

**ESTIMATING THE DEMAND FOR MONEY IN A  
DEVELOPING  
COUNTRY: THE CASE OF SOUTH AFRICA**

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**Abstract**

*In this paper, the demand for real money, M3, is estimated for South Africa for the period 1965 to 2003. The paper employs an Autoregressive Distributed Lag (ARDL) model using a two equation technique that includes cointegration and an error-correction model (ECM). The cointegration model estimates the long-run relation that might exist between the dependent variable and the explanatory variables, and the ECM determines the short-run relationship between money demand and its determinants. Recent studies (Nell, 1999; Moll, 1999; Jonsson, 2001; and Nell, 2003) found inconclusive results with regard to the stability of M3, as a monetary policy tool. While some researchers (Jonsson, 2001 and Nell, 1999) found significant relationship between M3 and its determinants, others (Moll 2000; Nell, 2003) concluded that there was no stable relationship between M3 and its determinants, with the level of inflation used as one of the determinants. Nevertheless, the test for stability conducted in this paper shows that the money demand function employed in the model is stable. The paper also found a strong and stable positive relationship between money demand and inflation, which shows that M3 as a policy tool is stable and can be used to target the level of inflation in South Africa. While previous studies did not employ statistical techniques that establish a long- and a short-run relationship between M3 and its determinants, this paper's contribution to literature is to establish a stable long- and short-run relationship between money demand and its determinants in the context of structural breaks. The paper found that structural breaks arising from changes in monetary and exchange policies had significant impacts on money demand, as expected,*

*while changes in the political regime did not have a significant impact on money demand. In general, the results suggest that the demand for money function employed in this paper is stable.*

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**DECLARATIONS**

I, Rudolph R K Humavindu, declare here that this study is a true reflection of my own research, and that this work or part thereof has not been submitted for a degree in any other institution of higher education.

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**Date**.....

**Rudolph R K Humavindu**

**ACRONYMS**

ADF	:	Augmented Dickey Fuller
AIC	:	Akaike Information Criterion
ARCH	:	Autoregressive Conditional Heteroscedasticity
ARDL	:	Autoregressive distributed lag
CMA	:	Common Monetary Area
CPI	:	Consumer Price Index
DF	:	Dickey-Fuller
DW	:	Durbin-Watson
ECM	:	Error-Correction Model
EMU	:	European Monetary Union
GDP	:	Gross Domestic Price
HQC	:	Hannan-Quinn Criterion
IMF	:	International Monetary Fund
JB	:	Jarque-Bera
LM	:	Lagrange Multiplier
M3	:	Broad Money supply
OLS	:	Ordinary Least Squares
SACU	:	South African Customs Union

SADC	:	South African Development Community
SBC	:	Schwarz Bayesian Criterion
VAR	:	Vector Autoregression

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Introduction and Background**

Effective monetary policy relies on a system or an economy's ability to identify a stable money demand function (Friedman and Schwartz, 1982; Laidler, 1982). Stability of a money demand function is a necessary condition to ensure that money supply would have a predictable impact on other economic variables such as, inflation, interest rates, national income, private investment and other policy variables. Therefore, the presence of stability in the money demand function becomes an interesting policy issue that needs to be addressed in order to assess the effectiveness of a given monetary programme. The general practice of many countries is to use monetary policies or a combination of policies, with the aim of targeting certain key policy variables. Towards the end of the 1990's, countries such as the United Kingdom, Sweden, Canada and New Zealand used inflation as targets, while others such as the United States, the European Central Bank and South Africa targeted money supply, where M3 was used as the target for South Africa (Moll, 1999). Empirical evidence shows that the use of M3 as a target has had mixed results. While South African authorities achieved to lower the inflation rate from as high as 20% to 10%, Moll (1999) argued that there was no empirical basis for targeting M3, due to a lack of relationship between money supply and real variables.

Further, South Africa's financial sector has undergone several changes, such as direct credit controls in the 1960's and 1970's; credit liberalization between 1980 to

1996; a dual exchange regime that managed a fixed financial rand and a floating commercial rand; and the change in the political system, in the early 1990's that lends it political stability and credibility internationally. In addition, South Africa is also a member and a dominant partner of several regional and monetary blocs, in the region that to some extent, has influenced the use of its monetary policies.

South Africa is located at the southern tip of Africa with a long coastline that stretches for more than 2,500 kilometers and lies between the Atlantic and the Indian oceans. The country covers an area of 1,221,000 square kilometers, with a population of 47 million of diverse origin ([www.wikipedia](http://www.wikipedia)). South Africa borders Namibia, Botswana, Zimbabwe, Mozambique and Swaziland, while Lesotho is an independent state surrounded by South Africa territory.

This geographical location has allowed South Africa to maintain its membership in the Common Monetary Area (CMA), where Namibia, Lesotho and Swaziland are members. This monetary union allows the South African currency, the rand to fluctuate as a legal tender in the other member countries, while their currencies are used as legal tenders only within their respective borders. In terms of policy, the use of the South African rand as legal tender in other members implies that South Africa's money supply does not only depend on its local demand, but it has also to meet the demand of the other member countries. Hence, the use of money supply as a monetary target, which includes the broader components of money supply.

South Africa is also a member of the world's oldest customs union, known as the Southern African Customs Union (SACU), where Botswana, Lesotho, Namibia and Swaziland are members. SACU has been operated under a common customer revenue pool, where South Africa collects the customs revenue accrued to all members, using a fixed formula, and then redistributes it to the respective members after a certain period. This type of trade arrangement has impacts on price, real and monetary variables, which in turn affect the stability of money demand. Historically, South African monetary authorities have used several monetary policy tools such as money supply, inflation and interest rates to influence, and to some extent, to control the economic performance of the country. Therefore, it is important to examine and analyze empirically, the stability of these monetary tools. This paper is using quantitative analyses to determine the stability of money demand in South Africa for the period 1965- 2003. A key challenge for monetary policy is that inflation is not just a monetary phenomenon, but in addition to the usual demand-pull and cost-push pressures it also poses challenges for the conduct of monetary policy. In 2000, South Africa moved away from targeting money supply and adopted a formal inflation targeting frame-work for monetary policy, after a less satisfactory experience with other monetary approaches (Moll, 1999). Monetary policy targets can be distinct from objectives that will work directly towards achieving the long-term objectives of policy. Monetary policy targets are classified as operating targets or intermediate targets. Intermediate targets are variables that affect the ultimate objectives of monetary policy and are not controlled directly by the reserve bank. On the other hand, operating targets are tactical goals that the reserve bank can influence better

in the short-run. Inflation results in a price level adjustment and substantial changes in relative prices. The adjustment of relative prices brings about a significant reallocation of resources and/or subsequent monetary financing of rising fiscal deficit resulting from a combination of decline in revenue and rigid expenditure patterns also generated through inflation pressures (Branson, 1989). Downward rigidities in goods and labor markets generate more permanent moderate inflation in the region, because of South Africa's influence in regional trade and monetary integration.

The South African Reserve Bank defines money demand according to the traditional monetary aggregates as follow: M1 consists of coins, banknotes and other demand deposits; M2 includes M1, plus other short- and medium-term deposits; while M3 includes long-term deposits in addition to M2. Between 1986 and 1999, the South African Reserve Bank used the broader monetary aggregate, M3, as its target to achieve price stability. One reason for choosing the broader definition that includes demand for reserves by commercial banks (in this case local and regional banks), could be to assess the demand for South African rands, not only by South African commercial banks and local communities, but also to account for money demand by other countries such as Namibia, Lesotho and Swaziland where the rand circulates as a legal tender<sup>1</sup>. The use of M3 as a monetary target did not seem to be satisfactory and the authorities adopted an inflationary target in 2000 using M3 as the policy tool.

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<sup>1</sup> Namibia, Swaziland, Lesotho and South Africa are in a monetary arrangement, known as the Common Monetary Area, where the South African Rand is used as a legal tender.

The inconsistency and non-continuity in which the South African Authorities adopted the policy tools call for a need to investigate the relevance and usefulness of some of those policy variables. It is against this background, that the current paper finds it necessary to analyze the extent to which M3 as the control policy tool is stable. Evidence from the literature show mixed results on the stability of monetary aggregates, such as M1, M2, and M3. Moll (1999) argued that there was no stable relationship between M3, real and nominal income for South Africa, and as such nullified prior findings as they lacked the necessary rigor needed to conduct the study. However, the aim of this paper is to assist policy makers in their overall objectives of ensuring price stability, through monetary policy. As is well known, the necessary condition for effective monetary aggregate targeting is the existence of a stable long-run and a short-run relationship between the monetary aggregate and the final target variables, which in this case is price stability (Halicioglu and Ugur 2005). A stable money demand function has long been sought after, because it can be very useful in explaining or even predicting, the behavior of the macro economy.

## **1.2 Statement of the Problem**

The use of different variables to achieve certain targets by the South African Reserve Bank calls for a need to analyze the extent to which these monetary aggregates are stable. Theoretically, money supply as a policy tool can be used to target a certain level of economic growth or inflation and help monetary authorities achieve such a target. In the case of South Africa, the use of the broad monetary aggregate, M3,

revealed mixed results as supported by others (Moll, 1999; Jonsson, 2001; and Nell, 2003). Although some have shown a lack of stability between M3 and real and nominal income, the support of a stable relationship between M3 and inflation cannot be overlooked, as it is necessary in the current paper in order to shape and direct the South African monetary policy framework.

Since the South African Reserve Bank currently uses broad monetary aggregate, M3, to achieve a certain inflation rate target, this paper's contribution is to investigate and determine the extent to which M3 is stable. While others (Moll, 1999; Nell, 2003) conducted similar studies for South Africa, this study uses a different time period and different statistical models in order to substantiate the literature.

South Africa is a leading economy and a stronger and influential member in most of the regional trade and monetary integration. This puts pressure on the South African currency to be demanded by its neighboring countries, which in turn subject the currency to external fluctuations. Therefore, it is necessary to establish the stability of monetary aggregates for them to become effective policy tools. This can be done through rigorous analyses of demand for money in order to inform the authorities of its effectiveness and stability as a policy tool.

### **1.3 Research Objectives**

The main objective of this paper is to investigate and determine the stability of the demand for money, broadly defined as M3 for the South African Economy. In order

to achieve this objective, the paper will employ econometric techniques to estimate the demand for money function for the period 1965 to 2003.

#### **1.4 Data and organization of the thesis**

Meaningful studies of money demand in many developing countries is often precluded by serious data limitations, including inadequate monetary records and lack of high-frequency such as monthly or quarterly indicators of economic activity. In the current study, the paper uses secondary annual data from International Financial Statistics CDROM published by the International Monetary Fund (IMF) for all the variables, from 1965 to 2003. The choice of the period is based on some important political and economic events that took place in South Africa. These events have been characterized by important changes in the South African money markets structures: ranging from progressive liberalization of capital movements, changes in exchange regime from a dual exchange rate to a managed float under a Common Monetary Area.

In addition to this chapter one, the remaining sections of the thesis are organized as follow: Chapter two describes the Monetary Developments in South Africa, followed by chapter three that provides a brief review of literature. Chapter four describes the model underlying the analysis and specification, while chapter five presents the empirical estimation. Chapter six concludes by presenting the results in the context of policy implications.

## CHAPTER TWO

### MONETARY DEVELOPMENT IN SOUTH AFRICA

#### 2.1 Institutional Development of Monetary Policy in South Africa

In modern day economic systems, economic growth and development rely heavily on the proper functioning of the country's financial system. The financial system is regarded as a critical engine for growth, since funds from surplus units to deficit units are transferred through the financial system. A well functioning financial system facilitates and allows projects undertaken by entrepreneurs to be translated into investment, employment and production of output, all of which are important factors of economic growth (Nel, 2003).

The financial sector in South Africa is well developed with a large formal sector and compares relatively well with those prevailing in some developed countries. This is supported by the volume of transactions and the amount of money handled by the commercial banks, which amounted to 769 million rand<sup>2</sup> in saving and demand deposits in 2003 (IMF, 2005). As part of the government policy in recent years, there has been a considerable attempt to expand the formal financial sector to include rural banks and micro-credit lending institutions. This would enable the financial sector to reach out to the rural communities, which in the long run affects the total demand deposits of the formal financial sector.

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<sup>2</sup> The exchange rate between the rand and the US dollar is about R7 to USD1 in 2007.

Between 1965 and 1970, the South African Authorities introduced direct monetary and fiscal control by repressing<sup>3</sup> the financial system through policy actions that held interest rates below market clearing level and introduced non-market considerations into credit-allocation decisions. Financial repression in general could hinder the development and efficiency of the financial sectors, due to limited and controlled availability of funds that could boost investments. In this period the financial sector was heavily regulated with direct government control over interest rates, exchange rates and credit lending. The Reserve Bank has controlled short-term deposit rates and determined the duration of hire-purchase loan agreements, because secondary markets were not yet developed. In this period, a dual exchange rate system was maintained, where a fixed financial rand was used for capital account transactions, while a market determined commercial rand was used for the current account transaction. Capital mobility for domestic residents was tightly controlled, such that non-residents where having a market-determined exchange rate and they were allowed to move their capital, while domestic residents were not allowed to move any of their capital outside South Africa. Central Bank direct credit constraints has let to ‘disintermediation’, because credit extension took place outside the banking system or was conducted as an “off-balance sheet” activity (Moll, 1999). The direct control system has responded well towards money supply, but the actual impact on money supply was not so strong for it to be effective in influencing inflation rates. During this period broad money growth was stable, while inflation has grown at the rate at of 2.5%, as shown in figure 2.3. The

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<sup>3</sup> See McKinnon (1973) and Shaw (1973) for the classic statements of this concept and its theoretical foundation.

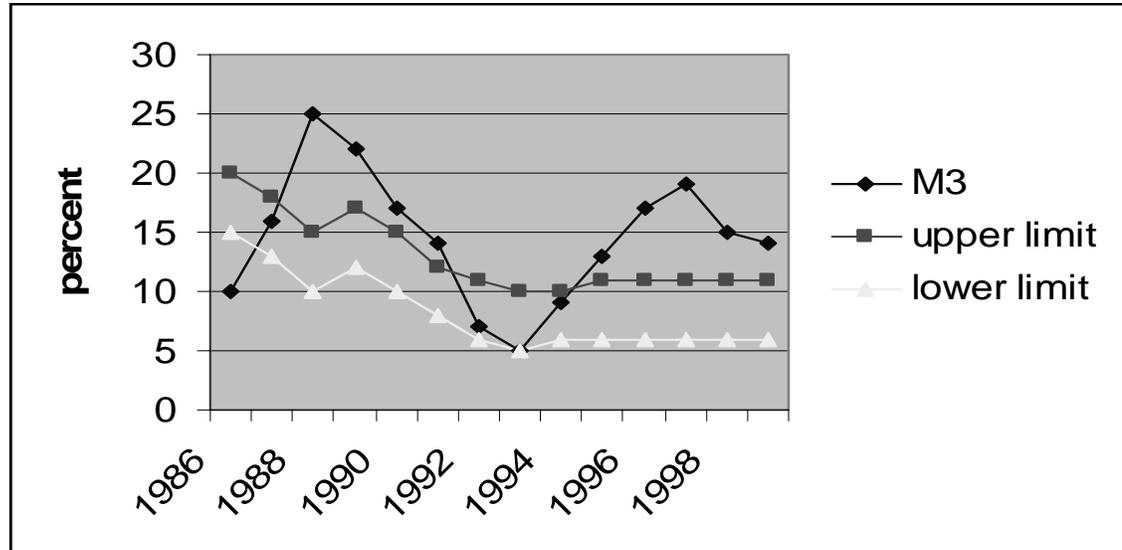
South African Reserve Bank has used the discount rate as the control variable for borrowing by commercial banks. The reason for using the discount rate was to control borrowings by commercial banks via inter-bank transactions in order to allow the South African Reserve Bank to influence the short-term interest rates quickly through adjustment of the bank rates.

In the early 1980s, the South Africa Reserve Bank adopted a strategy of liberalization due to the ineffectiveness of the direct control system. The liberalization strategy was recommended by a commission headed by Mr. De Kock and became known as the De Kock Commission. The main task of the commission was to analyze the efficiency of the monetary policies following the financial repression period. The De Kock Commission recommended that the Reserve Bank should opt for a market-determined or an indirect control credit system that would lead to more efficient financial intermediations. The commission's recommendations were accepted and implemented by both the government and the South African Reserve Bank.

Liberalization is defined as elimination of financial regulations in domestic financial markets, such as credit ceiling, lending requirement or entry restrictions to reduce excess demand for credit (MacKinnon, 1973). The two institutions initially agreed to a gradual process of liberalizing the financial sector over a five year period from 1980 to 1985. However, this process was accelerated, when government introduced the liberalization of not only the financial sector, but also the international capital markets flow and the domestic labor market in 1983. The authorities abolished interest controls and allowed domestic residents to transfer capital outside the country, and

factors of production were allowed to work where they deem fit as well as outside South Africa (Moll, 1999).

Between 1983 and 1985 liquid asset requirements were reduced and banks started paying interest rates on their customers' checking accounts, which was not done before liberalization. The introduction of managed floating exchange rate in 1983 which led to an increase in exchange rate flexibility, gave the monetary authorities a greater scope for using short-term interest rates, to regulate the money supply and influence income and prices. In 1986, the South African Reserve Bank in an attempt to bring down the level of inflation adopted a monetary policy framework of setting predetermined monetary growth targets for broad money, M3. During the period 1986 to 1999, M3 grew by an average of 14 percent (see figure 2.1) and inflation fell substantially over the same period. Moll (1999) and Nell (2003) argued that despite the money growth rate, which was accompanied by a decrease in the rate of inflation, the Reserve Bank often missed the explicit money growth target.

**Figure 2.1: M 3 Growth targets, 1986 to 1998**

Source: S.A. Reserve Bank, Internal Statistics

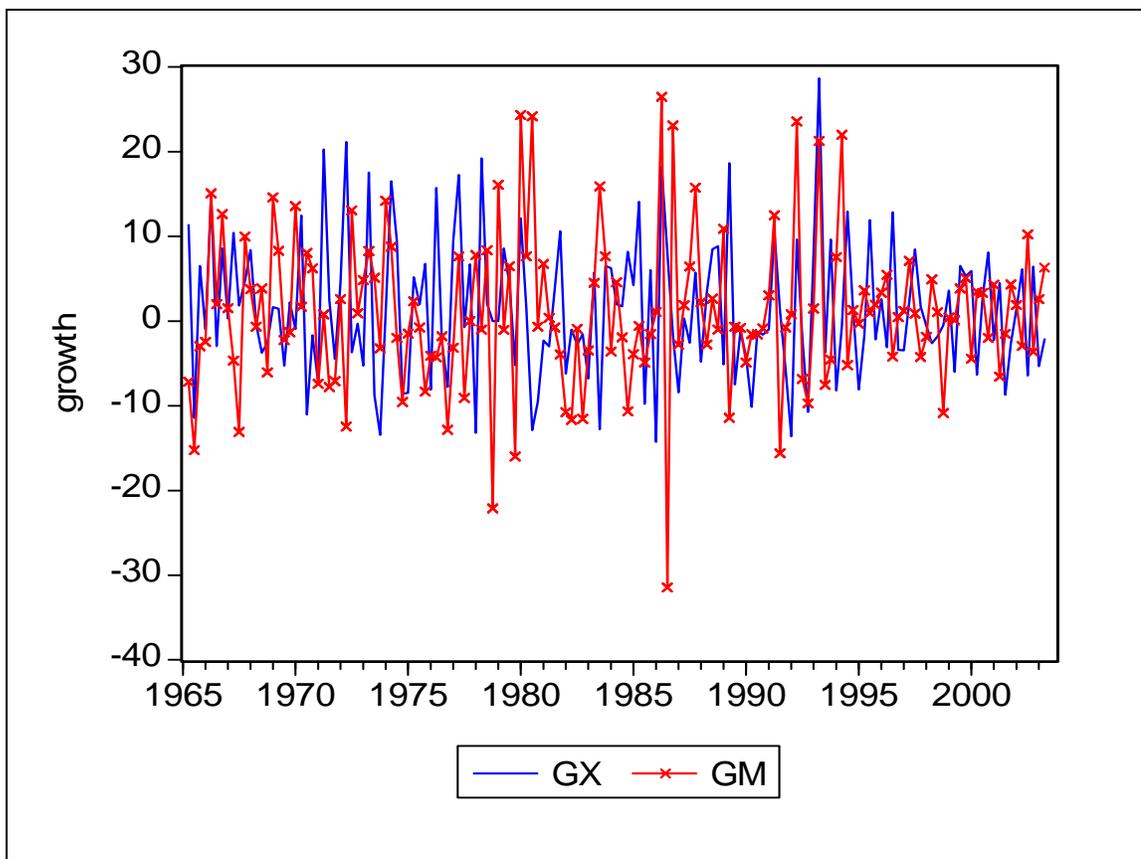
Figure 2.1, shows that the growth rate of broad monetary aggregate, M3 far exceeded the upper limit of the predetermined monetary growth for M3 by the South African Bank, which confirms that the bank's target was off the actual growth rate. According, Nell, 2003, the growth in M3 was attributed to multiple monetary policies that the reserve bank had undertaken during the period of the 1990's. These policies ranged from movements in exchange rates, changes in the credit extension and interest changes. When the authorities missed the money growth target, they adopted inflation targeting as the new monetary policy in 2000.

In 1994, after the general election, a government of National Reconciliation came to power and intensified the liberalization efforts. The new government further liberalized the financial systems by abolishing the dual exchange regime. Free capital mobility was introduced for domestic and non-domestic residents and these raised the

flow of short-term capital and foreign direct investment in and out of the country (Nell, 2003).

The new exchange regime and capital mobility enhanced trade flows as shown in figure 2.2, which illustrates growth in exports and imports respectively. The figure demonstrates that in 1995, the free movement of capital and reduced trade tariffs has led to a sharp growth of 29% and 25% in import and export respectively.

**Figure 2.2: Exports and Import growth**

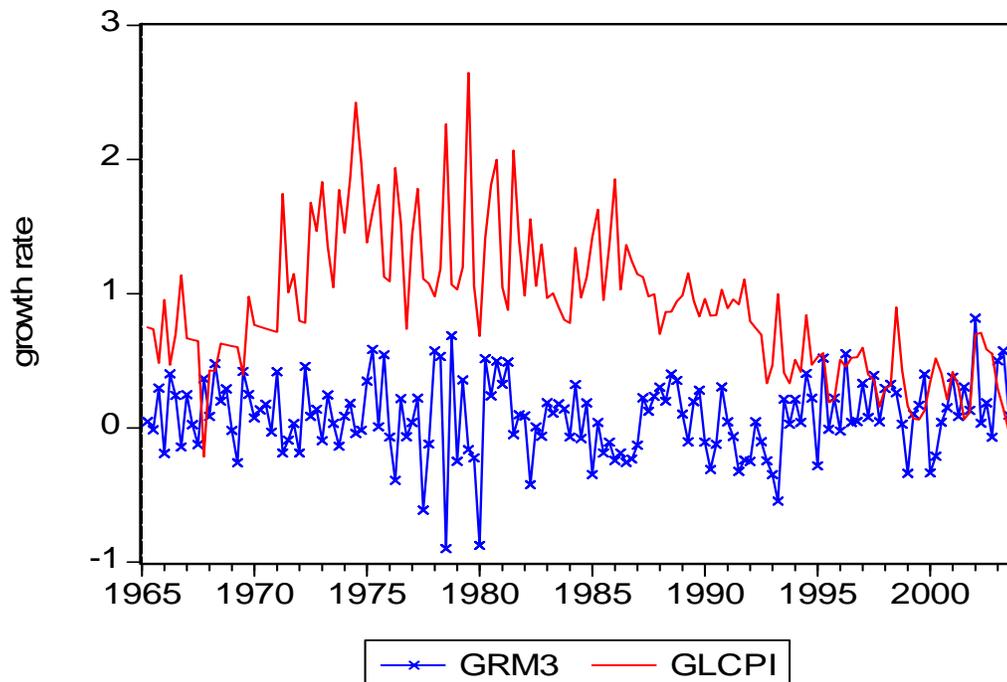


Inflation rates during this period were very high, hence the substantial degree of financial deepening<sup>4</sup> which took place, as low income households gained access to formal banking services to a large extent.

## 2.2 Money and inflation

Theoretically, an increase in the rate of inflation is expected to reduce the money supply in an economy as shown in figure 2.3.

**Figure 2.3 Growth Rates of M3 and the General Price Level (CPI)**



<sup>4</sup> See Shaw (1973) for this concept and its theoretical foundation

Figure 2.3 shows that growth in real money balances, M3 for South Africa was falling with the increase in the level of inflation between 1965 and 2003. These empirical findings are in line with theory, which states that a persistent increase in the general price level could reduce the growth in the value of money or the purchasing power of money. The Figure illustrates that inflation between 1980 and 1985 grew at an average rate of three percent, while real money balances declined over the same period by an average of a negative one percent. The figure further shows that the gap between the two growth rates had narrowed since 1994, when the new government came to power. This could be attributed to the change of political regime, abolishment of the dual exchange regime, introduction of free capital movement and inflation targeting. It is also evident from the figure 2.3 that since the adoption of inflation targeting in 2000, money demand and inflation have started to show some relationship, which supports the bank's effort of using M3 to target inflation within a certain range.

A number of studies (Nell, 1999; Moll, 1999; Nell 2003; and Jonsson, 2003) have been conducted to estimate and test the stability of some of the policy variables used by the South African Authorities, such as M3 and inflation to mention, but a few. Jonsson (2003) and Nell (1999) found that the money demand function using the broad definition, M3 was stable. Empirical findings revealed that the South African monetary authorities achieved the objectives of inflation targeting within the target range of 3%-6% for the period 2000 to 2003 (Nell, 2003). As a result, inflation also became the official monetary target in the other CMA countries, which shows the dominance of

South Africa as a partner in monetary arrangements and the extent of its policy influence to other members.

Other studies found mixed results with regard to the stability of M3 as a policy tool. Some (Moll, 1999; Nell, 2003) found that the relationship between money, income and price has become less stable and discredited the use of M3 as a useful and reliable monetary policy indicator. On the contrary, some other studies (Jonsson, 2001 and Nell 1999) showed that the money demand function using the broad definition was stable, and found a stable relationship between money demand and its determinants. The stability of the demand for money is one of the important factors in predicting influence on the economy so that the monetary authorities can control money supply as an economic policy tool. A stable demand for money implies a stable money multiplier and therefore, stability makes it easier to predict the effect of a given money supply on the aggregate economic performance.

## **CHAPTER THREE**

### **LITERATURE REVIEW**

#### **3.1 Literature Review**

Nell (1999) analyzed the stability of the long-run relationship of the demand for money in South Africa with the three different definitions of money, namely M1, M2 and M3. His empirical analysis concluded that there exists a stable long-run demand for money function for M3 in South Africa, while the other monetary aggregates have shown parameter instability following financial reforms since 1980. On the other hand Moll (1999) showed that there was no stable long run relationship between nominal or real variables and monetary aggregates, M3. He argued that though the South African Authorities managed to reduce inflation, that objective was not achieved through M3 targets, since the realized growth rate of M3 fell outside the target for most part of his analysis. His argument was that inflation control by the authorities may not necessarily have been via money supply, but instead could stem from interest rates on real activities. This was further supported by Nell (2003) in his study on the stability of money demand, defined as M3 and monetary growth targets. He argued that broad monetary base provide insignificant information to predicate the future of inflation in South Africa. He concluded that M3, become unreliable indicator for monetary policy. Hence, he states that money stock is endogenous, with inflation determined by money through the stable monetary aggregates. While Nell (1999) found a stable long run relationship

between M3 and its determinants, findings by others (Moll, 1999; Nell, 2003) raised doubt about the stability of M3 as a policy tool for the South African Authorities. This is one reason that motivates a justification to conduct the current study in order to confirm or reject some of these previous findings.

According to Laidler (1985) and Dudley (1948), the analysis of money demand was greatly stimulated by Keynes' approach to money demand, which is elaborated in his General Theory of unemployment. The Keynesian approach was to analyze the demand for money according to three motives namely: transaction, precautionary and speculative demand for money. Keynes states that people have transaction motives in order to purchase goods and services, while the precautionary motive is to take precaution against unforeseen events. On the other hand, speculative demand for money stems from uncertainty about the future prices of bonds and this demand is more responsive to the change in the rate of interest (Rose, 1986).

Keynes further extended his argument to what is known as the liquidity preference theory, which established a negative relationship between money demand and interest rate and a positive relationship between money demand and income. The Keynesian argument is that people hold less money when interest rates go up since this is an incentive to save and earn more returns, and it is also costly to borrow money, while people will hold more money when interest rates are low, since the opportunity cost of holding up would also be low.

Friedman (1956) argued that interest rates have little effect on demand for money, which, is in disagreement with Keynes' demand for money theory. Friedman treated money as an asset and he states that money demand should be a function of permanent income and the expected returns on alternative assets relative to expected return on money. Friedman's demand theory is relatively stable, because he argues that a constant money supply growth rate would in practice ensures the highest degree of macroeconomic stability which could realistically be achieved, since it would imply a stable increase in aggregate nominal income.

James Tobin (1947) investigated the demand for money by using data from the United States of America (U.S.A.) and his findings support the Keynesian argument that there exists a negative relationship between money demand and interest rates. In his work, James Tobin (1947) analyzed portfolio allocation between money and bond holdings, with the interest rates being the expected returns on bond. He showed that there exists a need for transactions for money to smooth the difference between income and expenditure. Thus means that when ever the interest rate increases, the return on bond holding increase and transaction for money declined. Within his framework, an increase in the rate of interest can be considered as an increase in the payment received for undertaking any risk, which confirms the Keynesian theory.

Meltzer (1963) used different kinds of interest rates, income and monetary aggregates on the United States data from 1900 to 1958. He concluded that interest rates and non-human wealth are important variables in explaining the demand for money. He also found that the M1 definition of money gives better results than other definitions of

money, when used to estimate the money demand function. In their article, Goldfeld and Sichel (1990) cover money demand models that focused on M1. They found that the M1 definition of money produced better results than other definitions for the United States' economy. Wealth was an appropriate variable, but did not add much to the explanation of money demand in the short-run. They found that wealth was highly sensitive to changes in interest rates. By incorporating the price level, they found that money demand is homogeneous with respect to price.

From the literature, it is clear that the introduction of interest-bearing assets in the early 1980's into the monetary aggregate made it difficult to construct a narrow measure of money which is dependent on transaction and therefore on economic activities. Furthermore, in the mid-1990s narrow measure of money was distorted more when banking institutions started transferring funds from non-interest bearing checking accounts to savings accounts at a high frequency, leading to an increase in checkable deposits and reclining in bank's reserves liabilities (Carpenter and Lange *et al.*, 2002).

Hayo (2000) examined the demand for real money for M1, M2 and M3 in Austria, one of the smaller open economies and a member of the European Monetary Union (EMU). The results suggested that there exist a long-run equilibrium for all the monetary aggregates employed in the study. Further, Hayo accounted for structural breaks in 1979 due to change in exchange policy and banking regulations and found that structural breaks did have impacts on narrow money, M1. According to his findings there was no significant relationship between M1 and the rate of interest, while M1 was found to be unitary elastic of real income. He concluded that the broader monetary

aggregate, M3, is preferable in a short-horizon target, because the long-term relationship between M3 and its determinants is less influential and appears to be less vulnerable to structural changes.

Pradhan and Subramania (2003) in their article argued that developing countries that have undergone extensive reforms in their financial sectors will lead to a further distortion of measuring the stability of M2. While Jonsson (2000) in his article on inflation, money demand and purchasing power parity in South Africa argues that shocks to broad money has a temporary impact on real output, before that impact has been translated to inflation. He further states that in a developing country with well developed financial sectors M3 is a better and more stable indicator for future inflation rates than other monetary aggregates and he also establishes that broad monetary aggregates have a negative relationship with interest rates. In the South African context M3 includes the demand for reserves by commercial banks locally as well as within the region, which makes M3 a good measurable variable to control inflation. The choice of M3 is also relevant for South Africa because the South African Reserve bank has been targeting broad monetary aggregate instead of the other monetary bases such as M1 and M2.

Some empirical studies have been conducted on the demand for money in developing countries. For example, Haliuiglu and Ugur (2005) found that in developing countries money demand is a function of interest rates, the expected rate of change in price (inflation rates) and current income when using narrow money aggregate as a target of monetary policy. They also concluded that stable money demand function in

developing countries reduces the uncertainty associated with the financial environment and increases the creditability of Central bank to pursue an effective monetary target.

Ikhide and Katjomuise (1999) did a study on the demand for money in Namibia. They found that real income and expected inflation rates are the appropriate scale and opportunity cost variables for the demand for money function. Carruth and Sanchez-Fung (1997) used data from the United States of America to estimate money demand in Dominican Republic. They found that foreign interest rate can serve as a proxy for the opportunity cost of foreign monetary developments and appears to have some significant effect on money demand behavior in the Dominican Republic. They also estimated the demand for developing countries using various proxies for financial innovation and they found that financial innovation played an important role in determining money demand functions.

In his article on the demand for money function in Uganda, Kararach (2002) argued that the definition of money for policy purpose depends on two considerations: the ability of the monetary authority to control the quantity, and the empirical stability of a function describing the demand for money. If money adjusts to the level of economic activities, then it is likely that the authorities' have the ability to control the monetary tool. He also argued that the monetarist views of dynamics of less developed economies are ineffective in regulating the economy. The study revealed that the demand for money function in Uganda was unstable and monetary policy could be achieved with other policies. Further, he states that central bank independence would also play a mayor role

in economic growth and structural reforms especially in less developed countries that have a low financial innovation.

The choice of model specification and estimation techniques is another significant consideration. Until the evolution of cointegration techniques most money demand models have been estimated in log-levels. This is evident from early application of cointegration to a money demand function such as Johansen and Juselius (1990) and Goldfeld and Sichel (1990).

Engle and Granger (1990) conducted empirical work on money demand and argued that econometrics estimation evolved substantially during the early 1980's. The use of nonstationary data common in time series led to the problem of spurious regression results, characterized by high correlation coefficients, incorrect signs and insignificant t- and F-statistics. To take care of the time series problem, analysts started using first-differenced time series in estimating money demand equations and this was found to be relevant and/or consistent with theory. However, first-order differencing neglects valuable information regarding the long-run relationship between variables. On this basis these issues of integrating short-term dynamics with the long-run equilibrium was first addressed.

In this paper, all variables employed will be integrated to first order and be tested for stationarity before the long-run relationship is established and the short-run dynamics determined by way of an error-correction model. The current study will use cointegration and error correction techniques in the context of an Autoregressive

Distributed Lag (ARDL)<sup>5</sup> model introduced by Pesaran and Shin (1999). The ARDL is an extension of a model introduced by Johansen and Juselius (1990) and Engel and Granger (1990) as it accounts for their limitations.

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<sup>5</sup> For more information with regard to ARDL model see chapter four

## CHAPTER FOUR

### MODEL SPECIFICATION AND METHODOLOGY

#### 4.1 Methodology

The paper uses econometric techniques to estimate the demand for money in South Africa for the period 1965 to 2003. Since the paper use time series data that is subject to nonstationarity due to trends, we employ unit root tests to test for stationarity of the different variables used. Once a variable is found to be nonstationary, statistical methods are used to ‘detrend’ the data through differencing. Then, the paper uses a technique known as cointegration to establish a long-run and short-run relationship between the different variables. Unit root or stationarity tests are performed on all variables to be estimated to avoid spurious regressions. This is done in a two-step framework, where the first step involves the estimation of the long-run equilibrium of the variables, the cointegrating vector, and in the second step this information is included into a model of short-run dynamics as an error correction term.

#### 4.2 Model specification, data description and source

The theoretical basis for the demand for money function follows the Keynesian model of money demand, which is defined as:

$$m = f(y, cpi, tb) \tag{1}$$

Where  $m$  is real money demand,  $y$  is real output,  $cpi$  is the rate of inflation and  $tb$  is the real rate of interest. This is the model adopted in this paper, which in log linear form can be stated in equation 2 as follows:

$$\ln M_t = \alpha_0 \ln Y_t + \alpha_1 \ln Tb_t + \alpha_2 \ln Cpi_t + \varepsilon_t \quad (2)$$

The variables used in the paper are defined in table 4.1 and the t-subscript is suppressed for convenience. The source of the data used in the paper is the IMF International Financial Statistics CDROM.

**Table: 4.1 Sources of variables employed in the study**

<b>Variable</b>	<b>Description</b>	<b>Expected Sign</b>
M	Real money demand, defined as M3	
Y	Gross Domestic Product (GDP) in real terms	Positive
Tb	Real interest rate using treasury bills as a proxy	Negative
Cpi	Consumer Price Index	Negative

Source: Author's Own Construct

The expected signs are based on theory and the coefficients that capture the statistical relationship between the dependent and the independent variables are denoted by  $\alpha_t$ , while  $\varepsilon_t$  denotes the disturbance term. Annual time series data from 1965 to 2003 is used to estimate and analyze the demand for money in South Africa. All data figures are expressed in the South African currency, the Rand and converted to natural logs.

#### **4.2.1 Scale variables: Income**

The level of income is used as proxy for the transaction in the economy and has therefore been widely used in empirical work of money demand (Nell, 1999; Moll, 1999; Jonsson, 2001; and Nell, 2003). For this reason, the current study uses GDP as a proxy for the level of income.

#### **4.2.2 Opportunity Cost Variables**

The expected inflation and domestic interest rates are intended to represent the opportunity costs with respect to holding physical assets and domestic financial assets. The rate on treasury bills is used as proxy for interest rate, given their stability relative to other interest rates. Treasury bill rates are included to capture the opportunity cost on money holding. The rates on treasury bills present commercial banks with less hazard and stable returns when compared with other interest rate variables, such as deposit rates.

#### **4.3 Stationary**

A time series is stationary if its mean, variance and covariance are constant through time. If we assume that  $Y$  is a time series, then series  $Y$  is weakly (covariance) stationary if the following three properties hold:

The mean is constant through time,  $E(y_t) = \mu$  (3)

The variance is constant through time,  $E[(y_t - \mu)^2] = \text{var}(y_t) = \chi(0)$  (4)

The covariance depends only upon the number of periods between two values

$$E[(y_t - \mu)(y_{t-\tau} - \mu)] = \text{cov}(y_t, y_{t-\tau}) = \chi(\tau), \tau = 1, 2, \dots \quad (5)$$

Models that contain non-stationary variables in the data can produce spurious regression results. The results could indicate existence of statistically significant relationships between variables shown by high R-square and other statistical diagnostics that may not be correct. Interpreting incorrect results as correct could lead to false conclusions with serious economic policy implications that could misguide the authorities.

In order to avoid the problem of spurious regression, trended data is differenced a minimum of time to generate a stationary series. A series is said to be intergraded of order one (d) or I(1), if it is stationary after differencing it once.

#### 4.3.1 Test for stationarity

Stationarity can be tested using a diagram known as the correlogram or by using statistics based on significance to test for the existence of unit roots. In this paper we employ the unit root test first developed by Dickey and Fuller. The Dickey-Fuller (DF) test is applied to regression analysis in the following forms:

$$\Delta X_t = \delta X_{t-1} + \mu_t \quad (6)$$

$$\Delta X_t = \alpha_1 + \delta X_{t-1} + \mu_t \quad (7)$$

$$\Delta X_t = \alpha_1 + \alpha_2 t + \delta X_{t-1} + \mu_t \quad (8)$$

Where  $X$  denotes the variable to be tested and  $t$  denotes the time trend. In all the equations the null hypothesis states that  $\delta = 0$ , which implies the existence of a unit root. Rejecting the null hypothesis implies that the series are stationary. The main drawback of simple DF test introduced thus far is that it is based on the AR (1) processes. The use of the standard DF test critical values would be invalidated if the error term in the test is correlated over time, violating the white noise assumption of the DF test. To correct for the possibility of autocorrelation, the paper uses an Augmented Dickey-Fuller (ADF) test that takes into account any auto correlation present by entering lagged values of the dependent variable in the regression:

$$\Delta x_t = \mu + (\delta - 1)x_{t-1} + \sum_{i=1}^n \eta \Delta x_{t-i} + \mu_t \quad (9)$$

Where  $\eta$  is chosen to ensure that the residuals are white noise. The t-statistics on  $\delta - 1$  is used instead of the basic DF critical value. The ADF test statistics have the same asymptotic distribution as the DF test statistic, such that the same critical values can be used (Greene 2003).

#### 4.4 Cointegration

Theoretically cointegration is defined as a long-run relation of variables that are linked to form an equilibrium relationship when the individual series themselves are non-stationary in their levels, but become stationary when differenced. For two series to be cointegrated they must have comparable long-run properties. This means that

individual series could be unstable and diverge from each other over a shorter period, but converges towards equilibrium over the long run. However, when two series are integrated of the same order and are non-stationary while their combination is stationary over time, causal relationship is said to potentially exist between the two series.

It can then be stated that cointegration highlights the existence of a long-run equilibrium to which the system converges overtime. The error term or the residual obtained from the long-run equation can be stated as the distance or disequilibrium at time  $t$  (Gujarati, 1995; Greene, 2003).

#### **4.4.1 The importance of cointegration**

Cointegration provides formal techniques to avoid the problem of spurious regressions of non-stationary series. It reinforces the use of ordinary least square for the estimations of equations in simultaneous equation models since it can be shown that consistent coefficient estimates can be obtained via ordinary least squares (OLS) of a cointegration equation. Finally, both the long and short run relationships are identified (Greene 2003)

#### **4.4.2 Test for Cointegration**

Empirical investigation of long-run equilibrium of time-series variables has resulted in several econometric methods in the last two decades. Univariate cointegration which includes Engel and Granger (1987)'s two step method by using

OLS; Multivariate cointegration by, Johansen and Juselius (1990) with the maximum likelihood procedure are widely used in empirical research. The autoregressive distributed lag (ARDL), which deals with single cointegration was introduced by Pesaran (2001).

Two of the important tests used in modern research in cointegration are the Engle-Granger and Johansen and Juselius procedures. The Engle-Granger procedures investigate the possibility of cointegration in bi-variate models. The existence of cointegration between a set of economic variables provides statistical foundation for the use of the error-correction model (ECM). The ECM depicts a clear distinction between long-run and short-run parameters. This gives an excellent framework to assess the validity of the long-run implications of theory as well as estimating the dynamic process involved (Haligioglu and Ugur 2005). The major limitation of Engle-Granger approach is that it assumes uniqueness of the co-integrating vector. For more than two variables, the approach does not provide a sufficient framework.

The Johansen-Juselius approach is based on a vector autoregression (VAR) framework. This approach can be used to investigate the possibility that there exist more than one co-integrating vector. The Johansen-Juselius procedures can also be used to counter-check the single equation framework in the Engle-Granger approach. Complications of identification issues arise when applying the Johansen-Juselius procedure in empirical analysis. The researcher is then required to provide an economic interpretation of the relationships identified. In addition the number of significant co-

integrating vectors found is often dependent on the length of the lags chosen for the VAR, so a careful reduction tests are called for (Greene, 2003).

The autoregressive distributed lag (ARDL) approach, which deals with single cointegration introduced by Pesaran (2001), is also used in recent empirical studies of the demand for money. ARDL model considers the long-run relationship between two or more variables. In the ARDL model all variables are in levels of first-order error correction model (ECM), because the ARDL model uses variables up to lag one. The ARDL model assumes that the residuals are serially uncorrelated and homoscedastic. The ARDL model is a useful approach, because it offers an alternative way to estimate cointegration coefficients, which may have some finite advantage over Engle-Granger approach. Patterson (2001) argues that ARDL model can accumulate more information in the regression results that produce better properties of the estimators.

The ARDL model was chosen in our study to ensure that co-integrating vector is unique and that the distinction between long run equilibrium and short run dynamics is adequately represented. The advantage of the ARDL model approach to cointegration analysis is that it offers explicit test for existence of a unique cointegrating vector, rather than assuming uniqueness. Another advantage of the ARDL model approach to cointegration analysis arises from the circumstances under which we are not entirely certain of the univariate time series characteristics of the data employed in analysis.

Pesaran (2001) demonstrates that a valid asymptotic inference on short- and long-term parameters can be made under least squares estimates of ARDL model that provided the order of the ARDL model, which is appropriately augmented to allow for

contemporaneous correlations between the stochastic components included in the estimation. Hence, ARDL will be applicable even where the explanatory variables are endogenous and since the existence of long run relationship is independent of whether the explanatory variables are I(0) or I(1) , the ARDL remains valid irrespective of the order of integration of the explanatory variables. Further, the ARDL model has the advantage of not requiring the identification of the precise order of integration of the data to be used in analysis (Haligioglu and Ugur 2005). In general, the ARDL enjoys more advantages over the Johansen technique.

An ARDL model representation of equation 2 is formulated as follows:

$$\Delta \text{LnM}_t = \alpha_0 + \sum_{i=0}^m \alpha_{1i} \Delta \text{LnM}_{t-i} + \sum_{i=0}^m \alpha_{2i} \Delta \text{Lny}_{t-i} + \sum_{i=0}^m \alpha_{3i} \Delta \text{Lntb}_{t-i} + \sum_{i=0}^m \alpha_{4i} \text{Lncpi}_t + \alpha_5 \text{LnM}_t + \alpha_6 \text{Lny}_t + \alpha_7 \text{Lntb}_t + \alpha_8 \text{Lncpi}_t + \varepsilon_t \quad (10)$$

The ARDL model presented in equation (10) gives the unrestricted error correction model. The error correction model is a useful tool which accounts for deviation (disequilibrium) of the pair of variables from their equilibrium. The existence of at least one cointegration vector among the variables implies that ECM can be estimated. The ECM estimation yields the instantaneous effect (short-run impact) as well as disequilibrium (from the long-run effects) and the adjustment coefficient. The long-run and error-correction estimates of the ARDL model can be obtained by

estimating equation (10). At the second stage of ARDL cointegration method, it is possible to test for stability of the parameters.

Where the coefficient on the lagged money demand variable depicts the speed of adjustment parameter. This parameter measures the speed at which money demand deviates or converges to its equilibrium level. Depending on the cause of the deviation, the adjustment requires that money demand either move progressively towards a new equilibrium level, or return from its temporary deviation to the equilibrium value.

At the second stage of ARDL cointegration method, it is possible to perform parameter stability testing. The stability of coefficient of money demand equations are tested by means of Ramsey's RESET stability test which requires a priori knowledge of structural breaks in the estimation period which is its shortcomings (Gujarati 1995).

#### **4.5 Structural Changes**

During the period under review South Africa underwent a number of economic and political changes. These include financial and credit controls in the late 1980s, financial sector liberalization, change in political and exchange regimes, to mention but a few. In order to account for these changes, the paper is testing for the impacts (if any) of structural breaks.

The paper will employ dummy variables to account for the various changes that took place during the study period. We define a variable D01 to account for structural breaks during the 1980's to 1990, which include financial and credit controls and financial sector liberalization. Another variable D94 accounts for possible structural

breaks associated with political and exchange regimes. This dummy variable can be divided into two to account for each regime change, which took place around the same periods between 1994 and 1995. One of these dummy variables can be omitted to avoid the dummy variable trap.

The study first estimate money demand as presented in equation 10 and the results are presented in table 5.2. Then an additional model with the dummy variables is estimated to account for structural breaks.

#### **4.6 Diagnostic tests of the Model**

The diagnostic test is used to investigate whether the model conforms to basic statistical requirements based on the classical assumptions of Ordinary Least Squares (OLS) regressions such as homoscedasticity, normality, no serial correlation and correct functional form.

The assumption of homoscedasticity refers to a stable variance of the error term, which becomes a violation if it is heteroscedasticity. Main deficiency of heteroscedasticity is that the estimates of the regression are unbiased but their variance is biased. The serial correlation assumption is that the residuals in time series data are correlated over time. In the study we used the Autogressive Conditional Heteroscedasticity (ARCH) which is a Lagrange multiplier test for conditional heteroscedasticity.

The study uses the Jarque-Bera (JB) test to test for normality. The Jarque-Bera test follows the chi-square distribution with two degrees of freedom. To test the null

hypothesis of normally distributed model, the JB test means that we can reject the hypothesis that the residuals are normally distributed, if computed p-values are sufficiently low. In case of reasonably high p-values, we do not reject the normality assumption.

The test for functional form in our model is of the Ramsey's RESET test. This is to test null hypothesis of correct specification of the model. The null hypothesis is rejected for no correct specification if the computed values are more than the critical values of Chi-square or if computed p-values is relatively very low.

#### **4.7 Stability tests**

Stability test is performed only on the error correction model, because it account for both the short-run dynamics and the long-run relationship. The paper further employs the CUSUMS and CUSUMS of squares test for stability of the money demand equation. The stability test can also be used to determine the impact of structural over the study period.

## **CHAPTER FIVE**

### **INTERPRETAION OF RESULTS**

#### **5.1 Results**

In recent studies in time series model specification and methodology required empirical verification of the existence of long-run relationship among variables. This hypothesis will be employed using cointegration, which involve the assessment of long-run relationship among variables and error-correction which involved the impact variables converge to the long-run equilibrium level.

#### **5.2 Unit roots tests**

We perform Augmented Dickey-Fuller (ADF) tests on all variables of the series compiled in this study. The analysis of unit root test is shown in Table 5.1 bellow. The tests were carried out in levels and first differences and were performed by including both constant and a deterministic trend in the regressions.

**Table 5.1: Unit root results**

<b>Variable</b>	<b>Constant</b>	<b>Trend &amp; Constant</b>	<b>Level of integration</b>
Lrm3	0.075896	-1.22816	I(1)
Ly	-0.662325	-0.342581	I(1)
Ltb	-2.546251	-2.898789	I(1)
Lcpi	-0.939770	-0.933899	I(1)
$\Delta$ Lrm3	-12.44990	-12.43137	I(0)
$\Delta$ Ly	-6.561943	-6.607711	I(0)
$\Delta$ Ltb	-6.520204	-6.564089	I(0)
$\Delta$ Lcpi	-2.607727	-2.43067	I(1)

Note: these tests were performed by including both a constant and a deterministic trend in the regressions

The critical values for ADF test at the one percent and five percent confidence levels are -3.478 and -4.101 respectively. The ADF tests accepted the hypothesis of nonstationarity for all variables tested in levels. After first differencing, the ADF tests reject the hypothesis of nonstationarity. With exception of the ADF test for inflation or *Cpi* series, which does not reject the null of nonstationarity at five percent confidence level. All other series reject the null at even one percent confidence level.

Our findings show that most of the series are stationary to the first order, which implies that we can test a possible long run relationship between real money balances and their explanatory variables as presented in chapter four.

### **5.3 Cointegration Results**

The results presented in table 5.1 shows that there is a long-run relationship between real money balances and the explanatory variables, which allows a test for cointegration to assess the stationarity of residuals and examine the existence of a long-

run relationship between money demand and its determinants. The long-run results are presented in table 5.2.

**Table 5.2: Long-run model given by equation 2**

<b>Variable</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>T-Value</b>	<b>Prob.</b>
Lry	1.113128	0.091977	3.388695	0.0000
Ltb	-0.049405	0.03916	-2.065783	0.0465
Lcpi	-0.037974	0.019117	-1.986399	0.0055
c	-1.311904	0.747936	-1.754034	0.0884
D01	-0.072168	0.08640	-3.871735	0.0005
R =0.96				
RSS = 0.072				

The results suggest that real money demand is significantly influenced by real income, interest rate and inflation rate. These variables are significant at one percent and the coefficients for all variables in the long-run have the expected signs. The results show that an increase in real income led to an increase in the demand for money, which is in line with theory. On the other hand, increases in the rate of interests and inflation respectively cause money demand to go down as predicted by theory. The dummy variable, D01 for credit control is significant at one percent and shows that an increase in credit controls led to a decrease in the demand for money as expected. The inclusion of dummy variable for regime has yielded insufficient results and is dropped from the model. It means that politics or regime change did not have major impact on money supply during the current period. The R-square of 0.96 is reasonably high suggesting

that in the long-run about 96 percent of the variations in money demand are explained by the variation in real income, interest and inflation rates.

The cointegration relationship on the variables used in the model produced an error-term that is stationary at one percent level of significance, substantiating the existence of a long-run relationship between the variables. The residuals also appear to be stationary when shown graphically (see figure A.5 in the Appendix). The estimated coefficients for variables in the long-run equation all have the expected signs in conformity with economic theories. In our residual estimates the Durbin- Watson statistic is 1.72 which is close to 2, and thus showing that the error term is not correlated over time.

### **5.3.1 Diagnostic Tests**

The standard specification tests are largely supportive for the long run model. The Lagrange Multiplier (LM) test for autocorrelation in the residuals up to order 2, shows that the  $p$ -values have no problems with autocorrelated in the residuals. *ARCH* is a Lagrange multiplier test for conditional heteroscedasticity. Again, the residuals do not demonstrate such kind of behavior.

### **5.3 ARDL Model results**

An ARDL cointegration procedure is implemented in estimating of Eq (10) for South Africa using annual data over the 1965 to 2003 period. To justify the existence of a long-run relationship among the variables in Eq. (10), we first identify the order of lags

on the first –differenced variables for Eq. (10), which is obtained from unrestricted vector autoregression (VAR) by means of Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC) and Hannan-Quinn Criterion (HQC). The estimated VAR model based on the highest values obtained from AIC, SBC revealed that the optimal order of lag is up to 2, see appendix on VAR lag order selection criterion. The results appear to provide evidence for the existence of a long-run money demand equation. These results also warrant proceeding to the next estimation of the ARDL model.

Given the existence of a long-run relationship, the next step is to use the ARDL cointegration method to estimate the parameters of Eq. (10) with maximum order of lag set to 2 to minimize the loss of degrees of freedom. An over-parameterized of the ARDL mode is estimated for broad monetary aggregates and through a process of model simplification, a parsimonious version is reported of this model. An ARDL model of the following properties (2, 2) has been selected based on the optimal length of the level variables of the long-run coefficients, several lag selection criteria such as the adjusted R, AIC and SBC.

The regression of ARDL for real money demand is estimated by OLS based on cointegrating VAR (2). The existence of at least one cointegration vector among the variables implies that an ARDL can be estimated. The ARDL model is an unrestricted ECM model. Short-run dynamics analysis is useful since it includes information on both short and long-run parameters. Long-run parameters are captured through the ARDL model. Our final reduced model is given by table 5.3 below.

**Table 5.3: ARDL Model equation 10**

<b>Variable</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>T-Value</b>
$\Delta Lrm(-2)$	-0.103968	0.140597	-0.739476
$\Delta Ly$	0.663000	0.321805	2.060253
$\Delta Ltb(-2)$	-0.049849	0.023356	-2.043833
$\Delta Lcpi$	-0.888124	0.232952	-3.812483
$\Delta Lrm(-1)$	-0.335214	0.130936	-2.560136
$Lry(-1)$	0.694842	0.205047	3.388695
$Ltb(-1)$	0.017183	0.026834	0.640353
$Lcpi(-1)$	-0.080083	0.026309	-3.043870
c	-3.046844	0.952252	-3.199620
D01	-0.04277	0.011655	-3.672804
R =0.746			
D.W = 1.53			
F- Statistics = 8.51			
RSS = 0.019			

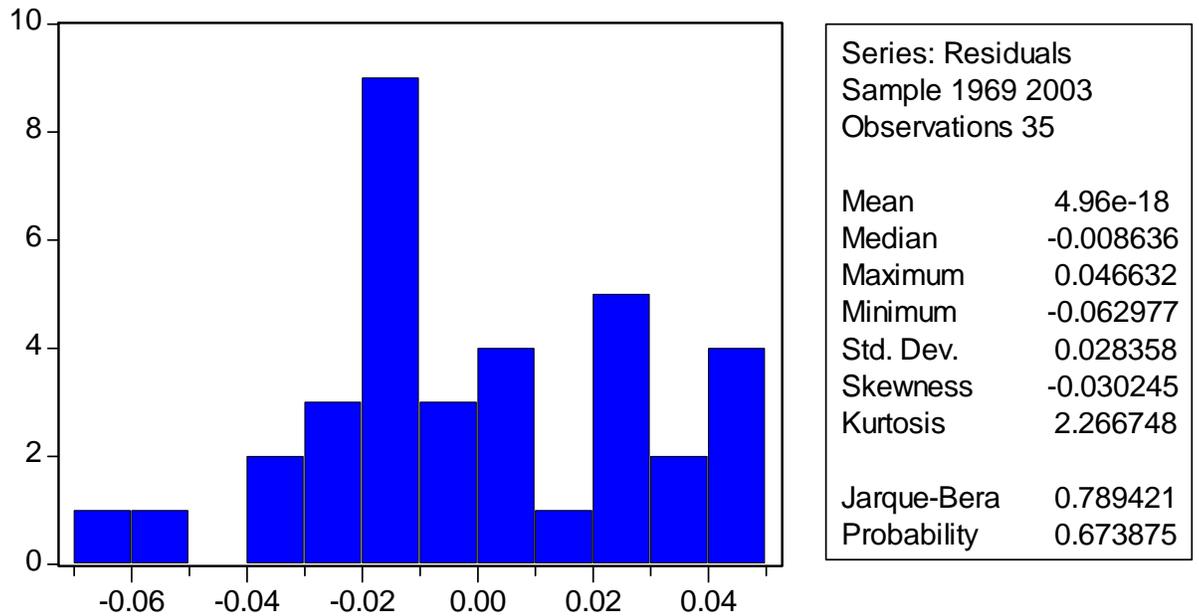
In our finding, the estimated coefficients for all variables of the included explanatory variables, that is,  $y$ ,  $cpi$ ,  $tb$  and the unrestricted ECM, has the expected sign. The ECM term is negative, thereby confirming earlier assertion that the variables are cointegrated. Both real income and inflation carries positive and negative coefficients respectively, consistent with the long-run results. The constant term carries a negative sign in consistent with the long-run results. A blemish of the short-run model is that interest rate does not carry the same coefficient sign as in the long-run. This is the main weakness of the short-run model and caution in the interpretation of the results is called for. Of importance, the coefficient of the disturbance term is highly significant at five percent level of significance, thus confirming the presence of cointegrating vector in

South Africa money demand function. Further the significance of this coefficient implies that the ECM is the appropriate approach of estimating the short-run relationship of demand for money function in South Africa. The R- square is highly satisfactory at 75 percent, indicating that 75 percent of the variation in broad monetary aggregate is explained by variation in the changes of real income, interest rate, inflation and the residual error-term. The F-test statistic of 8.51, with a p-value of 0.00, indicates that both variables jointly determined demand for money.

The coefficient for lagged real money implies a speed of adjustment of about 33.36 percent per annual of the difference between actual and long-run equilibrium. The t-statistic implies that this variable is statistically significant at one percent confident level. The coefficient represent a moderate speed as they imply that, after an initial deviation with respect to long-run relationship, about four month of the year are need for full adjustment to take place.

### **5.3.1 Diagnostic Tests**

All the diagnostic tests for equation 10 are satisfactory, and pass the standard specification tests which are largely supportive for the model. *LM* is a Lagrange Multiplier test for autocorrelation in the residuals up to order 2. The *p*-values show, that no problems with autocorrelated residuals occur. *ARCH* is a Lagrange multiplier test for conditional heteroscedasticity. Again, the residuals do not exhibit such kind of behavior. Furthermore, they are distributed as normal, as indicated by the Jarque-Bera test in the figure below.

**Figure 5.1: Jarque-Bera**

### 5.3.2 Stability tests

This section attempts to investigate whether demand for money function in South Africa have encountered structural changes over the study period and whether it can be used for a reliable predictive purposes by the monetary authorities. The study employs CUSUMS and CUSUMS of squares to test for stability on the ECM. Both the CUSUMS and CUSUMS of squares do not indicate any structural breaks in the regression coefficients. This is evident from figure 5.1 and 5.2 below. It can further be observed that the figures are statistically well within the 5 percent critical bounds. The implication is that all coefficients in the ECM are stable. This also confirmed by Ramsey RESET test that point to some linearity's in relationships of the fitted endogenous variable,

which turns out to be insignificant at 5 percent level (RESET1). It means that the model is corrected specified and stable.

**Figure 5.1**

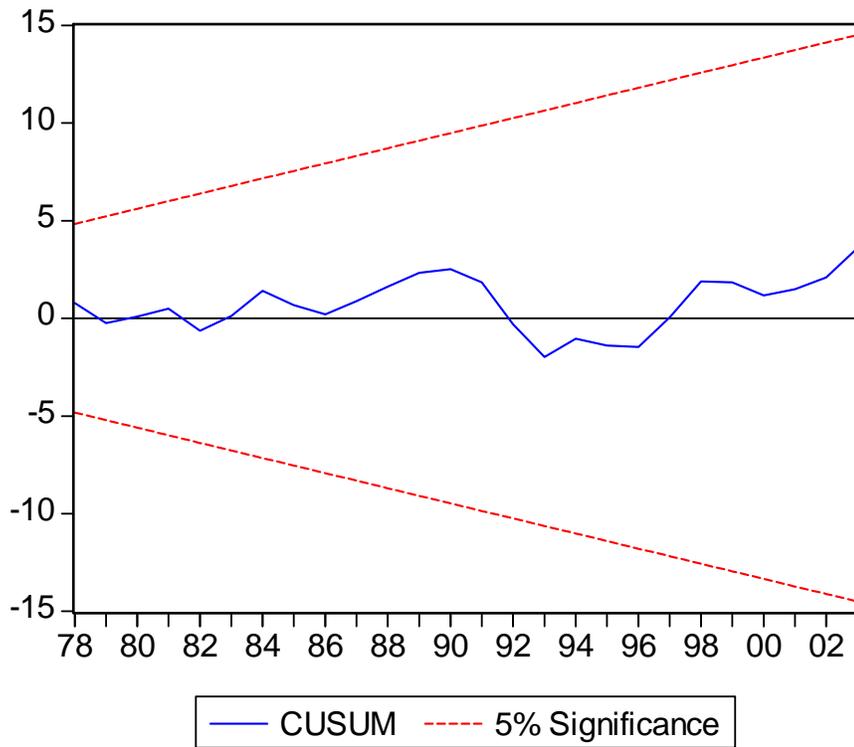
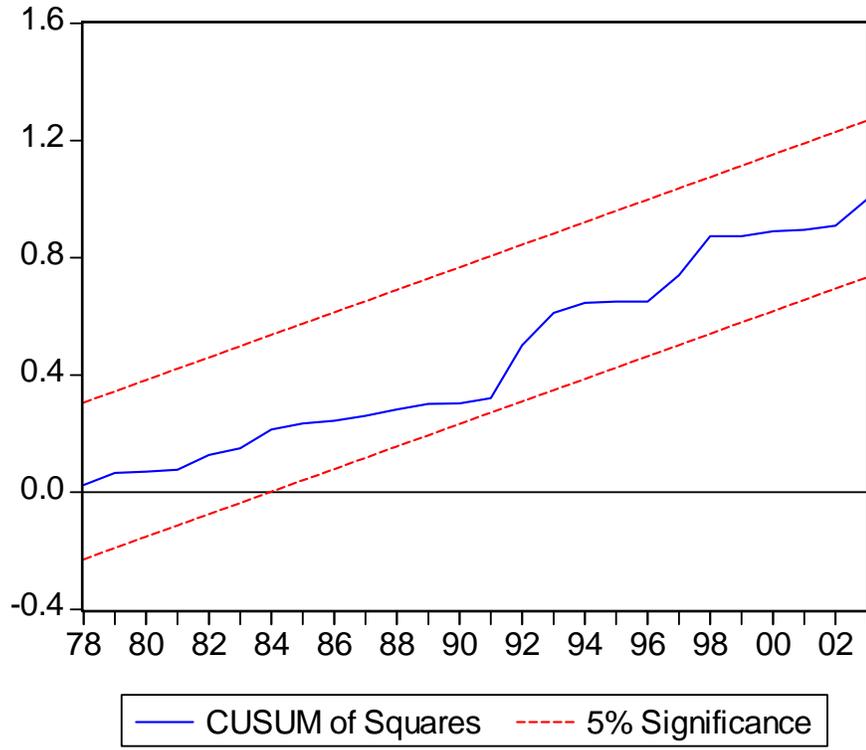


Figure 5.2



## CHAPTER SIX

### CONCLUSIONS AND POLICY IMPLICATIONS

#### 6.1 Conclusions

The objective of this paper is to estimate the demand for money using the broad definition of monetary aggregates M3. The focus of the analysis is on the stability of M3 as a policy tool in order to guide the South African authorities in their efforts of targeting inflation using M3.

The paper employs an ARDL model using cointegration and an unrestricted ECM framework. The use of the two equations technique is to address the problem of nonstationarity common in time series data, by establishing a long run and short run relationship of M3 with its determinants, through cointegration and ECM.

Previous studies found mixed results with regard to the stability of M3 as a policy tool, such that some (Jonsson, 2001 and Nell, 1999) found a stable relationship between M3 and real and nominal variables, while others (Moll 2000; Nell, 2003) could not find empirical evidence for such as stable relationship.

Nevertheless, this paper found a stable relationship between M3 and its determinants, using the CUSUMS and CUSUMS of squares tests. Knowing that South Africa had undergone several political and economical changes we tested for structural

breaks and found that changes in economic policy does have an impact on money demand, while change in political regime was found to be insignificant.

## **6.2 Policy implications**

A stable money demand function for the South African economy could serve as a guide to policy makers in their effort of targeting inflation using the broad definition of money supply. This implies that M3 as a policy tool is stable and can be used effectively. However, the South African Authorities need to revisit their upper and lower bounds when predicting M3 growth targets, as the data shows that their prediction was off the actual growth rates for most part of the study period. This in turn have implications for achieving the true inflation target using M3 as the control variable.

The results show a significant positive relationship between real money balances, M3 and the level of real income, using the Gross Domestic Product (GDP) as a proxy. The results indicate that a one percent increase in real income leads to a sixty six percent increase in the money demand. This implies that the increase in real income could make money available for transaction purposes, which would be absorbed in the economic activities.

The relationship between money demand and inflation is significant and negative as expected. This is in line with previous studies and support the theory that an increase in the general price level would reduce the value of real money balance, and hence, the demand for money. A one percent increases in inflation leads to an eighty-nine percent

decrease in the demand for real balances, M3. Both the long-run and short-run impact is highly significant suggesting that money demand is determined by inflationary factors in South Africa. This supports the use of monetary aggregates M3 to target inflation as a policy tool, currently conducted by the South African Authorities.

Interest rate is an important variable in the Keynesian demand for money model, whereby an agent is expected to hold money for transaction purposes and for speculative motives, which depends on the rate of interest. In both the long- and short-run models, the results indicate significant and negative relationship between interest and money demand as expected. However, the ARDL model produced insignificant results, with an unexpected positive sign. While theoretically one would expect a negative relationship between interest and money demand, empirical evidence reveal mixed results as Nell (1999) also found a positive relationship. The unexpected sign of the rate of interest could be attributed to the nature of the demand for money, where transaction demand accounts for the largest portion of money demand and is less sensitive to interest rates as people use money to meet basic needs. The insignificant impact suggest a less concern for policy purposes and follows the Friedman theory that interest rates have little effect on money demand. This supports the finding of Nell (1990 and 2003) as he argued that there is no constant spread between the long term opportunity cost of holding money and the rate of return. The results could also imply that in the short-run, other policy instruments could have a large interest stimulating effect.

### **6.3 Areas of further research**

For future empirical work, a choice of other opportunity cost variable, instead of treasury bill rates could be considered for demand estimation. There is also a need for future empirical work to examine in detail the relationship between money demand and inflation rate in order to shape policy efforts by the authorities. Previous empirical work on money demand in South Africa found mixed results and there is a need to clarify their findings through more rigorous work in order to substantiate the literature. Future research need to take note of the type of model and data they use and bear in mind the impact that arise from different observations and models when comparing results.

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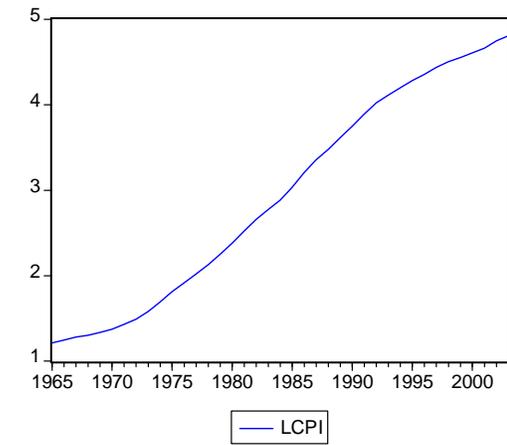
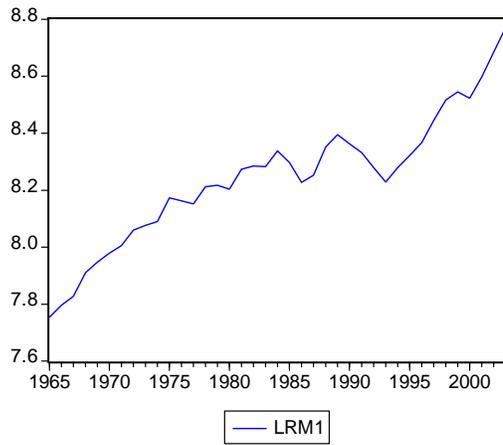
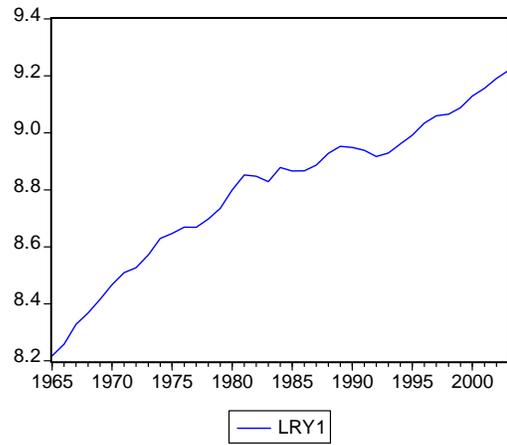
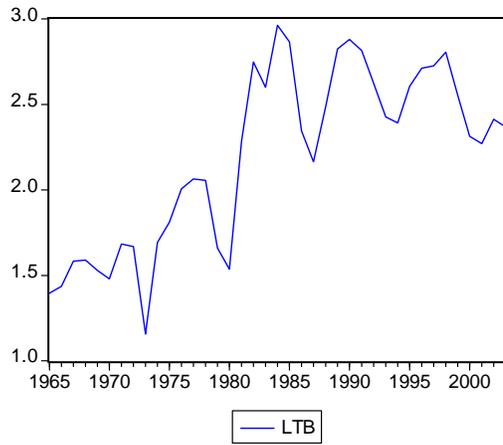
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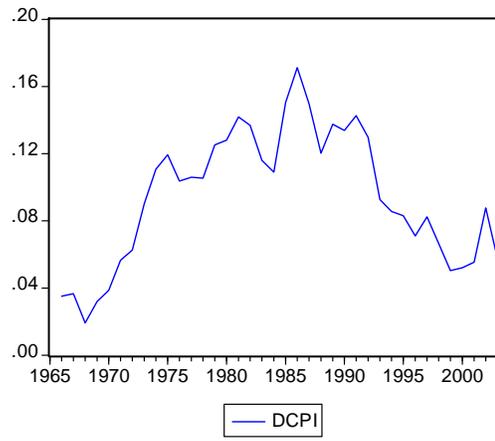
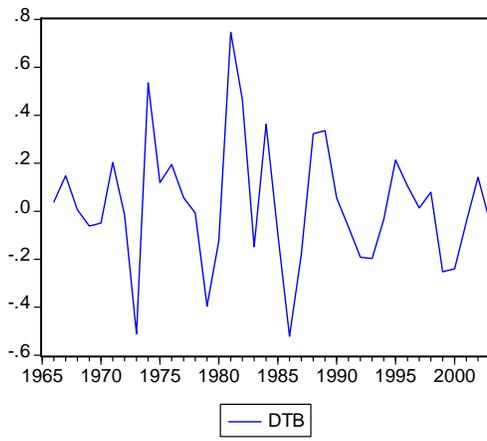
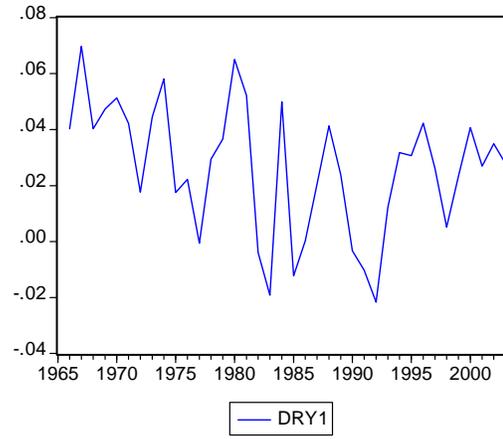
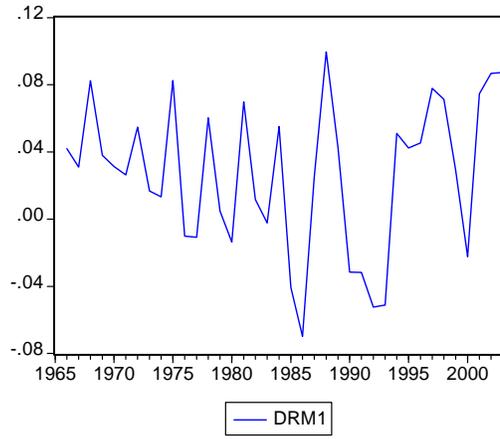
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**APPENDIX**

**A.1 Variables in levels**



### A.2 Variables in first differences



**A.3 Equation 2 Result**

Dependent Variable: LRM1

Method: Least Squares

Date: 03/21/07 Time: 23:25

Sample: 1965 2003

Included observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.311904	0.747936	-1.754034	0.0884
LRY1	1.113128	0.091977	12.10226	0.0000
LTB	-0.049405	0.023916	-2.065783	0.0465
LCPI	-0.037974	0.019117	-1.986399	0.0551
D01	-0.072168	0.018640	-3.871735	0.0005
R-squared	0.964619	Mean dependent var	8.244181	
Adjusted R-squared	0.960456	S.D. dependent var	0.230789	
S.E. of regression	0.045894	Akaike info criterion	-3.205764	
Sum squared resid	0.071612	Schwarz criterion	-2.992487	
Log likelihood	67.51240	F-statistic	231.7411	
Durbin-Watson stat	0.815744	Prob(F-statistic)	0.000000	

#### A.4 Residual Test

Null Hypothesis: EC22 has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.514267	0.1201
Test critical values: 1% level	-3.615588	
5% level	-2.941145	
10% level	-2.609066	

\*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(EC22)

Method: Least Squares

Date: 03/21/07 Time: 15:13

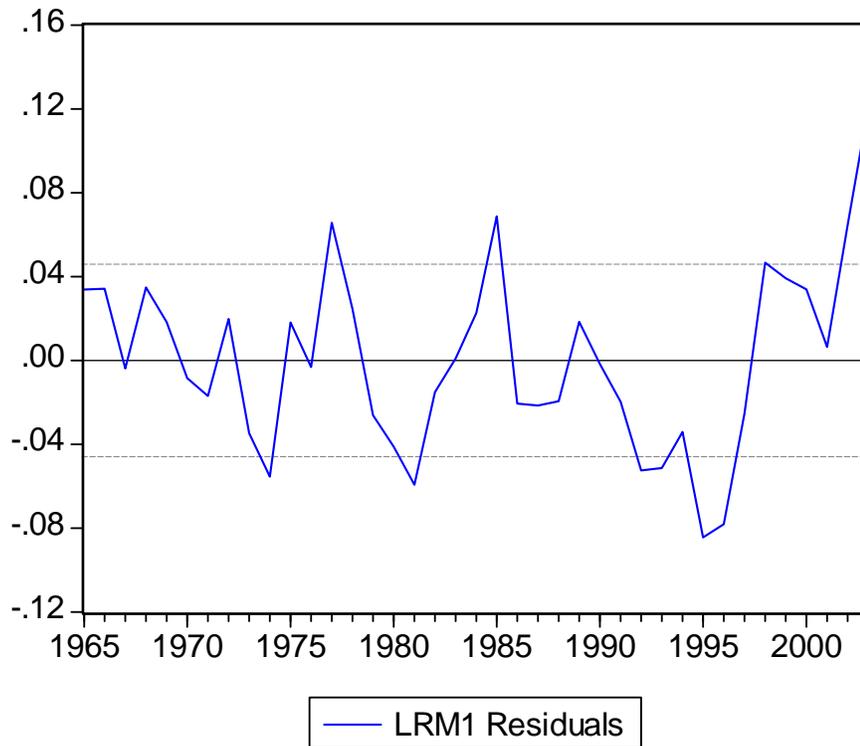
Sample (adjusted): 1966 2003

Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EC22(-1)	-0.392012	0.155915	-2.514267	0.0165
C	0.001046	0.006037	0.173268	0.8634

R-squared	0.149369	Mean dependent var	0.002294
Adjusted R-squared	0.125741	S.D. dependent var	0.039667
S.E. of regression	0.037089	Akaike info criterion	-3.699797
Sum squared resid	0.049521	Schwarz criterion	-3.613608
Log likelihood	72.29615	F-statistic	6.321538
Durbin-Watson stat	1.718661	Prob(F-statistic)	0.016538

### A.5 Residual Graph



### A.6 VAR Lag Order Selection Criteria

Endogenous variables: LRM1 LRY1 LTB LCPI

Exogenous variables: C

Date: 02/12/07 Time: 10:05

Sample: 1965 2003

Included observations: 36

Lag	LogL	LR	FPE	AIC	SC	HQ
0	38.90069	NA	1.69e-06	-1.938927	-1.762981	-1.877517
1	273.1397	403.4117	9.24e-12	-14.06332	-13.18358	-13.75627
2	303.7791	45.95901*	4.25e-12*	-14.87661*	-13.29310*	-14.32392*
3	312.6769	11.36951	6.92e-12	-14.48205	-12.19475	-13.68372

\* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

**A.7 Equation 11**

Dependent Variable: DRM1

Method: Least Squares

Date: 02/12/07 Time: 11:27

Sample (adjusted): 1968 2003

Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.046844	0.952252	-3.199620	0.0036
DRM(-2)	-0.103968	0.140597	-0.739476	0.4662
DRY1	0.663000	0.321805	2.060253	0.0495
DTB(-2)	-0.049849	0.024390	-2.043833	0.0512
DCPI	-0.888124	0.232952	-3.812483	0.0008
LRM1(-1)	-0.335214	0.130936	-2.560136	0.0166
LRY1(-1)	0.694842	0.205047	3.388695	0.0022
LTB(-1)	0.017183	0.026834	0.640353	0.5275
LCPI(-1)	-0.080083	0.026309	-3.043870	0.0053
D01	-0.042771	0.011645	-3.672804	0.0011
R-squared	0.746484	Mean dependent var	0.026225	
Adjusted R-squared	0.658728	S.D. dependent var	0.045809	
S.E. of regression	0.026761	Akaike info criterion	-4.173625	
Sum squared resid	0.018620	Schwarz criterion	-3.733759	
Log likelihood	85.12526	F-statistic	8.506392	
Durbin-Watson stat	1.534855	Prob(F-statistic)	0.000008	

**A.8 ARCH Test:**

F-statistic	1.891746	Probability	0.178558
Obs*R-squared	1.897788	Probability	0.168326

**A.9 White Heteroskedasticity Test:**

F-statistic	1.819481	Probability	0.108823
Obs*R-squared	22.75691	Probability	0.157333

**A.9 Ramsey RESET Test:**

F-statistic	0.013728	Probability	0.907664
Log likelihood ratio	0.019763	Probability	0.888201

**A.10 Breusch-Godfrey Serial Correlation LM Test:**

F-statistic	3.238903	Probability	0.056850
Obs*R-squared	7.651503	Probability	0.021802