries) about the possible effects of financial liberalization undertaken by three SADC countries, namely, Malawi, Zambia and Zimbabwe, on the role of monetary policy. It has been argued in chapter 3 that the kind of reforms embodied in the SAPs could have significantly changed the environment in which monetary policy operates and that ultimately this would affect the demand for money and have some feedback effects on the efficacy of monetary policy in macroeconomic management. Monetary theory postulates that if the demand for money is stable, then monetary policy has a predictable and significant impact on the economy. We argued that stability of demand for money could be adversely affected by a change in the environment in which monetary policy operates, such as the reform program currently in place in the SADC.

Although there are numerous studies which have been undertaken on the subject of demand for money, recent developments in monetary theory are critical of the conventional specification and estimation of the demand for money function. The main reason is that these models have ignored the time series properties of the data used in the empirical work. Several studies cited in chapter 3 showed how the use of non-stationary time series data could yield spurious regression results. The remedial solution of using first-difference values as suggested by some researchers, has also been shown to have problems. In order to assess the responsiveness of demand for money to the reforms, the study specified and estimated a function which takes explicit cognizance of these circumstances. We adopted a cointegration approach to modelling demand for money in order to avoid the spurious regression problem and thereby have results which are theoretically acceptible. This chapter summarizes the conclusions of this study and discusses some policy implications.

6.1 Overview of results

Our results are mixed. We tested for stationarity of all time series by applying the Augmented Dickey-Fuller and Phillips-Perron tests. Results indicated the existence of unit roots in most of the time series for all three countries and this was evidence of non-stationarity in the levels of the variables. Unit root tests also indicated that various measures of the velocity of circulation of money were non-stationary. It was evident therefore that a conventional specification to model demand for money would be inappropriate.

Cointegration tests were carried out using Engle and Granger's (1987) bivariate approach and the multivariate test of Johansen (1990). There was evidence of the existence of cointegration relationships in the case of Malawi and Zimbabwe. This indicated that an error correction approach could only be applied to Malawi and Zimbabwe data. The estimated error correction models had a fairly good fit as judged by various test statistics. Chow tests for model stability indicated that demand for narrow money was unstable in both Malawi and Zimbabwe. The same tests showed that demand for broad money in both countries was stable.

In the Zambia case, there was no evidence of any significant cointegration relationship among the variables. Thus, a conventional demand for money specification was adopted but even that did not fit the data well. The failure to find any significant cointegration relationship (implying the variables move further apart in the long - run) among the series suggests instability of the demand for money function in the Zambia case. This was also confirmed by the failure to reject the null hypothesis of unit roots in the real velocity of circulation of both narrow and broad money.

Thus, for Zambia, the evidence showed that there was no tendency towards some equilibrium relationship between the demand for money and the factors which determine it, a factor which indicates instability in the demand for money function. Chow tests for stability could not be relied on since the conventional model was not a good fit.

Another significant finding for all the three countries was that although SAPs entailed rather drastic changes in interest rates, these factors had an insignificant role in the determination of demand for money.

6.2 Policy Implications

The results we obtained have some important policy implications. The finding of non-stationarity among most of the time series used in the study is significant. It cautions against wholesale application of conventional demand for money models which merely assume that all such series are stationary. For policies to be useful or relevent, it is important that the models on which they are based should be theoretically consistent; otherwise when policies are implemented, it may be difficult to attain desired policy targets.

Another significant finding is that SAPs have affected the demand for money in the three countries in different ways. In the case of Malawi and Zimbabwe, results indicate that the despite the reforms, the demand for broad money has remained stable. However, the unstable demand for M1 could be evidence of some destabilizing effect of the reforms especially in terms of portfolio shifts. This could suggest that financial liberalization has clouded the predictability of monetary developments, at least in the short-run. In this context, implementing monetary policy could be a problem in terms of predicting its effects.

In the case of Zambia, adjustment appears to have had a more destabilizing effect on the demand for money. This was evidenced by the failure to find a satisfactory error correction model in this case. Such a result implies that the short-run predictability of monetary developments is poor.

Overall, the results suggest that although there is scope for effective use of monetary policy (Malawi and Zimbabwe), the policy would be ineffective in the Zambian context. Other tools of macroeconomic management would, therefore, be recommended after a careful and rigorous study on the transmission mechanisms of any such policy.

The result that interest rates had insignificant coefficients despite the very sharp increases under the reforms confirms the monetarist theory, that demand for money is interest-insensitive, though this result was arrived at using an error correction approach. This would suggest that there is a role for monetary policy in macroeconomic management. But this statement should be qualified. There is still some measure of limitation with regard to the observation that narrow money is unstable.

Although the results of the study are useful for policy purposes, it should also be realized that the results should be taken in conjuction with many other considerations. The models used to estimate demand for money in this case were single equations and were dealt with in a partial equilibrium framework. Logically, an analysis of demand for money in a broader or more general equilibrium framework would be relatively useful. The case of Zambia needs further analysis to resolve the apparent dilemma that conventional modelling was inappropriate because of the non-stationarity of many of the key series and also the absence of cointegrating relations among them. At the same time, given the nature of the data generating process, an error correction model was not applicable. The issue then is how best to model demand for money under Zambia's circumstances.

APPENDIX A

MALAWI DATA

M1	Y	M2	MB	BR	TB	P
130.9	1069.3	204.3	67.7	10.3	9.07	58.1
129.2	1093.5	249.2	81.7	10.3	9.0	55.9
114.8	1122.7	241.4	65.1	10.3	9.0	55.8
105.9	1156.9	233.9	105.4	10.3	9.0	58.2
137.1	1190.5	285.0	93.5	10.3	9.0	59.5
141.8	1224.6	290.9	84.8	10.3	9.0	59.8
130.8	1265.6	276.4	93.5	10.3	9.0	62.7
111.8	1313.4	263.5	84.9	10.3	11.0	67.1
139.5	1360.2	263.5	108.7	10.3	11.0	69.8
150.8	1408.0	303.2	130.6	10.3	11.0	68.2
127.8	1465.8	323.9	89.9	10.3	11.0	72.2
144.9	1533.4	292.8	96.6	10.6	11.0	78.0
166.7	1604.1	369.0	149.6	10.6	12.8	81.1
164.2	1671.9	391.5	198.9	10.6	12.8	81.1
166.9	1745.1	384.4	165.9	10.6	12.8	88.5
143.9	1823.6	373.6	130.4	11.5	12.8	90.5
181.3	1907.3	406.3	162.3	11.5	12.8	91.9
193.5	1986.0	429.5	197.7	11.5	12.8	94.5
166.9	2060.2	384.4	165.9	11.5	12.8	96.5
154.8	2129.8	361.1	132.6	11.5	12.8	100.0
196.6	2179.9	420.4	168.9	11.5	12.8	135.8

237.5	2248.9	481.9	225.8	11.5	12.8	150.8
220.8	2353.4	488.8	286.4	11.5	12.8	160.3
223.5	2493.5	468.8	264.2	11.5	12.8	177.9
299.4	2646.9	594.1	329.4	11.5	12.8	135.8
351.1	2787.7	703.6	442.5	11.5	15.8	150.8
298.0	2943.7	668.5	445.3	11.5	15.8	160.3
313.0	3114.9	597.1	315.6	11.5	15.8	177.3
395.9	3285.6	721.5	356.3	11.5	15.8	185.3
458.9	3456.7	843.3	468.6	11.5	15.8	197.9
435.9	3647.9	812.5	495.7	11.5	15.8	203.4
398.5	3859.1	476.2	476.2	11.5	15.8	214.8
445.3	4091.5	865.3	451.7	11.5	15.8	216.0
513.5	4303.7	976.1	499.1	11.5	15.8	218.2
427.0	4495.1	861.7	447.5	11.5	15.8	210.7
507.2	4801.7	985.7	364.9	11.5	15.8	235.9
565.9	4970.9	1041.6	437.7	11.5	11.5	243.8
482.1	5188.0	957.1	374.5	11.5	11.5	247.9
465.5	5453.0	944.3	365.6	11.5	11.5	259.5
620.8	5776.9	1174.9	492.1	11.5	11.5	267.6
735.5	6044.4	1405.9	663.7	11.5	11.5	274.8
633.4	6244.4	1199.5	462.1	11.5	11.5	280.1
521.0	6376.1	1056.2	318.5	11.5	11.5	297.0

APPENDIX B

ZAMBIA DATA

M1	Y	M2	MB	TB	P
522.2	2928.7	891.4	277.2	5.8	43.9
529.0	2929.7	896.0	278.6	5.8	35.9
537.7	3051.5	975.1	321.7	5.8	35.9
561.4	3294.0	978.8	332.2	5.8	36.2
538.5	3654.3	983.3	307.2	6.0	38.1
585.7	3904.9	1079.4	318.5	6.0	40.0
641.3	4055.7	1209.2	360.0	6.0	40.0
682.3	4106.6	1309.3	379.5	6.0	40.3
631.9	4072.3	1278.0	377.6	7.5	44.3
661.4	4122.2	1324.3	386.4	7.5	46.8
738.0	4240.1	1398.2	435.3	7.5	48.7
795.3	4426.1	1454.2	440.7	7.5	50.3
698.9	4569.9	1393.8	403.3	7.5	53.6
735.6	4754.2	1483.6	421.7	7.5	55.7
893.0	5109.3	1637.5	470.2	7.5	57.1
869.9	5635.8	1703.8	518.5	8.2	63.2
860.4	6071.1	1680.8	478.4	9.5	70.3
944.3	6589.5	1731.3	506.6	9.5	74.4
1037.4	7561.7	1037.4	561.2	11.2	80.2
1231.5	8988.0	2101.9	634.2	11.1	100.0
1457.0	10706.3	2494.5	642.4	23.5	348.8

1544.0	12172.5	2713.0	685.2	23.5	374.2
1888.0	13753.7	3185.0	1080.0	24.0	378.1
2304.0	15449.9	4062.0	1719.0	26.0	183.2
2150.0	17038.8	4154.0	2092.0	21.3	185.1
2510.0	18724.4	4548.0	2213.0	15.7	206.9
2648.0	20833.9	5447.0	2402.0	14.5	225.2
3041.0	23367.4	6266.0	2418.0	14.5	251.4
3045.0	24165.1	6321.0	2222.0	14.5	294.5
3399.0	27626.5	6851.0	2415.0	14.5	320.1
4126.0	32462.4	8207.0	2892.0	14.5	349.1
4882.0	39672.6	10163.0	5018.0	17.2	387.5
5829.0	47631.0	11005.0	4580.0	18.5	500.7
6061.0	54956.3	11914.0	4610.0	18.5	500.7
6240.0	65127.4	12567.0	4673.0	18.5	887.6
7143.0	78144.2	13569.0	6925.0	18.5	899.8
7727.0	91486.6	16623.0	7877.0	25.0	1263.6
8294.0	104549.8	17882.0	10366.0	25.0	1459.3
10803.0	122178.1	21109.0	10497.0	25.0	1832.4
12543.0	144371.4	24390.0	11269.0	28.7	2142.5
13094.0	167146.5	29691.0	12917.0	37.0	2558.4
13269.0	189417.3	29326.0	14108.0	37.0	2886.8
17332.0	218479.2	34380.0	17504.0	37.0	3206.9
22360.0	254332.3	48357.0	22704.0	37.0	4247.8

APPENDIX C

ZIMBABWE DATA

M1	Y	M2	MB	BR	TB	P
590.2	4184.3	1158.4	241.8	10.0	3.8	53.1
645.6	4435.3	1239.3	275.7	10.0	3.8	53.8
686.4	4620.9	1371.5	310.8	11.7	6.0	54.9
678.8	4741.0	1399.4	325.4	13.0	8.2	56.1
636.8	4782.0	1391.4	320.8	13.0	8.5	57.3
731.4	4900.2	1558.4	344.0	13.0	8.5	59.5
776.4	5110.2	1666.7	356.8	13.0	8.5	61.2
826.9	5412.2	1748.1	388.5	13.0	8.4	63.1
699.9	5826.8	1663.1	370.2	13.0	8.4	68.1
728.7	6134.7	1679.9	368.1	13.0	8.5	71.2
723.0	6313.9	1690.7	366.3	13.1	8.6	74.3
751.4	6364.5	1748.1	407.3	13.3	8.7	83.3
670.9	6289.0	1769.6	386.0	13.3	8.7	85.3
749.9	6338.5	1791.2	425.9	13.3	8.4	87.4
861.2	6510.0	2033.4	441.8	13.3	8.5	90.7
873.5	6803.5	1950.2	411.2	13.4	8.4	93.2
768.8	7159.6	1883.4	417.8	13.4	8.4	94.6
858.5	7455.6	1983.8	423.7	13.3	8.4	95.7
953.1	7762.4	2189.4	495.5	13.2	8.6	96.6
1005.2	8079.9	2157.1	541.4	13.2	8.7	100.0
941.9	8476.7	2153.9	557.3	13.2	8.7	217.8

943.9	8797.2	2150.2	523.2	14.0	8.9	225.8
1044.3	8963.5	2357.0	585.9	14.0	8.9	223.9
1102.8	8975.6	2240.5	625.9	14.0	8.5	241.3
1054.1	8760.1	2401.7	579.6	14.0	8.7	246.8
1057.2	8771.9	2455.2	601.2	14.0	8.9	259.3
1206.6	9086.7	2751.4	643.0	14.0	8.8	264.0
1224.6	9704.3	2844.2	669.1	14.0	8.5	263.2
1191.8	10519.9	2833.1	665.3	14.0	8.5	133.2
1446.8	11732.6	3134.2	754.7	14.0	8.3	141.6
1602.7	12269.1	3462.5	843.4	14.0	8.3	142.6
1436.8	12736.4	3384.8	803.2	14.0	8.4	146.4
1431.3	13270.1	3483.1	803.3	14.0	8.2	153.2
1643.3	13896.1	3878.8	920.2	14.0	8.2	159.9
1905.1	14614.4	4292.5	1026.8	14.0	8.2	164.1
1865.7	15275.9	4176.9	959.9	14.8	8.2	169.6
1819.9	15991.6	4115.6	1029.8	14.9	8.2	180.7
2156.7	16941.2	4431.5	1201.5	15.4	8.2	188.2
2464.1	18124.8	5073.1	1290.0	15.7	8.2	193.4
2387.9	19304.7	4723.6	1380.3	16.9	8.2	204.1
2601.7	20488.0	5099.6	1444.7	17.4	8.2	224.5
3289.3	21981.1	5998.4	1737.7	17.4	8.2	232.4
3030.4	23783.9	5044.5	1705.4	17.4	8.2	248.8

APPENDIX D

GENERATION OF QUARTERLY SERIES FOR REAL NET NATIONAL INCOME

$$q1=\frac{4Y_t}{\sum qi}[Y_{t-1}+\frac{7.5}{12}(Y_t-Y_{t-1}]$$

$$q2=\frac{4Y_t}{\sum qi}[Y_{t-1}+\frac{10.5}{12}(Y_t-Y_{t-1}]$$

$$q3=\frac{4Y_t}{\sum qi}[Y_t+\frac{1.5}{12}(Y_{t+1}-Y_t)]$$

$$q4=\frac{4Y_t}{qi}[Y_t+\frac{4.5}{12}(Y_{t+1}-Y_t)]$$

<u>Notes</u>: q_1 ..... q_4 denote quarterly data.

Y_t represents annual GDP data.

<u>Source</u>: Diz, A.C., Money and Prices in Argentina, 1935-1962 in Meiselman, D., <u>Varieties of Monetary Experience</u>, 1970.

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