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**THE IMPACT OF A CHANGE IN MONETARY POLICY BY
MEANS OF A MONETARY MACRO-ECONOMETRIC MODEL**

By

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**Dissertation submitted to the Faculty of Economics and Business Science
(Department of Economics) in the fulfilment of the requirements for the
M.Com degree at the University of the Free State**

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Bloemfontein

May 2001

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Oranje-Vrystaat
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CHAPTER 1 IDENTIFICATION OF THE PROBLEM AND FRAMEWORK

1.1 Introduction

Macroeconomics concerns the behaviour of the economy as a whole, and focuses on the policies and policy variables that affect the performance of the financial, fiscal and real sectors of the economy. Monetary policy, as a macroeconomic stabilisation policy, reflects monetary theory, and as the financial system is so complex in nature, it becomes virtually impossible for an individual to conceive without a theory to simplify its structure (Fourie, L. et al., 1992:3). Monetary policy frameworks are generally perceived to be a suitable means to elucidate the process of monetary policy implementation, and the presiding governor of the South African Reserve Bank (2001), Tito Mboweni, has accordingly released a statement on the new monetary policy framework to be followed by the Bank (Mboweni, 2000: 57). This statement explains how the Bank hopes to achieve price and financial market stability by means of an inflation targeting framework, and how monetary policy influences the domestic financial environment, real economic activity and inflation. It is precisely this reason that constitutes the main motivation for this study.

Central bankers generally agree on the ultimate goals and objectives of monetary policy, but there will always be a difference in opinion on the various alternative combinations of monetary policy instruments used to achieve the ultimate goal. Furthermore, volatile price fluctuations throughout the world since the early 1980's has taught central bankers that "credibility" (i.e. having the reputation for pursuing price level stability consistently and persistently) is the key to an effective anti-inflationary monetary policy (Broaddus & Goodfriend, 1996: 3). It is primarily this credibility of the central bank that has forced the need for monetary policy intentions (signals) to be conveyed more clearly and transparently to the domestic markets (Van der Merwe, 1997: 15). This greater transparency and better understanding of central bank activity in the monetary policy decision-making process is

expected to increase the effectiveness of monetary policy, since many policy decisions can now be linked to the movements and/or the projected movements in a selection of core economic variables¹.

The central bank's credibility in achieving price and financial market stability is not something new in South Africa, and has frequently been emphasised as a monetary policy goal by many of the previous governors of the Bank. For example, in the De Kock commission's final report (1985) of inquiry into the monetary system and monetary policy in South Africa, it was recommended that monetary policy should follow a market oriented approach specifically aimed at price stability. However, this did not mean that other policy objectives such as a balance of payments equilibrium, domestic growth and employment should be disregarded (RSA, 1984: A9).

In addition, a previous governor of the South African Reserve Bank (C.L. Stals) emphasised financial stability on numerous occasions. Stals originally linked monetary policy decisions to the change in the growth rate of the M3 money supply, which seemed to serve the country well during the period when South Africa was isolated from international markets and capital flows. However, as South Africa became more integrated in the financial markets of the world, the Bank was forced to move away from the formal money supply guidelines towards a more eclectic approach to monetary policy formulation and implementation. Stals nevertheless frequently expressed his concern to persevere with the need to protect the value of the domestic currency, as this was the only way to ensure a stable financial environment (see Stals, 1998: 1) and generate sustainable economic growth and development over the longer-term.

1

Some of these core economic variables refer to targets for inflation (which is gaining more and more prominence in many of the first world countries), the money supply and/or domestic credit extension, real economic activity and the prevailing balance of payments position.

Even under the new Mboweni regime, the primary objective of protecting the value of the rand remains of paramount importance, and has even been articulated in the Constitution of the Republic of South Africa and in the South African Reserve Bank Act, No 90 of 1989 (Mboweni, 2000: 57). The presiding governor states that price and financial stability are closely related. In order to achieve this, the Bank has adopted an inflation targeting monetary policy framework, i.e. where a numerical target for the inflation rate is set by the Minister of Finance and must be achieved by the Bank over a specific period of time (Mboweni, 2000: 59).

The most important monetary policy instruments in the inflation targeting framework is the way in which the South African Reserve Bank accommodates the liquidity requirements of banks. The operational interest rate charged by the Bank on its overnight loans was previously referred to as "bank rate", and has since been replaced by the repurchases rate or "repo rate" as from 9 March 1998. The repurchases rate is determined on a daily tender basis and is currently used as the main apparatus to regulate liquidity in the market (Mboweni, 2000: 62). Essentially repo or bank rate, refers to the Bank's discount policy, i.e. the central bank's credit extension to the domestic financial system to satisfy its need for cash reserves. From a monetary policy perspective, it is an absolutely crucial instrument as it enables the central bank to exert a dominating influence over the level of the market interest rates that are used in the bank's rediscounting operations (Meijer et al., 1991: 135).

The Bank's influence on domestic interest rates supposedly has a huge impact on the trend of real economic activity in the economy. There therefore seems to be an opposite link between the Bank's monetary policy initiatives, domestic demand and real economic growth. This study intends showing that it is primarily via this impact on real economic activity that the Bank can influence the trend of inflation over the long-term. The only way to measure and analyse the pass-through and magnitude changes of the key economic

variables is by means of an econometric model. The estimation and specification of the model will assist in identifying the intricacies of the financial market, and illustrate how monetary policy can be used to constrain inflation. This channel of events is commonly referred to as the transmission mechanism of monetary policy and forms an integral part of the empirical results at the end of the research paper.

1.2 Identification of the problem

Inflation is essentially a monetary phenomenon (Meijer et al., 1991: 179), and the curtailment of excessive domestic money supply growth in order to ensure domestic price stability remains the primary goal of the South African Reserve Bank. To this end, the Bank's actions are aimed at influencing the repo rate to fluctuate at a level that the Bank considers to be consistent with its final goal of protecting the value of the currency. Stated alternatively, the Bank needs to determine the level of the interest rate conducive for a given growth in domestic credit extension that it believes will offer no real threat of a further stimulus to inflation (Stals, 1998: 4).

The legitimate interest rate conducive for generating a stable financial environment can best be determined by means of a theoretical economic framework, such as a demand for money function. Reputable demand for money functions and theories pertaining to the supply of money make it possible to identify the complex behavioural patterns of the economic agents in the financial market. Any assistance in understanding the relationship between the interest rate, the financial sector and the real sector will hence contribute significantly to the monetary policy implementation process undertaken by the Bank.

Money demand theory has evolved substantially over time, but generally conforms to two main ideologies. These originate from the functions of money, and essentially concern the various motives for holding money, i.e. a transactions motive, stemming from money's

use as a medium of exchange, and an asset or portfolio motive, derived from money as a store of value (Artis & Lewis, 1991: 79). In this regard, many diverse approaches to money demand theory can be distinguished, namely classical quantity theory, Keynesian, post-Keynesian, and monetarist theory (Wachtel, 1989: 330), while later innovations such as the Baumol-Tobin inventory theoretic models and buffer stock or portfolio adjustment models have also come to the fore.

The wide spectrum of these money demand approaches indicate that there can be vast differences in the functional form of the behavioural equation which makes it difficult to accept a specific relationship without in depth analysis. It therefore becomes important to take note of these various theories of the demand for money, as this makes it easier to select the functional specification best suited to define the complexities in the South African financial system (i.e. the theory most conducive for guaranteeing price and financial market stability).

Given the various theories for the demand for money, it is not difficult to realise why the modelling of the demand for money has received so much attention in recent years. Despite the fact that many of these studies claim to offer structurally sound and stable demand functions, subsequent studies often proceed by demonstrating the inadequacies of their predecessor before commencing with their suggested alternative proposition (Hall et al., 1989: 1). It is therefore also the intention of this study to give a general description of the innovative research that has already been concluded on the South African demand for money functions.

To summarise, The South African Reserve Bank is tasked with the formulation and implementation of monetary policy. As the central bank, it has various tools at its disposal to change the supply of liquidity in the financial markets, i.e. to influence the domestic money supply and the demand for credit. The identification and specification of a set of

behavioural relationships depicting the financial sector will hence valuably assist the monetary authorities in achieving their goal of domestic price stability. The best way to illustrate the dynamic structural inter-relationships of the financial sector in relation to the real economy is by means of a set of monetary equations in the form an econometric model. This will not only augment the forecasting power of the model, but will also provide a reasonable framework in which the impact of alternative monetary policies (or interest rates) can be evaluated.

1.3 Main objective

There has been a dramatic shift in emphasis towards the use of quantifiable tools such as econometric models to identify and understand the complex intricacies of the financial market. The primary aim of this study is hence to incorporate fundamental money demand and supply theory in the construction of a fairly detailed econometric sub-model. This model should be geared towards the ultimate objective of elucidating the intricacies and inter-relationships of the monetary sector in the domestic economy. It should also have the capacity to define and measure the impacts of a monetary policy shock in order to clearly illustrate the transmission of monetary policy. The development of this model is therefore expected to not only define the intricate relationships in the macro economy, but should also offer valuable assistance in evaluating the various alternative monetary policy scenarios proposed in the study.

1.4 Specific objectives

The specific objectives of this study are formulated as follows :

- * To identify and clarify fundamental money demand and money supply characteristics and theory, and to give an overview of the evolution of money

demand models in South Africa ;

- * To empirically define a behavioural relationship (based on economic theory) for each sub-component of the monetary aggregates from M1 to M3, as well as the main statistical accounting counterpart of the M3 money supply (i.e. bank claims on the private sector) ;
- * To determine and illustrate the separate elasticities of the selected income and interest rate variables for each of the relationships described above ;
- * To give a summary and overview of the macro-econometric model of the SARB, and to graphically represent the linkage between the monetary sub-model and the main model by means of a flow-chart ;
- * To formulate and implement a series of hypothetical monetary policy shocks (interest rates) to the stationary economic system, and to highlight and analyse the dynamic impacts on the key economic variables (as suggested by the results of the main macro-model).

1.5 Research methodology

The research strategy of this study entails an initial literature study which is to be substantiated by the results obtained from the empirical research. The study is accordingly segmented into three sections, namely, the analysis of the theory underlying money supply and money demand behaviour, secondly, to empirically estimate the models regression equations and finally to evaluate the results of the monetary sub-model in a macro-economic context.

The literature study will form the theoretical foundation of the **supply** of money, which analyses the creation of money and the supply of money as a tradable commodity and to briefly describe the supply of money from the central bank's point of view culminating in the description of the balance sheet of the monetary sector. The **demand** for money is analysed within a framework elaborating the theories of money demand ranging from the classical version of the quantity theory of money, the Cambridge approach to classical quantity theory, Keynesian and post-Keynesian theories on money demand, and inventory theoretic and buffer stock approaches to the demand for money. Reference will also be made to the previous efforts of South African analysts in estimating suitable money supply and demand for money equations.

As the literature study and technical aspects embedded in the empirical research cannot be seen in isolation, both will be sufficiently utilised in the estimation of the parameters and elasticities of the equations in the monetary model. The monetary model will then be incorporated in the main macro-econometric model in order to verify and validate the financial relationships contained therein.

1.6 Framework

Chapter two will introduce and define the concept of the supply of money. It will focus on the evolution of money supply and the creation of money, as well as the use of money as a commodity and the money creation multiplier. Reference will also be made to money as a stock concept and the exogeneity and the endogeneity of the supply of money.

Chapter three examines the various theories for the demand for money, incorporating the evolution from the classical version of the quantity theory of money to the Cambridge approach to the demand for money. Keynes's liquidity preference theory will be highlighted by means of his three demand motives, i.e. transactions, precautionary and speculative.

The chapter will conclude with a brief description of the monetarist version of the demand for money function, inventory theoretic approaches and the use of buffer stock models to define the demand for money equation.

Chapter four scrutinises the theoretical and empirical research that has already been undertaken on the estimation of a stable South African demand for money equation. The modelling of the demand for money has received a considerable amount of attention in recent years. As a result, a range of new approaches have been tried and tested. This section of the study takes cognisance of these various approaches and intends expanding on these efforts to specify a structurally sound and stable demand for money function.

Chapter five introduces the concept of econometric models and illustrates the reasons and benefits that eventually caused the shift towards the use of these quantifiable tools for policy assessment purposes. It also emphasises the process of integrating economic theory, mathematics and statistics for the express purpose of quantifying the parameters of the economic relationships (for example, elasticities, propensities and marginal values etc.). This section will also make reference to the data selection and source that will be used in estimating the behavioural relationships in the model.

Chapter six defines the process of estimating the monetary model, i.e. the classification of the exogenous and endogenous variables of the model. There are basically three sections pertaining to the estimation process, i.e. the monetary aggregates, the accounting counterparts of the M3 money supply and the wide spectrum of money and capital market interest rates. All the individual deposit categories that comprise the monetary aggregates from M1 to M3 will be modelled as behavioural equations. The main statistical counterpart of the M3 money supply, namely the claims of the monetary sector on the private sector constitutes will also be determined endogenously. Money market interest rates will be primarily influenced by the change in the repo rate, while capital market rates will be

modelled to react to the supply and demand of loanable funds and the repo.

Chapter seven describes the SARB macro-econometric model in which the monetary model is to be tested. It is an econometric model consisting of approximately 200 equations and is capable of reliably illustrating the economic interrelationships between the key variables of the South African economy. This section gives a brief overview of the SARB macro-model, concentrating mainly on the major influences that are expected to have an impact on the results of the proposed alternative monetary policy scenarios.

Chapter eight presents four alternative scenarios in which the results from the simulations of the macro-model are analysed. The primary aim of this section is to illustrate the reactions of the financial variables that comprise the monetary sub-model, i.e. the monetary transmission mechanism. The first test will be to determine the model's stability and whether it is structurally sound. This stability test will be followed by a series of further exercises in which a consistent change to the exogenous and endogenous "repo rate" is implemented. These alternative scenarios will be used to evaluate the model's ability to suitably replicate the possible outcome from a change in the key monetary policy variable. This study hence makes use of the monetary model for policy simulation purposes and the results of the various alternative simulations should not to be seen as a means to evaluate the forecasting ability of the model.

Chapter nine presents a summary and final concluding remarks to the functionality of this study. It will also highlight a few recommendations for further discussion and mention a few reservations pertaining to the results that have been illustrated by the various alternative scenarios in the empirical sections of the dissertation.

It is important to note that the model put forward in this study is not a guarantee for successful monetary policy implementation, but should rather be seen as a further useful

tool in the wide arsenal of operational instruments that the Bank has at its disposal. The model and theoretical grounding of the behavioural relationships of the monetary model can hence be seen as a further step towards generating a transparent environment, i.e one that would be conducive for signalling the intentions of the central bank, and one in which these intentions are effectively interpreted by the various stake holders in the financial market. This utopian environment in which the wide range of financial market players become well attuned to the factors influencing central bank's monetary policy decisions, is therefore expected to increase the effectiveness of the central banks monetary policy implementation process.

CHAPTER 2 THE MONEY STOCK AND THE MONETARY ANALYSES

2.1 Introduction

From a monetary policy perspective, the curtailment of excessive money supply growth cannot be over emphasised. Broad money supply growth in excess of real output growth essentially means that too much money is chasing too few goods in the economy. This process can seriously undermine the monetary authorities' endeavours to maintain price and financial market stability. The supply of money hence plays an integral role in monetary policy measures aimed at constraining rising rates of inflation. Monetarists believe that the quantity of money is the dominant factor determining the level of economic activity measured in current value, i.e. money determines money gross national product (GNP) (Froyen, 1998: 259):

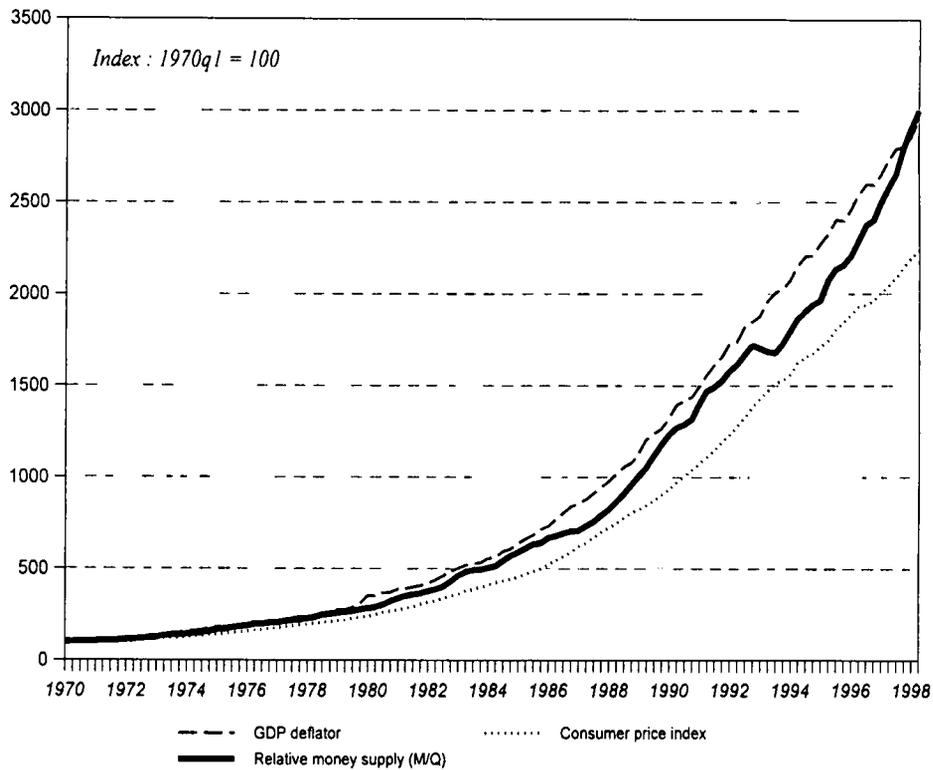
$$\text{Money GNP} = Y = P * y$$

Indicating that nominal GNP (Y) is equivalent to money GNP, and equals the real GNP (y) multiplied by the aggregate price level (P). It is the value of this product (P * y) that in the monetarist view is determined by the money supply (Froyen, 1998: 259). However, this simple relationship is ideal in illustrating the link between excessive money supply growth and inflation, i.e. if money supply (money GNP) is growing and real output (y) is stagnating, prices (P) must be rising to keep the model in equilibrium.

The afore-mentioned relationship has gained even more prominence since the De Kock report noted that the excessive and highly unstable growth in the monetary aggregates was the prime element, in both the causal (or initiating) and permissive (or accommodating) sense in accounting for the high rates of inflation experienced during the 1970's and 1980's (RSA, 1984: 155).

The following graph supports this finding and depicts the close correlation between the long-term upper trend in the general price level, as measured by the consumer price index, and the money supply after adjustment for the real growth of the economy (i.e. the M3 money supply per unit of production).

Figure 1 : GDP deflator, consumer price index and the relative money supply (M3/Q)



Source: Compiled from Data on the M3 money supply and the Gross Domestic Product at Nominal Prices :
Extracted from the South African Reserve Bank Quarterly Bulletin (December 1998)

Figure 1 shows that although the long-run trends are consistent, there is no strict 1:1 proportionality between the general price level and the relative money supply over the short-term. The persistent and accelerating rise in the gross domestic product deflator from 1970 to 1998 can therefore be seen to match the rise in the ratio of M3 to the real gross domestic product (i.e the rise in the derived relative money supply (M3/Y)) relatively

closely, and it was primarily the variations in velocity that led to the growing disparities between the trajectories of these two quantities in the short-term². In specific, the periods observed during the second half of 1979 and early 1980, and again in 1986 and early 1987, as well as in 1993 when the levels of the deflator increasingly rose above the levels "implied" or suggested by the prevailing level of the concurrent relative money supply.

Ultimately, it was these variable and erratic rates of velocity that caused the SARB to de-emphasised the significance of aggregate money growth in its eclectic approach to monetary policy implementation (SARB, 1998 : 32). In specific, the period between 1993 and 1998 was characterised by strong declines in income velocity. This was primarily the consequence of the re-establishment of money as a store of wealth, large capital inflows in the aftermath of the democratic general elections, and the process of financial deepening as more and more South African citizens increasingly gained access to the formal banking sector.

The close long-term correlation (given the variations over specific periods of time) implies that there can be no strict proportionality between the two variables shown above. Nevertheless, a quick rudimentary measurement of the elasticity between the two would reveal that the average annual rate of growth in the relative money supply (M3/GDP) amounted to approximately 12,5 per cent over the sample period, while the annual rate of growth in the consumer price index amounted to roughly 11,3 per cent. A crude calculation of the elasticity between the relative money supply and inflation seems to suggest a value of 0,90 per cent, i.e. for every 10 per cent increase in the relative money supply, inflation can be expected to increase with 9 per cent over the long run.

² See Meijer (1991) in which he attributes this to a variable rate of the income velocity of the circulation of the money supply (Meijer. et al., 1991: 183)

This relationship would therefore seem to justify the Reserve Bank's concern about excessive money supply and domestic price instability. So much so, that the previous governor, C.L. Stals, specifically stated that the policy of the Bank was to strive to achieve an average rate of growth in the broadly-defined money supply (M3) of between 6 and 10 per cent per annum. These growth rates could be regarded as consistent with acceptable objectives for the rate of inflation and the potential real rate of growth in the economy. He concludes further that although these are not absolute targets, the growth in money supply was still to be regarded as a vital element in containing inflation over the longer term (Stals, 1998: 36).

The crudely derived correlation between the relative money supply and inflation indicates furthermore that the current rate of growth in the money supply can be seen to have an important influence on the future rate of consumer price inflation and the real sector of the economy. It therefore becomes prudent to understand the evolution and dynamics of money supply and how it is generated in the financial market. A theory of interest rate determination becomes absolutely necessary to determine the level of domestic national income (P^*y), and the information obtained from the supply and demand functions for money can be used to determine the equilibrium level of the market interest rate and to derive the so-called LM schedule (Truu & Contogiannis, 1996: 106).

The following sections will therefore define the evolution and concept of the supply of money, i.e. how money is created, the use of money as a commodity and the money creation multiplier in a one-bank and multi-bank system. Money supply analyses has been developed substantially both on a theoretical and empirical level, and in most cases, the analysis is based on the relationship between the money supply and the monetary base through a multiplier (Contogiannis, 1977: 268). These multipliers are of interest in that they illustrate how the banking system operates given various alternative scenarios, i.e. what happens to the multiplier if the members of the public were to increase their demand for

currency holdings, or prefer to shift towards time deposits. The relationships also show that small variations in bank or public behaviour can lead to major changes in the money multipliers (Wachtel, 1989: 212).

The remaining part of this chapter takes a look at the endogeneity and exogeneity of the money supply. This mainly relates to the amount of control the authorities have over the supply of money, and therefore has important implications for monetary policy formulation and implementation. For example, the moment the stock of money becomes interest-rate inelastic, the multiplier cannot rise further and money stock becomes completely exogenously determined (the monetary base approach). If on the other hand, money stock remains partly interest elastic, the authorities will have a reasonable degree of control on the money stock (the flow of funds approach), and the money supply is therefore deemed to be partly endogenous (Truu & Contogiannis, 1996: 116). The study will hence also emphasise the difference between these two approaches, as well as the SARB's role in money creation and elaborating on the reasons why it has opted for the endogenous flow of funds approach.

This chapter forms the basis of the fundamental theory on the supply of money that will be used in the development of the monetary model, and is appropriately concluded with a section on the South African perspective on the supply of money and the balance sheet of the monetary sector.

2.1 Money stock and the creation of money

Money is widely used and can be seen as an absolute necessity in the diverse modern day economies. The primary role of money is to separate the acts of buying and selling of goods. In a mythical barter economy in which there is no money, every transaction would have to involve the exchange of goods on both sides of the transaction. The wants of the

two parties would therefore have to be identically matched before the transaction could take place. In this context, money is a *medium of exchange* and that is its most important function (Dornbush & Fisher, 1984: 218).

There are three other traditional functions of money, namely the store of value, a unit of account and as a standard for deferred payment. The *store of value* implies that money as an asset maintains its value over time, i.e. an individual holding a store of value can use the asset to make a purchase at some future date. Much of the money held in bank balances is held against prospective purchases of financial assets such as bills bonds and shares, and the owners of these balances are interested in the price of these securities rather than in the price of goods. A depreciating asset is obviously not a good store of value and although savers have faith in the value of money, inflation can destroy that faith leading potential savers to forsake money for other forms of wealth-holding (Struthers & Speight, 1986: 7). The *unit of account* merely refers to the price in which the product is quoted, and in which the accounting books are kept (i.e. rands and cents), and it is these rands and cents in which money stock is determined. Money as a *standard of deferred payment* refers to money that is used in long-term transactions, i.e. for transactions such as loans in which the amount to be redeemed in 5-10 years is specified in rands and cents. Money is therefore whatever substance that can generally be accepted in exchange (Dornbush & Fisher, 1984: 219).

The phrase "money supply" is often used synonymously with "money stock", although it is most frequently referred to as the "supply of money" by economists and journalists alike in reference to the actual nominal quantity of money that is in existence in the domestic economy. The proper use of this phrase is in respect of the behaviour of the money supply, i.e. the behaviour of domestic banks and other monetary institutions whose liability structures (primarily deposits) serve as part of the medium of exchange in the financial sector. The term "money stock" is normally preferred to "money supply" as this stock of

money concept refers specifically to the quantity of money in the economy (McCullam, 1989: 55). It is, of course, the acceleration in this so-called "money stock" that is of major importance to the monetary authorities, as it is this phenomenon that impedes their endeavour to achieve their objective of overall price stability.

Stock level considerations of money are primarily aimed at alternative methods to determine the quantity of money in circulation, and many economic models view the money stock as exogenous (Visser, 1974: 17). In these models, the monetary authorities (the central bank and/or Treasury) determines the level unequivocally by simply making a decision on the amount of money that they feel is adequate, i.e. which they believe should be issued in the domestic financial market. Questions relating to whether the quantity of money is "exogenous" or "endogenous" depends to a large extent on the institutional setting of the central bank and on the prevailing policy objectives of the monetary authorities. Nevertheless, it seems far more plausible to rather present the determination of the money stock as a process which results from the complex interaction of various economic agents rather than as a process dominated by an external authority (Boorman et al., 1972: 3).

It therefore becomes imperative to understand the potential factors that could alter or affect the decision making processes of the many different financial institutions (agents) in the monetary sector. These decisions (impacts) usually take place within the domestic monetary framework (market) and are crucially important in attempting to adequately analyse the supply of money, and the extension of credit. The following two terms are useful concepts to assist the efforts to analyse the behavioural patterns of the economic agents, and will be referred to throughout this study :

- *Financial assets/ instruments :*

Financial instruments are defined as an evidence of a claim against another

economic unit (an individual or institution) for the payment of a future sum of money and/or periodic payments of money in lieu of the claim. The and/or in this definition implies that either of these payments is sufficient, but that both may be promised on a specified date. In many cases there is no periodic payment, such as Treasury Bills which are issued at a discount, and repaid on the agreed date at par (Fourie, L. et al., 1992: 13).

- *Financial institutions/ intermediaries :*

Savings from income are unlikely to be matched by the economic agent's desired investment. This automatically means that some units will have a surplus of loanable funds (become an ultimate lender), while others find themselves in a deficit position (become an ultimate borrower). Financial institutions provide the conduit (financial market) to transfer the excess funds of the surplus units to the deficit units either directly or indirectly. Direct financing involves the use of a broker to match the claims of a borrower to the requirements of a lender. This tailor-made form of financing is rather difficult to affect and could result in a conflict between the two parties (i.e. as lenders generally tend to require investments (financial instruments) that differ from those the borrowers prefer to issue). Indirect financing by the financial intermediary helps to resolve this conflict by creating a market for the two types of financial instruments (i.e. one type for the borrower and the second for the lender) so that both these parties are in a position to simultaneously satisfy their financial requirements (Fourie, L. et al., 1992: 9).

2.2 The evolution of money and the South African Reserve Bank

As previously mentioned, central bank monetary policy measures are primarily aimed at curbing the rate of increase in the domestic money supply and credit extension. Maintaining the correct balance between the growth rate in the money supply and price

stability makes it necessary to take cognisance of the evolution of money and how it was initially created as a medium of exchange.

Historically, a base commodity such as gold served as money, and the domestic supply of this so-called money was left free to be determined solely by the international forces of the supply and demand for this commodity. The government essentially remained passive and the supply of gold had to come from the countries' existing stock, from current production levels or from any surpluses accrued from the international payments that were essentially settled in gold. Gold production levels were however fairly erratic and if the production of gold during a specific year was relatively small, a growing economy would require a continuous increase in gold production in order to keep the level of prices (inflation) constant. As a result, the erratic changes in the supply conditions of gold could precipitate fluctuating domestic price levels (for example the discovery and exploitation of new gold fields in the country etc). The price level may thus fall or rise for certain periods of time as a result of forces outside anyone's control, and perhaps even more importantly, subject to unforeseen changes (Visser :1974, 20).

It was these unforeseen changes and supply-side forces beyond anyone's control, that eventuated in the use of token money as an alternative to gold as a medium of exchange. This so-called token money could however not simply be issued by the monetary authorities, it also had to be accepted and respected as a medium of exchange by the stakeholders in the economy. These stakeholders (economic units) had to have confidence in the money that is issued, which essentially meant that there was a strong direct relationship between the supply of money, and the level of confidence in the monetary authorities as the money-issuers. Only as long as there is sufficient confidence in the central bank, or the bank of issue, could commodity money (gold/silver) be successfully replaced by token or paper money (Visser :1974, 22) .

Confidence in the currency of any country remains of the utmost importance, and the convertibility of deposits into some generally accepted source of value represents the cornerstone of bank intermediation. The crucial development in early banking lay in the appreciation that a proportion of the specie (whether it was gold or silver) could be left with the bankers for safe keeping and convenience. This portion kept at the bank was then made available by the banker as loans to other clients. However, the banker had to be sure that his clients would be confident (guaranteed) of converting the banker's notes and deposits back into the initial specie on sight or at notice. Failing to do so, the bank could experience a severe onslaught of withdrawals from the clients' existing balances with the bank. The contagious effect of such withdrawals, would inevitably precipitate a "run" on the bank, and bring the domestic financial sector into confusion, chaos and massive disorder (Goodhart, 1992: 15).

It was precisely this confidence in the monetary authorities as the issuer of token money that eventually lead to the establishment of the South African Reserve Bank. In the aftermath of the First World War, there was a distinct period of wide ranging financial turmoil and disruption, and the Reserve Bank was founded as a direct consequence of these unsatisfactory monetary and financial conditions. As part of a general war measure intended to prevent gold falling into the hands of the enemy, an embargo on the export of gold in either coin or bullion form from South Africa was imposed in November 1914 (SARB, 1999:22). This embargo allowed banks to expand credit and to increase their note circulations by more than they would have otherwise been able to.

Another major concern was the lack of uniformity in the issue of the various types of banknotes circulating in South Africa at the time, and there was a strong possibility of an over-issue of notes (money) by the different provinces in the country. More importantly, the establishment of the central bank came about due to the evident large illegal outflow of gold from South Africa (Fourie, L. et al., 1999: 61). The financial system and

transactions were therefore largely dependent on the physical displacement of gold holdings, and the South African Reserve Bank was required by law to maintain a minimum gold reserve ratio during the early 1920's. Under this statute, the domestic commercial banks had to acquire a minimum reserve balance by selling some of their gold certificates to the Bank. This provided the Bank with a dominant position in its efforts to influence the domestic money supply, and this specific period in time was commonly referred to as the **gold standard** which meant that gold coins and notes were redeemable in gold (Meijer et al., 1991: 253).

According to the gold standard, the management of gold and other foreign reserves occurred in a so-called automatic way, i.e. where the value of a country's money is legally defined and related to a fixed quantity of gold holdings. The domestic currency hence takes the form of gold coin and/or notes that can be converted on demand into gold at the legally determined rate (price) of tender (Pearce, 1992: 173). In this scenario, a country with a balance of payments deficit would have to surrender some of its gold in payment for its import bill. This would in turn reduce its ability to create money stock, and consequentially lead to an environment in which domestic prices start to decline (deflation). The difference in the price levels (competitiveness) between the deficit country and the rest of the world would eventuate in increasing exports from, and reduced imports to the deficit country. It was basically this adjustment process that eventually started to bring the deficit country back into a state of current account equilibrium. This adjustment process was also normally assisted by capital movements attracted to the deficit country, on account of the raised level of the discount rate in the deficit country (Meijer et al., 1991: 253).

After the collapse of the gold standard at the end of the depression year 1932, there were various improvements and amendments to the statutory restrictions regarding the Bank's lending and investment transactions, as well as its ability to grant credit. The Reserve Bank Act of 1944 came into existence as a result of the expiry of the 25-year period in

which the Bank was granted the right of sole-issue of banknotes under the Currency and Banking Act of 1920. The new Act extended the Bank's powers relating to discounts, advances and investments and allowed the Bank to grant loans and advances, discount and rediscount bills, and to trade in bills and other securities (Fourie, L. et al., 1999: 62). These facets (powers) strengthened the Bank's ability to implement effective monetary policy, and increased the awareness of the need for a flexible monetary policy and more adequate monetary policy instruments. Further changes relating to the Bank's freedom of its operations were brought together and promulgated in the Reserve Bank Act of 1989. This Act made specific allowance for the peculiar nature of the South African financial environment, and legally provided the Reserve Bank with the necessary operational instruments to stabilise the economy (Fourie, L. et al., 1999: 62).

When it comes to monetary policy implementation, the South African Reserve Bank was no different from many of the major central banks of the industrialised world. As a consequence, it followed the growing trend amongst these countries to adopt a quantitative monetary target to curb the threat of rising inflation during the 1970's. These targets led to periods of tight monetary policies during the 1980's which essentially had the desired effect of significantly reducing the rate of inflation in the money target countries, albeit at the expense of temporary periods of recession (Goodhart, 1992: 15). The adoption of an intermediate monetary target had long been propagated by monetarists who argued that the medium-term stability of money velocity, i.e. the close historical relationship between the growth in money supply and inflation (see figure 1), made monetary targets a necessary safeguard against a deteriorating (rising) rate of inflation. It moreover freed domestic monetary policy to control the rate of growth in domestic inflation by merely adjusting the level of interest rates (Goodhart, 1992: 27).

2.3 The role of the central bank and banks in the money supply process

Banks are custodians of the general public's money, which they accept in the form of deposits, and pay out on their clients' instructions (Falkena et al., 1992: 22). They are hence defined as financial intermediaries which take in funds (money), principally as deposits that are repayable to the depositor either on demand or at short notice. These funds are then employed by the bank to make advances in the form of overdrafts and loans to the general public, to discount bills, and to holding and trading in other financial assets (marketable securities). An important banking function is to maintain a money transmission system by accepting deposits from the public on current account, and operate a system in which these funds can be transferred by cheque, GIRO transfer or electronic transfer (Pearce, 1992: 28). In the past, South African banks were functionally divided into commercial, merchant and general banks. However, this distinction is no longer valid since many of these banks have moved into each other's banking spheres and now offer the entire spectrum of bank services under one roof (Fourie, L. et al., 1999: 73).

Banks in general, now operate a wide variety of money transmission services. Since money is traded in the financial market it seems obvious to simultaneously consider both the supply and demand factors. However, the discussion on the determination of the stock of money supply will focus on two specific models or approaches, i.e. the money base control (money multiplier), and the so-called flow of funds approach (banks' balance sheet).

2.3.1 *The monetary base approach*

A bank has the ability to create money on the basis of the amount of primary money or high-powered money in its possession, but not without limit. This high-powered money consists of the banks' actual currency on hand, and their deposits or reserves with the

central bank. The money supply is comprised of the deposit money that has been created by the banks in the financial system, and the primary money that is created by the monetary authorities. The central bank does not try to exercise separate control of reserves and currency, but lets the banks and the private sector decide on the composition of currency and reserves they wish to hold. By making use of open market transactions the central bank can add to or subtract from the total amount of bank reserves plus currency whenever it chooses (Hall et al., 1993: 415).

The monetary base view fits neatly into early ideology in which the equilibrium money stock is represented by an inverted demand function. If the demand for money depends only on its opportunity cost (rate on long-term government debt), then the authorities may influence the latter (with open market transactions) and slide up and down the demand for money function to achieve the desired money stock (Cuthbertson, 1985: 148). High powered money or the money base (B^s) is a subset of the liabilities of the central bank and bankers' balances at the central bank. The base may be held by the non-bank private sector (NBPS) denoted by (R_p) or the banks (R_b). The money supply (M^s) is defined as cash held by the non-bank private sector (C_p) and deposits (D) of the banking system (Cuthbertson, 1985: 166).

$$M^s = C_p + D$$

$$B^s = R_p + R_b$$

A simple money supply identity can then be derived by rearranging these two identities, i.e. one where the money supply is described by the cash to deposits ratio (C_p/D), and the reserve asset to deposit ratio (R_p/D) of the NBPS (α_p and β_p respectively), and the reserve assets to deposit ratio (R_b/D) of the commercial banks (β_b). These ratios afford the monetary authority the statutory right to diminish the banks' ability to create money by influencing their marginal net revenues, and hence allows the authorities to keep a close

scrutiny on the amount of credit that is granted by the banks.

$$M^s \equiv \frac{1 + (C_p / D)}{(R_p / D) + (R_b / D)} B = \left[\frac{1 + \alpha_p}{\beta_p + \beta_b} \right] B = mB$$

The term in square brackets is often referred to as the money multiplier m , so that changes in the money supply are the product of the changes in the base B and in the value of the multiplier. It is worth noting at this juncture that the multiplier can be composed of several ratios and the exact form of the multiplier differs according to the definition of the money supply that is adopted, the definition of the money base, and the specification of the various components (Contogiannis, 1977: 269).

Advocates of base control assert that since B may be controlled by the authorities, and as the asset ratios of the money multiplier are predictable (α , β_p and β_b), then the money supply can be predicted as well (Cuthbertson, 1985: 166). The money supply is therefore said to be **exogenously** determined, in that the monetary authorities pre-determine the supply of money to the market. Should the level of the money supply be determined **endogenously**, then the central bank would not impose any limit to the money supply, but merely provide what the market requires (i.e. the needs of the market that is determined by the forces within the economy itself, such as the rates of interest and the level of business activity) (Pearce, 1992: 126). In general, the multiplier highlights an important issue in that although the central bank may be able to determine the supply of high-powered money, the resultant money supply depends on two distinct items, namely the portfolio preferences of money holders and the statutory reserve ratios in question. Reserve ratios are largely determined by legal requirements, but the banks are permitted to hold more than these statutory requirements, which means that these ratios could

become distorted for short periods of time (Wachtel, 1989: 212).

The more traditional instruments used in the monetary policy implementation process, such as open market operations, reserve requirements and the refinancing facilities for commercial banks affect the supply of money by influencing a change to the stock of reserve money or by adjusting the money multiplier. The composition and analysis of the components of the money multiplier is hence essentially important in order to fully comprehend the change in money supply which has resulted from a change in any of these instruments or combination thereof. First, the reserves of commercial banks consist of required reserves against their demand deposits, required reserves against savings and time deposits, and excess reserves. Secondly, each of these components of reserves and currency held by the nonbank public can be assumed to be proportional to demand deposits. Given these assumptions, the money multiplier (m) can be alternatively expressed as follows (IMF, 1998: 14):

$$m = \frac{c + 1}{c + r_d + br_t + r_e}$$

where :

C = currency to demand deposits ratio

r_d = required reserve ratio against demand deposits

r_t = required reserve ratio against time and savings deposits

b = the ratio between time and savings deposits and demand deposits

r_e = excess reserves as a ratio of demand deposits

In addition, the reserve money as it is defined above (required reserves plus excess reserves), represents the liabilities of the central bank. This comprises all the deposits of the member banks with the central bank. The central bank actively makes use of open

market purchases of government bonds to increase the supply of money. Once the Bank buys the government bonds from the public, it writes a check against itself, which when deposited increases the amount of the member banks' deposits at the central bank (currency liabilities of the Bank). The increase in reserve money would increase the supply of money due to the fact that reserve money, if it is held by the public as currency, is a part of the money supply. Furthermore, reserve money which is not held by the public as currency would then flow through to commercial banks or other depository institutions which would then provide these institutions with more reserves and allow them to make more loans to the public. Similarly, by increasing the discount rate/repo rate (the cost of borrowing from the Bank), banks are discouraged to make loans and money supply declines (Wachtel, 1989: 218). In this way, the central bank controls its liabilities by controlling its asset counterparts which consist of net foreign assets (NFA*), net claims on the government (NDCG*), claims on commercial banks (DCB*), and claims on other financial institutions and other items net (OIN*). On the basis of the balance sheet identity (IMF, 1998: 13) :

$$RM = NFA^* + NDCG^* + DCB^* + OIN^*$$

The product of the money multiplier (m) and reserve money (RM) equations yields the following identity for base money (M0) :

$$M0 = \frac{c + 1}{c + r_d + br_t + r_e} (NFA^* + NDCG^* + DCB^* + OIN^*)$$

This equation illustrates that the base money supply variable on the left-hand side can be influenced by any one of these items on the right hand side (or a combination thereof), and that monetary policy can also affect the initial supply of money through changes in the

money multiplier. For example, a reduction in reserve requirements would immediately increase the excess reserves of the banking system and thereby tend to result in an increase in the supply of money because commercial banks may increase their lending which would be accompanied by additional deposits and currency outside the banks (IMF, 1998: 14).

The multiplier identity shown above would be fairly reliable for forecasting the effect of a change in the base money on money stock if the parameters r_d , r_t , r_e , C and b were stable over time, and if the monetary base and the monetary multiplier were not affected by each other. Here, the reserve ratio and currency ratio are assumed to be fixed, so that the central bank can control the money supply as accurately as it wants by controlling the money base. However, in practice, neither of these conditions seem to hold true for most countries, as the parameters that enter the multiplier tend to vary over time so control of the money supply is not so simple (Hall et al., 1993: 417). In addition there is a strong feedback between changes in reserve money and the money multiplier in today's modern open economies. For example, an open market operation which is designed to inject liquidity into the economy (i.e. to increase the monetary base) will, more often than not, lead to some sort of change in key interest rates. This in turn will affect the magnitude of the excess reserve ratio, the ratio between time and demand deposits, the currency ratio and ultimately the money multiplier (IMF, 1998: 15).

It therefore seems self evident that the monetary authority cannot operate directly on the financial quantities which policy seeks to control. The levels of employment and income and prices, and the balance of payments, are largely the consequence of expenditure decisions by firms and households. Policy operates on the variables which are believed to have some bearing on these decisions. The question arises as to the links or channels between the financial quantities and spending decisions (i.e. how does monetary policy operate?). There does, however, seem to be agreement that the financial variables do

affect the economy through its impact on aggregate demand, but how monetary policy actually works is still a matter of dispute. The source of this disagreement is the conflict between the various monetary theories and the operation of monetary policy, i.e. the transmission mechanism (Struthers & Speight, 1986: 295).

2.3.2 The flow of funds approach

The endogenous flow of funds approach (adopted by the UK) is usually contrasted with the exogenous money base control (adopted by the USA), and consists of a "package deal" approach to control the money supply. It describes the funds that are transferred (i.e. flow) from one economic agent to another as a result of their financial transactions (usually in matrix form), which takes place over a specific period of time. Another formal tool originating from the development from the flow of funds analysis, is the simple relationships that can be seen from a source and uses-of-funds matrix. This matrix asserts that the sum of all the asset components should equal the sum of the liabilities, or that the change in assets should equal the change in liabilities (Gowland, 1985: 107). From the definition of money supply it is apparent that its components form part of the liabilities of monetary institutions. To balance the consolidated balance sheet for these institutions, liabilities need to equal total assets, which means that an accounting identity for money supply will be equal to all assets less those liabilities not included in money supply (Meijer et al., 1991: 48).

The two most crucial flow of funds relationships are the government finance equation and the money supply identity (also known as the bank balance sheet equation). The government finance equation states that the amount government borrows must equal the amount that is lent to it. The *PSBR* is the public sector borrowing requirement, which in a closed economy can only be lent by either the non-bank private sector or the banking sector. Currency held by the non-bank private sector (C_p) is a peculiar form of a loan to

the public sector in that it bears no interest and in practice need never be repaid, and it is the prerogative of governments to borrow in this way, i.e. an I.O.U. as the famous wording on bank notes makes clear "*I promise to pay the bearer on demand....*". Another form of a loan by the non-bank private sector to the public sector takes the form of a government securities and bonds (*PLG*). While the final form of public sector loans take the form of Bank loans (*BLG*). This leaves the basic government finance equation (Gowland, 1985: 110). :

$$\begin{aligned} \text{PSBR} &= \Delta \text{ Currency held by the non-bank private sector } (C_p) \\ &+ \Delta \text{ Non-bank private sector loans to the public sector } (PLG) \\ &+ \Delta \text{ Bank loans to the public sector } (BLG) \end{aligned}$$

The money supply equation for a closed economy can similarly be derived in that the broad definition for the money supply (*M*) is equal to the non-bank private sector holding of the currency (*C_p*) plus all bank deposits. Since bank deposits equal bank liabilities, money supply can now be defined as currency plus bank liabilities. In a bank, convention liabilities (deposits) equal bank assets (loans), so that money supply then equals the currency plus bank loans. Bank loans can take the form of bank loans to the public sector (*BLG*) or Bank loans to the non-bank private sector (*BLP*), leaving the equation as follows (Gowland, 1985: 112). :

$$M = C_p + BLG + BLP$$

or...

$$\Delta M = \Delta C_p + \Delta BLG + \Delta BLP$$

The government finance equation can now be rewritten by moving loans to the government (*BLG*) to the left hand side and the public sector borrowing requirement (*PSBR*) to the right, and then substituted in the above equation to yield :

$$\Delta M = \Delta C_p + (PSBR - \Delta C_p - \Delta PLG) + \Delta BLP$$

where..

$$\Delta M = PSBR - \Delta PLG + \Delta BLP \quad (\text{by cancelling out the } \Delta C_p)$$

This relationship has many uses and highlights the supply side counterparts on the right hand side (i.e. domestic credit extension). For an open economy, the equation can be adjusted by merely adding the overseas impact on the money supply to the right hand side. It also highlights the debate between the monetarist and Keynesian approaches to money supply. The monetarist prescription is to allow the money supply to grow at a constant rate approximately proportional to the rate of growth in output (i.e. the money supply rule) (Pearce, 1992: 287). They furthermore argue that the size of nominal income depends only on the size of nominal money supply, and that the effect of a change in the money supply is independent on how it is created, i.e. none of these variables on the right hand side play a role. Non-monetarists on the other hand challenge this opinion and argue that the size of the money multiplier does depend on which right hand side variable of domestic credit extension changes (Gowland, 1985: 113).

What this in effect means is that fiscal and monetary policy are not independent, but are in fact interdependent. This holds true since an increase in the PSBR (fiscal policy) must either be accompanied (financed) by a change in government induced money creation (i.e. monetary policy, which comprises currency C_p , plus Bank loans to the government sector BLG), or by higher interest rates to induce a higher level of non-bank private sector loans to the government (PLG)(Gowland, 1985: 116).

The South African Reserve Bank adopts a similar *endogenous* flow of funds framework in that the monetary policy instruments work through the supply as well as the demand for credit and money to restrict (or expand) the equilibrium amount of credit and money in the financial system. Given the present inflation targeting approach to monetary policy, the

Reserve Bank's operations will remain aimed at influencing the overall lending policies of banks, and also the demand for money and credit in the economy indirectly through changes in bank liquidity and interest rates in the market. The regular repurchase transactions between the Bank and banks will hence remain the main apparatus to regulate liquidity in the market (Mboweni, 2000: 62). However, the main driving forces behind the supply of credit and money from a South African perspective are the level of economic activity (real gross domestic product), and the profits that the banks can make in extending this credit (De Wet et al., 1995: 582). The following section takes a look at the balance sheet of the South African Reserve Bank in an effort to illustrate the endogeneity of the supply of money.

2.4 The supply of money and the balance sheet of the monetary sector : A South African perspective

The operational control framework implemented by the Reserve Bank relies on the repo rate (previously bank rate) and other variables as a means of exerting an influence on interest rates in general. This framework is referred to as the **cash reserve system** of monetary control in which the Bank attempts to control the banks' credit creating ability by influencing the cash base, i.e. their balances with the Reserve Bank. This can be supplemented at certain times by varying the required cash reserve ratios of the banks. The primary aim of this approach is not to directly influence the amount of cash reserves of the banks, but to rather influence the **cost** of holding such cash reserves (SARB, 1999: 120).

Under the cash reserve system the Bank uses policy instruments such as open market transactions to influence the total cash reserves of the banks and the associated money supply. These operations are not directly used to affect the banks' cash reserves, but rather to compel the banks to make use of the Reserve Bank's accommodation facilities

through the repo system, or the marginal lending facility (a penalty rate set above the repo) at the interest rates influenced by the Reserve Bank for such accommodation (SARB, 1999: 120). In determining what is the appropriate level of interest rates, the authorities will be guided by recent movements in the money supply (as shown by the monetary statistics as well as evidence forthcoming from the financial markets that may suggest too rapid or too slow a rate of increase in the money supply). Judgement and discretion will remain the essence at all times as some trends may be purely technical and temporary (Fourie, L. et al., 1992: 301).

The role of interest rates in monetary policy under the cash reserve system is crucially important. Banks would ideally prefer not to hold any such cash reserves with the Bank, since the Reserve Bank does not pay interest on those balances (although it is empowered to do so following an amendment to the Reserve Bank Act in 1984) (SARB, 1999: 122). In view of their reluctance to hold such reserve balances, the banks will normally not hold any surplus balances above the required balances. In fact, they normally have to make use of the accommodation facilities of the Reserve Bank to prevent them from falling below the required minimum reserves. Under this monetary regime, the private banking sector enjoys access to cash reserves through the **repurchase tendering system** at a rate that is partly influenced by the Bank. If the level of interest rates is too low, the demand for money from the banks will start to rise, and the Bank will be confronted with a threatening increase in the growth in the domestic money supply. In effect, under this classical cash reserve system, the growth in the money supply is demand determined, with the Reserve Bank attempting to attain its monetary targets by influencing the level of interest rates and not the banks' cash reserves (SARB, 1999: 122).

Attempts by the monetary authorities to contain growth in the money supply are often frustrated by completely rational demand responses to changes in the level and term-structure of interest rates. The offered deposit interest rates on money balances are

determined independently by the banks and other financial institutions, in competition with one another for increased market share. As the greater part of money supply consists of interest-bearing deposits, a rise in interest rates will tend to increase the overall holdings of these money balances. For a broad definition of money, such as the *M3*, it is not only the actual level of the interest rate that influences the demand for money, but also the differential between rates available on various non-money assets and those paid by banks (De Jager, 1997: 1).

Competition among banks prevents an unlimited rise in the margin between deposit and lending rates. Furthermore, banks' lending rates are usually very similar to those offered outside the banking sector. The absolute differential between deposit and lending rates is consequently unaffected by, or relatively inelastic to, the general level of interest rates. In fact, as the level of interest rates begin to rise, the **absolute** size of the margin between deposit and lending rates remains essentially unchanged and may even decline somewhat. A perverse reaction or increase in the *M3* money supply may well be noticed, primarily as a result of a narrowing of the **relative** differential between the bank's deposit and lending rates as domestic interest rates rise. The narrowing of the differential provides an incentive for re-intermediation to occur, in which an increase in bank lending relative to credit extended by non-bank sources is recorded³ (De Jager, 1997: 1). The re-routing of these funds through the bank sector therefore has a significant impact on the level of bank deposits (money supply) and hence on monetary policy considerations as well (Pearce, 1992: 110).

The methodology used to compile South Africa's money and banking statistics is based

3

The process of dis-intermediation involves the flow of funds that, because of interest rate considerations, were directly routed from the ultimate provider of surplus funds to the ultimate user (lender) of these funds. Re-intermediation is the alternative process in which these funds are now routed through the formal banking sector or via other financial intermediaries.

on "A Guide to Money and Banking Statistics in International Financial Statistics", a publication of the International Monetary Fund. The separate balance sheets of the monetary institutions form the basis of these statistics and are aggregated for certain types of institutions. The balance sheets of the various monetary institutions are also consolidated, i.e. the claims of monetary institutions on one another are netted out. The so-called monetary analysis is derived from the consolidated balance sheet of the monetary sector, which in an *ex post* sense, explains changes in the broadly defined money supply (M3) on the basis of its statistical counterparts (see the accompanying Table). The statistical counterparts of the money supply that are distinguished in this analysis are the net gold and other foreign reserves of the monetary sector, the net claims on the government sector, the monetary sector's claims on the private sector and net other assets and liabilities of the monetary sector (SARB, 1993: 1).

Table 1 : The consolidated balance sheet of the monetary sector

| Liabilities | Assets |
|---|---------------------------------|
| Money supply : | Claims on the private sector |
| - Notes and coin in circulation outside the monetary sector | Claims on the government sector |
| - Deposits of the domestic private sector | Foreign assets: |
| Government deposits | - Gold and foreign exchange |
| Foreign liabilities | - Other |
| Capital and reserves | Other assets |
| Other liabilities | |
| Total liabilities | Total assets |

Source : South African Reserve Bank, "Money and banking statistics of South Africa 1973-1992", *supplement to the South African Reserve Bank Quarterly Bulletin*, September 1993.

As stated earlier, the South African Reserve Bank's methods of control over the growth in *M3* are seen as operating primarily on the demand for credit from the domestic banking sector. Because bank credit extension to the private sector is one of the main sources of money creation, efforts to keep the growth in the money supply in check must therefore also be directed towards controlling the rate of increase in total bank lending. Policy operations therefore also need to focus on the "asset" side of the banks' balance sheet, rather than only on the demand for bank "liabilities", i.e. deposits. Consequently, monetary control requires consideration of both sides of the banks' balance sheet.

The balance sheet shown in Table 1 indicates that the sum of the liabilities is equal to the sum of the assets. Consequently, any liability item identified must be equal to all the asset items less the remaining liability items. This in essence means that changes in the total *M3* money supply (i.e. notes and coin in circulation plus deposits of the domestic private sector with banks) can also be alternatively derived by means of the following identity:

$$\begin{aligned}\Delta M3 = & \Delta \textit{lending to the domestic private sector} \\ & + \Delta \textit{lending to the government} - \Delta \textit{government deposits} \\ & + \Delta \textit{foreign assets} - \Delta \textit{foreign liabilities} \\ & + \Delta \textit{other assets} - \Delta \textit{capital, reserves and other liabilities}\end{aligned}$$

where : Δ indicates the change in the mentioned variable

Net lending by domestic banks to the government equals the government's total borrowing requirement less the sales of public sector debt to the domestic private non-bank sector and non-residents. The net lending by the banks to the government sector (consisting of the change in the lending to the government less the change in government deposits) can hence be substituted into this identity. Through substitution and by combining the first three terms of the right-hand side, the equation is adjusted to yield the following :

$$\begin{aligned}\Delta M3 = & \Delta \text{ domestic credit extension (private and government sector)} \\ & + \Delta \text{ net external flows} \\ & + \Delta \text{ net other assets}\end{aligned}$$

It is within this framework that monetary control can readily be reviewed in South Africa. The South African Reserve Bank influences growth in the money supply in an indirect way, working through domestic credit expansion on the asset or lending side of the banks' balance sheet, and not directly by operating on the demand for money. Moreover, since net lending by the banks to the government relates to fiscal policy and external flows to exchange rate policy, the framework also illustrates the interrelationship of these various arms of economic policy (De Jager, 1997: 2).

2.5 Conclusion

Price stability remains the ultimate objective of monetary policy, and during the 1960's and early 1970's it was generally assumed that employment could be increased by mildly inflating the economy. Since the first oil crisis in 1973 and the ensuing acceleration of inflation in most of the major economies, this relationship has faltered over time and inflation was seen to be positively correlated with unemployment. It is now generally accepted that monetary policies which promote higher inflation may well lead to a poorer performance of the real economy, as high rates of inflation discourage savings and investment and thereby damages the economies potential for real economic growth. Consequently, most monetary authorities from around the world have come to realise that price stability is of the utmost importance for ensuring sustainable economic growth over the long-term (SARB, 1999: 112).

The long-term relationship between excessive money supply creation and the rate of rising inflation in South Africa and many of the other major industrialised nations of the world

cannot be disputed. To this end, the various policy methods and objectives aimed at influencing the supply of money have varied radically between the many different central banks of the world. For example, the Federal Reserve Bank in the United States of America opts for an exogenous money base control approach to monetary policy implementation, i.e. one in which the level of base money is influenced by altering the prevailing reserve and deposit ratios (RSA, 1984: 182). On the other hand, the central bank in the United Kingdom prefers a flow of funds approach in which the supply of money is determined endogenously by the predominant interest rate and through central bank trading in domestic open market transactions (RSA, 1984: 184). The latter of these two compares favourably to the cash reserve system which has been adopted by the South African Reserve Bank. In accordance to this framework, the Bank's principal method to control the rate of growth in the money supply is one that operates primarily on the demand for credit from the domestic banking sector. The Bank influences the demand for private sector credit by means of the interest rate, i.e. the repurchases accommodation rate (Repo), or the marginal lending facilities rate.

To attain and achieve intermediate and ultimate objectives, the monetary authorities have to adopt an operational control framework that specifies the operational variables of monetary policy. There are **two competing views** in this respect, and both are mutually exclusive in that the monetary authorities have to adopt either one or the other.

The first involves the **controlling of interest rates** in which the monetary authorities have the power to control monetary aggregates (or exchange rates), through the change in interest rates. The emphasis lies in control over interest rates, and the interest rate is used as the operational policy variable. This is the monetary policy framework adopted by most central banks (including South Africa) and is based on the repo and marginal lending facility as the policy variables. The control of inflation is the Bank's ultimate policy objective, while the M3 money supply was but one intermediate target previously adopted

in the eclectic approach to monetary policy formulation and implementation. By changing short term interest rates (via its accommodation policy), the money supply can be influenced in a certain way (SARB, 1999: 118). This monetary policy framework has since been substituted by an inflation targeting framework, i.e. without compromising the emphasis the Bank makes on financial market and price stability. According to this framework, the Bank will strive to maintain the average domestic rate of consumer price inflation (excluding the mortgage interest rate component) for the metropolitan and urban areas "CPIX(mu)" within a specific target range over a future annual time period (see Mboweni, 2000: 59).

The second alternative involves the **controlling of the monetary base** and is usually associated with money supply targeting only, and is not suitable for targeting the exchange rate. The main policy instrument used in this system is the cash reserve requirement which has to be adhered to by the banks. Short-term interest rates are hence free to fluctuate and are determined by market participants (i.e. supply and demand). The policy instrument under these conditions is then the central bank's reserve asset requirements, since this determines the size of the monetary aggregates. This control system currently enjoys little support from central banks as most central banks do not attempt to aim directly at meeting quantitative targets for bank reserves (SARB, 1999: 118). This process essentially boils down to the money multiplier, in which an increase in reserve availability (lower reserve requirements), can lead to a multiple expansion of the money supply. The extent of the multiplier depends on the size of the reserve requirement and the willingness of banks to make loans.

From a South African viewpoint, in which domestic inflation is the major factor influencing monetary policy decisions, it hence becomes prudent to rather make use of the first alternative in which interest rates are controlled, and not the monetary base. Due to the fact that it is difficult to target exchange rates by means of monetary base control, and the

fact that exchange rates have a great influence on domestic inflation rates (via the cost of our imports), it would seem plausible to rather model the effects and impacts on money supply (and credit extended to the domestic private sector), from a variable interest rate perspective, i.e. the cash reserve system.

The link between private sector credit and the M3 money supply can best be illustrated by the monetary analysis, which is derived from the consolidated balance sheet of the monetary sector. This analysis is primarily used to explain the change in the broadly defined money supply (M3) on the basis of its statistical counterparts. One of these is the credit extended to the private sector, which forms an asset item on the consolidated balance sheet of the monetary sector, while the broadly defined M3 money supply comprises the various categories of deposits that are held by the domestic banks in the monetary sector (shown as a liability item on the balance sheet). The consolidated balance sheet furthermore shows that, as per definition, the sum of all the assets should equal the sum of all the liabilities, which essentially means that the M3 money supply is equal to the sum of all the net assets (loans) less the remaining liability items. The reconciliation of the money supply in this manner hence illustrates the indirect way in which the South African Reserve Bank influences the rate of growth in the money supply, i.e. via its influence on domestic credit expansion on the asset or lending side of the banks' balance sheet. This framework can also be seen as a useful tool to illustrate the impacts and interrelationship of the various policy measures to be implemented, namely, monetary, fiscal and exchange rate policy.

Since money supply in South Africa is essentially demand determined, the next obvious step would be to determine the impacts and explanatory variables that are capable of influencing the demand for the various categories of money from an economic and monetary policy perspective. The following chapter is dedicated to elucidating the various theories for the demand for money which can ultimately be used in determining the

functional behavioural relationships for the different classes of money that have been earmarked for estimation purposes, i.e. as endogenous variables in the monetary model.

CHAPTER 3 THE DEMAND FOR MONEY

3.1 Introduction

The De Kock commission specifically states that in the long run, control over the rates of increase in the money supply aggregates is a necessary condition for controlling total effective demand, and thus the relative stability of the price level (RSA, 1984:240). It is therefore not surprising that research on the demand for money remains one of the oldest research areas in the field of economics both domestically and abroad. This could be ascribed to various factors, such as the development of reasonably well developed theories on the demand for money, fairly easy access to and the availability of data pertaining to the monetary aggregates, and the fact that stability in the demand for money function is relevant for monetary policies aimed at controlling the growth in domestic money demand and inflation.

The demand for any commodity (even if it is money) is to a large extent also dependent on the consequential change in the supply of the specific commodity in question. The interest rate can be seen as the equilibrium price level between the supply and demand for money, and is determined via the trade in money and money market instruments (Fourie F.C., 1999: 39). This simple theoretical framework is more suitably depicted by an upward sloping supply curve and downward sloping demand curve. It rests on the basic assumption that no buyer, nor seller of a specific commodity can influence the actual price at which the specific commodity is traded, and secondly that the decisions of both the buyers and sellers of the specific commodity in the market are independent of one another. The upward slope of the supply curve illustrates the increased supply (quantity) of the commodity as revenues start to accrue from the raised price level, while at the same time and more importantly, the downward slope of the demand curve indicates a decline in the demand for the same commodity as it continually becomes more expensive for the

consumer to purchase the product at the higher price level (given that all other things remain equal in the system) (Laidler, 1993:3).

The exchange of goods in this market is voluntary and the act of a sale is simultaneously reflected in an act of a purchase, i.e. the market for the commodity (even if it is money) will be in equilibrium at the equilibrium price level determined by the intersection of the supply and demand curves. Any increase or expansion in supply, for whatever reason, will tend to shift the supply curve outwards from left to right (lowering the equilibrium price). The magnitude of this price change originating from the shift in supply primarily depends on the sensitivity of consumer demand to the price fluctuation, i.e. the elasticity of demand. If demand is sensitive to a change in price, the demand curve will be relatively shallow and reflect a large decline in the quantity that is demanded for only a slight decline in the equilibrium price. If demand is insensitive to price, the demand curve will be fairly steeply sloped and any large price fluctuation from a supply side shift (whether the price is increased or decreased) will be analogous to a fairly small change in the actual quantity demanded (Laidler, 1993:5).

The gradient of the slopes of the supply and demand curves are hence of major importance, as these illustrate to what extent the demand for money changes due to a given change in the equilibrium price level, i.e. the predominant interest rate. Two special characteristics of money that provide the starting point for a number of theories on the shape of the demand for money curve, are its use as a universally accepted **means of exchange** and its role as a **store of value**. The former primarily refers to "*transaction models*" while the latter refers to "*portfolio models*" (Cuthbertson, 1985: 12). The historical development of the demand for money theory originates from the classical view of money as a transaction asset, the quantity theory of money, the Keynesian motives in the demand for money function and then proceeds to portfolio models (Wachtel, 1989: 86).

In general, money (liquidity) is not in demand for the mere pleasure of holding cash balances, but rather for the sole purpose of purchasing other goods and services. The precise nature of the demand for money function remains a contentious issue, and gains its origins from two broad schools of thought, i.e. the Keynesian and modern quantity theories for the demand for money. Keynes viewed the demand for money on the basis of three motives, namely, transactions, precautionary and speculative motives. On the other hand, classical quantity theorists argued that individuals will demand money for transaction purposes only, and that their money holdings would be maintained at the minimum that would be required to carry out these transactions (Pearce, 1992: 286).

As is the case with money supply in the previous chapter, the demand for money function plays an important role in the transmission mechanism of both monetary and fiscal policy. This makes it necessary to take cognisance of a number of key economic factors (i.e. influential variables that are supported by economic theory), before trying to proceed with the estimation of an equation that suitably portrays the South African demand for money function. The purpose of this chapter is hence to track the evolution of the demand for money function, i.e. ranging from the classical quantity theories of the demand for money, Keynesianism and neo-Keynesianism, to modern monetarism and buffer stock inventory models. These various theories will be shortly discussed in the following sections, before concluding with the advantages and disadvantages of the alternative theoretical demand for money functions.

3.2 The quantity theory of money

The quantity theory of money is distinguished and characterised by the classical economists Irving Fisher, Alfred Marshall and Arthur Pigou, where the latter two were associated with the so-called Cambridge view of quantity theory. Both Fisher and the Cambridge economists were concerned with money as a means of exchange and therefore

provided models of the transactions demand for money. The difference between the two is reflected in Fisher's emphasis on the identity linking sales to the amount of money changing hands, while the Cambridge approach is more concerned with the individual's desire to hold money (Cuthbertson, 1985: 14). The key concepts and differences between the two approaches are elucidated below.

3.2.1 The classical version of the quantity theory of money : Irving Fisher

Although the quantity theory of money evolved from as far back as the mid-eighteenth century, it is still seen as a fundamental basis of the demand for money. It even maintains a large degree of relevance in the complex and integrated nature of today's money markets. As can be seen below, the dominant version of the quantity theory at that stage stressed the transactions velocity of the circulation of money, i.e. the rate at which money passes from hand to hand.

Quantity theory according to Fisher begins with a simple identity in which every transaction concerns a buyer and seller, and the value of sales should equal the value of receipts in an aggregate economy. The value of sales in turn is equal to the product of the number of transactions (T) conducted over a specific period of time and the average price (P) at which the transaction takes place. The value of purchases on the other hand, must be equal to the product of the amount of money in circulation (M_S) and the number of times it changes hands during the same period (V_T), i.e. the transactions velocity of the circulation of money (Truu & Contogiannis, 1996: 148). This yields the following identity

:

Buyer = Seller

Sales = Receipts

$$M_S * V_T = P * T$$

Money appears on the one side of every transaction, whether the transaction itself is seen from the viewpoint of the buyer or seller. This identity can be used as a device in the process of formulating the fundamental theory behind the demand for money and it is hence imperative to determine the factors that influence movements in these four variables. The quantity of money, otherwise referred to as the money supply (M_s), is regarded as exogenous (determined by the monetary authorities)⁴. By the same token, the transactions velocity of circulation (V_T), and the volume of transactions (T) are also treated as independent of the other variables in the identity. This postulation permits the identity or "equation of exchange" to be transformed into a version reflecting the "quantity theory of money", i.e. a theory that is useful in the determination of the price level in the economy, and can be rewritten as follows (Laidler, 1993: 47) :

$$\bar{M}_s \bar{V}_T = P \bar{T}$$

The bars on top of the variables signify that they are exogenous in nature, i.e. they are determined independently of the remaining variables of the equation. Given the assumption that (V_T) and (T) remain constant, any change in the quantity of money will be duly reflected in a proportional change in the equilibrium price level. Money, is of course, constantly moving backwards and forwards between the industrial and financial circuits as a result of lending and borrowing, which makes the demand for money quite complicated. The use of this concept of velocity hence makes it possible to distinguish between the quantity of money, and the volume of money that is actually in use for transaction purposes (Newlyn, 1971: 82).

⁴ Note the difference between this and the South African monetary framework in which the money supply is primarily endogenously determined (see section 2.4)

Fisher furthermore shows that in an equilibrium situation, the demand for money must at all times equal money supply, which in the above case is exogenously determined. The demand for nominal money in turn depends on the current value of the transactions conducted in the economy, and is hence equal to a constant fraction of these respective transactions (Laidler, 1993: 47). This is algebraically formulated as follows....

$$M_d = \overline{M}_s$$

$$M_d = k_t * P * \overline{T}$$

The combination of these two equations identifies money demand in terms of a demand function linking money balances to the volume of transactions in an economy, or alternatively in terms of a supply function relating the approach in terms of the transactions velocity of circulation and can be reformulated as follows :

$$\overline{M}_s * \frac{1}{k_t} = \overline{M}_s * \overline{V}_T = P * \overline{T}$$

Implying that :
$$\overline{V}_T = \frac{1}{K_t}$$

From a theoretical point of view, the assumption of a constant income velocity of money is based on the view that this is mainly determined by institutional factors, like credit and communications systems, the frequency of wage and salary payments etc. Such factors certainly can and do change in the course of time, but usually they do not do so rapidly so velocity would normally be reasonably constant in the short-run (Truu & Contogiannis, 1996: 149), (Mishkin, 1998: 531). According to Fisher, the velocity (V) is considered to have a constant equilibrium value to which it will return after any shock or disturbance, so

that the price level (P) can then be determined by the relationship between money (M) and the nominal value of transactions in the economy ($P \cdot T$) (Pearce, 1992: 356), i.e. with the volume of output fixed from the supply side, the quantity of money determines the price level (Froyen, 1996: 61).

Classical monetary economists argue that at least over the short-term, the ratio of money holdings to national income remains constant, especially under the assumption that velocity (V_T) is an institutionally determined constant, and the ratio of transactions to national income is exogenous or given (Laidler, 1993: 49). This means that the level of transactions generated by a fixed level of nominal income determines the quantity of money that people demand. Therefore Fisher's quantity theory of money demand suggests that the demand for money is purely a function of income, and interest rates have no effect on the demand for money (Mishkin, 1998: 532). Although they maintained that (V_T) remains constant in order to contend their logical implications, they did leave the possibility open that velocity might fluctuate around its equilibrium value in the short-run. The reasons pertaining to the possibility of such short-run fluctuations in velocity emerged clearly from the quantity theory version initiated by the Cambridge economists Alfred Mashall and Arthur C.Pigou at the University of Cambridge (Laidler, 1993: 49).

3.2.2 The Cambridge approach to the classical quantity theory

The emphasis in Fisher's model of the quantity theory of money is on the supply of money and on the institutional and technical factors influencing the level of production and the velocity of circulation. Fisher also had very little to say on the psychological factors that influence the individual habits that finally determine an individual's and society's velocity of money. An alternative approach to Fisher's flow of spending approach is the cash balances theory in which the (V) of the transactions-velocity approach is replaced by 'the demand for money', i.e. an analysis as to why money is held rather than why it is spent,

and the emphasis switches to the individual's decision on the optimal amount of money to hold (Froyen, 1996: 62). This concept of the demand to hold money-balances primarily concerns the analysis of the motives to hold these cash balances. Needless to say, the analysis of these motives have been documented quite extensively in the long history of the demand for money function (Struthers & Speight, 1986: 149).

The Cambridge approach hence differs from the classical approach of Irving Fisher in that it finds its origins in the behavioural (choice-making) nature of the individual, i.e. more specifically, the motivation behind the **individual's desire** to hold a specific amount of money balances in order for him to conduct and facilitate a desired amount of transactions. This must be seen in contrast to the early classical quantity theory which was aimed specifically at the amount of money the **economy needs** in order to conduct a given volume of transactions (Pearce, 1992: 356). This approach mainly concentrates on the universally accepted nature and convenience of money as an asset and/or as a medium of exchange for goods and services as the primary determinant governing peoples desire to hold money balances. The number of transactions the individual wishes to conduct necessarily becomes proportional to the amount of cash the individual wants to hold. The emphasis therefore lies crucially in the individual's "want" to hold money balances rather than on the amount they "have" to hold (Laidler, 1993: 50).

The Cambridge economists therefore recognise that individuals generally desire to hold money for the same reason they desire to hold goods, as both money and goods yield some degree of utility or satisfaction. The utility from money arises because it is a universally accepted means of exchange, which means that the transactions motive is a major determinant of desired money holdings. They were also aware that the more money the individual already holds, the less satisfaction any additional money balances will yield, which is nothing more than the law of diminishing marginal utility. Cambridge economists contend that one alternative to holding money is to hold an interest bearing asset or bond,

and that the higher the rate of return on these bonds, i.e. relative to the marginal (transactions) utility from their money holdings, the more individuals (who are basically utility maximisers) are encouraged to switch some of these money holdings into bonds (Cuthbertson, 1985:15).

A trade-off or choice now has to be made, in which the individual has to decide to either hold money balances, or to sacrifice some of these cash holdings in order to obtain some source of interest income. Individuals hence need to base their decisions not only on the volume of transactions they intend conducting, but also on the opportunity costs associated with the possible loss of interest revenues from holding alternative assets, i.e the extent that money's yield in terms of convenience and security outweighs the income lost from not investing it in a productive activity (Froyen, 1996: 62). The Cambridge approach therefore contends that the demand for money in nominal terms varies proportionately to the price level, and that if the prices of goods and services begin to increase, the quantity of money held by the individual would need to increase by the same proportion in order to achieve the same level of convenience (Laidler, 1993: 50).

In formalising the model, the Cambridge economists recognised that two properties of money motivate people to want to hold it, i.e. its utility as a medium of exchange and as a store of wealth. As a medium of exchange, people use it in order to carry out transactions so that the demand for money would be related to (but not determined solely by) the level of transactions which in itself is proportional to income. As a store of wealth, Cambridge economists suggest that the level of people's wealth also affects the demand for money, i.e. as individual wealth grows, individual's need to store it by holding a larger amount of assets - one of which is money (Mishkin, 1998: 532). Pigou in particular after assuming that the level of individual's wealth, the volume of transactions and the level of income are stably related to one another in the short-run argued that the nominal demand for money is a constant proportion of the nominal income of that individual

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(Pearce, 1992: 357).

Given the stock of money (however defined), it is always held by someone in the economy. Most people acquire money as a flow of income, received in either weekly or monthly intervals. Money holdings just before pay-day will be at a minimum, while just after pay-day it will be at a maximum. During the interval, between two successive pay-days a person's income is gradually spent (thus running down his money balances). The actual demand for money refers to the average amount of money held during this period (i.e. the average between two periods in which the maximum and minimum money balances were held). While the amount of money demanded is equal to the money stock, the income received represents a regular flow, i.e. if (M_d) is the demand for money, and (PY) the level of income, then the average propensity to hold money (the fraction k), equates the demand for money in terms of money income in the following equation (Truu & Contogiannis, 1996: 150) :

$$M_d = k * P * Y$$

when combined with the equilibrium condition for the money market, in which a given supply of money must equal the quantity of money demanded, it yields

$$M_d = \overline{M_s}$$

which implies that

$$M_d = \overline{M_s} * 1/k = \overline{M_s} * V = P * Y$$

The reciprocal of the factor of proportionality (the average propensity to hold money, or the Cambridge "k") is equal to (V) the income velocity of circulation or the "rate of turnover" of

money in the purchase of goods and services. The Cambridge equation is fairly similar to Fisher's equation, with the exception that (V), in the above equation, now refers to the income velocity of money and not to the transactions demand for money implied by (V_T) in the Fisher equation. Although Cambridge economists often treated " k " as a constant, and agreed with Fisher that nominal income is determined by money, their approach allowed individuals to determine how much money they wished to hold, i.e. the possibility that " k " could in fact fluctuate over the short-term because the decisions about using money to store wealth would depend on the yields or returns on other assets that also function as stores of wealth (Mishkin, 1998: 533).

To summarise, both Fisher and the Cambridge economists developed a classical approach to the demand for money, i.e. in which the demand for money is proportional to nominal income. However, the two approaches differ in that Fisher's equation emphasised technological factors and ruled out the effect of interest rates, while the Cambridge approach emphasised individual choice, and did not rule out the effects of interest rates (Mishkin, 1998: 533).

3.2.3 A comparison between the two quantity equations.

In order to quantify and elucidate the difference between the Fisher and Cambridge quantity approaches, a hypothetical example can be used in which it is assumed that (R) equals Fisher's (T) (for transactions) and (P) stands for the average of the same set of prices in both equations. Regardless of whether money is held against transactions, or as a proportion of income and wealth, the average value of actual money held can be expressed as a proportion of (PT). Suppose $M = 100$, then it must be held by someone. If the constant of proportionality " k " = $1/3$, then according to the Cambridge equation in which $M = kPR$, nominal income (PR) must equal 300. Since " $PR=PT$ ", (PT) by implication also equals 300. On the premise that " $MV=PT$ ", (V) must now equal " PT/M ", which must

also equal 3 in this example, so that the value of k is simply the inverse of the value of V (Struthers & Speight, 1986: 150). There hence seems to be a strong similarity between the two versions, but the question has to be posed whether they are identical?

The total value of goods and services bought and sold (T) in a given period of time comprises all transactions and should include "financial transactions" such as the purchase of shares on the stock exchange. It follows then that (PT) must be some multiple of the value of final goods bought or sold. Variable (V) comprises the transactions velocity, i.e. the relation between (M) and the total value of transactions ($MV=PT$) and (R) can have different meanings if financial transactions were included. This means that " k " will differ as the constant of (R) differs (the proportion of desired money holdings to wealth is probably different from the proportion of desired money holdings to income). If all financial transactions are included in the equation, it follows that (R) will not be equal to (T), and hence that " k " is not simply the inverse of (V). However, if (R) is defined as income, " k " will be the inverse of income-velocity of circulation ($MV=PY$), which is the relation between the value of output and sales of final goods and services and the quantity of money. This implies that (PT) will always be bigger than (PR), hence transactions velocity will always be higher than income velocity (Struthers & Speight, 1986: 151).

Despite these two approaches being fundamentally similar, there were essentially strong differences in the Cambridge economists views on the impact of the rate of interest, and the expectation of its future value. Keynes developed on the ideas of Marshall and Pigou in his liquidity preference schedule, and while the Cambridge economists viewed the role of interest rates as implicit in their model, Keynes made it explicit (Pearce, 1992: 357). The following section takes a brief look at Keynesian demand for money functions and the motives to why individuals demand money balances.

3.2.4 Keynesian demand for money theory

The debate about the nature and form of the demand for money function, was the earliest, one of the longest-running and arguably the most important of all the monetarist-Keynesian debates. The classical economist's conclusion that nominal income is determined by movements in the money supply rested on their belief that velocity (PY/M) could be treated as reasonably constant (Mishkin, 1998: 533). Until the great depression, economists did not recognise that velocity declines sharply during severe economic contractions. This explains why, after the great depression, economists began to search for other factors influencing the demand for money, i.e. factors that might help explain the large fluctuations in the velocity of money. Keynes's liquidity preference theory can be seen as one of the theories for money demand that arose from this search for a better explanation of the behaviour of velocity (Mishkin, 1998: 535).

The classical approach to money centers on quantity theory emphasising the transactions role of money. Keynes's point of departure from the classical approach was the idea that money has at least two functions, i.e. money is not only a transactions asset, but that it is also a store of value or a financial asset (Wachtel, 1989: 330). The simplest form of the Keynesian demand for money function emphasizes the three demand "motives" for holding money balances. Firstly, individuals demand money to finance daily purchases of goods and services, *the transactions motive*; second, individuals demand money for contingency purposes, *the precautionary motive*; and third, individuals hold money as a store of wealth, *the speculative motive* (Pearce, 1992: 286). Followers of Keynes argue that the demand for money for "speculative purposes" was inversely related to the interest rate and level of wealth, and that the demand for money for "transactions" and "precautionary" reasons was solely determined by the individual's level of income (Laidler, 1993:56).

In Keynes's terminology, the focus was on real balances, and the demand for real money

balances is called "liquidity preference", or stated alternatively, "why do individuals hold money?" (Mishkin, 1998: 535). Hence, the main innovation of liquidity preference theory was that the demand for real money balances depends on the rate of interest, as well as the level of income.

Keynes's improvement on the Cambridge approach was somewhat arbitrary as he concentrated to a great extent on these three motives and the precise convenience that compelled individuals to hold money balances. The following section contains a brief description of the three demand motives in a little more detail.

3.2.4.1 *The transactions demand for money*

Income and expenditure are seldom perfectly synchronised over time, prompting individuals to hold funds or money balances for the purpose of meeting their transaction needs and to be able to make payments. The transactions demand hence involves the individual's requirement for cash balances in order to finance day-to-day routine purchases and transactions (Gowland, 1985: 34). Obviously the size of the transactions demand for money depends on the magnitude of the individual's income, personal expenditure patterns and the frequency at which the individual wishes to repay outstanding debt. For example, the expenditure patterns of the individual could impact on the transactions demand through a personal preference for making payments on a monthly basis instead of providing for a lump sum payment on completion of a specific task or project. As income is received periodically, and expenditures occur daily, it is necessary to hold a stock of currency and checking deposits, i.e. an inventory stock of money balances to handle these payments. This inventory theory of the demand for money falls neatly into Keynes's category of transactions motive (Hall et al., 1993: 424).

Transactions demand is hence the need for money to use in active form in transactions

and depends largely on the value of transactions, i.e. nominal income Y (Fourie F.C., 1999: 41). In general, it is reasonably assumed that individuals are by nature utility-maximisers and that they will tend to select a suitable amount of cash balances with which they feel comfortable. In a similar fashion to classical economists, Keynes's traditional theory of money demand is determined primarily by the level of people's transactions, as these transactions were in turn proportional to the level of income Y (Laidler, 1993: 52) (Mishkin, 1998: 535).

3.2.4.2 *The precautionary demand for money*

A suitable example of precautionary demand is seen where prudent individuals tend to hold onto physical money balances as a precautionary store of wealth. Their desire to keep these money balances is closely linked to the degree of risk and rate of return associated with the assets that are currently available for portfolio investment. The primary motivation for maintaining precautionary money balances can therefore be seen as the individual's need to be prepared for bargains (unforeseen opportunities of advantageous purchases) or alternatively for providing for extraordinary contingencies requiring sudden unforeseen expenses (Truu & Contogiannis, 1996: 117). Since one cannot at all times foresee all transactions, money can be held in 'passive' form. This holding of cash balances primarily depends on income, and the opportunity cost of holding money (interest rate). In times of pessimism about the future, people tend to hold onto more money balances merely as a precautionary step (Fourie F.C., 1999: 41). In politically unstable countries or in countries without a well-developed financial system, this motive for holding money would be more important. It is precisely this precautionary motive, or store-of-wealth notion, that convinces the individual to save wealth in the form of money to counter any emergency need for funds (Hall et al., 1993: 426).

Keynes suggests that the precautionary motive for individuals to hold money balances to

bridge the gap between receipts and irregular payments is therefore similar to the transactions demand for money and that it is also closely related to the individual's level of income (Froyen, 1996: 116). However, he did not regard the relationship between the transactions demand and precautionary demand to the level of income as being fixed and constant, and stipulated that the convenience from holding money balances for these purposes also had to be traded off against possible revenues accrued from the holding of some other form of financial asset, i.e. the transactions and precautionary demand for money were in fact also functions of the interest rate. The role of interest rates were however never specifically stressed as the main concern in Keynesian analysis, not because it was unimportant in the transaction and precautionary demand, but rather because it came to prominence in its role in determining the speculative demand for money (Laidler, 1993: 52).

3.2.4.3 *The speculative demand for money*

Traditionally, cash balances did not bear any interest, although they did have the added feature of being the most liquid of all assets. This means that they can quite easily be converted into any other form of asset, allowing the individual to take advantage of any unexpected interest rate arbitrage opportunities that may arise. Speculative balances therefore represent money balances held over and above the joint transactions and precautionary requirement. Not all individuals can be expected to hold speculative balances, but merely those who keep an eye out for what they believe to be a good financial bargain in terms of expected future gain (Truu & Contogiannis, 1996: 117).

The speculative demand for money is primarily based on investors' different expectations of future interest rates and future cost of debt. Keynes assumes that all rational individuals wish to avoid losses, and that this essentially meant that there was an additional demand for money resulting from the uncertainty about future interest rates and the relationship

between changes in the interest rate and the market price of bonds (Froyen, 1996: 116). Individuals will usually include money balances in their portfolios, indicating the existence of some speculative demand for money. For example, speculative balances would be held when the price of some other asset was expected to fall, i.e. an individual would sell shares or bonds when it was expected that their price would fall (in this case the individual would rather hold money balances instead) (Gowland, 1985: 34). It follows then that if interest rates were to move in such a way as to cause capital losses on bonds, it was possible that these expected losses would outweigh the interest earnings on the bonds and cause the investor to hold money instead. Such money would be held by those "speculating" on future changes in the interest rate (Froyen, 1996: 116).

Rational individuals are by nature profit-maximisers, and strive to realise capital gains (or minimise their capital losses) from the physical holding of these alternative assets. Fluctuations in the interest rate therefore implies that the bond holder either makes a capital gain or loss. As a result, speculative demand or liquidity preference is intensified when individuals believe the rate of interest will rise in the near future, (i.e. they will rather prefer to hold onto cash balances now, than by alternatively investing their money in interest-earning assets) (Laidler, 1993: 53).

Unfortunately, the theory lacked a variable as an indicator to point out when the rate of interest rate was expected to change and more specifically in what direction. Keynes's answer to this dilemma was to hypothesise that individuals have a subjective view about the "normal" rate of interest, and that interest rates gravitate to some "normal" level (Mishkin, 1998: 536). He argued that there was a value or range of values that could be considered as normal, so that when the actual level exceeds this normal level, the tendency is for individuals to expect a future decline in interest rates so that they will be able to make a capital gain (Cuthbertson, 1985: 19). This also holds true when the interest rate is below the normal level, as individuals would now expect the following interest rate

movement to be upwards and therefore opt rather to hold onto their money balances.

In general, the capital losses associated with the holding of bonds will only be tolerated if the interest income from the holding of the bond fully compensates the capital loss. As soon as these revenue losses exceed the interest income, the individual will revert back to holding money balances. Peoples perceptions of where the interest rate is and the following direction it will take, differ widely throughout the spectrum of economic agents in the economy - although the lower the current rate is, the more definite can the response be for an expected rise in interest rates in the near future. This implies that the speculative demand for money becomes a smooth and negative function of the current level of the interest rate (Laidler, 1993: 54).

In summary, Keynes envisaged the transactions motive and the precautionary motive for holding money balances as depending primarily on income and the interest rates offered on alternative assets, while the investors' speculative motive can be depicted by a downward sloping demand curve money (i.e. as the current interest rate falls, individuals perceive that the current rate is low enough to warrant them holding all their financial wealth in the form of money balances⁵)(Boorman et al., 1972: 148). Although these three motives are primarily used to define the individual's behavioural pattern, they will be used as a suitable foundation for the development of a behavioural relationship (regression) to portray the domestic community's demand for money function. The community's (economy wide) demand for money can hence be seen as the aggregate of the separate demands for money due to three Keynesian motives analysed in this section. Now that the three motives have been discussed in detail above, it seems plausible to construct the total demand for money function in the Keynesian system.

⁵ Financial wealth consists of either all bonds, or all money in the Keynes model

3.2.5 *The total or expanded Keynesian demand-for-money function*

In combining these three motives to form one demand for money function, Keynes was cautious to distinguish between nominal quantities and real quantities. Money is valued in terms of what it can buy, with the result that if all prices in the economy were to double, the same nominal quantity of money will only be able to purchase half as many goods as before. Keynes therefore reasoned that people want to hold real money balances (i.e. the quantity of money in real terms) (Mishkin, 1998: 537). Liquidity preference theory in the form of the Keynesian demand for money function is largely a function of uncertainty, primarily focusing from the individual's uncertainty about the exact point in time when he will need cash balances - i.e. the precautionary and transactions motive - and his uncertainty about future interest rates - i.e. the speculative motive (Pearce, 1986: 282). Income and the interest rate are the primary variables influencing the Keynesian demand for money function and have been augmented with a wealth variable, indicated as (W), to make allowance for the speculative demand for money that is cast in terms of the proportion of its total assets the economy seeks to hold in the form of cash (Laidler, 1993: 55).

$$M_d = [k * Y + l(r) * W] P \quad \text{or} \quad M_d / P = f(Y, r)$$

The transactions and precautionary balances are represented by the first term (kY) in the bracket, while the second term ($l(r)W$) represents the speculative balance which is in fact negatively correlated with interest rates. Keynes disputes the existence of a stable linear relationship between the speculative demand for money balances and the rate of interest, and rather sees it as a functional relationship. Despite the additive nature of the equation the interest rate (r) shown above is of course negatively correlated with money demand, while the (l) denotes that it is a functional relationship and not a linear parameter. The fact that the money demand identity is multiplied by the price level (P) is indicative of a theory

of the demand for money in real terms, and implies that if all things remain equal, the demand for nominal money balances is proportional to the price level (Laidler, 1993: 55).

The negative relationship between interest rates and money demand warrants some further explanation in that the individual essentially decides to hold wealth in either money balances or bonds. The composition of this wealth primarily depends on what the individual perceives the following movement of the interest rate to be. Obviously, different individuals have different expectations of the interest rate, i.e some may be bullish, while others may be bearish. However, the general rule of thumb is that if the interest rate is generally perceived to be low, this would necessarily be associated with a strong expectancy for interest rates to increase in the near future, and that the price of bonds would fall (Pearce, 1992: 286).

Keynes's conclusion that the demand for money balances is not only related to income, but also to interest rates was a major departure from Fisher's view of the demand for money function, in which interest rates had no effect on money demand. Keynes's theory was closer to the Cambridge approach, which did not rule out the possible effects of interest rates. However, classical Cambridge economists did not explore the explicit effects of interest rates on the demand for money (Mishkin, 1998: 537).

By deriving the liquidity preference function for the income velocity of money (PY/M), Keynes alluded to the fact that velocity is not constant but fluctuates with movements in interest rates (Mishkin, 1998: 537). By inverting Keynes's demand for money function we get :

$$P / M_d = 1 / f(Y, r)$$

As the identity for velocity equals nominal growth divided by domestic money supply

($V=PY/M$), both sides of the equation can be multiplied by real growth Y . Furthermore, in recognising that M_d can be replaced for M , since they must be equal in money market equilibrium, we can now solve for velocity :

$$V = PY/M = Y / f(Y,r)$$

so that if the demand for money is negatively related to interest rates;- as interest rates (r) rise, $f(Y,r)$ declines and velocity will begin to increase. Stated alternatively, interest rate increases encourage individuals to hold less real money balances for a given level of income, therefore, the rate of turnover of money (velocity) must be higher (Mishkin, 1998: 537). Velocity can then be expected to change as expectations about future levels of interest rates change, and unstable expectations of the interest rate can lead to volatility trends in the velocity of money.

Volatile velocities and expectations of future interest rates imply that if all the economic agents in the economy perceive the current interest rate to be low, and that it will rise rapidly in the future, it will make the holding of bonds unattractive and therefore increase their preference to hold money balances instead. Clearly, if everyone is holding money, then the current interest rate must be below the lowest critical rate of the population as a whole (Pearce, 1992: 286). In these instances, the downward sloping demand for money hence becomes perfectly elastic (infinite) with regard to the interest rate, and because the interest rate can fall no further, any increase in the quantity of money supplied will simply be absorbed without a respective decline in interest rates; - commonly referred to as the *liquidity trap*. This doctrine argues an increase in money supply will not result in a decline in the interest rate, but will merely result in an addition to idle money balances, so that the interest rate elasticity of the demand for money takes on the value of infinity at low levels of the interest rate, and ultimately leaves monetary policy measures ineffective (Pearce, 1992: 249)(Boorman et al., 1972: 272).

A usual method to test the liquidity trap hypothesis is to estimate the interest elasticity of the demand for money during a period in which the interest rates are low, and to repeat the exercise for periods in which the interest rates are high. Once these two interest elasticity estimates are compared to one another, it will be possible to ascertain the existence of a liquidity trap phenomenon. However, if the rate of inflation provides an anchor for nominal interest rates, the liquidity trap may just as well apply equally well in periods of high nominal interest rates (Cuthbertson, 1985: 21).

The choice between money and bonds (the rate of interest), which is the opportunity cost of holding money, is the long-term rate, and liquidity preference is the demand for money. But, there is a wide variety of short-term near money assets available as alternatives to money, and as such, they can be easily substituted (exchanged) for money if need be. This existence of near-money assets, and the ease and speed at which they can be exchanged for money, means that the 'money versus bonds' choice of liquidity preference is unrealistic and has serious implications for the demand for money function (Struthers & Speight, 1986: 193).

3.3 Modern quantity theory : Friedman's neoclassical reformulation of quantity theory

Keynes's liquidity preference theory casts doubt on the classical quantity theory that nominal income is determined primarily by movements in the quantity of money (Mishkin, 1998: 538). Although Friedman frequently refers to Fisher and the quantity theory, his analysis of the demand for money is actually closer to Keynes and the Cambridge economists than it is to Fisher's (Mishkin, 1998: 544). The neoclassical approach of Milton Friedman pursues the question of why people choose to hold money, and accordingly suggests that the price of money is the opportunity cost of holding it (i.e. the return foregone by holding it rather than some other asset). Friedman argues that rational

individuals will hold money (demand money) up to the point where its marginal benefit (return) equals the marginal cost of holding these money balances (Gowland, 1985: 35). The general modern quantity theory of the demand for money initiated by Friedman draws attention away from the motives prompting individuals to hold money balances, and carefully analyses the factors that determine how much money individuals desire to hold under various circumstances. Money is hence treated as any durable consumer good when developing a model depicting the demand for it (Laidler, 1993: 57).

Friedman postulates that as in the case of any other financial asset, money yields a flow of services to the bearer or economic agent who holds it (Pearce, 1992: 357). Although Friedman gives no detailed analysis of the motives for holding money, he does suggest that the services from money derive from the fact that money is a readily available source of purchasing power, i.e. for transaction purposes (Laidler, 1993: 57).

Friedman hence viewed money and goods as substitutes and that people choose between them when deciding how much money to hold. More importantly, the assumption that they are substitutes indicates that changes in the quantity of money may have a direct effect on aggregate spending (Mishkin, 1998: 546). As a substitute, Friedman clearly states that the more money is held, the less valuable money becomes relative to the services of other assets, i.e. the application of the general principle of the *diminishing marginal rate of utility or substitution* between goods (money and various other assets) in consumption (Laidler, 1993: 57). This is of course contrary to the Keynesian notion that idle balances will rather be spent on financial assets, and not commodities or goods (Pearce, 1992: 357).

The measurement of the opportunity costs associated with the holding of money is hence of prime importance . Wealth is considered as an appropriate budget constraint⁶ to asset holding, as the maximum amount an individual can convert into money consists of his net financial wealth (i.e. gross wealth less financial advances/loans) and his physical wealth held in the stock of housing and consumer durables (Cuthbertson, 1985: 16). Other quantity theorists such as Marshall and Pigou make allowance for the incorporation of wealth in the demand for money function, but unlike Friedman, fail to provide a specific definition thereof that can be used in the analysis of the demand for money on an empirical level (or a listing of the relevant rates of return that need to be considered as suitable opportunity costs) (Laidler, 1993: 57).

Friedman furthermore states that an all inclusive definition of wealth should be employed, and that the opportunity cost of holding money is the combined impact of revenues accrued from holding bonds (or any other form of financial asset) and human and non-human wealth, if it is included in the constraint (Laidler, 1993: 58). The marginal rate of substitution between money balances and these alternative assets asserts that the demand for money will fall as the return on these other assets rise. There are therefore two components associated with the return on these other assets, namely the interest income or service yielded, and secondly the way in which the market price is expected to vary (implying either capital gains or losses). The inverse relationship between interest rates and market value of the asset (price) means that the interest rate can be used as a suitable measure for the expected percentage rate of capital gain and loss from holding the other asset. This interest rate variable is fairly similar to the one identified in the Keynesian approach, although Keynes essentially relates the expected rate of change in the interest

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The budget constraint implicitly defines the maximum amount of a good that can be bought, or the maximum amount of assets that can be held. If an individual was to hypothetically dispose of all assets, durable goods and bonds and was to acquire money balances instead, this stock of money can be referred to as the individuals wealth.

rate to its current level, while Friedman does not (Laidler, 1993: 59).

As all the rates of return of the various classes of assets tend to move in unison, the demand for money function can be greatly simplified by the choice of one representative interest rate. The actual choice of the representative interest rate can be somewhat ambiguous, but will be referred to as the "rate of interest" and is included as such in Friedman's demand for money function. The inclusion of the interest rate hence reflects the influence of rates of return on alternative wealth forms in determining the individual's desired level of money balances.

The rate of inflation also influences the demand for financial assets, in that the return on bonds and near money is in nominal terms, and high inflation increases the return obtained from holding real assets such as housing, consumer durables, stocks of finished goods etc. A higher rate of inflation encourages a shift to real assets, but it is not certain whether this substitution is from money into the real assets. Friedman nevertheless assumes that there will be substitution from money to real assets as inflation starts to increase (Cuthbertson, 1985: 17). The expected rate of change in the price level therefore has an important impact on the demand for holding money balances in that if the expected rate of return increases (i.e where the price of assets decline) more money will be held and vice versa. It hence follows that the demand for money function needs initially to be measured in terms of real money balances, and that it would have to be multiplied by the price level to render it in nominal terms. Friedman's restatement of the quantity theory for the demand for money can hence be defined as follows (Laidler, 1993: 60) :

$$M_d = f \left(W, r - \frac{1}{r} \frac{dr}{dt}, \frac{1}{P} \frac{dP}{dt}, h \right) P$$

Where (M_d) is the demand for money in nominal terms, (r) refers to the rate of interest, (W)

to wealth, (h) the ratio of human to nonhuman wealth. The price level is referred to as (P), while all the time derivatives (dt) denote the expected rates of change. The wealth term reflects the constraint imposed on an asset holder by the size of his portfolio, and plays a similar role to that of the income constraint in traditional theory concerning the demand for consumer articles. The human to non-human ratio (h), incorporates Friedman's recognition of the fact that an individual can increase the flow of his income (wealth) by investing in his education or any other activity specifically aimed at increasing the value of his labour input, i.e. the larger the human component or factor in the individuals total stock of wealth, so too will the greater the demand for his money balances be, as the holding of larger money balances can be seen as a suitable means of balancing the illiquidity or non-marketability of human wealth (Cuthbertson, 1985: 17).

The demand-for-money function or velocity function for the whole economy can consequently be seen to take on the same form as the identity shown above, and will include interest rate terms, measures of wealth and price factors as explanatory variables. The influence of both the interest rate variables and the price variables in the function will be negative, while a positive relationship between wealth and money demand can be expected.

There are several differences between Friedman's theory of the demand for money, and the Keynesian theories. One is that by incorporating many assets as alternatives to money, Friedman recognises that more than one interest rate is important in determining the demand for money. Keynes, on the other hand, lumped financial assets other than money into one big category called bonds as he felt that they all move in unison (Mishkin, 1998: 545). Another important difference is the fact that Friedman viewed money and goods as substitutes, i.e. changes in the demand for money have a very large and direct impact on aggregate spending. In addition, Friedman's theory suggests that changes in interest rates should have little effect on the demand for money (i.e. the demand to hold

money balances is insensitive to interest rates), while Keynes viewed interest rates to be an important determinant of the demand for money (Mishkin, 1998: 546).

However, Friedman's equation fails to disclose the magnitude and the level of importance for each variable in his equation, and leaves the measurement thereof to empirical investigation. It is also important to note that there are no separate transactions, precautionary and speculative demands for money. Money balances are simply used as a temporary abode for purchasing power, and current income (which determines transactions demand and partly precautionary demand in the Keynesian equation), is not included as an explanatory variable. Friedman thus emphasises the store of value function of money (Struthers & Speight, 1986: 215).

3.4 Monetarism

Modern monetarism is merely an extension of classical monetary theory in that the demand for money to finance transactions is viewed as being stably related to a number of other key variables as well (i.e. in addition to the interest rate and income), as advocated in Friedman's theory in the previous section. The rate of return on a wide spectrum of financial and physical assets therefore influences an individual's demand for money. The term money is now seen as a substitute for all these other financial assets, and the demand for money is hence a function of the rates of return on these substitute assets. In contrast, Keynesian "money" was seen as a substitute for financial assets only, and it was the rate of return on these (the interest rate) that influenced the demand for money (Pearce, 1992: 286).

3.4.1 The monetarist version of nominal income determination

Monetarists believe that changes in the quantity of money are the dominant influence on

changes in nominal income, and over the short-run, on changes in real income as well. It therefore follows that stability in the behaviour of the money stock would go a long way towards producing stability in income growth (Froyen, 1996: 238)

The monetarist approach largely centres on the quantity theory of money : $MV = PY$. Quantity theory is used to provide a basic explanation of the demand side behaviour of the economy. Monetary velocity is regarded as stable (similar to the classical model), which means that money supply is the chief determinant of nominal aggregate expenditure, and therefore also of nominal income PY . Changes in aggregate nominal expenditure are hence largely explained by the change in nominal money supply. Money is also viewed as the most dominant determinant of the price level, i.e. without an increase in the money stock, there can be no increase in the average price level. This is a pure monetary theory of the price level, and can be contrasted to Keynesian theory which is more of a real theory of the price level. Keynesians argue that real aggregate demand and real supply interact independently to determine the average price level (Fourie F.C., 1999: 326).

Friedman's monetarist version of the transmission mechanism to the real sector of changes in the monetary sector is one of a portfolio adjustment mechanism incorporating various interest rates. Monetarists argue that the demand for money to finance transactions is now no longer solely dependent on the interest rate and income, but that the rate of return on a much wider spectrum of physical and financial assets will influence an individual's demand for money (Pearce, 1992: 286). There are therefore many variables in the monetarist demand for money function, of which the interest rate is one (i.e. confirmed in the previous section on Friedman's demand for money function). The interest elasticity of the demand for money is regarded as low, and the main determinant in the monetarist demand for money function is permanent income which changes rather slowly (Struthers & Speight, 1986: 302). This means that a change in the supply of money does not have a significant effect on interest rates or the demand for money. It simply leaves the

economy with excess money balances. The effect on interest rates results from this excess supply of money which causes portfolio adjustments to take place, and it is this process that ultimately pushes up the prices of other assets (Struthers & Speight, 1986: 302). Monetarists therefore argue that the interest rate channel (transmission mechanism) between the monetary and real sectors of the economy is not particularly important, and in any case is not the exclusive monetary transmission channel (Fourie F.C., 1999: 325).

As expenditure is largely insensitive to interest rates, monetarists tend to regard the link between nominal money supply and aggregate expenditure as being robust and direct, which means that a change in money will feed through to expenditure. Private consumption decisions are made on the basis of the consumption of a consumer's (individual) portfolio, which is defined not only to include financial assets, but also real assets and goods. The consumer continually strives to optimise his portfolio by swapping money and goods, as he would generally regard an excess of money in the portfolio as being sub-optimal, and he will then try to exchange money for real goods (Fourie F.C., 1999: 325). An increase in the supply of money therefore leads to a monetary sector disequilibrium. If the public has excess money balances, it will reduce them by increasing their expenditure. Due to the fact that this expenditure includes the purchase of financial assets and of real goods and assets, an expansion in the money supply can hence lead directly to an expansion in output (Wachtel, 1989: 312).

The monetarist approach hence explicitly includes real assets (i.e. the present value of future services of real assets), as well as financial assets. There are therefore two portfolio adjustment effects on the demand for goods and services. First, the usual wealth and substitution effects via the chain of repercussions of a variety of financial assets, which impinge on expenditure by raising the prices of existing real assets. This essentially makes the production of new assets more profitable. Secondly, with the simultaneous rise in prices of financial assets, portfolio adjustment will take the form of expenditure on real

assets as well as on financial assets, in which the effect on real assets comes via the implicit 'own interest' rates (Struthers & Speight, 1986: 302). The monetarist transmission mechanism can thus also be viewed as a portfolio adjustment mechanism.

In conclusion, the monetarist view is that money is the dominant determinant of nominal income. This position contrasts with the modern Keynesian view that money is one of several variables with important effects on income. It is therefore these different views on the importance of money that lead monetarists and Keynesians to different conclusions about the implementation of monetary and fiscal policy. With regard to monetary policy in specific, monetarists are seen to be *noninterventionists*. They tend to favour a growth rate rule for the stock of money that creates an environment in which a stable private sector of the economy can function effectively. Keynesians are *interventionist* or policy activists, and see the need for active discretionary monetary and fiscal policies to keep an unstable private sector economy on track (Froyen, 1996: 245).

3.5 The Baumol-Tobin inventory model of the transactions demand for money

The previous theoretical demand for money models and so-called neoclassical quantity theory equations relate to the amount of money that economic agents wish to hold, in order to conduct a number of transactions rather than the analysis of the motives underlying that choice. As with Keynes's transactions and precautionary motives, the term money refers to a means of exchange for goods and services, and the Baumol-Tobin model is a mere adaptation of the precise variables determining this aspect of the demand for money. Because interest rates were viewed as a crucial element in monetary theory, a key focus on the demand for money research was aimed at the better understanding of the role of interest rates.

Baumol and Tobin independently developed similar demand for money models, which

demonstrated that even money balances held for transaction purposes were sensitive to the level of interest rates (Mishkin, 1998: 539). This implies that costs are incurred when holding money or when changing non-monetary assets into money, and consequently relates to the problem of minimising the costs of acquiring and holding cash balances, or alternatively to maximise the return on the whole portfolio. This specific problem can hence be related to an entrepreneur's problem of minimising the costs of physical inventories that are held by holding an optimal level or proportion of money and bonds (Boorman et al., 1972: 136). For example, if a large inventory stock is held, interest opportunities will be sacrificed, and when a small inventory is held, the small orders that are made could be quite costly. The transactions demand for money can hence be seen as a problem of inventory theory, in that if the individual holds money itself, thus enjoying the advantage of ready purchasing power (liquidity), he would incur a cost in the form of interest foregone at the same time (Truu & Contogiannis, 1996: 126).

The simplest version of Baumol's model contains a number of assumptions concerning the incomes and revenues received by firms or individual households. The key element of this inventory model is that all the relevant information is known with some degree of certainty, and that the model yields a square root relationship between the demand for money and the level of income, the brokerage fee and the bond interest rate (Cuthbertson, 1985: 21).

The main assumptions of the model are :

- (a) the individual receives a known lump sum cash payment of T per period (i.e. per annum), and spends it all, evenly over this period ;
- (b) the individual either invests in "bonds" paying a known interest rate r per period, or holds cash (money balances) paying zero interest ;
- (c) the individual sells bonds to obtain cash in equal amounts K , and incurs a fixed brokerage fee b per transaction.

Individuals essentially try to minimise opportunity costs over time, and split these costs into two components, namely, the "brokerage fee" which needs to be paid every time a bond is sold, and secondly the "interest" that is foregone when money is held instead of bonds or any other interest earning asset. Assuming the real value of the agent's income is (T) which equals the volume of transactions undertaken, (r) represents the interest rate and is assumed constant over the period, (b) signifies the brokerage fee or cost of exchanging bonds into cash, and (K) the real value of bonds which is exchanged for cash every time such a transaction is undertaken.

As all income is spent, and bonds are sold in equal lots of size K , the overall outlay or provision for the brokerage fees is equal to $b(T/K)$. Since expenditure is seen as a constant flow, the average money holding of the agent over the period is $(K/2)$, which is half the amount of the agents receipts from the sale of bonds. The average money holding is then multiplied by the interest rate r over the period to give the opportunity cost or total cost of holding money (Laidler, 1993: 64). These two cost components can hence be combined to give an identity for the total cost of making transactions γ , i.e. :

$$\gamma = b\frac{T}{K} + r\frac{K}{2}$$

In order to minimise these total costs in respect of K , the first derivative is taken and is then set to equal zero before solving for K , this yields the following :

$$\frac{\delta\gamma}{\delta K} = \frac{-bT}{K^2} + \frac{r}{2} = 0$$

leaving:
$$K = \sqrt{\frac{2bT}{r}}$$

As previously stated, it is assumed that money holdings over the period have an average value of $(K/2)$, leaving the demand for money equation as :

$$\frac{M_d}{P} = \frac{K}{2} = \frac{1}{2} \sqrt{\frac{2bT}{r}}$$

By transforming the demand for money for transaction purposes from nominal to real terms, the price term (P) can be moved to the left hand side of the equation indicating that real money demand is proportional to the square root of the volume of transactions and inversely proportional to the square root of the rate of interest and can be rewritten as follows (Laidler, 1993: 65) :

$$M_d = \frac{1}{2} \sqrt{\frac{2bT}{r}} P = \alpha b^{0.5} T^{0.5} r^{-0.5} P$$

where :

$$\alpha = \frac{1}{2} \sqrt{2}$$

If there were no brokerage fees, b could be substituted by zero, which would result in the equation representing the real demand for money being reduced to zero (i.e. $M_d = 0$). This illustrates that it would be beneficial for the agent to synchronise bond sales perfectly with the purchases of goods and services (transaction needs), and means that money will not be held, except for the explicit purpose when it passes through the hands of the bond seller when he wants to purchase goods (Cuthbertson, 1985: 23).

Brokerage fees are important in determining the net return on an asset. They are defined to include all fees charged by middlemen in asset markets, and are assumed to be

collected only when the assets are sold (Boorman et al., 1972: 116). The brokerage fee b is extremely important in the inventory model and should be interpreted correctly, i.e. to merely think of it being analogous to the commission or fee charged by a bond dealer for selling the asset for a client could be misleading. The brokerage fee in this instance therefore entails many other abstract costs such as "shoe-leather costs" which are seen as the costs associated with the wear-and-tear on an individual's shoes when he/she has to physically walk to a savings bank in order to obtain cash for a deposit (Laidler, 1993: 65).

The model, as shown above, predicts that the demand for money increases in less than proportion to the volume of transactions T , and that the individual's demand for holding money balances shows characteristics of an economy of scale. This has important implications, in that the demand for money now depends on the distribution of income as well as on its level and the interest rate. Assuming an exogenous interest rate and price level, the doubling of the quantity of money demanded would require a doubling of real income in order to absorb the increase. By making use of the square root rule, a quadrupling of real income would be required. However, as in all the money demand models discussed previously, the price level P will move in proportion to the money supply over the long-term, i.e. given a constant level for the brokerage fee and real transaction volume (Laidler, 1993: 67).

It is important to note that there is a flaw or logical error in this derivation. The premise is that households obtain cash for the period's purchases by making one, two, three or more withdrawals. These withdrawals are assumed to be evenly spaced, so that the household's cash holdings are divided by the number of withdrawals, i.e. the larger the number of withdrawals per period, the smaller the number of money balances held on average over the period. The problem is that the number of transactions per period by households should be constrained to an integer value, as one cannot make 1.37 transactions in a single period. The practical implication of this problem is that by recognising this integer

restriction, many households are assumed to make only one withdrawal per period (McCullam, 1989: 51).

As outlined above, the transactions model views money as inventory and its demand is determined in the same way as a wholesaler determines his optimal stock of goods he wishes to keep on hand for sale. Clearly this model is somewhat unrealistic, particularly for firms who face uncertain receipts and payments. For persons, the assumption of a known fixed lump sum payment is more realistic, and the opportunity cost for holding cash is likely to be the interest rate on other alternative liquid assets (time deposits etc.), rather than bonds (Cuthbertson, 1985: 23).

In summary, the essence of inventory theoretical models of the transactions demand for money and bonds is the assumption of certainty concerning the timing of income receipts, the brokerage fee and the timing of the return on money and bonds. For persons, the inventory model may have some relevance, but the relationship between money, interest rates and transactions is perhaps likely to be more complex than in the simple inventory model.

3.5.1 Tobin's demand for money : money and monetary wealth

The weakness of the Keynesian analysis of the demand for money as an asset is that it logically implies that any one person or corporation will hold either asset money or bonds or both. This therefore surmises that practically no one holds a diversified portfolio of bonds and money simultaneously as a store of wealth. Since diversification is apparently a sensible strategy for choosing which assets to hold, the fact that it rarely occurs in Keynes's analysis is somewhat unrealistic, and constitutes a serious shortcoming of his theory of the speculative demand for money (Mishkin, 1998, 542).

At most times an individual's wealth will likely consist partly of money and partly of income earning assets (held in variable proportions). Tobin believes that an investor's expectations are neutral, i.e. he regards a rise or fall in interest rates as being equally probable. Psychologically there is a net risk of loss when holding bonds, and the return on bonds is the compensation for this risk. The exposure of risk obviously increases with the quantity of bonds held, but so does the income earned from the overall portfolio. In choosing a particular combination of money and bonds, the investor is balancing income against risk (Struthers & Speight, 1986: 200).

Tobin assumes therefore that most people are risk-averse and that they would be willing to hold an asset with a lower expected return if it is less risky, individuals can also reduce the total amount of risk in a portfolio by diversifying, i.e. by holding both bonds and money simultaneously as stores of wealth (Mishkin, 1998: 543). Tobin also argues that individuals act according to own preferences. Some may be risk-lovers, in which high risks afford them a utility, and they would be willing to accept a lower income in order to take on these higher risks (capital gains), while others are risk averters and will only accept more risk along with guaranteed higher income. The majority of investors are believed to be risk averters, in which there are plungers - i.e. where the individuals wealth is entirely in bonds at or above some given rate of interest, and entirely in money below this interest rate, and diversifiers - where the individual hedges his bets by holding both money and other assets (Struthers & Speight, 1986: 200)(Sriram, 1999: 13).

Tobin presents a blend of both the Keynes and Cambridge approaches to monetary theory, in which the assets in his model (money, government debt, private debt and physical capital) are not perfect substitutes. Interest rates and yields may vary and will depend on the relative supply of the asset in question (Boorman et al., 1972: 230). This in a sense, provides a more sophisticated liquidity preference hypotheses, as it now dispenses with Keynes's assumption of a certain "expected" interest rate, as well as the restriction that this

rate is fixed by the individual (although the expected rate itself differs between individuals).

The Tobin approach marked a turning point in research on financial models and is hence of great importance to monetary analysis. It is also often referred to as the precursor of the portfolio balance approach to monetary theory. The portfolio balance approach makes allowance for a vast number of financial assets which can be seen as alternative investments by the economic agent, as well as introducing many different interest rates as there are imperfect substitutes for these assets (Kim & Kim, 1999: 151). Portfolio theory holds that each economic agent determines the optimal size of his assets and liabilities by considering yields on each financial asset and other variables, and keeping an adding-up condition between his assets and liabilities. This means that each individual is assumed to have his own optimal component ratio of each class of assets (liabilities) in choosing financial assets (liabilities). Therefore, he holds low yielding assets as well as high yielding assets because of transaction costs, custom, and uncertainties over changes in yields. Besides this, in the short-run, the real component ratio of each class of assets (liabilities) may differ from the optimal ratio, but in the long-run, the optimal component ratio is assumed to be accomplished by stock adjustment transactions (Kim & Kim, 1999: 152).

The portfolio balance version of the transmission mechanism asserts that monetary policy operates via changes in the composition of asset holdings in response to changes in relative yields on assets. It describes how and why these adjustments take place and how they influence aggregate expenditure. This theory asserts that money is just one of several assets, i.e. one form of 'capital'; hence the use of the term capital-theoretic to describe portfolio theories of the demand for money. Tobin believed the rise in price of equities to be crucial. An equity is a title to real assets, and the willingness to hold equities at low yields is the same as the willingness to hold existing real capital at lower returns (Struthers & Speight, 1986: 300). The value of any stock of capital is equal to the anticipated future return on it (discounted back to the present date) - if the discount rate were reduced, the

present value would rise. Once this value of real capital rises above the cost of producing new real capital, there is an inducement to invest. If existing assets replaceable for R1 million are valued at R1,5 million on the JSE, this would induce investment. A decline in yields on existing equities means that new equities can be sold at lower prospective yields, i.e. the cost of raising equity finance has fallen, which would encourage firms to raise new equity finance for investment.

Tobin confines this part of his analysis to equities and does not consider the issue of new debt, since his argument proceeds from the concept of the equity holder's willingness to hold real capital. A weakness in his theory is his assumption that the market price of a firm's equity is the market price of its real capital assets, and that it is this excess price of shares which motivates investment decisions. He therefore takes no account of the effects of stock exchange speculation on share prices nor of the divorce of ownership from control of the firm (Struthers & Speight, 1986: 300).

Tobin's model differs slightly from earlier Keynesian models (which refer to the interest rate as the key variable in the transmission mechanism), as his emphasis lies primarily on the money-capital margin, and it is the **supply price of capital** (SPC) that links the monetary sector to the real sector, and not so much the interest rate itself. The rise in equity prices and willingness to hold real capital is central to Tobin's theory, and in many ways is also related to the Keynesian hypothesis since it assumes that changes in interest rates and other rates of return influence aggregate demand through its effect or impact on investment expenditure. However, the Keynesian hypothesis that the interest rate forms the direct link between the monetary and real sectors is strongly denied by Tobin. He argues that the main link or strategic variable in the transmission mechanism, which can be used to measure the expansion or restriction of monetary policy in the economy, is rather the rate of return required by the wealth owners. This rate is referred to as the SPC (Boorman et al., 1972: 230). However, the central bank cannot operate on the latter and therefore has

to influence the interest rate as a policy variable.

3.6 The demand for money in a buffer stock approach

A number of problems has occurred with regard to the empirical work on the demand for money. The demand for broad money seems to be unstable in a number of countries, and the lag response of money demand to changes in income and interest rates seems to be implausibly long (Sriram, 1999: 33). This implies that the demand for money functions predict an acute over-shooting of the interest rate in response to exogenous changes in the money supply (Carr & Darby, 1981: 183). A number of attempts to solve these problems have been analyzed in which sophisticated estimation techniques, more flexible lag structures, alternative functional forms, the addition of variables (such as the own rate of money), the expected rate of inflation and non-human wealth have all been added and have proved moderately successful. However, there is still room for more improvement (Cuthbertson, 1985: 122).

In addition, there are concerns as to the interpretation of the estimated demand for money functions, i.e. are they actually demand for money functions, or do they merely represent reparameterised real balance equations (where causation flows from money to the arguments of the demand for money function)? The idea that buffer holdings of money are voluntarily held over the short-run and is then expended in a slow real balance effect has many attractions as an explanation for the "temporal instability" in the demand for money functions, and contributes to efforts to suitably explain the long and variable lags of monetary policy (Cuthbertson, 1991: 20).

Buffer stock money is a further attempt to improve the understanding of the demand for assets (money), and recognises that an individual's desired money holdings consists of an expected or planned component, and an unexpected or transitory component. The former

is determined by planned or expected levels of transactions and rates of return, while the latter refers to temporary holdings caused by unexpected 'shocks' (such as unexpected receipts or disbursements). Buffer stock money essentially refers to disequilibrium money, i.e. when money supply is endogenous and passively responds to changes in demand, then it would be correct to equate desired money holdings in the aggregate to the actual money supply. If there is an unexpected shock to the money supply (independent of changes in the demand for money), then either the money market will not clear in the current period, and a disequilibrium will exist, or individuals may experience an unexpected change in their income - with the result that 'buffer-stock' holdings of money will ensue. It is when independent changes in the money supply take place, that the disequilibrium model yields conclusions somewhat differently to the conventional demand for money models (Cuthbertson, 1985: 122).

Sriram (1999) and Carr and Darby (1981) propose that money balances serve as a shock absorber or buffer stock which temporarily absorbs unexpected variations in income (transitory income) until the portfolio of securities and consumer durable goods can be conveniently adjusted. Since it is costly to make continual portfolio adjustments, an unexpected inflow might remain as excess money holdings for some time (Sriram, 1999: 33). A similar adjustment response would seem reasonable for the portfolio shock brought about by an unexpected change in the nominal money supply. For example, if money supply were to increase via open market transactions, the initial impact on the price of treasury bills will quickly spread to the price of other assets. In this process, investors will find they cannot obtain their expected yield from their planned portfolio, and will take some time to revert to a new alternative portfolio (where larger average money balances will be held). Others find that they are now able to sell their assets (stocks, houses, cars etc) more easily and will hence have larger average money balances on hand. Credit availability will be greater, and loans approved more readily with temporary increases in money balances. They do add, of course, that the temporary increase for each individual

may be brief, but as this effect is quite common, it becomes significant when aggregated (Carr & Darby, 1981: 187).

As a further illustration of the buffer stock of money concept, the probable behaviour of firms in an uncertain environment can be considered. Costs associated with marginal adjustments to prices, wages, production and real stock levels may be significant in relation to the opportunity costs of interest forfeited in holding onto idle money balances. These shocks to the firms production and employment projections will necessarily lead to a change in the cash balances held by the firms over the short-term until the shocks have been identified as being permanent or temporary. Similar shocks to the money supply (caused by an increase in bank advances) could also lead to unexpected changes in the money holdings of other agents when these advances are eventually spent. The buffer stock concept explicitly considers the disequilibria that originates from shifts in either the demand or the supply of money. The speed at which firms react and adjust their excess holdings of money balances depends on (Cuthbertson, 1991: 20) :

- their initial cash holdings ;
- the width of the band within which money balances are allowed to fluctuate ;
- the review period for making decisions ;
- the costs associated with transactions and information in moving into alternative assets ; and
- the source that brought about the change (i.e. whether this source is permanent or temporary)

Mizen (1994) views the buffer stock model as a means to illustrate the disparity between the actual and desired level of the asset stock. If this asset is money, then the disequilibrium described for individuals could be useful in describing the divergence between the supply and demand for money in aggregate. In the buffer stock model, a money supply increase leads to expenditure on goods and services, which raises the

domestic price level until the money balances are then returned to their original level in real terms. In the orthodox buffer stock models, money is held willingly in the short-run, since it is less costly to diverge from equilibrium in the money market, than to alternatively have to adjust asset balances immediately (Mizen, 1994: 26).

In summary, individuals and firms find it costly to continually monitor the level of their money balances and will therefore tolerate limited deviations in these balances around certain pre-set and predicted levels. Once the balances move out of this band, a transfer of funds into or out of the buffer stock will be considered. Any unexpected revenue windfall will raise the level of the money balance and prompt a transfer into an interest earning asset (taking the balance back closer to its initial starting point before the ceiling was breached). Conversely, an unexpected decline in the money balances, accompanied by a threatening high overdraft cost burden would prompt a transfer in the opposite direction once the pre-set floor level (minimum) has been broken (Artis et al., 1991: 81).

3.7 Conclusion

There are two characteristics of money that provide the starting point for a number of theories of the demand for money. One looks at the functions of money to suggest various motives for holding money balances. For example, a transactions motive stemming from money's use as a medium of exchange and an asset or portfolio motive derived from money as a store of value. Friedman offers an alternative approach in which he dispenses with the need to identify any specific roles for money, and takes a general value theory approach to the demand for money, i.e. where money is treated as a representative asset like any other in producing a flow of utility services for its holder (Artis et al., 1991: 79).

When defining the demand for money by considering the motives for holding money, the theories in general are only partial models in that only one motive is usually considered

(e.g. transactions motive) (Cuthbertson, 1991: 4). The transactions motive assumes that balances held for transaction purposes tend to increase in proportion to money incomes, and consists entirely of money (which is anyway needed to complete a transaction by means of payment). An impediment to this approach was that no cognisance was taken of the costs of exchanging out of funds held in some other form into money balances at the point of need. Baumol and Tobin altered this assumption and allowed balances set aside for transaction purposes also to be invested in securities (bonds and equities), and applied inventory theory to determine the amount that is held as money. Determinants for the demand for money are the flow of transactions, interest foregone by holding money instead of securities, and the costs - brokerage charges and inconvenience - of affecting the transfer between two assets (Artis et al., 1991: 79).

Tobin presents a blend of both the Keynes approach (three motives for holding money - transactions, precautionary and speculative) and the Cambridge approach to monetary theory. The assets in his model (money, government debt, private debt and physical capital) are not perfect substitutes, and interest rates may vary. This contrasts to Keynes's assumption that the individual has a certain fixed "expected interest rate". The concept of an upper threshold of interest rates and a desired level of money balances was explored once again in the buffer stock approach. Here the role of money was primarily seen as a shock absorber which enables economic agents to temporarily postpone an otherwise costly adjustment to changes in key economic variables, such as employment, investment and output (Cuthbertson, 1991: 19).

From the preceding sections of this chapter it becomes apparent that there are a number of factors and economic variables that can be used in order to determine an appropriate demand for money function for South Africa. Income variables, such as the nominal gross domestic expenditure and the gross domestic product have been used successfully in almost all of the various demand for money approaches mentioned here. The price

variable can be considered to be representative of the gross domestic product deflator, or alternatively the level of domestic prices as defined by the consumer price index. Various interest rates have also come to the fore, namely the own interest rate on deposits, and the prime overdraft lending rate as well as other relevant interest rates such as those applicable to bonds which can be used as alternative substitute interest rates. The opportunity cost for holding money invariably rests upon the domestic price level as the appropriate cost variable. On the basis of these theoretical approaches, a range of new behavioural equations have been estimated and tested in the South African context. The following chapter is dedicated to the previous efforts of some economists in their endeavour to define a suitable and stable demand for money function, and serves as a foundation for the demand for money functions contained in this study.

CHAPTER 4 MODELLING THE SUPPLY AND DEMAND FOR MONEY IN SOUTH AFRICA

4.1 Introduction

This chapter focusses on elucidating a few of the more important econometric contributions to the modelling of the money supply from a South African perspective. It also highlights some of the more reputable regression models that have been determined with specific reference to the South African economy. These various models have originated in an effort to discover and understand the factors that have an influence on the movements of the M3 money supply or any other dis-aggregated component of the broadly defined money supply category.

The first section of this chapter elucidates various approaches to the modelling of the money supply. In the simplest demand for money function, money-demand depends primarily on income and an interest rate. The second section of this chapter concentrates on the evolution of the money demand and supply function in South Africa, and accordingly strives to determine the explanatory factors that are capable of influencing the change in the money supply in South Africa. This will be concluded with a short paragraph on the key variables that this paper intends utilising as explanatory variables in the demand for money function of the proposed money model.

4.2 Various approaches to the modelling of the M3 money supply

Van den Heever (1990) points out that there are basically three approaches to the modelling of the M3 money supply, namely the monetary analysis approach, the money multiplier approach and the direct money supply regression approach. These three approaches are discussed in more detail below :

4.2.1. The monetary analysis approach

The monetary analysis approach refers to the consolidated balance sheet identity of the monetary sector (see table 1 on page 36) in which changes in the broadly defined M3 money supply is equal to the sum of the changes in the claims on the private sector, the change in net claims on the government sector, the change in net gold and other foreign exchange reserves and the change in net other assets. Due to the fact that this is merely an accounting identity, it will have to be adjusted to be of use in empirical models aimed at behavioural relationships. This adjustment entails that each of these statistical counterparts of the change in the M3 money supply be endogenously specified as further behavioural equations in the model. For example, the change in net reserves can be determined via an identity incorporating the sum of the balances on the current and capital account of the balance of payments (which can in turn be endogenised by means of further structural equations for the various categories of imports, exports and capital movements). Claims on the private sector can for example be illustrated as a function of income and interest rates, etc. This approach is the one that is followed by Van den Heever (1988) in his monetary model aimed at quantifying the impacts on key macro economic variables under various policy option scenarios.

4.2.2. The money multiplier approach

This approach refers to the process in which the eventual money supply is determined by the product of a "monetary base" and appropriate multiplier. For obvious reasons, factors leading to the growth in the base or growth in the money multiplier lead to growth in the money supply. De Wet and Herbst (1981) made use of this approach in which the stock of liquid assets in the economy were used as the monetary base and was influenced by a variable multiplier. The multiplier reflected the effect of various liquid asset requirements on the different time deposit categories of banks liabilities. However, due to the phasing

out of the important role that liquid asset requirements had on money and the extension of credit since the early 1980's, much of the previous benefits of this approach have now been forfeited (Van den Heever, 1990: 2).

4.2.3. Direct money supply regression equations

This approach estimates regression equations in which key economic variables are used as primary determinants or influencing factors for the money supply, i.e. with an appropriate money supply category as the dependent variable of the behavioural equation. Examples of documented studies in which this approach is preferred are illustrated in publications by Tavlas (1989) and Courakis (1984). The underlying assumption in these models is that the equation should be in a reduced form, and suitably depicts the various factors that influence the demand for and supply of money in the South African economy. These models essentially define a money demand function, while the supply of money essentially adjusts to the demand thereof. This is perhaps the most widely used method to illustrate the demand for money function, and makes even more sense under the assumption that money supply in South Africa is predominantly demand driven (Van den Heever, 1990: 2).

4.3. Factors influencing the modelling of money supply in the 1980's and 1990's

There are various factors that have had a profound influence on the trends of money supply during the past two decades. Prior to 1980 monetary policy was aimed at direct measures such as credit ceilings and deposit rate controls. During these phases, disintermediation in which primary lenders sought loanable funds outside the formal banking sector took on immense proportions. This was largely due to the fact that bank credit extension to the private sector was kept within strict limits by means of the statutory credit ceilings at that point in time. Under this regime, it became apparent that factors outside the Reserve Bank's monetary control on credit ceilings started to become more

prominent in influencing changes in domestic money supply (these included the change in net gold and foreign exchange reserves and the net claims on the government sector). In instances where liquidity was generated by rising gold and foreign reserves, it led to the eventual reduction of fiscal discipline, lower interest rates and special concessions with regard to credit ceilings in order to stimulate domestic expenditure. Under these circumstances rising money supply usually led to rising domestic expenditure (Van den Heever, 1990:3)

Since the 1980's monetary policy concentrated on control of the money and credit aggregates by means of interest rates. The banking sector was accommodated fully with its daily cash and cash reserve requirements through the discount window, but at a price. This price later became known as the Reserve Bank's "bank rate". For conservative monetary policy, bank rate should be sufficiently high to dampen the excessive money and credit extension in the economy⁷. Banks stipulated their lending rates on the basis of bank rate, i.e. at a premium to the Reserve Bank's accommodation rate, and it is this prime overdraft lending rate that deters the general public from making use of too much credit. Therefore, the link between prime lending rates and bank rate was seen to be useful in assuring a quick and reliable effect of the central bank's actions on the cost of credit (Meijer et al., 1991:151). Credit extension ultimately flows back to the banking sector by means of deposits on the liabilities side of their balance sheets. At the same time, banking institutions deposit rates are determined by their lending rates and bank rate, which means that it also influences the public's desire to hold their money in different deposit categories. In this sense the money supply is demand determined and coincides with domestic income and expenditure (Van den Heever, 1990:4).

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Stals (1998) considered the average growth rate in the broadly defined M3 money supply of between 6 and 10 per cent per annum to be consistent with acceptable objectives for the rate of inflation and the potential real rate of growth in the economy (Stals, 1998: 36)

With the introduction of a market related repo tender system as from March 1998, the repo rate has now become more volatile and the banks' prime lending rates change more frequently than before. By making less liquidity available to the formal banking sector, banks now have to tender higher for the scarce funds from the Reserve Bank, and in the process influence the movement in the repo rate and ultimately their own prime lending rates. However, the eventual impact of the repo rate on the domestic economy is fairly similar to the influence of bank rate on the economy. What this essentially means, is that due to the changes in monetary policy instruments, the period prior to and after 1980 cannot be defined by the same empirical model, and that functions and co-efficients determined with a data set prior to 1981 can differ somewhat from the same model's elasticities after 1981. For this reason it is assumed that money supply is essentially demand determined, and consequently a money demand function will be determined and incorporated in the monetary model.

4.4 The evolution of empirical money demand and supply models in South Africa

Initially the money supply analysis was developed on a theoretical and empirical level and in most cases was based on the relationship between the money supply and the monetary base through a multiplier which was composed of several ratios. The magnitude of the multiplier was determined by decisions of banks, the non-bank public and the monetary authorities. Contagiannis (1977) investigated the forces underlying the money supply process in the South African economy in order to assess the effectiveness of monetary policy. His model expressed the money stock as the product of a monetary base and a monetary multiplier, i.e. a typical money multiplier approach. An important aspect of his findings was that estimates of the various elasticities indicated that the bank credit multiplier was more sensitive to changes in interest rates than the money and near money multiplier. This intuitively implies that the broader the definition of money, the higher the interest elasticity of the multiplier. Due to the fact that this study was undertaken prior to

1980 in which the policy regime was somewhat different than what it is now, it is perhaps feasible to not apportion too much significance to these results, and to concentrate more on general demand for money equations.

Literature on the most important features of the demand for money functions in South Africa began prior to 1980, i.e. while credit ceilings were still imposed and used as a monetary policy instrument. Despite this impediment, it is worth mentioning the contribution of Heller (1966) who initially stipulated the use of the gross national product (GNP) as the stable parameter indicative of the transactions demand for money. Heller states that in the proper specification of constraint on the demand for money, the literature on other countries (notably the USA), suggests consensus that wealth or permanent income, rather than current income, should be the relative constraint if a broad definition of money is employed. Heller's conclusion was that there is a stable demand for money in the long-run, and that the gross national product, rather than wealth, is the relevant constraint. He also found the price level and interest rates to be important explanatory variables. However, in the short-run, he was unable to define a demand for money function with significant explanatory power (Heller, 1966: 340).

Maxwell (1971) initiated research motivated by Heller's assertion that there was a stable demand for money in the long-run. Forced savings during the second World War, and the subsequent rapid evolution of the financial sector made this assertion questionable. His findings were that the demand for money function had undergone a parametric shift from the pre-war period to the post-war period. He furthermore states that this shift cannot simply be ascribed to the mere running down of idle balances during the war period, and that it would be impossible to define a demand for money function in isolation of the institutional environment. Maxwell's research also pointed out that whenever a reasonable fit for the demand for money was obtained, the interest rate coefficient had the predicted sign and was significant, i.e. conclusive evidence that the demand for money is interest

elastic (Maxwell, 1971: 21).

Stadler (1981) published his findings on a study of the demand for money in South Africa, in which a single-equation regression approach was undertaken using the ordinary least squares technique. The simplest demand for money function takes on the form of being dependent on the level of income and the interest rate. The former refers to the transactions demand for money, while the latter refers to the demand for idle balances (as the interest rate is the opportunity cost associated with holding cash balances). Alternative demand for money functions were estimated in logarithmic form in order to easily assess the income and interest rate elasticities, while the money stock and income variables were generated in real terms and have been deflated by the consumer price index. In almost every case the interest rate elasticity had the incorrect sign and the autocorrelation Durbin-Watson statistic suggested misspecification of the function.

A possible explanation for this phenomenon is that the broad definition of money includes interest-bearing deposits, and that a rise in interest rates would increase the demand for such deposits. This could account for the positive correlation between the demand for money and interest rates. Stadler consequently concludes that there is no discernable relationship between the demand for money and the rate of interest and that increases in the price level appear to have a distinct negative effect on money balances, but that the rate of change of the price level was found to be statistically insignificant when included as a separate variable in the demand for money function (Stadler, 1981: 152).

Studies by Contogiannis and Shahi (1982) suggest a number of variables to be considered in the demand for money functions. Although a number of interest rate variables have been tested, they were found to be statistically insignificant, perhaps due to structural changes and other institutional arrangements in the South African economy. A number of other reasons may be advanced for the evident interest inelasticity of the demand for

money, and an alternative proxy for the degree of credit restraint is proposed. The price level as an opportunity cost for holding money and price expectations were introduced in the form of an adaptive expectations mechanism. They found that the long-run income elasticity for the demand ranged upwards from 1,2 to 1,6 from the narrow to the broad definition of money. This was in line with findings in other countries at that time and suggests that people treat money in the same way as a luxury good, i.e. as something which individuals like to hold proportionately more of when their real income is higher.

Contogiannis and Shahi furthermore ask the question whether inflation in South Africa is self-generating by examining the product of the price elasticity and the coefficient of price expectations in the model. This product measures the total reaction of the changes in the quantity of money on the price level, and where the product is less than unity it is not deemed to be self-generating in nature. If it is greater than unity, rising prices produce higher expectations of inflation and is therefore self generating. Their results suggest that the product is less than unity and that although inflationary expectations have risen over the period under consideration, inflation itself has not yet assumed a self-generating characteristic (Contogiannis & Shahi, 1982: 31).

Contagiannis and Shahi's findings that the interest rate had insignificant explanatory power in the demand for money function concurs with the results of Stadler, but differs somewhat to that of the earlier conclusions formulated by Maxwell. These various findings led to large scale debate on the role that monetary policy plays in aggregate demand management. Courakis (1984) was motivated by this curiosity about the behaviour of the financial markets and monetary policy in South Africa, and stated that it was possible to explore three avenues open to the functional form of the demand for money equation. The first was that the demand for money comprised other variables besides permanent income and the permanent price level (i.e. Friedman's quantity theory for the demand for wide money). The second is to consider other expectation formation processes for income and prices,

while the third is to describe the desired level of money balances and turn the attention to the process of adjustment from the "actual" money balances to their "desired" level (Courakis, 1984: 4).

This study furthermore attests that future research on the demand for money in South Africa should entail a relationship that includes an opportunity cost for holding money balances in terms of financial assets at least, and dispels the myth that previous studies have tended to cast on the significance of opportunity costs in terms of financial assets in explaining the demand for money function. Besides real income, the price level and opportunity costs, other factors also seem to play a role in the demand for money. The inclusion of opportunity costs resulted in significant decreases in the value of the elasticity with respect to real income, and significant increases in the value of the elasticity with respect to the price level. For real income, the results suggest that, as theory predicts, the elasticity of the demand for narrow money is less than or equal to unity (Courakis, 1984: 36).

Whittaker (1985), in reply to the work done by Courakis, found that whilst it correctly raised some of the shortcomings of previous studies, it brought us no closer to knowing the functional form of the demand for money equation in South Africa, nor of its numerical parameters in the model. Courakis pointed out that an interest rate should represent the opportunity cost with respect to alternative financial assets and that the treasury bill rate (TB) was arbitrarily selected. Whittaker stated that the bankers' acceptance rate (BA) may be the better measure of the market cost of short term credit, but also suggested that it was not clear that either of these rates were truly the opportunity cost of holding money (as perceived by the average holder), nor was it obvious that short term rates should be preferred to longer term rates. With regard to the income variable, it should represent the value of transactions. Although the gross domestic product at factor costs (GDP) has conventionally been used, gross domestic expenditure (GDE) may be the more reliable

measure to use in the South African context. In a closed economy GDE and GDP should be equal, which may well not be the case in South Africa's more open economy. Another assertion of Whittaker's study was that Courakis's negative values obtained for the opportunity costs for holding money with the TB rate became positive; although not significantly different from zero when the BA rate is used (Whittaker, 1985: 191). This leads Whittaker to believe that the influence of the interest rate on money demand is not fully substantiated, which concurs with the previous findings of Stadler (1981) and Contogiannis & Shahi (1982).

Deregulation of financial markets and an upsurge in innovation in these markets had widespread monetary policy implications in a number of countries during the late 1980's. Simple, well behaved relationships between money and nominal income that held in the regulated framework, seemed to break down in this changing global financial environment. New innovations and deregulation led to a blurring of the distinctions between the various monetary aggregates. The buffer stock model gained widespread popularity at this time, and could supposedly distinguish between shifts in the demand for money due to traditional factors (such as income and interest rates), and shifts due to unexpected changes in monetary policy. The role of money is therefore essentially seen as a buffer asset or shock absorber to temporarily smooth the response of the economy to unexpected changes in the money supply. Tavlas (1989) stated, however, that the one problem in estimating the demand for money from a South African perspective, is the importance of the manipulation of the bank rate in the conduct of monetary policy, i.e. the concern that the supply of money may be completely endogenous. If this is true, it would cast serious doubt on the validity of the buffer stock model, which partly relies on exogenous shocks to the supply of money (Tavlas, 1989: 2).

Tavlas (1989) agrees and asserts that empirical estimates of the coefficients of the demand for money models have been unstable since the middle 1970's. He adds that by

treating real money balances as a function of money supply shocks, the buffer stock model is able to directly confront Whittaker's criticism of Courakis's findings that a stable money demand relationship was found (i.e. despite the direct interventionist policies of the authorities and the wide fluctuations in South Africa's economic activity during the period under review). Also, to the extent that real money balances are influenced by changes in the money supply, Tavlas contends that the conventional model is mis-specified (Tavlas, 1989: 5). The buffer stock model in this study hence suggests that the money demand function for M3 money balances is determined by real income (GDP), an opportunity cost variable (long-term bond yield), the own rate of return on money (deposit rates), and adds a monetary shock term (the difference between the actual money supply and an anticipated money supply series). The anticipated money supply series is determined by regressing the log of M3 on a polynomial distributed lag of its past values over 16 quarters.

In the South African context, bank rate influences credit (albeit with an unpredictable lag and magnitude) and then expenditure and output (Meijer et al., 1984: 469). The money supply aggregates then passively follow the volume of credit, and given the availability of Bank accommodation, the money base adjusts according to the demand for its components, currency and bank reserves. This would seem to imply that money supply in South Africa is endogenous and that the buffer stock model is therefore inappropriate since this type of model relies on exogenous shocks to the quantity of money to influence real money demand (Tavlas, 1989: 9).

During the 1990's, the monetary policy instruments in South Africa worked through the supply as well as the demand for money to either expand or restrict the equilibrium amount of money in the system. Given this scenario, there was in principle no limit to the amount of credit and thus the amount of money which the banks could supply to the non-banking sector, since they could always obtain cash from the discount window to support a further increase in the amount of credit extended. There was, of course, a practical limit to the

amount of credit banks could extend by means of accommodation through the discount window at a cost as determined by bank rate. De Wet, Jonkergouw & Koekemoer (1996) set this limit by the amount of free liquid assets which can be exchanged for cash at the discount window, and can be measured by the ratio of liquid assets (LA) to required liquid assets (RLA). If LA rises relative to RLA banks will attempt to exchange liquid assets for cash at the discount window, which could then be lent out. Alternatively if RLA rises relative to LA banks will have to curtail their lending activities in order to meet their liquid asset requirements.

This ratio of (LA/RLA) was then included as an explanatory variable in their supply of money function. The other two explanatory variables include the level of economic activity (as measured by the real gross domestic product) and the profit that banks can make in extending credit. The profit margin is measured by the difference between their real lending rate at the market interest rate (RS-P) and their real cost of borrowing cash at Bank rate (BR-P), where P denotes the rate of inflation. As long as real GDP and [(RS-P)-(BR-P)] increases, banks will attempt to supply credit and thereby increase the supply of money (De Wet, Jonkergouw & Koekemoer, 1996: 188).

Since the Reserve Bank always stands ready to provide the banking sector whatever they require at bank rate, it is only bank rate that brakes the money creation process, while the liquid asset requirement is merely a channel through which the Bank remains informed on the financial status of the economy. Whenever bank rate rises, banks will need to increase their lending rates so as to maintain a positive profit margin, which implies that market rates adjust to the rates that the Reserve Bank sets according to its discount policy. The increase in the banks' lending rates will thus raise the whole interest rate structure and curb the demand for money through the negative influence of interest rates on expenditure, production and the demand for liquidity (De Wet, Jonkergouw & Koekemoer, 1996: 189).

The conventional demand for money function in this study is hence a positive function of real aggregate income (GDP), and a negative function of the real market interest rate (RS-P), where RS denotes the bankers' acceptance rate. In addition to these two explanatory variables, there also has to be an expectations variable. This expectations variable reflects the individual's demand to hold less money as a store of value when economic conditions are expected to improve, and more money when they expect conditions to slow down. An important finding of the study was the fact that bank rate could be used as an indicator of what can be expected of future economic conditions, i.e. an increase in bank rate signals the efforts of the monetary authorities to slow down the pace of domestic economic activity and thus positively stimulate the real demand for money. Similarly a decline in bank rate will negatively affect the real demand for money since this can be regarded as an effort to stimulate the economy (De Wet, Jonkergouw & Koekemoer, 1996: 190).

The demand for money function in this study contains an income variable, a real market interest rate variable and an expectations variable of future economic conditions. Due to the fact that the bankers' acceptance rate (BA) is a money market rate, it will tend to track bank rate quite closely. This in effect means that bank rate has an affect on both the real interest rate component and the expectations variable of the model. In addition, the trend in the South African money supply is characterised by large swings in re-intermediation and dis-intermediation, i.e. as the gap between lending and borrowing rates diminishes economic agents switch back to formal bank intermediary financing and vice versa. As re-intermediation takes place, the broad money supply starts to grow and warrants the conviction that some sort of variable should be used in the South African demand for money function to incorporate this phenomenon as well.

4.5. Conclusion

Money demand and supply functions depicting the behavioural patterns of economic agents in the South African economy have tended to vary over time. Reasons for this shift could be attributed to the changing economic environment in which early monetary policy measures were based on features such as credit ceilings and deposit rate controls. As the emphasis of monetary policy shifted towards a more market related approach, so too did the behavioural relationships between domestic economic agents and the monetary aggregates. As from 9th March 1998 with the introduction of the repo rate, monetary policy has become even more market related in which the repurchases rate can now vary daily on the tender system.

Income and interest rate elasticities of the empirical money demand and supply functions have hence tended to show various degrees of change during the different monetary policy regimes. However, due to the endogeneity of money supply in the South African economy, the supply of money is primarily demand driven and recent studies on monetary models have tended to emphasise demand for money functions. Early works on demand for money functions stressed the need for an income variable and an interest rate component to at least be present in the demand for money functions, but tests for statistical significance for the interest rate were found unsatisfactory. Later studies tended to emphasise the relationship between the real monetary aggregates, real income variables, the interest rate on own deposits, substitute interest rates and the opportunity costs of holding money as the primary explanatory variables or suitable combination thereof in the South African demand for money function. The actual functions of the monetary model will be proposed and discussed in chapter 6 of this study, i.e. by emphasising the explanatory variables of each equation and elucidating the implications of the estimated price and income elasticities.

CHAPTER 5 ECONOMETRIC MODELS AND DATA SELECTION

5.1 Introduction

The science of model building consists of a set of quantitative tools which are used to construct and then test representations of the real world. It can hence be seen as a schematic simplification of the complex and intricate interrelationships that exist between variables in the real and financial sectors of the economy. Multi-equation models presume to explain a great deal about the structure of the actual process that is being studied. Not only are individual relationships specified, but the model also accounts for the interaction of all these interrelationships and describes the dynamic structure implied by the simultaneous operation of those relationships (Pindyck & Rubinfeld, 1998: XVI).

The tradition of modelling began in North America and in Western Europe, but has since spread increasingly throughout the world. As political and economic links between countries became more manifested in recent times, there have been increased attempts to incorporate the joint dependence of economies, either through linked models (project LINK) or by the construction of integrated global (world market) models (Whitley, 1994: 1). The object of this chapter is hence to give a brief historical overview on the development of macro-econometric models in the United States of America and the United Kingdom, as these two countries were essentially regarded as the pioneers of early econometric modelling activity.

The second section of this chapter is dedicated to the purpose of building models in order to quantify the interrelationships in the economy. It also gives a short description of the three principles associated with the generation of an econometric model (i.e. whether the model is to be used for structural analysis, for future forecasting or for alternative policy evaluations). In conclusion, there is a brief summary of econometric model building in the

South African Reserve Bank, and the evolution of the main macro-econometric model of the Bank.

5.2. A brief history of macro-econometric models

The first empirical model is believed to be that of Tinbergen, who published a model of the Dutch economy in 1936. Although Keynes strongly criticised Tinbergen, it was Keynes himself that stimulated modelling activity in formulating the system of National Accounts. Since the second World War, Lawrence Klein was the architect of much of the modelling activity, and along with Goldberger constructed the now famous Klein-Goldberger model of the United States economy. Klein's influence spread world-wide through his students, and in 1961 he became a major figure in the development of the first United Kingdom model, i.e. Klein, Ball and Vandome. During the 1960's the Brookings model in the USA involved Klein and a large team of researchers who developed the first version of the model, consisting of 200 equations (this model was later expanded to 400 equations). The Brookings model made major strides in the field of policy analysis and solution techniques, and many current procedures stem from this project. The Brookings model exercise also spawned other models in the USA such as the MPS (developed by Ando and Modigliani) and the Wharton and DRI models (pioneered by Eckstein) of the 1970's (Whitley, 1994: 6).

In the United Kingdom, modelling activity began with the Oxford model of Klein, Ball and Vandome, which was particularly noted for being based on quarterly data. Later the Growth Project model (under Richard Stone) at Cambridge came to the fore. It was used in a planning framework capacity rather than a fully fledged macro-econometric model. This model's distinguished feature was that it was highly disaggregated. Model activity at Oxford spurred the London Business School (LBS) to start producing forecasts in 1966, which was later augmented by efforts of the National Institute of Economic and Social Research and Her Majesty's Treasury. All three of these models initially favoured the

Keynesian income expenditure approach. Evolution in computer hardware and software has had a pronounced impact on the development of macro models. In specific, The National Institute adopted radical changes initiated and stimulated by new econometric concepts by Stephen Hall and Brian Henry. The Treasury model and its forecasts were highly confidential and secret, and it was only in the 1980's that an act of parliament obliged Treasury to make the model publicly available which at the time had become rather large and unwieldy. Steps were already initiated to slim it down to a type of "core model" with a few equations encapsulating the major links between key macroeconomic variables (Whitley, 1994: 6).

With the growing interdependence between economies, there has been a shift to multicountry systems such as the establishment of Project Link in 1968. This effort aimed at linking independent country models together through integrated merchandise flows and prices. By the 1980's this project included almost 100 independent models, and became the official model of the United Nations. Econometric models generally started to become instrumental for many international organisations, and the MULTIMOD model used for policy analysis (developed by Masson and Symansky in 1990) was perhaps the most important of these efforts at the time (Whitley, 1994: 12).

During the early days of modelling the tendency was to introduce many new variables and sectors to the system. However, the size of the macromodels was limited by technical problems and computer constraints. Today, there are several costs associated with larger models, such as the resources required for data management, the time taken to monitor and modify the equations in the model and more specifically the difficulty in understanding the intricacies of the model (Whitley, 1994: 16). The larger the model, the more complicated it becomes, which has led to some institutions such as the Bank of England in the UK (BoE) to adopt a more pragmatic approach to macro-econometric modelling. They suggest that different problems call for different tools and that separate tools should

be used in analysing the problem, the results of which should be integrated into one macroeconomic setting in order to solve or analyse the current state of affairs at hand. For this purpose, they have proposed a suite of models that includes a core model, vector autoregressive models (VAR's) and structured VAR's, and other smaller scale models and methods that vary in terms of how much emphasis of the theoretical structure is placed on data-based estimation procedures (BoE, 1999: 13). This seems to be the trend throughout the world where monetary policy decisions are based on the results of various model scenarios rather than on the results of one specific macro-econometric model. This is because no single model can possibly assimilate in a comprehensible way all the factors that matter for policy in an ever-changing economy (BoE, 1999: 1).

5.3. The purpose of econometric models

Econometric models are tools for thinking about and analysing economic problems. Well specified models simplify and clarify economic problems by focusing on the factors judged most essential to their understanding. Crucially, models also provide frameworks for empirical quantification - both on how the economy has on average behaved in the past, and of the degree to which its current or prospective behaviour might differ. For these general practical reasons, monetary policy needs economic models (BoE, 1999: 3).

These reasons have in part played a large role in the shift in emphasis towards the use of quantifiable tools such as econometric models to identify and understand the intricacies of the variables in the macro economy and financial markets. The term econometrics can be seen as the branch of economics that is specifically concerned with the empirical estimation of these economic relationships. The "metric" part of the word signifies measurement and makes use of theory (as embodied in an econometric model), facts (as summarised by the relevant data), and statistical theory (as refined into econometric techniques) in order to measure and test empirically certain relationships between a set of

economic variables. This process thereby gives empirical content to fundamental economic theory and reasoning (Intriligator, 1978: 2).

Econometrics can hence be considered the integration of economics, mathematics and statistics for the purpose of providing numerical values for the parameters of economic relationships (for example, elasticities, propensities, marginal values etc.), and as such provides a suitable basis for the verifying of economic theories. Econometrics therefore presupposes the existence of economic theory. This is important as the economic theory should form the foundation of the econometric model, since it first sets the hypothesis about economic behaviour, and secondly allows this hypothesis to be tested with the application of certain econometric techniques (Koutsoyiannis, 1977: 5).

There are basically three principle purposes of econometrics, namely structural analysis, forecasting and policy evaluation. Any econometric model may have one, two or all three of these purposes, depending on the specific use and intention of the model. The three purposes are however closely related as the structure (determined by the structural analysis) is used in the forecasting of the econometric model, while the policy evaluations using the econometric model can typically be described as an example of a conditional forecast. The three principles are summarised shortly below (Intriligator, 1978: 5).

Structural analysis :

Concerns the use of an estimated econometric model for the quantitative measurement of economic relationships. It also facilitates a comparison of rival theories and can be used to quantify, to measure, to test and to validate the economic relationships that are under consideration.

Forecasting :

Concerns the use of an estimated econometric model to predict and quantify the values

of certain variables, i.e. values that fall outside the sample period of the data that is actually observed. It can hence serve as a basis for action if the prediction of the forecast warrants some degree of monetary intervention.

Policy evaluation :

Concerns the use of an estimated econometric model to choose between alternative policy measures. It serves as a useful tool to policy makers as they can simulate the outcomes of alternative measures and make conditional forecasts of the future values of relevant variables under each alternative. This process allows for the selection of the most desired alternative amongst a number of simulated possible candidates, hereby identifying the policy measure that should be pursued and the one that has the greatest potential for success.

These three principles are central to the purpose of generating econometric models, as it would be extremely difficult to base policy judgements on the observation of current economic developments (i.e. in the light of past experiences on how we perceive how the economy works). The lessons of past experience are by no means immediate - if ever - clear, nor is it easy to gauge how the economy might be operating differently now from how it has done in the past without the aid of some specifically designed behavioural relationships to simplify and clarify the intricacies of the economy (BoE, 1999: 3).

5.4. A historical review of the South African Reserve Bank model

By the end of the 1960's the standardised system of national accounts was well documented, and fairly reliable and comprehensive estimates of macroeconomic aggregates were available for most countries, including South Africa. Since then, modern economic analysis strived to develop a macroeconomic model suitable for the quantitative measurement of key economic variables. This quantification process later became known

as the science of econometrics, and through the application of modern statistical techniques, numerical values could be estimated for the coefficients of the mathematical models.

Late in 1974, a decision was taken that a quantitative macroeconomic model had to be developed for the South African economy. At that time, it was intended to develop the model in a joint venture between the Reserve Bank and the Secretariate of the Economic Advisory Council of the Prime Minister (which later became known as the Central Economic Advisory Service). The late Geert de Wet at the University of Pretoria was commissioned to lead the team assembled from staff members of the two institutions involved, and the construction of the model began in earnest in January 1975 (De Jager, 1998: 2).

The structure of the model closely resembled the structure of the Klein-Goldberger model of the United States economy. It reflected the notion that output was determined by changes in aggregate demand. The model consisted of 23 equations (today there are 178 equations) and was a full linear system where lag structures were essentially geometric with the weights fading as the lag length was extended. After De Wet's departure in 1976, it was realised that for the mathematical model to be realistic, it would have to be dynamic and non-linear in addition to the stochastic properties of the behavioural equations (De Jager, 1998: 3).

The development of the model remained a joint venture of the Bank and the CEAS and was essentially used to prepare objective forecasts for regular quarterly meetings of the Economic Advisory Council. In 1980 the model development activities of the Bank and the CEAS took separate roads. The Bank hence continued with efforts to develop a short-term forecasting model, suitable for performing policy simulations, while CEAS proceeded with the design of a model which emphasised the long-term growth properties of the South African economy (De Jager, 1998: 4).

At the time of the debt standstill in 1985, the Bank was requested by representatives of the foreign creditor banks to prepare medium-term projections in addition to the short-term projections of the most likely evolution of the South African economy. A structural model based on annual data was developed for this purpose. It broadly emulated the structure of the quarterly model, and the multi-year interim arrangements between the South African Standstill Co-ordinating Committee and the foreign creditor banks was tested by means of these two models (De Jager, 1998: 4). Further responsibilities were assigned to the Bank's modelling unit in the form of the development of the Growth Employment and Redistribution model (GEAR) in 1996. This was initially a joint venture between the Bank and the Department of Finance in which allowance was made for the incorporation of alternative fiscal policy simulations and scenarios by means of an appropriately adjusted version of the Bank's annual model. In addition to the development and maintenance of the macromodels of the Bank, estimation and forecasting procedures were later augmented by the introduction of cointegration estimation techniques and the development of single-equation vector autoregressive models to augment the forecasts of the Bank.

In conclusion, there have been concerted efforts to maintain progress and improve the South African Reserve Bank's econometric model in line with the evolution of technical advances in the USA and the UK. The collection of the behavioural equations within the framework of the Bank's econometric model provides a basis to predict the future patterns (behaviour) of economic agents, or for quantitative advice on the effects and impacts of alternative economic policy scenarios. For the purposes of this study, the development of the monetary model in the following chapter will be confined to the analysis of the cause and effects on key economic variables - i.e. via the monetary model framework, and not so much on the predictive power of the model.

CHAPTER 6 ESTIMATION OF THE MONETARY MODEL

6.1 Introduction

The monetary model possesses the basic features of a flow-of-funds monetary analysis model. It is primarily based on demand for money functions and is specifically constructed to analyse the South African financial market and how the market is affected by monetary policy decisions (i.e. the transmission mechanism). The model is designed to evaluate the effects of monetary policy through changes in the short-term interest rate, as well as sectoral money supply and demand behaviour in the financial market. For this purpose, aggregate domestic demand and prices are treated as endogenous variables, and exogenous variables (such as the monetary policy variables), are included in the behavioural equations to specifically enhance the structural characteristics of the monetary model.

This chapter first alludes to the data selection and the source of data for estimation purposes, before discussing the estimation technique to be used in quantifying the parameters of the behavioural equations. Reference is also made to the reasons for and benefits of error correction models, as this technique will be used in the regression analysis. The final part of the chapter is dedicated to the actual estimation of the equations in the monetary model and identifies which monetary aggregates are to be stochastic behavioural equations, which will be exogenous and which will be determined via identities.

6.2. Data selection and sources for the estimation of the monetary model

The establishment of a sound and reliable data base is absolutely imperative to perform any acceptable economic analysis on the functional behavioural relationships and elasticities between the various variables envisaged in the model. The most important

variables are of course the monetary aggregates ranging from M0 (base money) to the M3 money supply. In addition, the statistical counterparts of the M3 money supply, or suitable proxy thereof, needs to be represented in the data file. Money demand theory dictates that at least income (i.e. various definitions for income), interest rates and substitute interest rates should be included as explanatory variables for the demand for money equations, and it may well be advisable to include an opportunity cost to holding money (i.e. in the form of an appropriate inflation rate).

All these variables are to be loaded as quarterly data. The monetary aggregates represent a weighted quarterly average of the corresponding monthly seasonally adjusted time series, while the interest rates and inflation rates comprise the average of the monthly levels over the specified quarter. The income variables in the form of the real gross domestic product (or real gross domestic expenditure) are the quarterly values of the seasonally adjusted time series. This data will be extracted in quarterly format from the South African Reserve Bank's data bank, which correspondingly reflects the data in the Bank's quarterly bulletins. It will then be reloaded into a software package (EViews) where all the estimation procedures can take place.

6.3. The estimation technique to be followed

Each of the behavioural models is estimated using the method of ordinary least squares (OLS). In some instances, cointegrating techniques will be used in order to estimate the long-run elasticities of the explanatory variables in the model. OLS estimation is fairly straightforward and probably the most commonly used of all econometric estimation techniques for determining the relationships between different economic variables. The cointegrating technique is an advanced form of estimation, and is specifically used to ensure that the dependent and independent variables of the equation are in fact cointegrated (i.e. follow the same trend over time) and to avoid the problem of spurious

regression. The purpose of this section is not to delve too deeply in the scientific representation of the cointegrating technique, but merely to highlight some of the appropriate econometric terms, and why the technique is used.

The cointegration technique is essentially seen as a means to counteract the problem associated with spurious regression. By regressing one random walk on another, such as a GDP variable and a price deflator, conventional significance tests will tend to indicate that a relationship between the variables exists, when in fact this is untrue and the results are said to be spurious. A spurious correlation is an observed correlation between two time series which, though appearing to be statistically significant, is a reflection of a common trend, rather than a reflection of any underlying association between the two variables. Typical spurious regressions hence have high R^2 statistics, very large computed t-value significance tests and very low Durbin-Watson autocorrelation statistics (Darnell, 1995: 378). This is why it is important to test if the time series follows a random walk. For example, the time series of the nominal GDP can be seen as a typical example of a random walk in that it is continually growing over time. The mean of this series is therefore time-dependent, as it changes depending on the sample period. This essentially implies that GDP is non-stationary and follows a random walk. If GDP is differenced one or more times, the resulting series will have a constant mean (throughout the sample period) and can be classified stationary (Pindyck & Rubinfeld, 1998: 499).

There are various tests to determine whether the time-series is stationary, of which the most widely used are the Dickey-Fuller and augmented Dickey-Fuller test, and closer inspection of the autocorrelation functions (i.e. the correlogram). The autocorrelation function for a stationary time series drops off as the number of lags increase, which is not the case for a non-stationary time series. The Dickey-Fuller test is relatively easy to

perform, and tests the hypothesis that the time series has a unit root or is non-stationary⁸. Although this test is widely used, it has limited power, as it only allows us to reject (or fail to reject) the hypothesis that the variable is a random walk. A failure to reject (even at a high significance level) merely provides weak evidence in favour of the random walk hypothesis (Pindyck & Rubinfeld, 1998: 510).

If a test fails to reject the hypothesis of a random walk, the data can be differenced before using it in the regression analysis. The fact that many economic time series seem to follow random walks (i.e. are non-stationary and therefore contains a unit root) suggests that they should first be differenced before estimating the behavioural relationship between the dependent and explanatory variables. However, there are cases in which the two variables of the regression each follow random walks, but the linear combination of the two is stationary. If this is true, the two variables are said to be cointegrated and there will be some long-run equilibrium relation that ties the variables together (i.e. the linear combination between them). For example, even though in some instances income and consumption expenditure exhibit a unit root (are non-stationary random walks), over the long run, consumption tends to be a constant proportion of income. This proportion would imply that the difference between the log of consumption and the log of income appears to be a stationary process. Furthermore, the residuals of this regression can also then be used to determine whether the two variables are indeed cointegrated by testing for stationarity in the residual of the equation (Hamilton, 1994: 572) (Pindyck & Rubinfeld, 1998: 514).

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It is necessary to test for the presence of unit roots in order to avoid the problem of spurious regression. The Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) approaches test the null hypothesis that a series does contain a unit root (i.e. that it is non-stationary) against the alternative of stationarity. If the test value falls within the critical region, the null hypothesis of non-stationarity is rejected and the series is regarded as stationary (Harris, 1995: 28).

There are many methods to test for cointegration which can be used to establish whether the set of explanatory variables used are sufficient to adequately model the series. When this procedure is followed on a simple demand for money function for each of the explanatory variables real income, interest rates and prices, the inability of this limited set of variables; to capture the major movements of the time series may become apparent. If a valid dynamic model of money demand is to exist, it must contain a set of variables which satisfy the tests of cointegration which are applied at the first stage. If this is not the case, the model will be subject to spurious regression problems and would not be structurally stable. This means that preliminary tests for cointegration may rule out many models as inadmissible (Hall et al., 1989: 2).

This standard cointegration technique involves estimating error correction models and is particularly relevant for demand for money functions for two reasons. First, while money stocks, price levels and income levels are non-stationary, they may well be cointegrated. If so, econometric models that disregard this property of the data are misspecified. Secondly, error correction models allow for a broad range of interrelationships between the variables. Given that we are interested in the stability of the money demand functions, it seems appropriate to make use of the error-correction model or strategy (ECM's) (Gerlach, 1994: 6).

A regression in the form of the ECM is a regression equation involving only stationary variables, and standard OLS regression theory applies. The Engle-Granger representation theorem demonstrates that if two variables are each $I(1)$ (integrated in first differences) but cointegrated, then the short-run dynamics may be written as an ECM. Knowledge of the error time series and knowledge of the cointegrating coefficient is required in order to estimate the ECM equation. The common two-step Engle-Granger procedure is to first test that the dependent and explanatory variables are $I(1)$, run a normal OLS regression, and then test whether the residuals are stationary. If the two variables are cointegrated, the

residuals will be stationary. A normal Dickey-Fuller test can be used to test for residual stationarity. The second step is to run the ECM form in first differences by replacing the true error, with an estimated lagged value of the error term of the long-run equation. Once inserted into the ECM, OLS will yield estimates of the short-run parameters and the speed of adjustment of the long run elasticities under the assumption that there is only one cointegrating vector (Darnell, 1995: 115).

Error correction models are widely used in econometrics, especially when economic theory dictates an equilibrium or stable relationship between two variables. This may be viewed as the long-run steady state solution of the ECM. The form of the ECM is hence seen to comprise the short-run transitory effects of the model and the elasticities of the long-run relationship, and essentially describes how the long-run solution is achieved via the negative feedback and error correction mechanism (Darnell, 1995: 119).

The technique followed in this study is to integrate the Engle-Granger two-step method into a one-step error correction mechanism in first differences. This method, sometimes called an "Equilibrium Correction Model" or "Auto Regressive Distributive Lag Model" (ARDL) can be used to indicate the long-run static elasticities (parameters) and short run dynamics of the equation in a single step⁹. The Engle-Granger two-step method has been criticised on the grounds of the small-sample bias present in the estimation of the cointegrating equation. This bias carries over into the estimates of the disequilibrium errors and hence

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An important advantage of the ARDL over other cointegration estimation procedures (such as the Johansen procedure) is that it explicitly tests for a unique cointegrating vector in the combined regression. Harris (1995) states that the test for cointegration using the ARDL method is powerful, and that it has other desirable properties, namely, that the unrestricted dynamic model gives precise estimates of the long-run parameters and that it furthermore generates valid t-statistics (Harris, 1995: 60). On the other hand, the Johansen procedure provides information on the uniqueness of the cointegration "space", and it hence becomes necessary to impose restrictions motivated by economic arguments to obtain the unique vector lying within that space (Harris, 1995: 110).

into the second-stage estimates of the short-run parameters obtained from the differenced equation. The presence of such bias has led some investigators to use the cointegrating regression as merely a means of testing for cointegration, and to adopt other methods to estimate the long-run parameters (Thomas, 1997: 434).

The single step error correction mechanism substitutes the true disequilibrium errors of the long-run equation into the short-term disequilibrium relationship, i.e. given the simple equilibrium relationship where x_t is a function of y_t , the relationship can be illustrated as follows:

$$y_t = \beta_0 + \beta_1 x_t$$

so that the disequilibrium error is given as :

$$u_t = y_t - \beta_0 - \beta_1 x_t$$

The Engle-Granger procedure asserts that provided two time series x_t and y_t are cointegrated, the short-term disequilibrium relationship between them can be expressed in the error correction form :

$$\Delta y_t = \text{lagged} (\Delta y_t, \Delta x_t) - \lambda u_{t-1} + \epsilon_t, \quad \text{where } 0 < \lambda < 1$$

and where u_t is the disequilibrium error, or extent of departure from the long-run relationship of the OLS estimation, and λ is the short-run adjustment parameter (identical to the error correction model).

Once the true disequilibrium error is substituted into the short-term disequilibrium relationship shown above, we get :

$$\Delta y_t = \lambda \beta_0 + \text{lagged } (\Delta y_t, \Delta x_t) - \lambda y_{t-1} + \lambda \beta_1 x_{t-1} + \epsilon_t$$

OLS can now be applied to this equation with the lag structure on the differenced variables being determined through experimentation. Although y_{t-1} and x_{t-1} are I(1) variables, OLS can be applied, since, assuming cointegration, there is a linear combination of y_{t-1} and x_{t-1} that is I(0). The existence of such a linear combination (cointegration) can be checked by testing the residuals from the error correction model for stationarity. There is some evidence from simulation studies that the small-sample properties of estimates obtained in this way are superior to those of the two-step Engle-Granger estimates (Thomas, 1997: 435).

Sriram (1999) aptly notes that this type of formulation can be seen as a dynamic error-correction representation in which the long-run equilibrium relationship between money and its determinants is embedded in an equation that captures the short-run variation and dynamics of the system. The impetus comes from the findings that in modelling the demand for money functions, due consideration should be given to not only the selection of the theoretical set up and empirical make up, but also in specifying the proper dynamic structure that is used in the regression analysis (Sriram, 1999: 14).

The short-run error correction model (ECM) provides information concerning how adjustments are taking place among variables to restore the equilibrium to the long-run level in response to short-term disturbances in the demand for money. The short-run model will have stationary I(0) representation of variables on both the left hand side and the right hand side of the equation. Since the variables are either I(0) or I(1), the right hand side contains the variables expressed as first differences as well as the long-run static variables that are expressed in lagged level terms. The error-correction term for the lagged dependent variable (in levels) should always be negative in order to validate the significance of the long-run co-integrating relationship. This conveys two important pieces

of information, first, that economic agents have corrected in the current period a proportion of previous disequilibrium in money balances, and secondly, it assures that the cointegration relationship is valid. The negative sign specifically implies that a fall in excess money holdings in the last period will result in a higher level of desired money holdings in the present period. In other words, it is essential for the existing disequilibrium to be reduced over time (Sriram, 1999: 25).

What this in essence means is that since the residual term in the ECM should always be negative, the parameter of the lagged dependent variable y_t in the equation shown above should also always be negative. The implicit elasticity of the long-run explanatory or income variable X_t is then determined by dividing this estimated lagged parameter by the estimated lagged parameter for the dependent variable y_t . The short-run dynamics of the model are then illustrated by the parameters of the variables in first differences in the conventional manner. Reference will also be made to the speed of adjustment, for example, if the explanatory variable income was to be hypothetically shocked from its steady state with an increase in value of 1 per cent, the long-run income elasticity would dictate to what magnitude (in per cent) the dependent variable y_t can be expected to change, while the speed of adjustment refers to the time frame (in quarters) for it to reach its long-run elasticity. This gives a graphical illustration of the sensitivity of the model to changes in the explanatory variables, as well as an idea on the time this dynamic effect will take to work through.

6.4. Estimation of the monetary model

In chapter 2 it was mentioned that the methodology used to compile South Africa's money and banking statistics is based on "A Guide to Money and Banking Statistics in International Financial Statistics", which is a publication of the International Monetary Fund (SARB, 1993: 1). This publication points out that the separate balance sheets of the

monetary institutions (once aggregated for each type of institution) should form the basis of the monetary statistics. This effectively means that the balance sheets of the various monetary institutions are consolidated, so that the claims and counter claims between these types of institutions are netted out. The so-called monetary analysis is then derived from the consolidated balance sheet of the monetary sector and is used to explain the change in the broadly defined M3 money supply, i.e. on the basis of its statistical counterparts. These statistical counterparts of the money supply dis-aggregate to form four main categories, namely, the net gold and other foreign exchange reserves of the monetary sector, the net claims on the government sector, the monetary sectors claims on the private sector and net other assets and liabilities of the monetary sector.

The issue now is to link M3 money supply and the monetary analysis to the main macro-econometric model so that any changes in the monetary aggregates or the statistical counterparts will suitably be reflected in changes in the key macro economic variables of the model. The change in the net gold and other foreign exchange reserves can be linked to the sum of the capital movements and the current account of the balance of payments of the model, while the net claims on the government and the net other assets and liabilities of the monetary sector can remain essentially exogenous assumptions. The monetary sector's claims on the private sector and the monetary aggregates comprising short-, medium- and long-term deposits will be determined by behavioural relationships. Interest rates form an integral role in the monetary model and all money market interest rates will be primarily determined by the change in the "repo" rate, while capital market rates will react to the supply and demand of loanable funds.

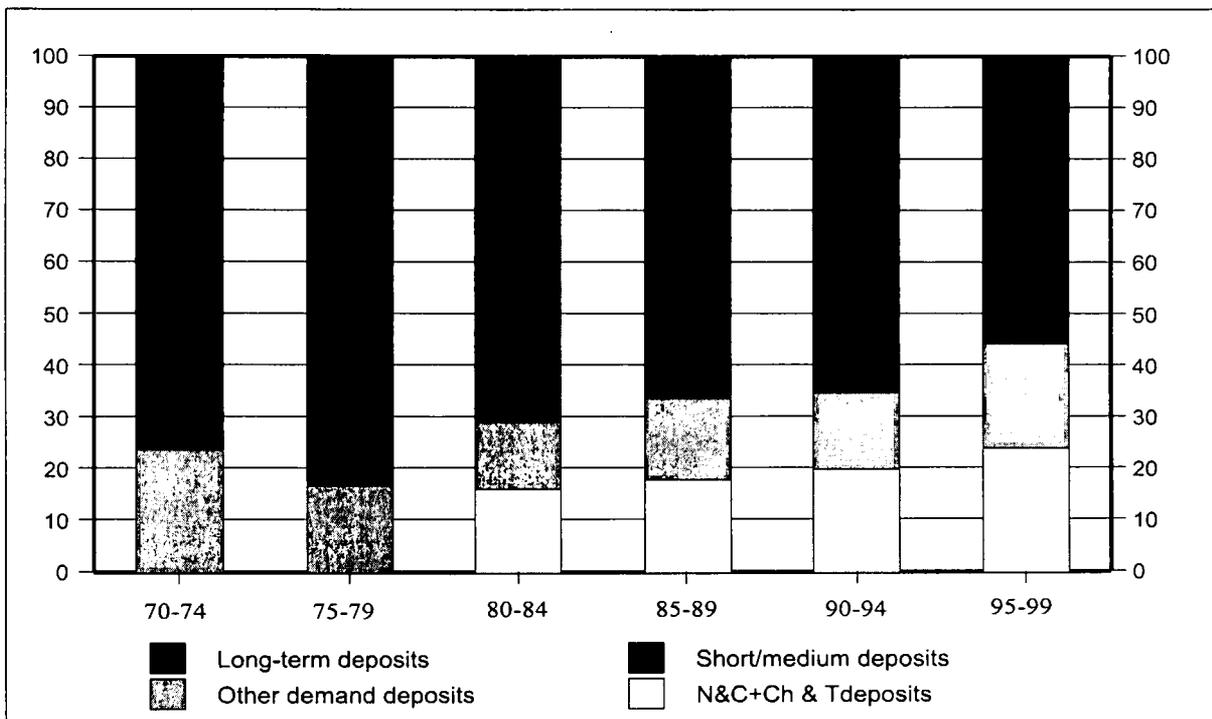
The following three sections of this chapter refer to the estimation of the equations and the identities which have been identified in the three broad categories of the monetary model, i.e. the monetary aggregates, the statistical counterparts of the M3 money supply and interest rates.

6.4.1. The monetary aggregates

The South African Reserve Bank compiles the following monetary aggregates :

- *M1A*: notes and coin in circulation plus the cheque and transmission deposits of the domestic private sector with monetary institutions;
- *M1*: *M1A* plus other demand deposits with monetary institutions held by the domestic private sector;
- *M2*: *M1* plus other short-term and medium-term deposits with monetary institutions held by the domestic private sector; and
- *M3*: *M2* plus long-term deposits with monetary institutions held by the domestic private sector.

Figure 2 : Contribution of deposits to the broad M3 money supply



Source : South African Reserve Bank, Quarterly Bulletin, December 1999

Figure 2 shown above illustrates the contribution of each of the four deposit categories to the total M3 money supply throughout 5-year periods starting from 1970-1974 through to the final period of 1995-1999. The diagram shows a remarkable switch in liquidity preference from long-term deposits to its short-term counterpart throughout the six columns depicting the 5-year periods. Long-term deposits declined from approximately 40 per cent in the first column to roughly 12 per cent in the final column, while the M1 component (consisting of the of notes and coin in circulation, cheque and transmission deposits (i.e. the M1A deposit category) and short-term and medium-term deposits) likewise increased from roughly 22 per cent to more than 40 per cent in the final column.

This general trend depicting an increased preference for liquidity is important and can partly be attributed to three important factors, namely :

- the general movement of individuals from illiquid long-term deposits to the more liquid short-term deposit category ;
- the change in banking legislation in which building societies became classified as commercial banks as from the early 1980's ; and
- the gradual change (relaxation) in liquid asset requirements which were reduced on 21 February 1970 from 45 per cent of short-term liabilities, 30 per cent of medium-term liabilities, 5 per cent of long-term liabilities and 10 per cent of liabilities under acceptances to the presiding rate of 5 per cent of banks' total liabilities as from April 1993 (SARB, 1993: B90-B96).

In estimating the monetary model, the broadly defined M3 money supply will be estimated as a structural equation, while the remaining categories of the monetary aggregates will be formulated by means of independent identities. Behavioural equations by means of regression estimation will hence be performed on each of the constituent components of these monetary aggregates. However, the "other demand deposits" category (i.e. the

difference between the M1A and M1) will be used as a balancing item in the money identity, as this component is characteristically very volatile which makes it difficult to establish a meaningful economic relationship between it and the other key variables of the model. This implies that in being the balancing item, other demand deposits capture all the resulting estimation errors of the monetary sub-model structure.

6.4.1.1 The *M1A* monetary aggregate

Two stochastic behavioural equations are identified in the monetary sub-model which together constitute the *M1A* monetary aggregate. These two components, to be discussed in detail in the following two sections, comprise the coin and banknotes in circulation and the cheque and transmission deposits.

Coins and banknotes in circulation

This category consists of the coin and banknotes circulating outside the monetary sector¹⁰⁾ (M_{cn}). During 1999, nominal coin and banknotes in circulation comprised approximately 4½ per cent of the total nominal M3 money supply. This is approximately 1 per cent lower than the contribution notes and coin made during the late 1970's. The steadily declining trend could be a further indicative of individuals striving to hold less and less physical money on hand as they have now become more accustomed to the idea that the money they require for transaction purposes is easily accessible through the many automatic teller machines

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The monetary sector is defined as all institutions within the monetary sector, i.e. the now-extinct National Finance Corporation, Corporation for Public Deposits and the so-called "pooled" funds of the former Public Debt Commissioners, the Land Bank, Post Office Savings Bank, private banking institutions (including the former banks, discount houses and equity building societies) and mutual building societies.

(ATM's) supplied by the commercial banks. It was only in late 1990's that this downward trend showed a strong reversal, and notes and coin in circulation started to show a strong increase. However, this was largely due to the scare associated with the consequences of the Y2K millennium transition, but even this increase was somewhat less than the demand for notes and coin initially expected by the Bank.

At slightly less than 5 per cent of the total M3 money supply, notes and coin may seem fairly insignificant. Due to the fact that this component comprises base money, it was deemed necessary to rather formulate this category by means of a behavioural equation. The standard theoretical properties of the demand for money function dictate that real money balances should depend on a real income variable, an interest rate, i.e. whether it be an own rate of interest, or a substitute interest rate, and an opportunity cost for holding money. In accordance hereto, the nominal amount of coin and banknotes in circulation was deflated by the consumer price index (P_{cpi}). Changes in the level of domestic interest rates were found to have no significant effect on the demand for real notes and coin balances held by the individuals, while there seems to be a definite opportunity cost associated with the holding these money balances.

The real income variable defined as the best in terms of goodness-of-fit properties for describing the changes in the real value of notes and coin in circulation, is the total real gross domestic product at market prices (Y_{mp}), while the opportunity cost for holding this classification of money is defined as the rate of year-on-year inflation as measured by the consumer price index (\dot{P}). The following cointegrated equation has subsequently been estimated first-differences and in logarithmic format, illustrated by the "DLOG" suffix, where "D" denotes the first-difference and "LOG" denotes the natural logarithm. The upper part of the equation (i.e. above the constant (c)), can be seen as the long-term static properties of the equation, while the bottom part can be seen as the short-term dynamics of the equation :

Regression 1 :

Dependent Variable: $DLOG(M_{cn}/P_{cpi})$

Method: Least Squares

Date: 01/20/00 Time: 16:33

Sample: 1985:1 1999:3

Included observations: 59

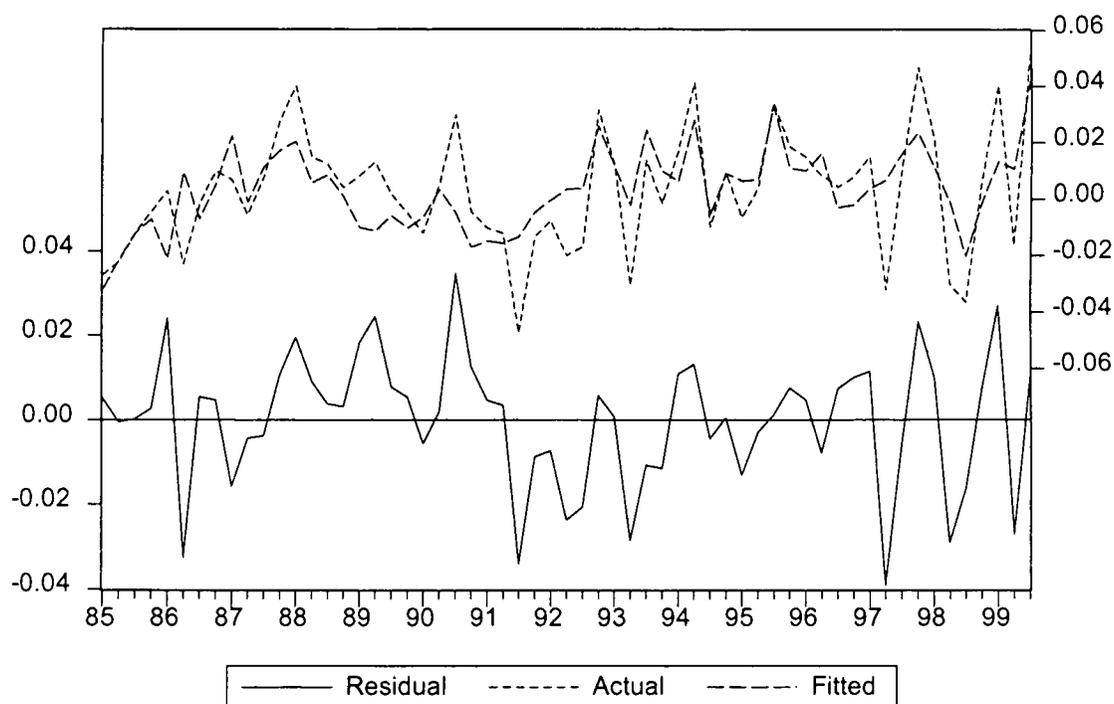
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|-------------------------------|-------------|-----------------------|-------------|-----------|
| $LOG(M_{cn}(-1)/P_{cpi}(-1))$ | -0.185443 | 0.085091 | -2.179346 | 0.0337 |
| $LOG(Y_{mp}(-1))$ | 0.219297 | 0.091794 | 2.389013 | 0.0204 |
| C | -0.834396 | 0.439259 | -1.899554 | 0.0628 |
| $DLOG(Y_{mp})$ | 0.723376 | 0.308988 | 2.341110 | 0.0229 |
| $D(\dot{P})$ | -0.007500 | 0.001706 | -4.396666 | 0.0001 |
| R-squared | 0.462102 | Mean dependent var | | 0.003213 |
| Adjusted R-squared | 0.422258 | S.D. dependent var | | 0.021398 |
| S.E. of regression | 0.016264 | Akaike info criterion | | -5.318760 |
| Sum squared resid | 0.014284 | Schwarz criterion | | -5.142697 |
| Log likelihood | 161.9034 | F-statistic | | 11.59770 |
| Durbin-Watson stat | 1.814739 | Prob(F-statistic) | | 0.000001 |

NB : The order of integration of the variables used in the regression are illustrated in Appendix 2 at the back of this study.

Closer inspection of the estimation results shown above reveals that the long-run elasticity of the demand for notes and coin with respect to real income is approximately 1,2. This is achieved by dividing the coefficient for the lagged real income (0,22) by the coefficient of the lagged dependent variable (0,18). This implies that a one per cent increase in the real gross domestic product is likely to increase the real value of coins and notes in circulation by 1,2 per cent. The income elasticity of this equation conforms closely to results obtained in the previous studies of Contagiannis and Shahi (1982) who determined an income elasticity of 1,2 for their definition of M1 money supply for the period 1965-1980 using South African data, and Stadler (1981) who determined an elasticity of 1,4 for roughly the same period.

Figure 3 depicts the goodness-of-fit of the estimated error correction model equation, and the residual. The graph shows a close correlation between the actual and fitted trends, and despite the low R^2 correlation coefficient of the function (which is expected as the model is estimated in first differences), the function tends to track the actual trend fairly closely.

Figure 3 : Notes and coin in circulation (actual and fitted)

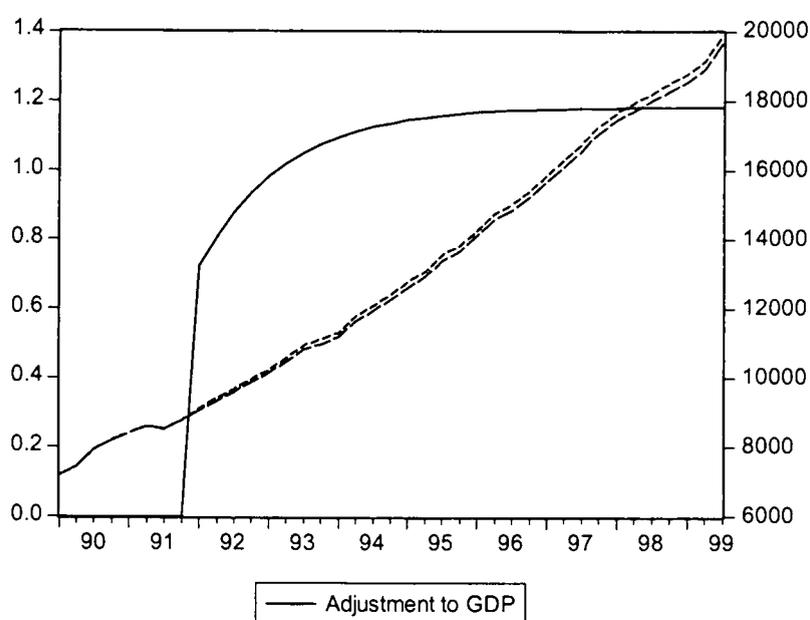


The following two graphs depict the long-run and short-run adjustment impacts of the explanatory variables of the model. In addition, these adjustments graphically depict the speed of adjustment (in quarters) for the category notes and coin to achieve its long-run equilibrium, or to return to its steady state if the explanatory variable only features in the short-run dynamics of the model.

Figure 4 shows that if the real gross domestic product was to be increased with 1 per cent over the period 1992 to 1999 the long-run impact would be at slightly under 1,2 per cent.

This elasticity is supported by the long-run income elasticity implied by the estimated regression for the real demand for notes and coin in circulation which is shown in regression 1. The speed of adjustment is rather quick, and nearly 85 per cent of the shock is registered within the first four quarters after the adjustment has taken place. The primary reason for the quick reaction of real notes and coin to a change in the income variable is due to the short-run dynamic elasticity of 0,7 (i.e. 0,723 from the equation) in the very first quarter of the simulation period. The trend in the elasticity shown hereafter tends to converge to its long-run equilibrium state of just under 2,1 per cent. The two upward sloping curves in the graph represent the normalised value of nominal notes and coin in circulation implied by the function, and its adjusted value after the real income variable has been increased with 1 per cent.

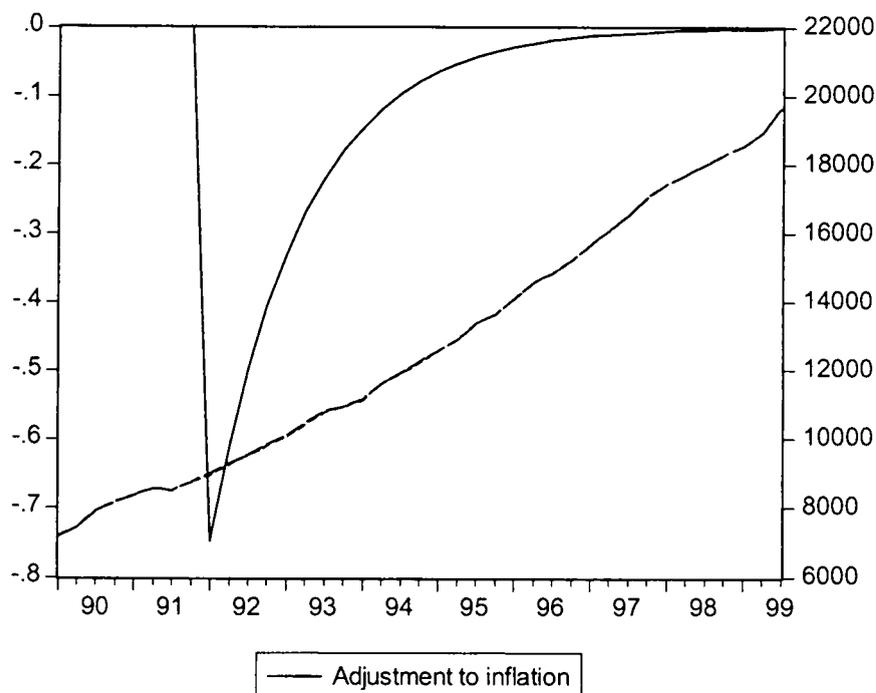
Figure 4 : The speed of adjustment to the GDP



The pass-through illustrated in figure 5 shows the short-run impact on notes and coin with regard to a change in the inflation rate as an opportunity cost to holding real money balances. The inflation rate only features as an explanatory variable in the short-run

dynamic part of this equation, and the graph shows the quick initial reaction of these real money balances to the inflation shock over the first quarter. Hereafter, the curve of the real balances resumes its gradual return back to its baseline state. This is of course a true reflection and characteristic of the short-run dynamic shock.

Figure 5 : The speed of adjustment to inflation



Once the rate of inflation has been shocked with 1 percentage point, real notes and coin in circulation should accordingly drop immediately by nearly 0,8 per cent. This is also borne out by the short-run dynamic elasticity of the inflation rate in the structural equation which amounts to 0,75 (i.e. $0,0075 \cdot 100$, as it represents a rate in the logarithmic function). The graph furthermore indicates that the impact is only short-lived and tends to die out after 8 to 12 quarters. The two upward sloping lines in figure 5 on which this initial real impact is superimposed represent the actual level and adjusted level of the nominal value of notes and coin once this hypothetical shock of 1 per cent to the inflation rate has been implemented.

The following table illustrates the speed of convergence :

Table 2 : The speed of convergence for coins and banknotes in circulation

| Adjustment after : | GDP | | Inflation | |
|--------------------|---------|-----|-----------|------|
| | (value) | (%) | (value) | (%) |
| 1 Quarter | 0,72 | 61% | -0,74 | 100% |
| 4 Quarters | 0,98 | 83% | -0,33 | 45% |
| 8 Quarters | 1,09 | 93% | -0,15 | 20% |
| 12 Quarters | 1,14 | 97% | -0,06 | 8% |

The first column illustrates the combined effect of the long-run static income elasticity and the short-run dynamic income elasticity of the real notes and coin to the 1 per cent adjustment in GDP. The table shows that real notes and coin in circulation are approximately 0,7 per cent above the baseline scenario after the very first quarter, and this adjustment represents roughly 60 per cent of its adjustment to the long-run equilibrium calculated in the regression. The rate of convergence, or pass-through of income is fairly quick in that after 8 quarters, real notes and coin are only 7 per cent below the level implied by its long-run equilibrium state.

As the inflation rate variable is only found in the short-run dynamics of the model, the brunt of the impact of the opportunity costs is felt on the value of notes and coin during the very first quarter, i.e. where it is approximately 0,75 per cent lower than the baseline scenario. This effect tends to die out quickly in that less than half the initial impact would still be found after the first four quarters, and only 20 per cent of the initial impact is still felt after 8 quarters have lapsed.

Cheque and transmission deposits

Cheque and transmission deposits (DEP_{ct}) are a subset of demand deposits which, together with the notes and coin in circulation outside the banking sector, constitute the total *M1A* monetary aggregate. This aggregate, in addition to being highly liquid and convenient, also offers substantial benefits to depositors who feel the need to be able to transfer funds virtually immediately to obtain possible arbitrage gains, e.g. by transferring idle funds into interest-earning assets. This usually happens if economic agents expect interest rates to decline in the near future.

Cheque and transmission deposits as a ratio to M3 money supply balances has risen radically from roughly 11 per cent during the early 1980's to 24 per cent by the third quarter of 1999. In terms of real balances, i.e. where the nominal cheque and transmission deposits have been adjusted by the private consumption expenditure, this increase is even more remarkable. Real cheque and transmission deposits have risen on average by roughly 2,8 per cent per year during the 1980's and at more than three times this rate at approximately 9,6 per cent per year during the 1990's. This rate of increase over the last decade is quite phenomenal in that income in the form of the real gross domestic product at market prices has only risen by 1,3 per cent per year during the 1990's. This in itself would indicate a high income elasticity (i.e. declining velocity) and can partly be attributed to the higher liquidity preference and greater financial liberalisation in the South African financial markets.

The value of nominal cheque and transmission deposits (DEP_{ct}) has accordingly been adjusted by the private consumption expenditure deflator (P_{pc}) to obtain a "real" quantity, and is expressed as a function of the real gross domestic product at market prices (Y_{mp}), the year-on-year rate of inflation in the consumer price index (\dot{P}) and a representative

substitute interest rate (R_{tm})¹¹. A time trend was also incorporated in the equation to allow for the increase in liquidity preference, but this caused the explanatory variables to become statistically insignificant over the sample period so it was excluded from the final model. It did however have the desired effect of lowering the income elasticity of the cheque and transmission deposits when included, and was also statistically significant.

The equation describing the demand for cheque and transmission deposits contains a single interest rate variable. Cheque and transmission deposits are by nature very low interest-earning deposits. This necessarily implies that the own interest rate on these deposits plays a fairly inconsequential role in the demand function and has hence been excluded as an explanatory variable. In contrast, a substitute interest rate consisting of a weighted combination of the real long-term, real medium-term and real short-term interest rates ($R_{tm} - \dot{P}$) has been used as a proxy to capture the investors' preference for interest-bearing assets.

The inflation variable (\dot{P}) has been included in the demand function in its own right, to make allowance for the impact of rising domestic prices. As prices start to rise and erode the purchasing power of these low-interest earning cheque and transmission deposits, individuals will tend rather to make some alternative use of these funds, i.e. to either spend them now or invest them in some other form of real-interest earning asset.

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A full description on the calculation of the weighted long-term, medium and short-term interest rates " R_{tm} " is provided on page 157 of this publication.

Regression 2 :

Dependent Variable: $DLOG(DEP_{ct}/P_{pc})$

Method: Least Squares

Date: 01/20/00 Time: 14:00

Sample(adjusted): 1980:2 1999:3

Included observations: 78 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------------------|-------------|-----------------------|-------------|-----------|
| $LOG(DEP_{ct}(-1)/P_{pc}(-1))$ | -0.155302 | 0.064373 | -2.412551 | 0.0185 |
| $LOG(Y_{mp}(-1))$ | 0.639492 | 0.263128 | 2.430340 | 0.0177 |
| $R_{trn}(-1) - \dot{P}(-1)$ | -0.005947 | 0.002058 | -2.890308 | 0.0051 |
| $\dot{P}(-1)$ | -0.010153 | 0.003293 | -3.082680 | 0.0029 |
| C | -5.750229 | 2.444935 | -2.351894 | 0.0215 |
| $DLOG(Y_{mp})$ | 1.076788 | 0.550386 | 1.956423 | 0.0544 |
| $D(R_{trn} - \dot{P})$ | -0.010231 | 0.003309 | -3.091683 | 0.0029 |
| $D(\dot{P})$ | -0.015110 | 0.004277 | -3.532421 | 0.0007 |
| R-squared | 0.293323 | Mean dependent var | | 0.015278 |
| Adjusted R-squared | 0.222655 | S.D. dependent var | | 0.040966 |
| S.E. of regression | 0.036119 | Akaike info criterion | | -3.707109 |
| Sum squared resid | 0.091318 | Schwarz criterion | | -3.465395 |
| Log likelihood | 152.5772 | F-statistic | | 4.150731 |
| Durbin-Watson stat | 1.837930 | Prob(F-statistic) | | 0.000718 |

NB : The order of integration of the variables used in the regression are illustrated in Appendix 2 at the back of this study.

As expected, the income elasticity of the demand for cheque and transmission deposits is much higher than the income elasticity of the notes and coins in circulation. The results indicate that a one per cent increase in the real gross domestic product would induce an increase of approximately 4,1 per cent in inflation-adjusted cheque and transmission money balances (0,639/0,155). This is much higher than the income elasticities determined by Stadler (1981) and Contagiannis and Shahi (1982), albeit for the M1 money supply aggregate. However, this could be attributed to the fact that their regressions were only estimated for the period prior to 1980, and did not take the rapid increase in cheque and transmission deposits into cognisance during the 1990's.

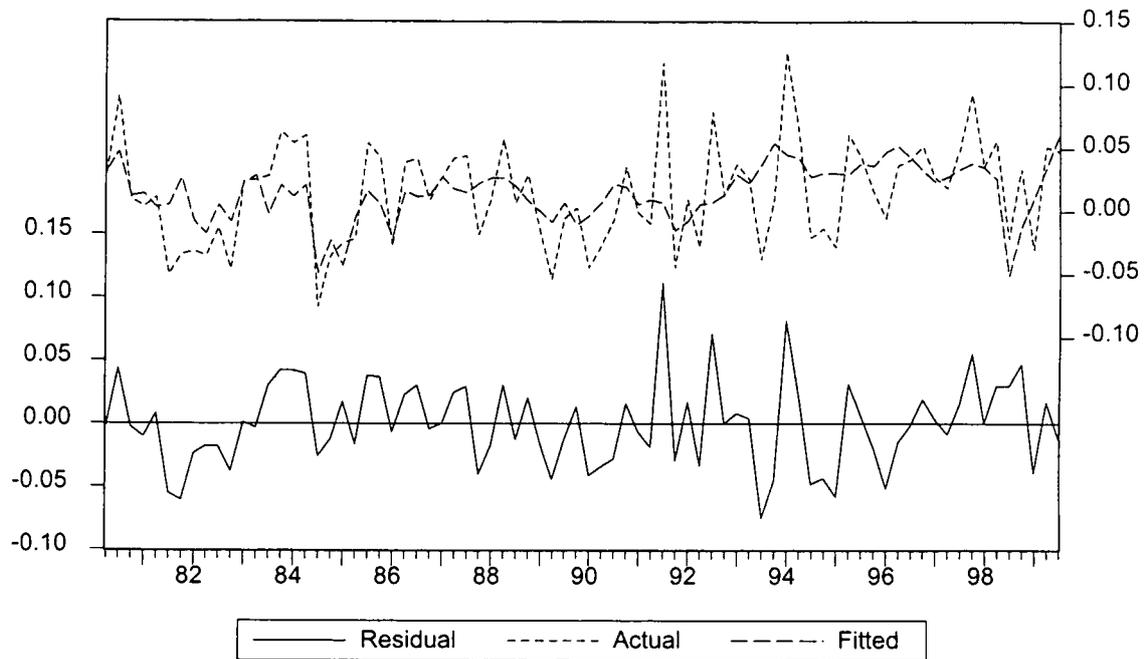
The long-run price semi-elasticities for the opportunity costs and the substitute interest rates have to be multiplied by 100 as they represent rates in the logarithmic function. This means that the semi-elasticity for the inflation rate in the regression estimate is then roughly 6,5 (1,0/0,155) and that for the substitute real interest rate amounts to 3,9 (0,6/0,155). The price semi-elasticity of 6,5 has to be adjusted by the assumed inflation rate of the sample period in order to determine the long-run elasticity of the opportunity cost variable. This means that at an assumed inflation rate of 12,4 per cent, the price elasticity of real money balances to the opportunity cost of holding this type of money becomes 0,8 (i.e. $6,5\% \times 12,4$). At slightly under unity, the price elasticity is fairly high and seems to suggest that inflation is an important determining factor for individuals to make use of these cheque and transmission deposits. The sensitivity of this category to the real substitute interest rate is significantly lower at less than 0,1 per cent under the assumption that the real interest rate average approximately 1,5 per cent over the sample period (i.e. $3,9\% \times 1,5$).

Stadler's (1981) findings were that thirteen out of twenty-four of his long-run estimates of the price elasticity of the demand for real M1 money supply balances fell within the range between -0,4 and -0,65. He attributes this to the fact that successive price increases cause decrements to wealth and the obvious way to avoid this is to hold less money balances (Stadler, 1981: 149). The long-run price elasticity suggested by this equation is much higher than the long-run interest rate elasticity, and implies that these money balances are perhaps more dependent on inflationary cost considerations, than on alternative substitute assets when it comes to decisions pertaining the demand for cheque and transmission deposits.

The results as shown in regression 2 illustrates the investors' overriding desire for the convenience and ease with which they move in and out of these cheque and transmission deposits, and is illustrated by the goodness-of-fit of the estimated error correction equation

in figure 6 :

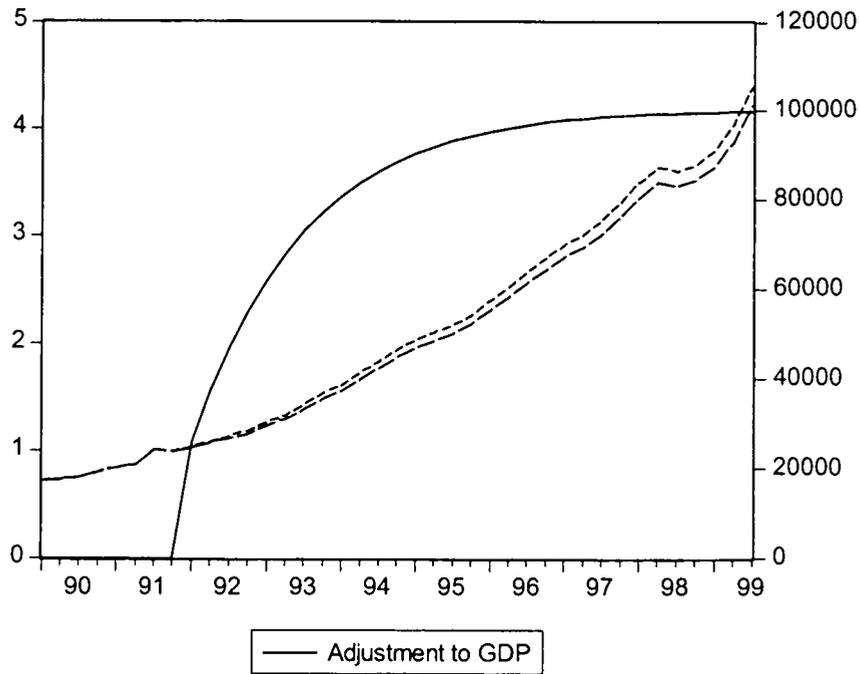
Figure 6: Cheque and transmission deposits (actual and fitted)



The following figures and table show the speed and magnitude to which real cheque and transmission deposits adjusts to its long run equilibrium once the explanatory variables of the function have been shocked by a hypothetical 1 per cent over the period 1992 to 1999. The income variable as illustrated by the real gross domestic product has subsequently been raised with 1 per cent, and real cheque and transmission deposits respond to increase with slightly over 1 per cent during the very first quarter. This combination of the long-run static elasticity and short-run dynamic elasticity suggests that nearly 26 per cent of the long-run equilibrium of 4,2 would be achieved immediately. Figure 7 confirms the long-run equilibrium state of the income elasticity as estimated by the coefficients of the structural equation of regression 2. The proportional rate of this conversion increases over time to reach 81 per cent after 8 quarters, which further suggests that cheque and transmission deposits responds at a somewhat slower pace to achieve its long-run

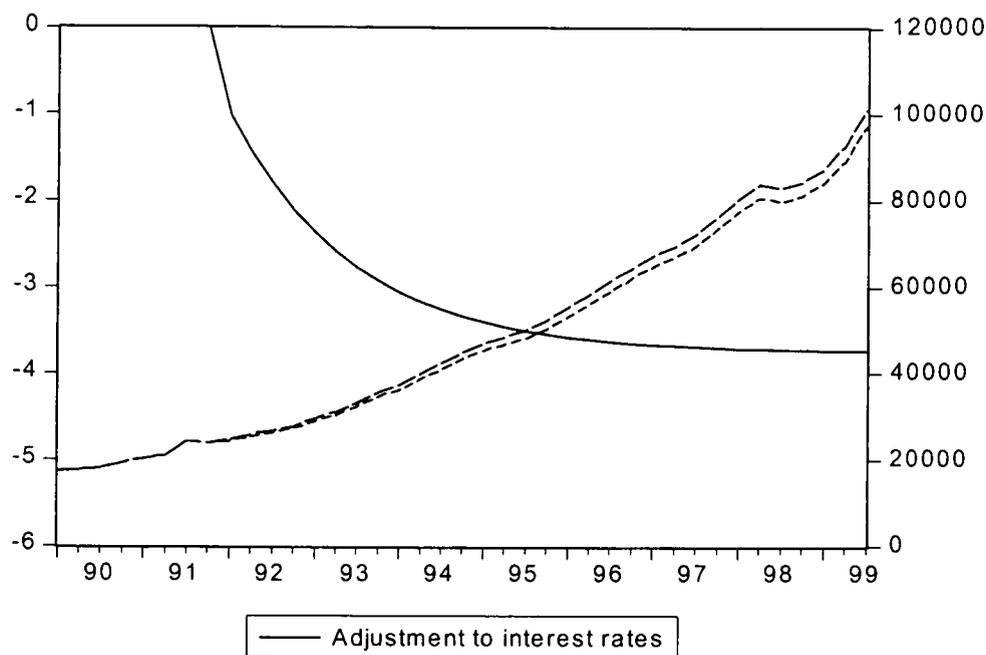
equilibrium level than notes and coin in circulation (i.e. with regard to a similar 1 per cent change in income). However, the magnitude change of real cheque and transmission deposits to this adjustment is nearly three times higher at 3,4 per cent after 8 quarters have lapsed.

Figure 7 : The speed of adjustment to the GDP



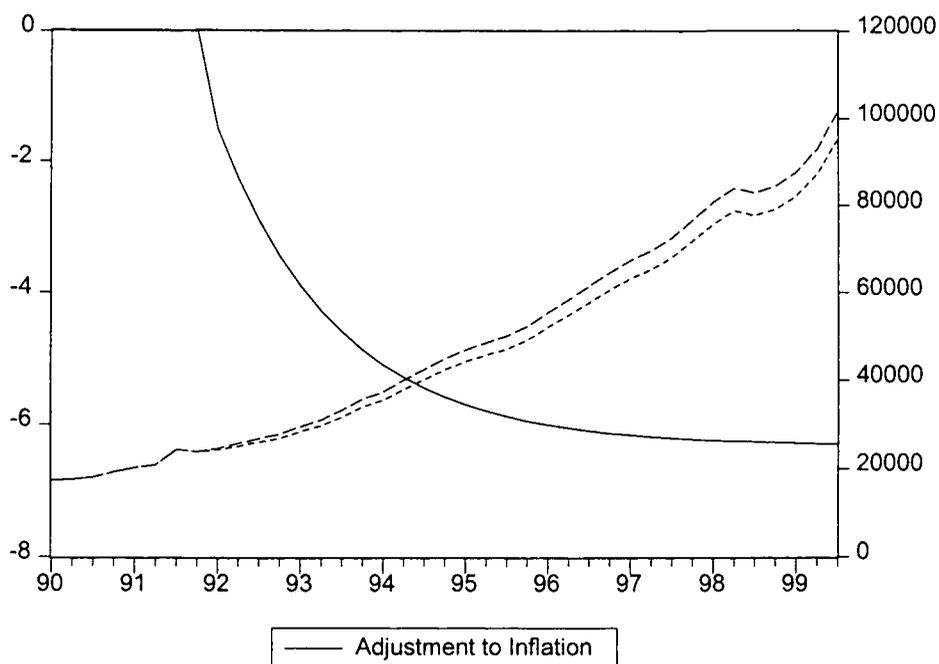
The following graph for the substitute interest rate suggests that the adjustment to the substitute real interest rate can either be achieved by increasing the level of the substitute nominal interest rate, or by lowering the inflation rate. Figure 8 shows that a corresponding increase in the substitute interest rate (or decline in inflation) amounts to roughly 3,8 per cent, which corresponds to the semi-elasticity implied by the parameters of the structural equation shown above. The fast initial impact for real cheque and transmission deposits to decline by slightly more than 1 per cent is primarily attributed to the short-run dynamic effect of the substitute interest rate in the regression analysis which amounts to a semi-elasticity of -1,0 (i.e. $-0,010 \cdot 100$).

Figure 8 : The speed of adjustment to the interest rate



The inflation rate variable acts as the opportunity cost variable in both the long-run and short-run dynamics of the error correction model. The graph in figure 9 suggests that the price semi-elasticity amounts to roughly 6,5 which corresponds closely to the result obtained from the estimated equation. The graph also illustrates the slow and gradual conversion of real cheque and transmission deposits to this equilibrium level, in that less than 90 per cent of the adjustment is found in the first twelve quarters.

Figure 9 : The speed of adjustment to inflation



The following table depicts the speed of adjustment of these explanatory variables :

Table 3 : The speed of convergence for cheque and transmission deposits

| Adjustment after : | GDP (value) | GDP (%) | Interest (value) | Interest (%) | Inflation (value) | Inflation (%) |
|--------------------|----------------|------------|---------------------|-----------------|----------------------|------------------|
| 1 Quarter | 1,08 | 26% | -1,02 | 27% | -1,50 | 23% |
| 4 Quarters | 2,59 | 62% | -2,37 | 64% | -3,90 | 61% |
| 8 Quarters | 3,37 | 81% | -3,05 | 82% | -5,10 | 80% |
| 12 Quarters | 3,77 | 91% | -3,40 | 91% | -5,70 | 89% |

6.4.1.2 The *M1* monetary aggregate

The M1 monetary aggregate is calculated as the sum of the M1A monetary aggregate and the "other demand deposits" of the private sector with the monetary sector. It is therefore defined as the sum of the notes and coin in circulation, the cheque and transmission deposits and these other demand deposits. As indicated earlier, other demand deposits will be the balancing item on the consolidated balance sheet of the banking sector. This essentially means that the M1 monetary aggregate can be generated by adding these "other demand deposits" to the M1A monetary aggregate.

Other demand deposits

This monetary component consists of all other demand deposits of the domestic private sector with the monetary sector (DEP_{odd}), i.e. all the other demand deposits excluding cheque and transmission deposits. As from the early 1980's other demand deposits as a percentage of the M3 money supply increased substantially from 5½ per cent to exceed 20 per cent in the second quarter of 1985. The contribution of other demand deposits to the M3 money supply subsequently declined to approximately 15 per cent by 1986 as a result of changes in the regulatory environment¹²). The ratio of other demand deposits to M3 remained within this proximity for the following decade up to 1996, but has since also started to show a rising trend to between 20 and 25 per cent during 1999. Increased

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The decline was primarily due to regulations which curtailed the banks' "averaging" procedure in their calculation of liabilities for cash reserve and liquid asset requirement purposes. Furthermore, as from 31 July 1985 banks' vault cash could qualify as part of their required cash reserves (SARB, 1993: B-88). This in effect meant that the cash reserves could be held in the form of any combination of vault cash and deposits in an interest-free reserve account with the South African Reserve Bank. The increase in private sector liquidity preference also contributed to the shift from longer term deposits to demand and other short-term deposits.

liquidity preference and the switching from longer-term deposits to those of a shorter-term nature could have contributed to this rising trend since 1996. However, due to the fairly stable relationship between other demand deposits and the M3 money supply prior to 1996, it was decided to make this item the balancing item on the liability side of the consolidated balance sheet of the monetary institutions. This means that any changes in the M3 money supply that are not explained by the respective deposit categories in the *ex post* and *ex ante* simulation projections will be absorbed by the other demand deposit component. This yields the following identity:

$$DEP_{odd} = M3 - DEP_{lt} - DEP_{sm} - DEP_{ct} - M_{cn}$$

where:

$M3$ = M3 money supply;

DEP_{lt} = long-term deposits of the private sector with monetary institutions;

DEP_{sm} = short-term and medium-term deposits of the private sector with monetary institutions;

DEP_{ct} = cheque and transmission deposits of the private sector with monetary institutions; and

M_{cn} = notes and coin in circulation outside the monetary sector.

6.4.1.3 The M2 monetary aggregate

The M1 monetary aggregate plus the other short-term and medium-term deposits of the private sector with the monetary sector constitute the M2 monetary aggregate. The other short-term and medium-term deposit component has accordingly been identified as a stochastic behavioural equation in the monetary block and is described in the following section.

Other short-term and medium-term deposits

The deposits in this instance exclude demand deposits, and include all savings deposits of the domestic private sector with the monetary institutions, including savings deposits with and savings bank certificates issued by the Postbank (previously known as the Post Office Savings Bank). During the latter half of the 1980's and early half of the 1990's, this category of deposits (DEP_{sm}) constituted more than half of the total M3 money supply and signalled a growing preference among individuals for deposits that can easily be converted, with a relatively short delay, into cash. However, this contribution has declined gradually to slightly more than 40 per cent over the last five years of the 1990's, and coincides with the rising trend in other demand deposits and cheque and transmission deposits that are immediately accessible.

As with the previous deposit categories, the function that best describes the behavioural pattern of holders of these real other short-term and medium-term deposits includes a real income variable, which is defined as the real gross domestic expenditure (Y_{exp}), the differential between the own interest rate on short- and medium-term deposits and a substitute interest rate in the form of the yield on Eskom stock ($R_{kmr} - R_{esk}$), and a dis-intermediation variable to account for the movement from the formal monetary market to the grey market when the differential gap between prime lending rates and deposit rates starts to diverge ($R_{por} - R_{trn}$). As short and medium term deposits comprise a large percentage of the M3 money supply, and the dis-reintermediation variable contributes substantially to the movement in the M3 money supply, it was decided to incorporate this variable in its own right in the demand for real short and medium term deposits as well. The inclusion of this variable in the demand for real money balances will be discussed in more detail in the M3 money supply equation.

The rate of inflation (\dot{P}) has also been introduced in the behavioural equation to make

allowance for the eroding impact of rising prices i.e. the opportunity costs associated with the holding of these other demand money balances. However, the inflation rate was only found to be statistically significant in the short-run dynamics of the system. In addition, a time trend was also introduced in the long-run equation, but this was found to be statistically insignificant as an explanatory variable in the demand for real other short-term and medium-term deposits. The estimated demand equation is specified as follows:

Regression 3 :

Dependent Variable: $DLOG(DEP_{sm}/P_{cpi})$

Method: Least Squares

Date: 01/19/00 Time: 16:13

Sample: 1985:2 1999:3

Included observations: 58

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---------------------------------|-------------|-----------------------|-------------|-----------|
| $LOG(DEP_{sm}(-1)/P_{cpi}(-1))$ | -0.134319 | 0.036842 | -3.645803 | 0.0006 |
| $LOG(Y_{exp}(-1))$ | 0.140943 | 0.074001 | 1.904608 | 0.0626 |
| $R_{kmr}(-1) - R_{esk}(-1)$ | 0.009807 | 0.002155 | 4.550420 | 0.0000 |
| $R_{por}(-1) - R_{trn}(-1)$ | -0.007593 | 0.003674 | -2.066747 | 0.0440 |
| C | -0.042915 | 0.756534 | -0.056726 | 0.9550 |
| $DLOG(Y_{exp}(-1))$ | 0.627189 | 0.323196 | 1.940587 | 0.0580 |
| $D(R_{por} - R_{trn})$ | -0.022637 | 0.006748 | -3.354495 | 0.0015 |
| $D(\dot{P})$ | -0.008470 | 0.003281 | -2.581489 | 0.0128 |
| R-squared | 0.444957 | Mean dependent var | | 0.007507 |
| Adjusted R-squared | 0.367251 | S.D. dependent var | | 0.038068 |
| S.E. of regression | 0.030282 | Akaike info criterion | | -4.029101 |
| Sum squared resid | 0.045849 | Schwarz criterion | | -3.744902 |
| Log likelihood | 124.8439 | F-statistic | | 5.726153 |
| Durbin-Watson stat | 1.631478 | Prob(F-statistic) | | 0.000067 |

NB : The order of integration of the variables used in the regression are illustrated in Appendix 2 at the back of this study.

The equation as shown above illustrates that the income elasticity of the demand for real short- and medium-term deposits is slightly in excess of unity (0,14/0,13). This means that

a 1 per cent change in income will induce slightly more than a 1 per cent change in real money balances. The income elasticity implied by this equation is slightly less than the income elasticities of roughly 1,5 that were estimated for the M2 monetary aggregate by Stadler (1981) and Contogiannis and Shahi (1982). However, it must be stated that the M2 at this period in time represented the broad money supply, so that it is not exactly comparable to the M2 money supply as we know it today.

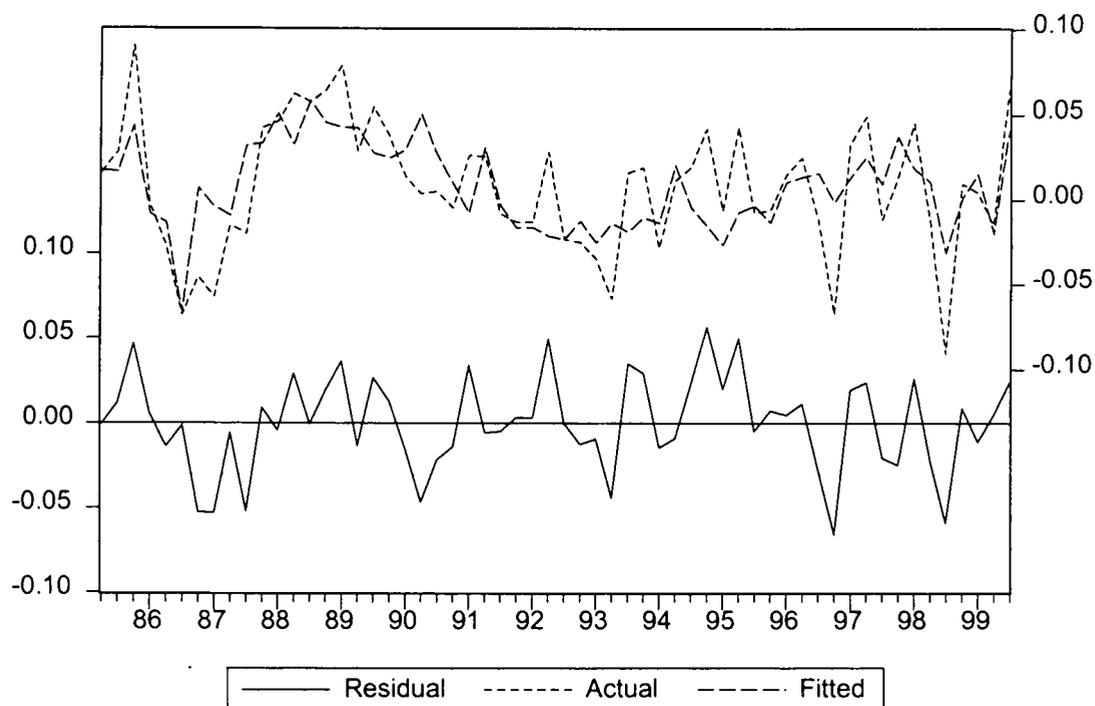
Usually the yield on the substitute asset represented by the rate on Eskom, stock is in excess of the rate on the medium-term deposits. However, during protracted periods of time, this was found to be untrue, and money market rates tended to be uncharacteristically higher than the yield on long-term Eskom stock. A reason for this characteristic could possibly be attributed to the fact that the prevalent high level of money market rates simultaneously raised the level of deposit rates. As domestic lending rates began to increase, future expectations for inflation became lower and the yield on Eskom stock trended downwards. It was basically this turn of events that started to put pressure on the gap between the own interest rate and the substitute long bond yield. These periods include 1982, the latter half of 1983 up to the first half 1985 and during the last quarter of 1988 up to the end of 1991. The equation above shows that the semi-elasticity of the differential between the own interest rate and substitute yield on an alternative asset is fairly high at 7,5 $((0,010*100)/0,134)$. However, when this is normalised by multiplying the semi-elasticity by the assumed level of this interest rate over the sample period, it shows that the elasticity of the demand for real short-term and medium-term deposits to the interest rate differential declines to 0,12 per cent (i.e. at a mean of 1,5 per cent for the differential over the sample period).

The interest rate semi-elasticity of the re-disintermediation variable with regard to the demand for real money balances shows a similar trend in that the elasticity of this differential amounts to 6,0 $((0,008*100)/0,134)$. Once normalised to show the sensitivity of real short-term and medium-term money balances to a one per cent change in this interest

rate differential, the elasticity declines to 0,24 per cent (i.e. at a mean of 4,0 per cent for the differential over the sample period). The elasticities of the equation seem to suggest that the re-disintermediation variable has virtually double the impact of the own to substitute differential interest rate. However, both of these elasticities are significantly low, implying that the demand for these real money balances (short and medium-term) are not primarily sensitive to the movement in interest rates, but that they are to a large extent determined by the fluctuation in real income.

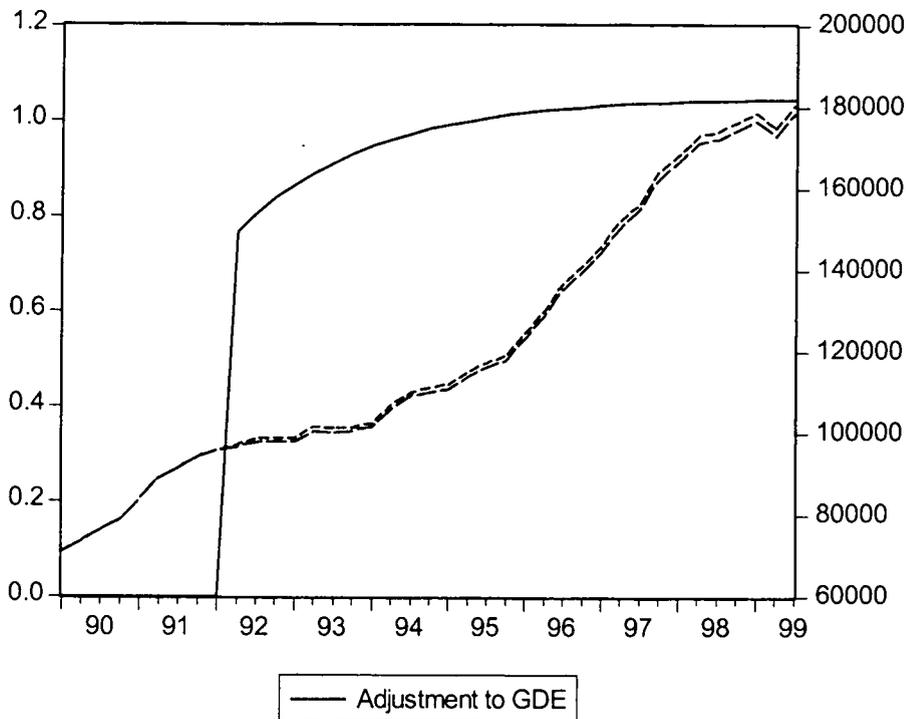
The residual of the error correction model and the actual and estimated real values of the change in other short-term and medium-term deposits are indicated in figure 10 :

Figure 10 : Other short-term and medium-term deposits (actual and fitted)



The following graphs illustrate the combined impact of the long-run properties and short-run dynamics of the income variable in the demand for real short-term and medium term deposits. The graph shows that the income pass-through is fairly quick and that nearly 83 per cent of its long-run equilibrium state is achieved within the first four quarters after the adjustment to the real gross domestic expenditure.

Figure 11 : The speed of adjustment to the GDE



The initial fast impact of this category of real deposits is attributed to the lagged impact of the income variable in the short-run dynamics of the equation. This means that by the second quarter of the simulation, these real deposits should have grown by the elasticity of roughly 0,6 (0,627 from the equation). However, figure 11 seems to indicate that real short- and medium term deposits grow by slightly more than this rate implied by the short-run dynamic elasticity. The extra addition to slightly under 0,8 per cent can hence be attributed to the long-run static impact, as it is the combined effect of the long-run static impact as well as the short-run dynamic impact that produces the eventual shock portrayed

by the graph during the second quarter of the simulation period. The graph also shows that the long-run equilibrium is slightly over 1 per cent which correlates closely to the long-run income elasticity implied by the results of the error correction model.

The pass-through of the interest rate differential (i.e. between the own interest rate on short-term and medium-term deposits and the yield on a substitute asset) to real money balances is much slower. The following graph (figure 12) shows the slow and gradual convergence to its long-run equilibrium state and that only 83 per cent of its equilibrium would be achieved after 12 quarters.

Figure 12 : The speed of adjustment to the interest rate differential

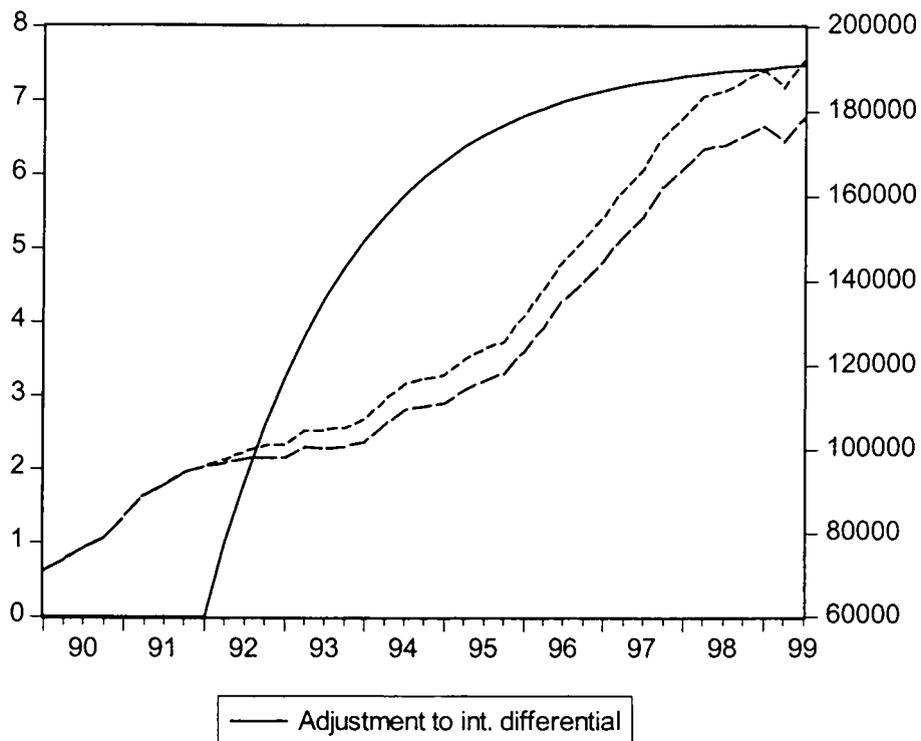
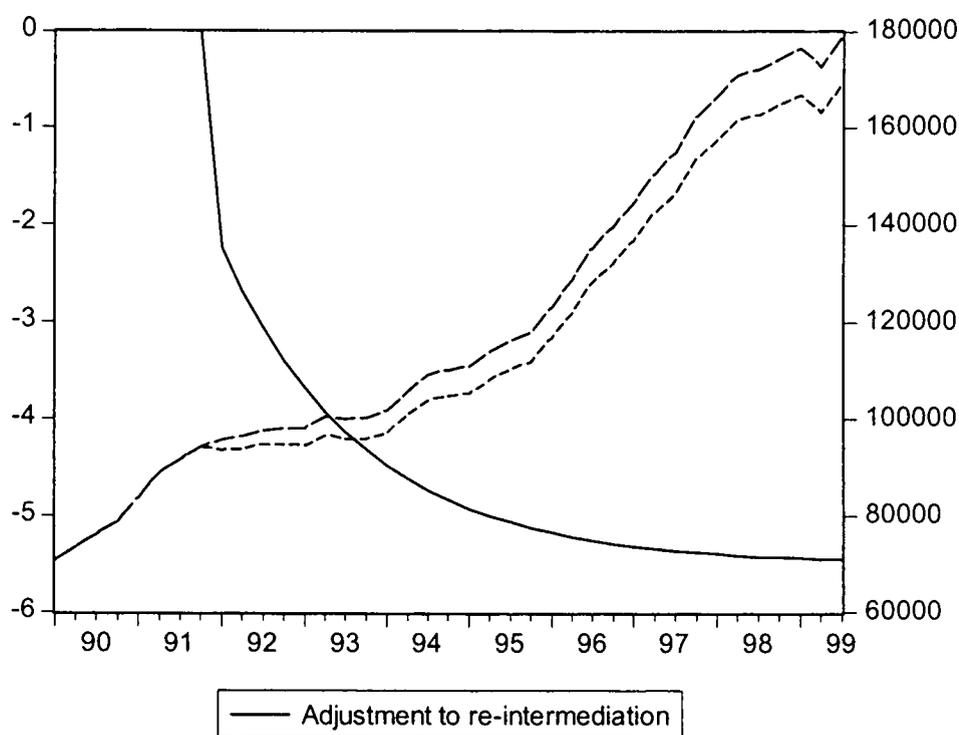


Figure 12 furthermore shows that the long-run semi-elasticity of the interest rate differential amounts to 7,5 which closely resembles the elasticity (0,0076) implied in the equation above.

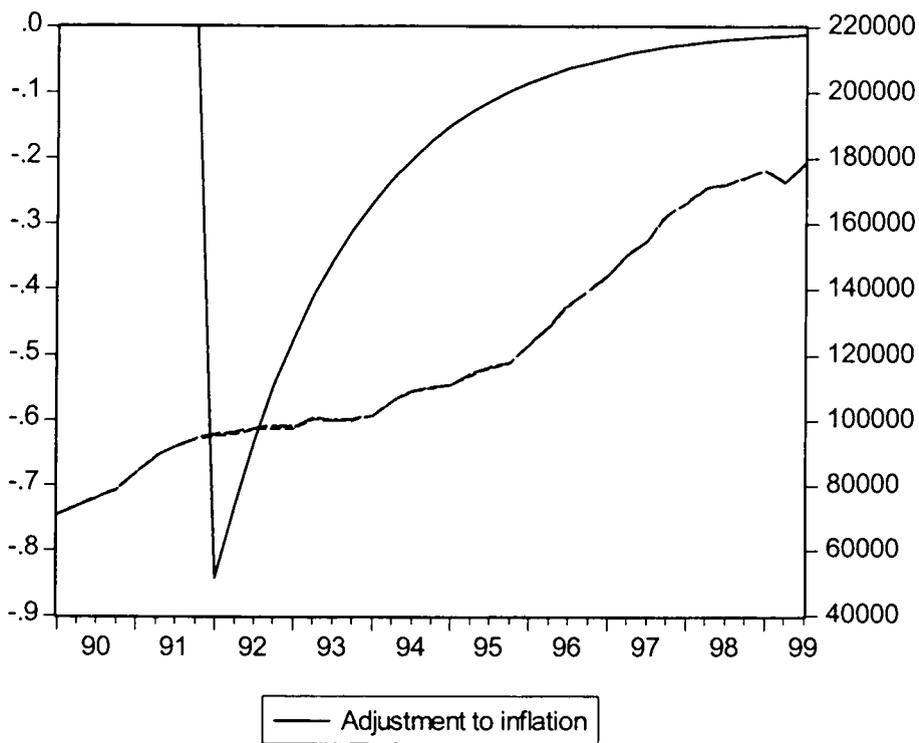
The pass-through onto real money balances as a result of a shock of 1 per cent to the dis/re-intermediation interest rate differential is initially much quicker than the differential between the own interest rate and the yield on a substitute asset during the first four quarters of the simulation. This is of course primarily attributed to the short-run dynamic impact of the re-intermediation variable in the equation which amounts to 2,3 (0,023 from the regression). However, thereafter the rate of convergence becomes much slower so that only 90 per cent of its long-run equilibrium is measured after 12 quarters have lapsed. Figure 13 shows that the long-run equilibrium state of the graph amounts to 5,5 which closely resembles the long-run semi-elasticity of 6,0 for this variable in the equation's error correction mechanism estimated in regression 3.

Figure 13 : The speed of adjustment to the re-intermediation variable



The inflation rate is viewed as an opportunity cost for holding short-term and medium-term money balances and only features in the short-run dynamics of the error correction model. A distinct characteristic of the short-run dynamics is that the initial impact is felt very quickly, but that this impact then starts to fade and disintegrate as time progresses. Figure 14 depicts this short-run trend of the 1 per cent shock to the price variable, and illustrates that it reaches its maximum of 0,8 during the very first period. By the end of the first four quarters the initial impact would virtually have been halved .

Figure 14 : The speed of adjustment to inflation



The following table illustrates the speed of adjustment of these explanatory variables :

Table 4 : The speed of convergence for short- and medium-term deposits

| Adjustment after : | GDE | | Interest differential | | Reintermediation | | Inflation | |
|--------------------|---------|-----|-----------------------|-----|------------------|-----|-----------|------|
| | (value) | (%) | (value) | (%) | (value) | (%) | (value) | (%) |
| 1 Quarter | 0,00 | 0% | 0,00 | 0% | -2,24 | 41% | -0,84 | 100% |
| 4 Quarters | 0,87 | 83% | 3,25 | 44% | -3,68 | 68% | -0,47 | 56% |
| 8 Quarters | 0,95 | 90% | 5,13 | 69% | -4,48 | 82% | -0,27 | 32% |
| 12 Quarters | 0,99 | 94% | 6,19 | 83% | -4,93 | 90% | -0,15 | 18% |

6.4.1.4 The M3 monetary aggregate

The M3 broad money supply aggregate consists of the sum of the M2 monetary aggregate and long-term deposits. The structure of the monetary sub-model proposed in this study makes allowance for structural behavioural equations for the demand for M3 money balances as well as the long-term deposits of the private sector with the monetary institutions. This implies that, with the exception of the other demand deposits, all the deposit categories will be generated as behavioural equations.

Long-term deposits

The long-term deposits of the domestic private sector with monetary institutions include national savings certificates issued by the Postbank. As stated previously, the increased liquidity preference of individuals has come to play a major role in the declining trend of the share of long-term deposits in the total M3 money supply. This was illustrated during the early 1980's when both the long-term and the medium-term deposits comprised approximately 37 per cent of the total M3 monetary aggregate, but as time progressed the shift from long-term deposits to medium-term and even to shorter term deposits began to gain significant momentum. In fact, the liquidity preference impact was so strong that in 1999 the contribution of long-term deposits to the total M3 money supply had declined to

less than 10 per cent, or roughly a quarter of the percentage registered in the early 1980's. A major contributing factor to this development was the initial very high cash-reserve and liquid-asset requirements against short-term deposits that applied to short-term and medium-term deposits with the monetary institutions over the first half of the 1980's¹³. These reserve requirements against short-term and medium-term deposits were subsequently relaxed leading to a gradual shift from long-term deposits to shorter-term deposits as the preference for liquidity began to gain momentum.

The equation describing the demand for real long-term money deposits by the private sector with monetary institutions (DEP_{lt}) is specified as a one-step logarithmic error correction model in which these nominal money balances have been deflated by the private consumption expenditure deflator (P_{pc}). The real gross domestic product at market prices (Y_{mp}) as the income variable is used as the major explanatory variable in the behavioural equation. The standard t-statistic for parameter significance tests failed in almost all cases in which an interest rate was added to the long-run dynamics of the regression, i.e. whether it was the own rate of interest rate on this type of deposit, or in the form of a yield on a substitute asset. However, the differential between the long-term interest rate and a substitute long-bond yield was found to be significant in the short-run dynamics of the equation and has consequently been added as an explanatory variable. The inclusion of the inflation rate as an opportunity cost was also found to be an insignificant motivating factor to hold money balances in these long-term deposits.

The interest rate differential used in the equation is the gap between the long-term interest rate on this type of deposit (R_{kir}), and the yield on Eskom stock as the substitute asset

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Over the years, liquid asset requirements were gradually lowered to 5 per cent of banks' total liabilities in April 1993. This has been drastically reduced from the approximate 50 per cent of short-term liabilities, and 30 per cent of medium-term liabilities that prevailed in the early 1980's. Supplement to the *South African Reserve Bank Quarterly Bulletin* September 1993 (SARB, 1993: B94-B96).

(R_{esk}). This differential signifies the gap between the own rate and a substitute interest rate, it should hence be positive so that rising long-term interest rates in relation to the substitute asset rate intuitively attract idle money balances to the long-term deposit category, and vice versa. The long-term nature of this type of deposit forces the individual to be cautious when investing in this deposit category. If depositors anticipate a rising inflation rate while long-term interest rates remain stable, they may well feel obliged to invest their money balances in an alternative inflation-hedging asset such as shares or long-term bonds. The opposite is also true in that if inflation is perceived to be at its pinnacle, the next movement can be expected to trend downwards, so that inflation expectations are on the decline. Synchronised lower inflation expectations usually mean that domestic interest rates as well as the yields on long-term bonds will tend to drift downwards in the near future. Under these circumstances, it may be more beneficial for the depositor to rather invest at the prevailing high interest rate now, thereby maximising his return by locking in at the high level of interest rates, i.e. before the anticipated downward movement in domestic interest rates.

Needless to say, increased liquidity preference has played a significant role in the steady decline in long-term deposits. As this type of deposit category becomes less and less attractive over time, i.e. relative to the more convenient shorter and medium-term depository investments, it is absolutely imperative to encapsulate this general trend in the equation used to describe the desire of individuals to hold onto long-term money balances. For this purpose, and in order to capture this steady decline in the relative importance of long-term deposits;- a time trend (TT) has been incorporated in the equation describing the demand for this type of depository investment. The time trend usually depicts a trend that is rising over time so that when it is used to describe a declining trend (as in this instance), the coefficient should be negative and of course statistically significant.

The estimated error correction equation for long-term deposits of the private sector with the monetary institutions is as follows:

Regression 4 :

Dependent Variable: $DLOG(DEP_{it}/P_{pc})$

Method: Least Squares

Date: 01/27/00 Time: 15:57

Sample: 1988:1 1999:3

Included observations: 47

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------------------|-------------|-----------------------|-------------|-----------|
| $LOG(DEP_{it}(-1) / P_{pc}(-1))$ | -0.413813 | 0.132008 | -3.134754 | 0.0032 |
| $LOG(Y_{mp}(-1))$ | 1.478709 | 0.690617 | 2.141142 | 0.0383 |
| TT | -0.010194 | 0.004288 | -2.377231 | 0.0222 |
| C | -11.73067 | 6.493389 | -1.806556 | 0.0782 |
| $DLOG(Y_{mp})$ | 1.945339 | 1.508389 | 1.289680 | 0.2044 |
| $D(R_{klr} - R_{esk})$ | 0.025097 | 0.012609 | 1.990442 | 0.0532 |
| R-squared | 0.335340 | Mean dependent var | | -0.017346 |
| Adjusted R-squared | 0.254284 | S.D. dependent var | | 0.079370 |
| S.E. of regression | 0.068540 | Akaike info criterion | | -2.404058 |
| Sum squared resid | 0.192606 | Schwarz criterion | | -2.167868 |
| Log likelihood | 62.49535 | F-statistic | | 4.137141 |
| Durbin-Watson stat | 1.840921 | Prob(F-statistic) | | 0.003913 |

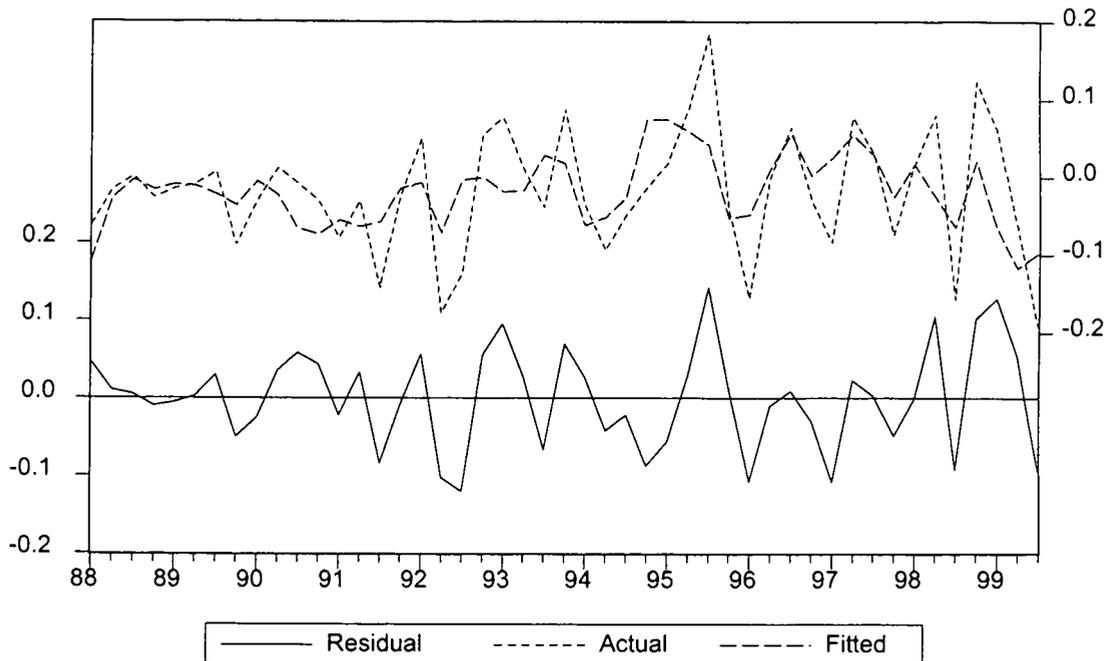
NB : The order of integration of the variables used in the regression are illustrated in Appendix 2 at the back of this study.

The estimated equation indicates that the income elasticity for the demand for long-term deposits with monetary institutions is highly sensitive to changes in the real gross domestic product, as the long-run elasticity is estimated at 3,7. This means that if real income was to increase with 1 per cent, real long-term deposits can be expected to increase with 3,7 per cent. The fact that interest rates were not significant in the regression analysis offers further proof that decisions to invest in long-term deposits are not driven by interest rate or opportunity cost considerations, but rather depend on real income and liquidity preference motivations. In addition, political unrest and uncertainty could also lead prudent long-term investors to rather maintain their funds in easily accessible shorter-term maturity deposits.

Figure 15 illustrates the goodness-of-fit of the estimated error correction model in which the

desire of individuals to hold long-term deposits is primarily determined by income and liquidity preference in the long-run, and the interest rate differential in the short-run dynamics of the equation.

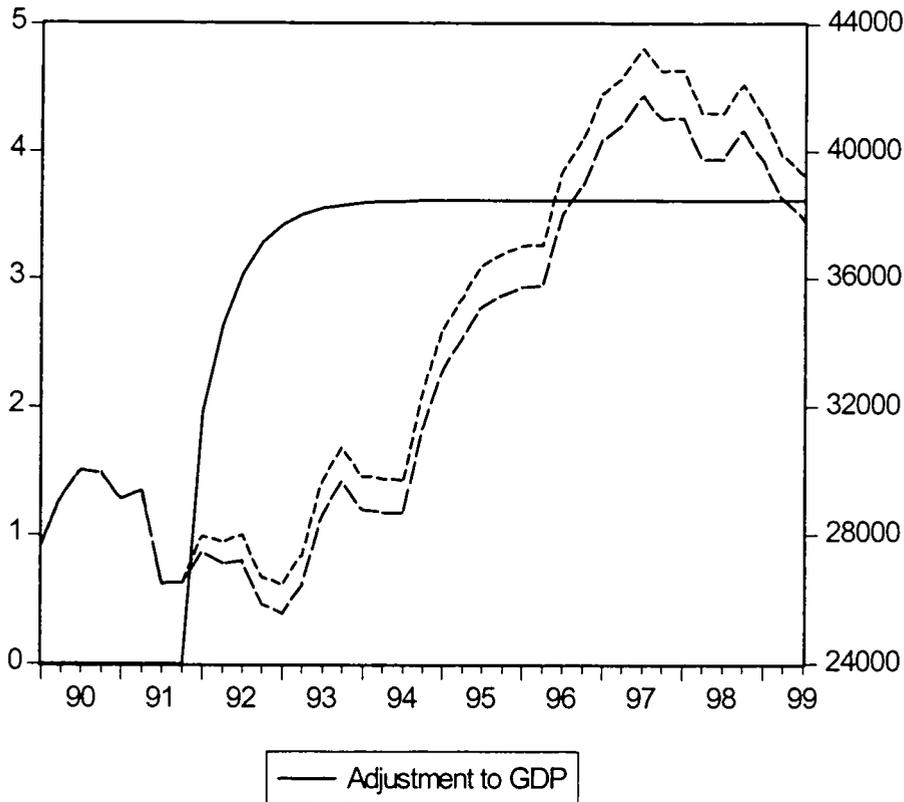
Figure 15 : Long-term deposits (actual and fitted)



The real gross domestic product as the income variable is seen as the most important variable driving the behaviour of individuals in investing in long-term deposits. Figure 16 illustrates how these types of nominal deposits reacts to a change of 1 per cent in real income. The long-run equilibrium is roughly 3,7 per cent which corresponds to the income elasticity determined from the regression, but what is important is the speed at which it reaches its long-run equilibrium state. This is to a large extent driven by the short-run dynamics of the equation in which real long-term deposits increase by nearly 1,9 (from the equation 1,945) in the immediate short-term before it resumes its trend to its long-run equilibrium level. The graph shows that more than half the impact of the shock will be felt within the very first quarter, and that by the end of the first year nearly 95 per cent of the

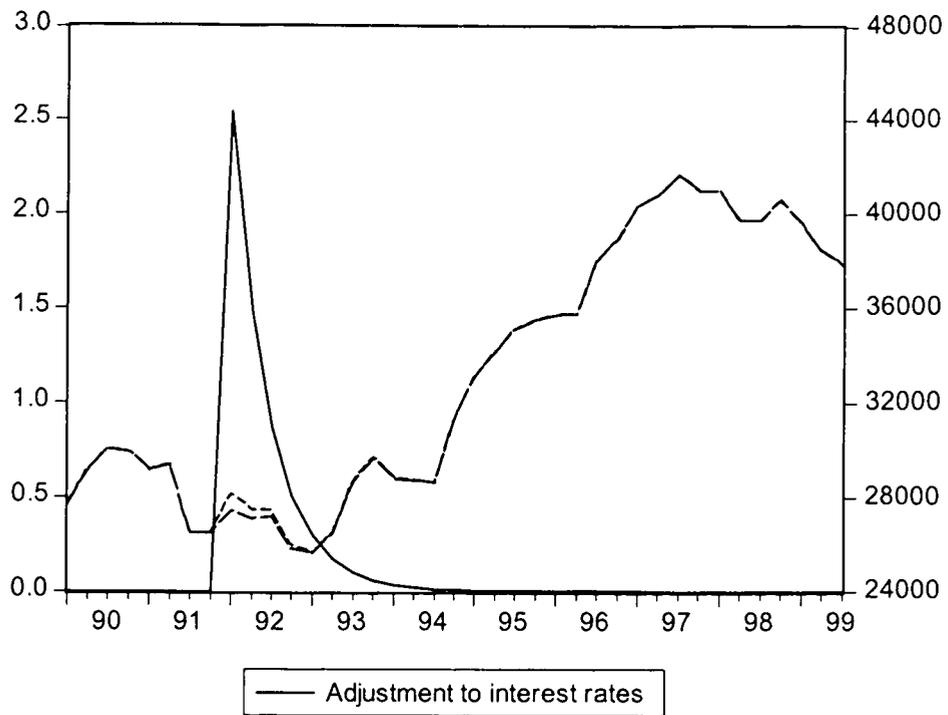
impact would be registered. This illustrates that the income pass-through is extremely quick and much faster on this type of deposit than on its other deposit category counterparts.

Figure 16 : The speed of adjustment to the GDP



The interest rate impact is only on the short-run dynamics of the estimated equation so that it will have the characteristic of a very quick impact during the first quarter which then seems to die out with time. Figure 17 depicts the speed of convergence and the short-run dynamics of the interest rate differential. The graph shows furthermore that the impact of interest rates is extremely quick to roughly 2,5 percent (which corresponds to the 0,025 in the equation) and that the initial impact would have worked itself out to slightly more than 10 per cent by the end of the first 4 quarters.

Figure 17 : The speed of adjustment to the interest rate differential



The following table illustrates these impacts and the speed of convergence for the two main explanatory variables of the equation.

Table 5 : The speed of convergence for long-term deposits

| Adjustment after : | GDP | | Interest differential | |
|--------------------|---------|------|-----------------------|------|
| | (value) | (%) | (value) | (%) |
| 1 Quarter | 1,95 | 54% | 2,54 | 100% |
| 4 Quarters | 3,42 | 94% | 0,30 | 12% |
| 8 Quarters | 3,60 | 99% | 0,03 | 1% |
| 12 Quarters | 3,65 | 100% | 0,00 | 0% |

Total M3 money supply

Ever since 1989 the main objective of monetary policy has been to secure a stable financial environment in which optimal economic growth and development can be sustained in the long run. To this end, the Reserve Bank has generally adopted a fairly orthodox or eclectic approach to monetary policy decision making, which in essence meant that the monetary authorities' decisions were primarily guided by prevailing circumstances, such as (Stals, 1998: 38) :

- changes in inflation and inflation expectations;
- changes in the balance of payments situation;
- changes in the exchange rate and expectations of further changes in the exchange rate in the light of current movements on the balance of payments;
- changes in the public debt and the budget deficit as ratios of the gross domestic product;
- changes in the growth of credit extension to the private and government sectors;
- the levels of and current trends in foreign reserves; and
- recent trends in short-term market-determined interest rates.

Guidelines for the growth of the M3 money supply are announced at the beginning of every calendar year by the South African Reserve Bank, but these guidelines should not be seen as rigid and uncompromising targets for monetary growth. On the contrary, monetary policy decisions are always subject to discretionary assessments of the prevailing market conditions. As the growth in money supply is still regarded as a vital element in the process of inflation creation, the Bank will continue to announce money supply guidelines, but a more medium-term to long-term approach will be adopted for this purpose (Stals, 1998: 38). Needless to say, if the money supply guidelines were uncompromising and rigidly adhered to, M3 could quite easily be seen as exogenous in the model as the rate of growth in the broad money supply would invariably be greater than the stipulated guideline or M3 money supply target.

A stable money demand equation for the South African economy can hence be considered as very important for conducting monetary policy. Historical events and policy regime shifts have also given rise to the possible instability of the money demand function over time. Since the development of the cointegration methodology it has become customary to specify and estimate money demand functions in error correction form in order to capture the non-stationarity of the underlying time series. In the demand for money literature there is general agreement that in the long-run, real money balances depend on a scale variable such as the gross national product (GNP) and at least one interest rate. The former reflects the fact that money is used for transaction purposes, while the latter represents the opportunity costs in holding money balances. This cost variable may also be reflected as an inflation rate in the cointegrated error correction model (Lütkepohl et al., 1999: 512).

The theory suggests that the scale variable for transaction purposes should be some sort of measure for economic activity, while the opportunity cost variables should be seen as an indication of the earnings foregone by not holding assets which are alternatives to money. This finding has been confirmed by various theoretical frameworks such as Keynes, who postulated that individuals held money balances for three distinct motives¹⁴. Instead of asking what prompts (motivates) individuals to hold money as Keynes did, Friedman assumed that people held money in a similar fashion to that postulated in the Cambridge approach of the quantity theory of money (i.e. that the demand for money was a public demand for money holdings in which the formal relationship between the demand for real money and real income is explicitly stressed). Friedman went on further to analyse how much of this money will be held under various circumstances and suggests that a broad range of cost variables (including the expected rate of inflation) have theoretical relevance in a demand for money function (Sriram, 1999(2): 14).

Post-Keynesians developed a number of models to provide alternative explanations to

¹⁴

See section 3.2.4 on page 55 on the Keynesian motives for holding money balances.

confirm the formulation relating real money balances with real income and some sort of interest rate. The medium of exchange function of money led to the inventory-theoretic¹⁵ formulation that emphasised the transactions costs under certainty and to the precautionary demand for money models that introduced uncertainty in otherwise transactions cost models. The asset function of money led to the asset or portfolio approach which evaluated the demand for money under the optimisation of a portfolio framework, where money was held as part of a portfolio of many assets which inherently differed in the yield and risk characteristics. The consumers demand theory for money retained characteristics of the portfolio approach, but considered money as any other consumer good (commodity) in which the demand can be determined by means of a utility maximisation framework (Sriram, 1999(2): 16).

Sriram (1999) points out however, that while there are many different theoretically based models for the demand for money, the resulting implications are almost all the same. In all instances, the optimal stock of real money balances is inversely related to the return on earning assets, i.e. the interest rate, and positively related to real income. The differences, of course, arise in terms of using the proper transaction (scale) variable and the opportunity cost for holding money (Sriram, 1999(2): 16). The empirical analysis of the demand for money equation does not deviate from this hypothesis, and takes this conclusion as a starting point.

For the South African economy, the best-fitting function for the aggregate demand for real M3 balances has been estimated in a cointegrated error correction model framework in which the following explanatory variables have been incorporated. As with all the other deposit categories, the formulation of the model will also incorporate (as a purely empirical matter), the lagged dependent variable to bring forth the short-run dynamics of the system which will be examined later in this section. The explanatory variables are as follows :

¹⁵ See section 3.5 on page 72 on the Baumol-Tobin inventory models.

- a variable depicting the real aggregate gross domestic expenditure, i.e. as the scale variable for transaction purposes (Y_{exp}) ;
- a dis/re-intermediation variable, indicating the incentive for holders of M3 money balances to alternatively make their funds available directly to economic agents that are currently experiencing a financing deficit ; and
- an interest rate differential between the yield on a substitute asset (R_{esk}) and the combined weighted interest rate on all classes of deposits (R_{trn}) ;
- an inflation variable (\dot{P}) to make allowance for the eroding impact of rising domestic prices.

The yield on long-term Eskom stock (R_{esk}) has been included in the demand function as an indicator of the yield on substitute assets. When capital market rates are high in relation to deposit rates (R_{trn}), the market price of fixed-interest securities is low and this tends to encourage investors to prefer keeping their funds invested in the long-term securities market. The yield on long-term bonds is therefore expected to affect the demand for M3 balances inversely, as higher bond yields relative to deposit rates would increase the differential between these two interest rates, and cause a substitution of deposits for bonds to take place ($R_{esk} - R_{trn}$).

The own interest rate on M3 balances is defined as the weighted average of the interest rates applicable to the various classes of M3 deposits, i.e. other demand deposits¹⁶⁾ (DEP_{odd}), short-term and medium-term (DEP_{sm}) and long-term deposits (DEP_{lt}). As this combination of the various interest rates constitutes the own interest rate on M3 type deposits, it should necessarily be positively correlated with the M3 monetary aggregate.

16

The interest rate on cheque and transmission deposits is far lower than the rates of the other interest-bearing deposits and has subsequently been removed from the identity. In addition, the other demand deposit category has its own rate known as the "call rate", however the trend in this rate is fairly similar to that of the short-term deposit rate.

The identity for determining the own interest rate on deposits is defined as follows:

$$R_{trn} = [DEP_{odd}/DEP_{trn}] * R_{kkr} \\ + [DEP_{sm}/DEP_{trn}] * R_{kmr} \\ + [DEP_{lt}/DEP_{trn}] * R_{klr}$$

where: $DEP_{trn} = DEP_{odd} + DEP_{sm} + DEP_{lt}$

and: $R_{kkr} =$ short-term deposit interest rate (30 days)

$R_{kmr} =$ medium-term deposit interest rate (6 months)

$R_{klr} =$ long-term deposit interest rate (12 months).

Disintermediation takes place when "direct financing", by "primary lenders" of "ultimate borrowers" is substituted for lending that previously was, or normally would have been, extended by a bank or other monetary institution (SARB, 1988: 33). It is usually fostered by an increase in the relative size of the disparity between the banks' average lending rates and their average deposit rates. Of course, lending and borrowing activities by banks will increase relative to those of the non-bank sector when the margin between banks' lending and deposit rates narrows. The effect of these changes on the demand for M3 balances is captured by including the gap between the prime overdraft (lending) rate to the combined yield on interest-bearing deposits ($R_{por} - R_{trn}$) as an explanatory variable in the demand equation.

The wealth-eroding impact of rising prices and inflation (\dot{P}) justifies the inclusion of this explanatory variable as an opportunity cost in its own right. As inflation starts to rise, investors begin to hedge against inflation by looking at alternative investments, i.e. by possibly transferring potential low real-yielding deposit balances into some alternative and hopefully higher real-yielding type of asset such as shares, bonds or even real estate.

Error correction models have proved to be one of the most successful tools in applied money demand research. As stated earlier, this type of formulation is a dynamic error-

correction representation in which the long-run equilibrium relationship between money and its determinants is entrenched in an equation that captures the short-run variation and the long-run dynamics of the model. Accordingly, the economic theory should be allowed to specify the long-run equilibrium, while the short-term dynamics should be defined by the data - i.e. with disequilibrium as a process of adjustment to the long-run equilibrium of the model. The single-step logarithmic error correction model that most adequately describes the relationship between the quantity of M3 money demanded and the real sectors of the economy is specified as follows :

Regression 5:

Dependent Variable: $DLOG(M3 / P_{cpi})$

Method: Least Squares

Date: 01/20/00 Time: 16:27

Sample: 1982:1 1999:3

Included observations: 71

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|-----------------------------|-------------|-----------------------|-------------|-----------|
| $LOG(M3(-1) / P_{cpi}(-1))$ | -0.112404 | 0.035420 | -3.173498 | 0.0023 |
| $LOG(Y_{exp}(-1))$ | 0.179941 | 0.053246 | 3.379411 | 0.0013 |
| $R_{por}(-1) - R_{trn}(-1)$ | -0.005250 | 0.001642 | -3.197334 | 0.0022 |
| $R_{esk}(-1) - R_{trn}(-1)$ | -0.001922 | 0.000764 | -2.514258 | 0.0145 |
| $\dot{P}(-1)$ | -0.001937 | 0.000760 | -2.548930 | 0.0133 |
| C | -0.664545 | 0.389492 | -1.706186 | 0.0929 |
| $D(\dot{P})$ | -0.006832 | 0.001316 | -5.189225 | 0.0000 |
| $D(R_{por} - R_{trn})$ | -0.005630 | 0.002740 | -2.055084 | 0.0440 |
| R-squared | 0.530461 | Mean dependent var | | 0.005858 |
| Adjusted R-squared | 0.478290 | S.D. dependent var | | 0.018653 |
| S.E. of regression | 0.013473 | Akaike info criterion | | -5.670405 |
| Sum squared resid | 0.011436 | Schwarz criterion | | -5.415455 |
| Log likelihood | 209.2994 | F-statistic | | 10.16772 |
| Durbin-Watson stat | 1.456740 | Prob(F-statistic) | | 0.000000 |

NB : The order of integration of the variables used in the regression are illustrated in Appendix 2 at the back of this study.

The real money demand function illustrated in regression 5 suggests a fairly strong elasticity

for the scale or income variable. The long-run income elasticity for the demand for real M3 money balances is estimated at 1,6. This implies that if the real gross domestic expenditure were to increase with 1 per cent, real money balances would increase with more than 1½ per cent. The fact that the estimation shows real money supply balances to be growing at a faster rate than real income, is a further indication that the velocity of money should be declining. The South African Reserve Bank Quarterly Bulletin (SARB : December 2001) suggests this to be true and that the income velocity of the M3 money supply has declined from a value of 2,13 to 1,82 between 1993 and 1999 (i.e. with nearly 15 per cent).

Previous estimates by Stadler (1981) and Contogiannis and Shahi (1982) for South Africa's income elasticities for the broad money supply suggest a long-run elasticity of 1½. The estimated parameter as shown above would indicate an elasticity that does not diverge too much from these findings, although recent models for the broad money supply in the United Kingdom propose that this elasticity should be homogenised and restricted to 1 so that rising real incomes have a proportional effect on real money balances. The reason for this is that money is specified as the nominal anchor in a monetary policy rule for interest rates in the Bank of England (BoE) model (BoE, 1999: 45). The BoE model assumes nominal neutrality so that the long-run real equilibrium is independent of the price level. This is guaranteed by ensuring that equations containing nominal variables exhibit static homogeneity, i.e. the real equilibrium remains unaltered, even if the level of all the nominal variables were to hypothetically double in magnitude (BoE, 1999: 26).

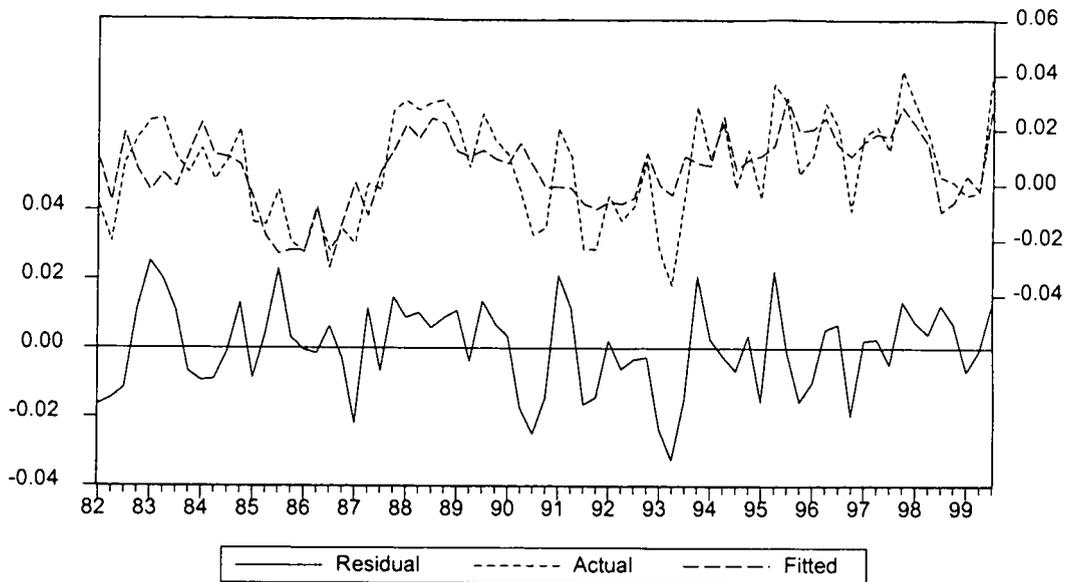
The interest rate semi-elasticity with regard to the dis/re-intermediation variable between lending and deposit rates is estimated at 4,5. The semi-elasticity is calculated as the ratio between the parameter of the interest rate differential (which is first multiplied by 100 as it represents an interest rate in the logarithmic money demand function) and the lagged dependent variable for real M3 money balances, i.e. $((0,005*100)/0,112)$. By the same token, the interest rate semi-elasticity for the differential between the substitute yield on Eskom stock and deposit rates is estimated at 1,8, i.e. $((0,002*100)/0,112)$. However, both

of these semi-elasticities have to be normalised to represent the final long-run impact that these interest rates have on the real money supply balances. This is achieved by multiplying the semi-elasticities by their assumed interest rate levels for the sample period. The long-run elasticities of these differentials hence amount to 0,18 for the dis/re-intermediation variable and less than 0,1 for the gap between the substitute interest rate and the weighted interest rate on all categories of deposits. This essentially means that interest rates have a very low impact on the movement in the M3 money supply, and that it is rather the secondary impact of interest rates on the real side of the economy (the scale variable) that should be relied on to change the trend in the broad money balances.

Inflation as an opportunity cost variable in the equation also has a semi-elasticity of 1,8, i.e. $((0,002*100)/0,112)$. However, once this has been normalised to calculate the long-run impact on money balances the elasticity increases to 0,22 which is still fairly small but is still greater than either of the two interest rate differentials. This offers further confirmation that neither interest rates nor inflation cost considerations will influence money supply immediately, and that it is rather the change to income that essentially changes the trend in the money supply. Perhaps this is why there is so much ambiguity on the transmission mechanism, and why many independent domestic economists believe the transmission mechanism between interest rates and the money supply to be rather long (i.e. interest rates first affect income, and it is then the secondary impacts of income that influence the change in money supply).

The single-step error correction model as shown in regression 5 indicates a R^2 correlation coefficient of nearly 50%, which is not poor for a function in logarithmic terms and in first-differences. The close relationship between the actual and fitted lines of the estimation are illustrated in figure 18 :

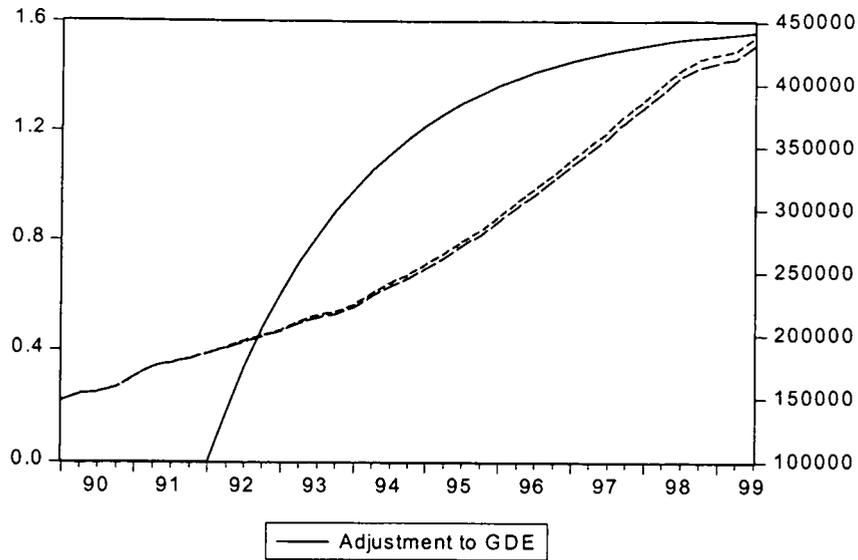
Figure 18 : Broad M3 money supply (actual and fitted)



From the results shown in the above equation, the income variable is obviously the most important independent variable explaining the movement in real money supply balances, and it would seem plausible to determine how fast income effects impact on the M3 money supply. Figure 19 shows the convergence and gradual speed of adjustment that money balances take to reach its long-run equilibrium once the real gross domestic expenditure has been hypothetically increased with 1 per cent.

The graph in figure 19 shows clearly that the income effects are fairly slow to adjust money balances, and that less than 80 per cent of the long-run equilibrium will be registered within the first 8 quarters. This is also partly due to the fact that the real income variable was found to be insignificant in the short-run dynamics of the equation and was subsequently excluded from the error correction part of the regression analysis. By the end of the 12th quarter only 87 per cent of this long-run equilibrium would have been achieved which offers further evidence that the pass-through of income to money supply is a slow and gradual process.

Figure 19 : The speed of adjustment to the GDE



The two graphs shown below depicts the rate of convergence of the dis/re-intermediation variable and the interest rate differential between the substitute rate and the own rate on deposits. Both figure 20 and figure 21 show a slow and gradual convergence to their long-run equilibrium state, and that in both instances only roughly 80 per cent of this adjustment would have been achieved after 12 quarters.

Figure 20 : The speed of adjustment to the re-intermediation variable

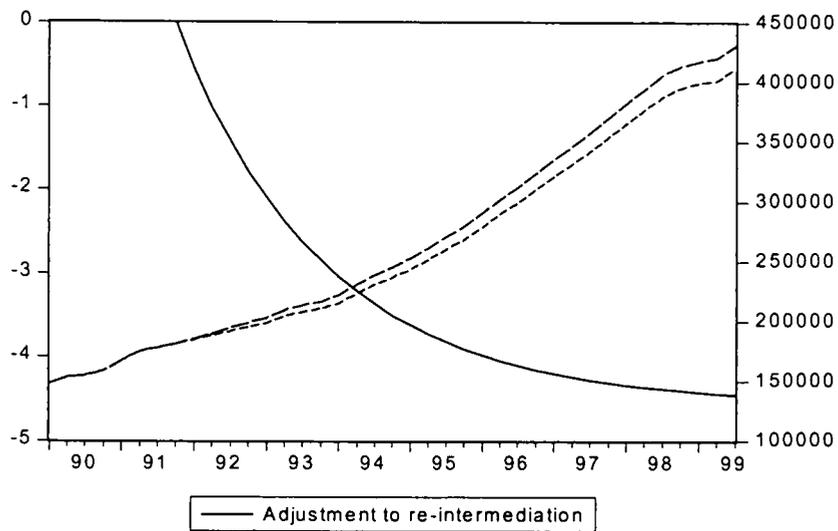
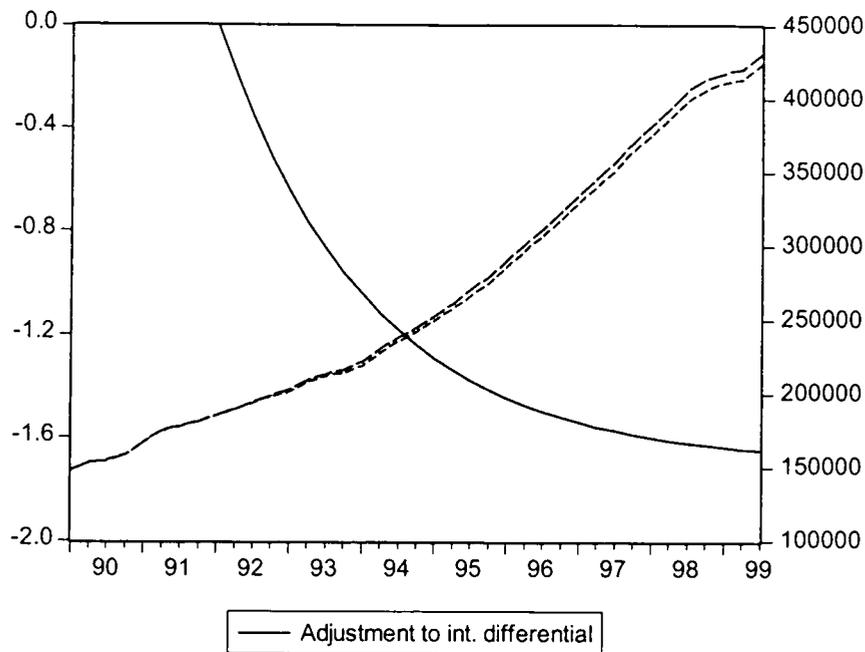


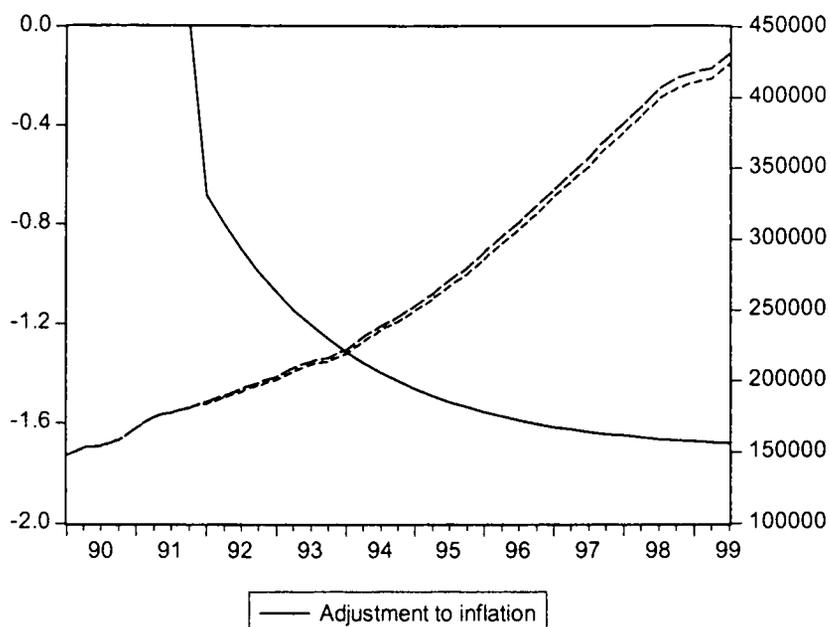
Figure 21 : The speed of adjustment to the interest rate differential



However, real money supply reacts far quicker over the short-term, but this can be attributed to the short-run dynamics of the equation in which the semi-elasticity for this variable amounts to roughly 0,6 (i.e. $0,0056 \cdot 100$ from the equation).

The opportunity cost in holding money balances as illustrated by the inflation variable in the error correction mechanism also shows a slow and gradual pass-through to its long-run equilibrium state (see figure 22). The fast initial impact of real money balances to roughly -0,7 (i.e. $0,0068 \cdot 100$ from the equation) is solely attributed to the short-run dynamics of real money to the adjustment in the inflation rate. Hereafter, real money balances resumes its long-run equilibrium growth path suggesting that the convergence seems to be a little quicker than those of the two interest rate differentials (especially during the first four quarters of the adjusted scenario), but by the end of the 12th quarter, it would still have only adjusted to 87 per cent of its long-run equilibrium state.

Figure 22 : The speed of adjustment to inflation



The following table shows the rate of convergence of the explanatory variables as indicated in the graphs above :

Table 6 : The speed of convergence for the broad M3 money supply

| Adjustment after : | GDE | | Interest differential | | Re-intermediation | | Inflation | |
|--------------------|---------|-----|-----------------------|-----|-------------------|-----|-----------|-----|
| | (value) | (%) | (value) | (%) | (value) | (%) | (value) | (%) |
| 1 Quarter | 0,00 | 0% | 0,00 | 0% | -0,56 | 13% | -0,68 | 40% |
| 4 Quarters | 0,61 | 39% | -0,65 | 39% | -2,10 | 47% | -1,07 | 64% |
| 8 Quarters | 0,98 | 63% | -1,05 | 64% | -3,04 | 68% | -1,31 | 78% |
| 12 Quarters | 1,22 | 78% | -1,29 | 78% | -3,62 | 81% | -1,46 | 87% |

6.4.2 Accounting counterparts of the M3 money supply

The institutional composition of the monetary sector - the sector whose deposit, coin and note liabilities to the domestic private sector constitute the money supply - has changed considerably over the last two decades. Factors contributing to this change include the scrapping of rigid distinctions between different types of deposit-taking institutions, and the acquisition of the functions of the dissolved National Finance Corporation by the Corporation for Public Deposits (SARB, 1993: 1).

The separate balance sheets of the monetary institutions form the basis for the compilation of the consolidated balance sheet of the monetary sector which can be used to explain changes in the broadly defined M3 money supply. The accounting counterparts of M3 distinguished in this analysis consist of the following components:

- the change in the monetary sector's net claims on the government sector, i.e. gross claims less government deposits with the monetary sector, which is seen as an exogenously determined variable (MC_{govt});
- the monetary sector's claims on the private sector, or credit extended to the private sector, which is determined by a behavioural stochastic function (MC_{priv}) in the model;
- the change in the net gold and other foreign assets of the monetary sector, i.e. gold, foreign exchange and other foreign assets less short-term foreign liabilities ($NGFOR_{sa}$); and
- the change in net other assets of the monetary sector, i.e. other assets less capital and reserves and other liabilities ($LARBO_{sa}$).

6.4.2.1. The net claims on the government sector

The net claims of the monetary sector on the government sector (MC_{govt}) are characteristically highly variable from quarter to quarter. This variability can partly be attributed to changes in government stock held by monetary institutions and changes in the level of government deposits with monetary institutions in an attempt to influence monetary conditions in the economy, or as part of government's debt management strategy. However, monetary institutions are not the major holders of short-term and long-term marketable government debt. The major holders of government stock are the so-called institutional investors, such as insurance companies and pension funds.

The lack of systematic change in the net claims of the monetary sector on the government sector and the policy-related nature of these changes lead to the exogenous treatment of this variable in the model, i.e. the net changes in this variable cannot easily be explained in terms of the interrelationships contained in the model. In addition, the long-term contribution of the change in the net claims of the monetary sector on the government sector is relatively small in comparison to the change in the M3 money supply.

6.4.2.2 The net foreign assets

Transactions between residents of South Africa and non-residents alter money supply if they change the net gold and foreign exchange reserves of the country. Changes in the net gold and other foreign exchange reserves are brought about by current account transactions as well as capital flows not related to reserves. If a resident receives foreign exchange from exports, transfers or an inflow of capital, these have to be declared and delivered to a registered authorised exchange dealer in accordance to statutory Exchange Control Rulings. These funds are then converted into rands and deposited in the accounts of the residents. The outcome of these transactions is an increase in money supply resulting from higher net gold and other foreign exchange reserves. Similarly, a payment

for goods imported, transfers or an outflow of capital causes a decline in money supply (Meijer et al, 1991: 61).

The holdings of foreign assets by the monetary sector ($NGFOR_{sa}$) therefore reflect the accumulated total of previous surpluses or deficits on the current account of the balance of payments plus the accumulated net inflow of capital from the rest of the world. It is through this variable that South Africa's interaction with the rest of the world makes itself felt on the domestic monetary conditions. For the model's purposes the surplus or deficit on current account ($CABOP_{sa}$) of the balance of payments will be determined by the interaction of the structural relationships of the main model, i.e. the balance on current account is largely determined by forces endogenous to the model.

On balance, the net capital movements ($CAPM_{sa}$) are seen to be determined essentially outside the identified structure of the model. The change in the level of net gold and foreign exchange reserves equals the sum of the surplus or deficit on the current account of the balance of payments and the net outflow or inflow of capital to or from the rest of the world.

Compared to the change in the M3 monetary aggregate, the change in the net gold and other foreign reserves is relatively small. However, this should not detract from the important role of the net gold and other foreign reserves in shaping decisions on monetary policy. The quarterly model offers no distinction between the long-term and short-term external capital movements.

The equation summarising the changes in the M3 monetary aggregate is as follows:

$$\Delta M3 = \Delta MC_{govt} + \Delta MC_{priv} + \Delta LARBO_{sa} + \Delta NGFOR_{sa}$$

and where :

$$\Delta NGFOR_{sa} = CAPM_{sa} + CABOP_{sa}$$

The role and composition of the net gold and other foreign assets in the model warrants further explanation; these will be elaborated on in section 6.4.3. on page 180 of this study.

6.4.2.3 The net other assets of the monetary sector

The change in the net other assets of the monetary sector constitutes the change in net other assets held by the South African Reserve Bank and the rest of the monetary sector ($LARBO_{sa}$). All other assets are reduced by the residual liabilities that do not appear elsewhere in the money identity to form net "other" assets (Meijer et al, 1991: 49). In the monetary model, it is determined as the residual item once the changes in the claims by the monetary sector on the government sector (MC_{govt}), the net gold and other foreign reserves ($NGFOR_{sa}$) and the claims of the monetary sector on the private sector (MC_{priv}) have been deducted from the changes in the M3 money supply.

The change in the net other assets of the monetary institutions is also highly variable. In the long run, it is relatively small in relation to the overall change in M3 and can be seen as being determined outside the endogenous interrelationships of the monetary model.

The change in net other assets of the monetary sector is derived in the model as a balancing item in the following way (for ex post simulation purposes) :

$$\Delta LARBO_{sa} = \Delta M3 - \Delta MC_{govt} - \Delta MC_{priv} - CAPM_{sa} - CABOP_{sa}$$

6.4.2.4 Claims of the monetary sector on the private sector

The prime purpose of monetary institutions, like other financial intermediaries, is to serve as a channel for funds from surplus to deficit sectors. The unique characteristic of monetary institutions is that they can create money in this process. This was discovered centuries ago when banks initially acted as middlemen and made profits by accepting gold and coins brought to them for safekeeping and lending them to borrowers. These banks soon discovered that the receipts that were issued to depositors were being used as a means of payment, and they realised that they could make loans by merely giving borrowers their promises to pay (banknotes). Moreover, more banknotes could be issued than the gold held in deposits, because only a portion of the outstanding banknotes would be presented for payment at any one time. Private monetary institutions could therefore create money by merely granting overdrafts or loans to customers. This essentially means that in the absence of legal reserve requirements, bank's could build up deposits by increasing their loans and investments, i.e. as long as they physically hold enough liquidity to provide for the needs of depositors who wish to convert their deposits into hard currency (Meijer et al, 1991: 56)

The claims of the monetary institutions on the private sector constitute mortgage advances, instalment sale credit, overdrafts, leasing finance, credit card and other loans and advances extended to both the households and businesses. Holdings of private-sector debt paper by the monetary institutions are also included. These holdings consist of bills discounted and investments in the form of promissory notes, bankers' acceptances and debentures.

Of all the credit facilities available to private sector households, mortgage advances consistently remain the most important type of credit, as more and more individuals continually revert to this form of credit for not only the exclusive financing of residences, but also for the purchase of durable consumer goods and other consumer articles. Although business enterprises do use mortgage facilities, the other loans and advances, instalment

sale credit and overdrafts are apparently the most popular credit instruments that the business community employs.

The magnitude of the credit extended to the private sector suggests that it is by far the most important of all the statistical accounting counterparts of M3, and that this trend has grown over time. Since 1985 it has shown a consistent rising growth pattern in relation to the broad M3 money supply, and by the end of the 1990's these claims were roughly 18 per cent above the level of the M3 money supply. As this constitutes an asset on consolidated balance sheet of the monetary sector, it signifies that the net other assets and liabilities and the cumulative flows of net foreign assets should show a corresponding negative balance. This was supported by the fact that net other assets continually showed a rising trend in negative balances so that by the third quarter of 1999, other liabilities exceeded other assets by as much as R85 billion (SARB, 1999: S-24).

The theory postulated in the demand for credit function defines the long-run real demand for credit from the monetary sector by the domestic private sector as being explained by a real income variable, an interest rate differential to capture the effects of dis- and re-intermediation, and the long-term level of the nominal prime rate. The short-run dynamics of the error correction model also allows for the expectations costs associated with high or rising rates of inflation. Expectations of rising inflation leads to the general belief that domestic interest rates will need to be increased shortly in order to combat these threatening inflationary pressures (i.e. especially in an inflation targeting environment).

The stochastic behavioural relationship accordingly consists of the following variables:

- a variable representing real aggregate private-sector demand (Y_{pdm}) which is defined as the sum of the real private consumption expenditure and real gross domestic fixed investment expenditure ;
- the level of the current and lagged bank's prime overdraft rate (R_{por}) which captures the direct costs involved when making use of any of the available credit facilities;

- a dis-intermediation or re-intermediation variable in the form of the differential rate of interest between the prime overdraft rate and the combined yield on interest-bearing deposits ($R_{por} - R_{trn}$).
- an expectations cost variable associated with rising inflation (\dot{P}).

A priori reasoning leads to the assumption that the algebraic sign of the estimated coefficient of the level of the prime overdraft rate should be negative, i.e. the actions of individuals in making use of credit facilities is to a large degree dependent on the prevailing level and longer-term trend of the banks' prime overdraft rate (R_{por}). It is for this reason that the current level and previous level of the prime overdraft rate has been incorporated in the behavioural equation depicting the demand for money by the private sector. Efforts to include the perverse effect of the short-term costs of loans in the function proved inconclusive as the statistical significance test of this explanatory variable failed to justify its inclusion in the model. This perverse effect incorporates the first-period impact of a change in the interest rate which may well be in the same direction as the change in the interest rate itself, and offers a possible explanation for the behaviour of individuals and business enterprises whose first response to an interest rate rise may be to increase their use of credit facilities rather than to sacrifice their standard of living and current expenditure patterns.

As in the case for the M3 money supply, dis-intermediation and re-intermediation have a profound effect on the claims of the monetary sector on the domestic private sector. Once the gap between the lending and borrowing rate starts to widen, businesses and individuals will tend to rather shift their demand for formal bank credit to the informal market, i.e. their financial needs will not be satisfied by a financial intermediary whose assets and liabilities are incorporated in the consolidated balance sheet of the monetary sector. Dis/re-intermediation ultimately affect both the asset and liability structure of the monetary sector to the same extent. This necessarily implies that the elasticity of the differential variable on the asset side should be fairly similar to that shown on the deposit or liability side. In other

words, it should be fairly close the elasticity defined in the M3 money supply.

The inflation rate variable in the demand for credit function, is perhaps somewhat ambiguous in that in some instances rising inflation may cause individuals to make use of credit now to purchase products that they know will cost more in future. However, due to the fact that interest rates respond, and will respond far quicker to inflationary pressures in future (especially under an inflation targeting environment), it seems plausible to incorporate this expectancy cost as an explanatory variable in the demand for credit function. The statistical significance of the variable in the regression analysis offers further conclusive support to this hypothesis.

Regression 6 :

Dependent Variable: $DLOG(MC_{priv} / P_{cpi})$

Method: Least Squares

Date: 02/02/00 Time: 13:58

Sample: 1988:1 1999:3

Included observations: 47

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|------------------------------------|-------------|-----------------------|-------------|-----------|
| $LOG(MC_{priv}(-1) / P_{cpi}(-1))$ | -0.148129 | 0.069772 | -2.123039 | 0.0400 |
| $LOG(Y_{pdm}(-1))$ | 0.377734 | 0.096659 | 3.907914 | 0.0004 |
| $(R_{por}(-1) + R_{por}(-2)) / 2$ | -0.003347 | 0.001110 | -3.016678 | 0.0044 |
| $R_{por}(-1) - R_{trn}(-1)$ | -0.005077 | 0.002285 | -2.221800 | 0.0320 |
| C | -2.408107 | 0.382445 | -6.296612 | 0.0000 |
| $D(\dot{P})$ | -0.004828 | 0.001412 | -3.419599 | 0.0015 |
| $D(R_{por})$ | -0.003106 | 0.002010 | -1.545576 | 0.1301 |
| R-squared | 0.619656 | Mean dependent var | | 0.012502 |
| Adjusted R-squared | 0.562604 | S.D. dependent var | | 0.016993 |
| S.E. of regression | 0.011239 | Akaike info criterion | | -6.002314 |
| Sum squared resid | 0.005052 | Schwarz criterion | | -5.726760 |
| Log likelihood | 148.0544 | F-statistic | | 10.86132 |
| Durbin-Watson stat | 1.992376 | Prob(F-statistic) | | 0.000000 |

NB : The order of integration of the variables used in the regression are illustrated in Appendix 2 at the back of this study.

The long-run static elasticities of the estimated equation indicate that the demand for bank credit in the private sector has an elasticity regarding private-sector aggregate spending in excess of unity at 2,5 (i.e. $(0,377/0,148)$). This indicates that a one per cent change in private-sector aggregate demand will bring about a more than double the impact change in the demand for bank credit in the private sector. Real claims of the banking sector on the domestic private sector grew at 4,7 per cent per year over the sample period, while real income grew at slightly over 2 per cent per year which could account for the high elasticity of claims to real income.

What is even more phenomenal is that real claims grew at almost 7,3 per cent per year during the post election period since 1994, while real income grew at roughly 3 per cent over the same period. This most probably accounts for the high income elasticity as shown by the regression analysis, despite the sample period starting from 1988. The fact that real claims grew so radically during the post election period could be ascribed to the fact that many individuals who were previously excluded from domestic formal bank financing could now turn to the banking sector and gain access to these credit facilities. This strong growth rate in the real claims could warrant the inclusion of a dummy for the post election era. However, it was found that the parameters and significance tests of the explanatory variables became distorted while the income elasticity remained fairly much the same as the elasticity when the dummy is excluded. It was hence decided to rather exclude the dummy variable from the long-run dynamics of the system and let the data ultimately determine its long-run parameters.

The interest rate semi-elasticity with regard to the dis/re-intermediation variable between lending and deposit rates is estimated at 3,38, and is calculated as the ratio of this interest rate differential to the lagged dependent variable for real claims on the private sector $((0,005*100)/0,148)$. For obvious reasons, the estimated parameter for the differential interest rate will first have to be multiplied by 100 as it represents an interest rate in the logarithmic function. In order to normalise this semi-elasticity to represent the true long-run

elasticity of the differential to the real claims, it will have to be multiplied by the assumed interest rate differential (roughly 4,2 per cent) over the sample period. This eventuates in a fairly low long-run elasticity of slightly under 0,15 for the real claims with respect to the interest rate differential. As the differential interest rate affects both the asset and liability side of the consolidated balance sheet of the monetary sector to the same extent, this elasticity should essentially be the same as that of the M3 money supply on the liabilities side. At just under 0,15 it is fairly close to the 0,18 elasticity that has been estimated for the same variable in the real money demand function and as they are both fairly small, it was decided that it is not necessary to restrict this variable to 0,18 in the real demand for credit function.

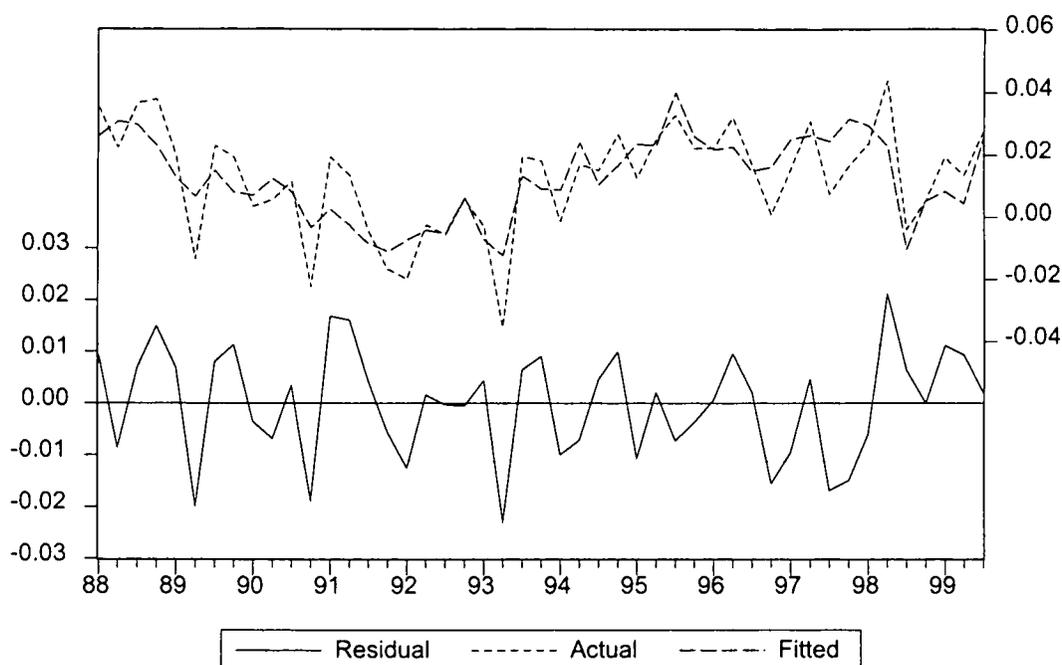
In a similar fashion, the semi-elasticity of the level of the prime overdraft rate is estimated at 2,2 $((0,0033*100)/0,148)$. On first inspection, it would seem as if real claims are less sensitive to the level of the prime overdraft rate than they are to the re/dis-intermediation variable. Once this rate is normalised to represent the true elasticity to a change in lending rates it becomes apparent that quite the opposite is true. The assumed level of the prime overdraft lending rate over the sample period amounts to 18,7 per cent, which when multiplied by the semi-elasticity of 2,2 it yields an elasticity of 0,41 which is more than double the elasticity estimated for the differential between the lending and deposit rates in the regression analysis. This elasticity also proves that the level of the lending rate is indeed significant and does have an impact on the individual's desire to make use of credit facilities. However, the high income elasticity for the demand for credit still means that the interest rate impact on real income is most probably the major effect influencing the individual's demand for bank credit.

Provision is made for both the level of the prime lending rate and the inflation rate in the short-run dynamics of the equation. The behavioural relationship suggests that real claims on the private sector would change by a semi-elasticity of 0,3 $(0,0031*100)$ per cent to a change in the prime lending rate, and by 0,5 $(0,0048*100)$ per cent to a change in the

inflation rate over the immediate short-term .

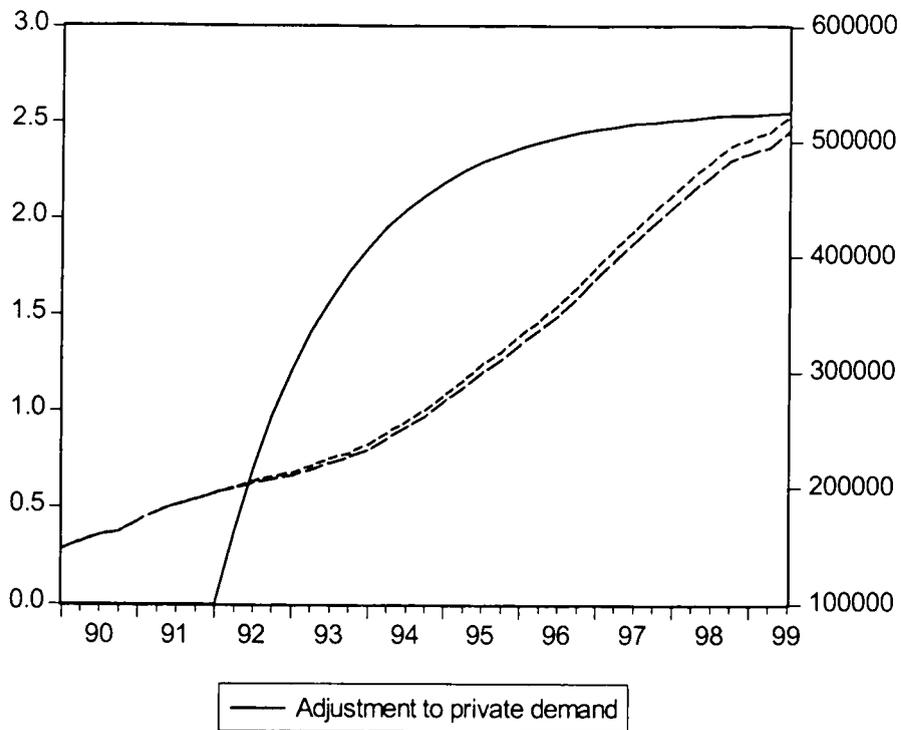
The single-step error correction model as shown in regression 6 indicates a high correlation coefficient of nearly 60% which is a fairly good fit for a logarithmic function in first differences. The close relationship between the actual and fitted lines of the equation are illustrated in the graph shown in figure 23 below.

Figure 23 : Claims of the banking sector on the private sector (actual and fitted)



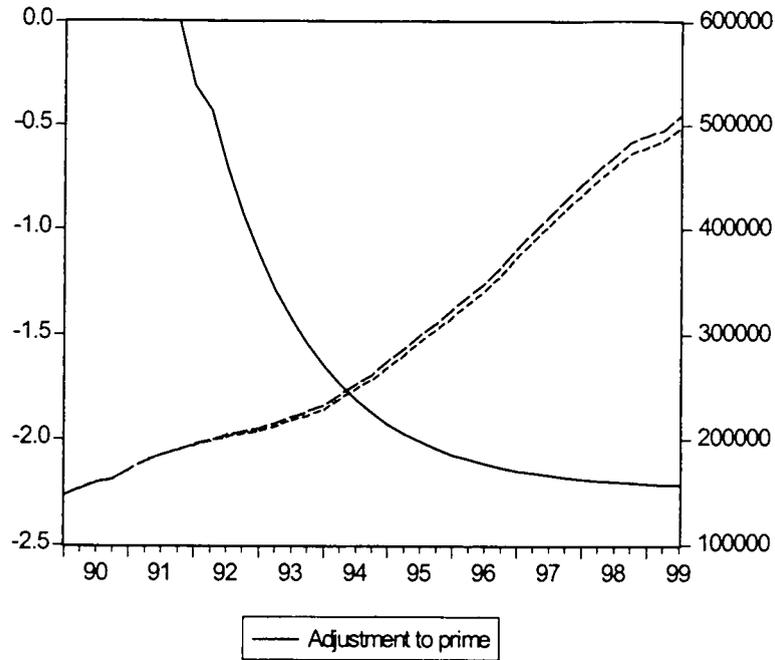
The results of the structural equation indicate that income is obviously the most important explanatory variable determining the individual's demand for credit. The transmission mechanism is hence of vital importance, and it seems plausible to determine how fast these income effects affect the claims on the domestic private sector. The following graph illustrates the time trend and speed of convergence of the trend in real claims to a sustained hypothetical 1 per cent increase in the real income variable.

Figure 24 : The speed of adjustment to private demand



The graph in figure 24 shows that without the short-run dynamic impacts, the income effects are fairly slow to adjust to its long-run equilibrium of approximately 2,5 as calculated by the parameters in the regression analysis. After 4 quarters, nearly 48 per cent of its adjustment would have been realised, while at the end of the 12th quarter approximately 86 per cent would of the adjustment would have worked through. The pass-through of the income variable to the real claims on the private sector seems a little quicker than the pass-through of income to the real money supply, which seems to suggest that real money supply is less sensitive to a change in income than the demand for real claims.

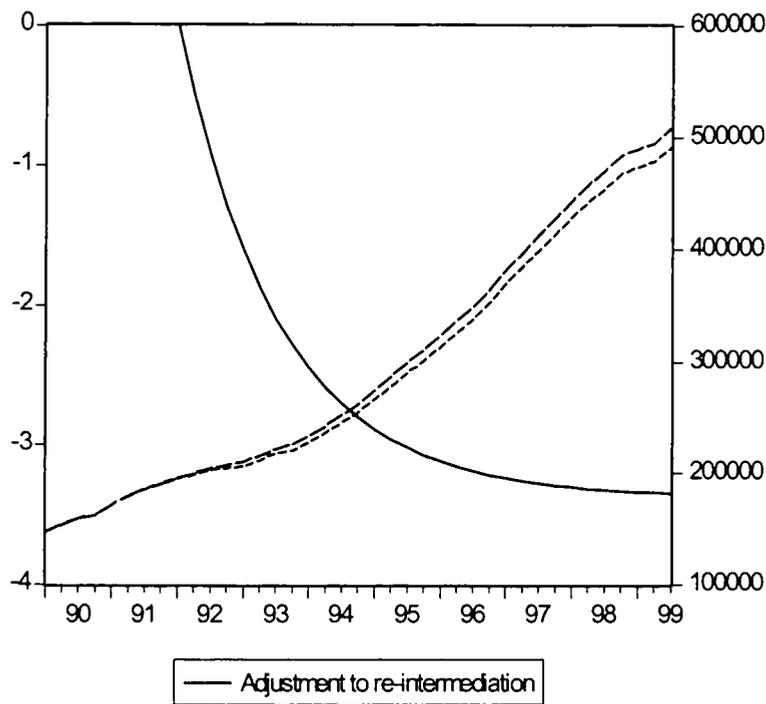
Figure 25 : The speed of adjustment to the prime lending rate



Rising prime overdraft lending rates can be seen as an important restraint in the individual's demand for credit. Figure 25 suggests that the combined long-run and short-run pass-through of the lending rate to the real claims on the private sector is fairly quick over the first four quarters, i.e. slightly over 50 per cent of its long-run equilibrium level of -2,2 would be realised during the very first year in which lending rates were hypothetically raised with 1 per cent. However, it takes a further two years to gain a further 36 per cent (i.e. to 86%) of its long-run equilibrium level, which seems to suggest that the initial impact is fairly strong, but that it then only gradually tends to taper off to long-run equilibrium state with the progress of time. The slight kink in the graph during the very first quarter (i.e. to -0,3) illustrates the initial short-run dynamics of equation to the 1 per cent change in lending rates, and confirms the short run impact as calculated in the regression analysis.

The shock to the re/dis-intermediation variable in figure 26 seems to suggest a somewhat similar trend to the change in the prime lending rate, despite the semi-elasticity being somewhat higher than the semi-elasticity for prime. The long-run equilibrium level for the interest rate differential amounts to approximately 3,4, and slightly less than 50 per cent of this would be realised within the first four quarters of the shock to the variable. The graph above shows furthermore that nearly 86 per cent of the pass-through would be realised by the end of the 12th quarter.

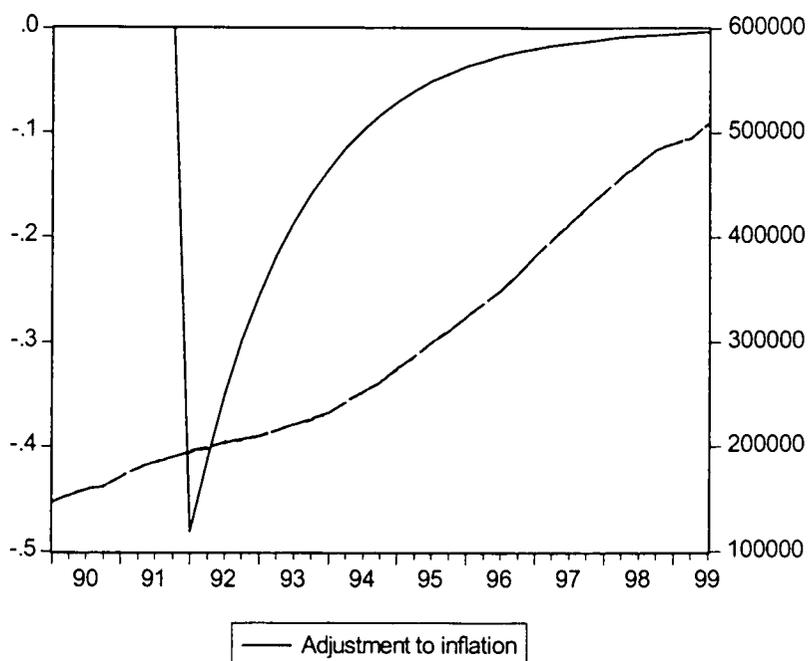
Figure 26 : The speed of adjustment to the re-intermediation variable



The annual rate of inflation is used as an indication for the expectancy of higher interest rates and is only used in the short-run dynamics of the equation. This suggests that the initial impact is extremely quick, but that it then dies out with the progress of time. Figure 27 shown above suitably illustrates this impact and the speed of convergence for the real claims to return to its normal growth path after the shock. The speed of convergence is

quick, and slightly less than 15 per cent of the initial impact would still be seen after the 12th quarter.

Figure 27 : The speed of adjustment to inflation



The following table shows the rate of convergence of the explanatory variables of the regression analysis.

Table 7 : The speed of convergence for the claims of the banking sector on the private sector

| Adjustment after : | Private Demand | | Prime Lending Rate | | Re-intermediation | | Inflation | |
|--------------------|----------------|-----|--------------------|-----|-------------------|-----|-----------|------|
| | (value) | (%) | (value) | (%) | (value) | (%) | (value) | (%) |
| 1 Quarter | 0,00 | 0% | -0,31 | 14% | 0,00 | 0% | -0,48 | 100% |
| 4 Quarters | 1,21 | 48% | -1,12 | 51% | -1,61 | 48% | -0,25 | 52% |
| 8 Quarters | 1,85 | 73% | -1,65 | 74% | -2,45 | 73% | -0,13 | 27% |
| 12 Quarters | 2,19 | 86% | -1,93 | 87% | -2,88 | 86% | -0,07 | 15% |

6.4.3. The net and gross gold and other foreign reserves

The balance of payments is a systematic record of the economic transactions of residents of a country during a given period with residents of the rest of the world. It is therefore a systematic double entry accounting statement in that for every credit entry, there has to be a corresponding debit entry. The transactions entering the balance of payments are classified in broad categories such as merchandise exports and imports, service payments and receipts, net capital transfers, capital flows and changes in the net gold and other foreign exchange reserves.

In order to analyse the balance of payments position, the items of the balance of payments are divided between those "above the line" (which make up the surplus or deficit) and those "below the line" (which represent the financing of the positive or negative balance). The surplus or deficit therefore refers to a selection of transactions as does the change in the net gold and other foreign exchange reserves, or as it is also called the balance of official settlements. The main purpose of the balance is to exclude compensatory borrowing (i.e. borrowing to support the level of gold and other foreign reserves from above the line) so that a balance is obtained that truly reflects the pure balance of payments transactions on the country's gold and other foreign exchange reserves (Meijer et al., 1991 : 250)

Changes in the net gold and foreign exchange reserves can therefore be calculated as the sum of the exports of goods and services less the imports of goods and services, plus the net long-term capital inflow and net short-term capital inflow (not related to reserves). Alternatively it can be calculated by subtracting from the changes in the gross gold and other foreign reserves, the changes in the liabilities that are related to these reserves (i.e. compensatory financing) and valuation adjustments (Meijer et al., 1991: 251).

Since the middle of 1999 the financial account which roughly comprises all the transactions in the former capital account has been implemented. This primary classification is by

functional category or type of investment (direct investment, portfolio investment and other investment) and not by the previous net long-term and net short-term capital inflows. For analytical purposes, the components of investment are all classified according to the institutional sector classification of the resident creditor or debtor (monetary authorities, public authorities, public corporations, the banking sector and the private non-banking sector) (Walters, 1999: 56).

In the monetary model, the change in the net gold and foreign reserves is determined as the sum of the exports of goods and services (including gold) minus the imports of goods and services, plus the net long-term and short-term capital inflows which are not related to reserves (as of June 1999 the capital account has become the financial account so it hence refers to direct, portfolio and other investment). The change in the net gold and other foreign reserves owing to the balance of payments transactions can therefore be determined by adding the current account of the balance of payments to the total capital movements:

$$\Delta NGFOR_{nsa} = CABOP_{nsa} + CAPM_{nsa}$$

where:

$NGFOR_{nsa}$ = *change in the net gold and foreign reserves owing to balance of payments transactions, not seasonally adjusted;*

$CABOP_{nsa}$ = *current account of the balance of payments, not seasonally adjusted;*
and

$CAPM_{nsa}$ = *total long-term and short-term capital movements, not seasonally adjusted.*

Once the change in the net gold and foreign reserves ($NGFOR_{nsa}$) has been determined, the change in the gross gold and foreign reserves can be calculated by adding the change in the liabilities related to reserves (LRR_{nsa}), and the allocation of Special Drawing Rights (SDR) and valuation adjustments ($VASDR_{nsa}$) to the change in the net gold and other foreign

reserves.

The identity for determining the change in the gross gold and other reserves can hence be written the follows:

$$\Delta GGFOR_{nsa} = \Delta NGFOR_{nsa} + \Delta LRR_{nsa} + \Delta VASDR_{nsa}$$

6.4.4. Interest rates

The monetary sub-model is designed to evaluate the effects of monetary policy through changes in the short-term interest rate, as well as sectoral money supply and demand behaviour. For this reason, real aggregate demand (income) and prices have been included in the model as endogenous variables, while the exogenous variables (such as the interest rate) comprise the policy variables that can be adjusted to determine the effects and impacts of alternative monetary policy measures. In so doing, the structural characteristics of the monetary model are suitably enhanced.

The interest rate structure of the quarterly econometric model provides for both the short-term money market and long-term capital market interest rates. Variations in the short-term interest rates primarily reflect money market conditions as determined by the South African Reserve Bank repo rate, whereas capital market rates reflect the supply of and demand for loanable funds, inflation expectations and the prevailing money market circumstances.

6.4.4.1 Short-term or money market interest rates

Bank rate/repo rate

The South African Reserve Bank originally opted for what is called the "classical cash reserve system", which is essentially a demand-determined system in which the Bank is

willing to refinance the money market shortage fully and automatically on certain predetermined terms, conditions and costs (i.e. to accommodate the banks' demand for funds at the discount window). The Reserve Bank regulates the growth in money supply and bank credit by influencing the public's demand for money and credit rather than the banking institutions' ability to meet the demand (Meijer et al, 1991: 47). This system of accommodation is characterised by bank rate, which refers to the operational variable at which the Reserve Bank provides overnight loans (funds) to banks registered in terms of the Banks Act, 1990. Financial assistance is extended against the collateral of certain financial assets at the discount window. These eligible assets consist of treasury bills, Land Bank bills, central government stock, and Reserve Bank bills with an outstanding maturity of less than 92 days (Van der Merwe, 1997: 3).

Stals (1998) states that the task of the Reserve Bank is to protect the value of the South African currency, and in order to achieve this objective, the Bank has adopted an eclectic approach to monetary policy in which recognition is formally given to a medium- to longer-term stance of monetary policy (Stals, 1998: 36). Under this approach, the Bank must (through the active management of overall liquidity), strive to maintain appropriate monetary conditions that will support the desired growth rate in the money supply. Various instruments can be used for this purpose, and as of the 9th March 1998, the Bank has introduced a more flexible accommodation procedure. From this date, banks will be offered the opportunity to tender on a daily basis for a fixed amount of central bank funds through repurchase transactions, and accordingly be given more scope to manage their liquidity positions effectively. The information made available by the Reserve Bank at the daily tender, will signal the policy intentions of the central bank to the market in a more transparent way (Stals, 1998: 39).

The objective of these new procedures is to create more flexibility, but not instability, in the determination of money market and other related interest rates in South Africa. It should also encourage banks to make more active use of surplus funds available within the banking

system, i.e. within the interbank market. In order to enable banks to meet an unforeseen shortage of liquidity in the daily settlement and to avoid excessive volatility in interest rates, the accommodation procedure has been adjusted further so that the discount window is replaced with a new marginal lending facility where overnight loans can be provided to banks at the penal marginal lending rate (Stals, 1998: 39).

The introduction of the repo rate can be seen as a substitute to bank rate, and refers to the rate at which banks regularly tender for central bank funds through repurchase transactions, i.e. by temporarily selling securities to the Reserve Bank. Repo's have accordingly become known as the primary apparatus, or refinancing instrument, in the management of the banking sector's liquidity positions and requirements.

Changes in the repo rate therefore have an impact on other market rates as this is seen as a clear signal of future movement in domestic interest rates. It is hence regarded as a highly responsive tool which is capable of reflecting the easing or tightening of monetary conditions in the money market. The system of repurchase transactions has the added advantage that it can be used by the central bank to signal its intentions to the market in a flexible and transparent way. In addition, counter-parties or participants in the new system can now also send more reliable signals to the Reserve Bank concerning their perceptions of the underlying financial market conditions. Repo's can furthermore be concluded frequently and in any quantity, and can be applied as a useful method to stabilise liquidity and domestic short-term interest rates (Van der Merwe, 1997: 21).

Consequently the minimum rate for Reserve Bank accommodation - bank rate up to 8 March 1998 and after that, the repo rate - constitutes the most important operational variable in the execution and implementation of monetary policy in the monetary model¹⁷.

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It should, however, be noted that throughout the remainder of this study, the term "**bank rate**" will henceforth be used to represent the "**minimum rate charged for accommodation**" by the South African Reserve Bank.

Ideally the model should include a "*policy-reaction function*" for the determination of the repo/bank rate. Such a policy-reaction would summarise in a single behavioural equation the decision rules adhered to when changes to the repo/bank rate are considered. For the purposes of this study, the rate of accommodation is seen as an exogenously determined policy variable. However, due to the major importance of the repo rate in the model, some alternative simulations to be performed later on in the study which will allow for changes in repo to respond to changes in some of the endogenous variables of the macro-econometric model.

The treasury bill tender rate

The treasury bills (TB's) considered in this instance are short-term government securities with an initial maturity of 91 days. TB's and government bonds are issued mainly to fund the budget deficit and current government expenditures. They are also issued to fund (finance) maturing issues, i.e. for rollover finance to obtain funds to pay for maturing paper. TB interest rates are benchmark indicators of money market conditions and act as a reference rate for the calculation of interest rates on all other money market instruments (SARB, 1999: 4).

The Department of Finance determines the annual amount of TB's to be issued and this figure is announced during the release of the budget. The Reserve Bank has a programme designed to determine the size of the weekly TB issue in order to fill the budgeted amount. The amount of TB's on offer is released via the Reuters information system at 14:00 on the Thursday before the tender takes place. The weekly tender for TB's is conducted by the Bank on behalf of the treasury. When first issued they are sold in the primary market. A liquid secondary market for TB's also exists where market dealers can trade the financial asset (SARB, 1999: 5).

The tendering procedure is based on an American tendering system where each bidder is

allotted TB's according to his specific bid price(s). In the alternative to this type of system, namely the Dutch system, all offered tenders are allotted TB's according to the average of the entire tenders bid prices (i.e. one price for all). In this respect tendering procedures differ from country to country, but in South Africa the American system is generally preferred by market participants. Interested parties are invited by the Bank to submit tenders each Friday of not less than R100 000 (which is the minimum tender amount) for the number of TB's on offer. The tender they submit should reach any branch of the Reserve Bank prior to 10:00 on the Friday. The TB's are allocated to the highest bidders in descending order until the amount of bills on offer is exhausted, due to the fact that the highest bid price represents the lowest amount of interest redeemable from government (SARB, 1999: 6).

The monetary sub-model makes provision for the repo rate to be the operational rate at which accommodation is provided by the South African Reserve Bank against collateral of treasury bills. This means that the TB rate tends to gravitate towards the repo rate.

In the context of the monetary model, the treasury bill tender rate (which is a money market interest rate) reacts to the full extent of the change in repo rate, so that it yields the following relationship :

$$R_{ttr} = R_{rep} + res_{ttr}$$

Where

R_{ttr} = Treasury bill tender rate;

R_{rep} = repo rate; and

$res_{ttr} = R_{ttr} - R_{rep}$ for ex post simulation purposes.

Under normal market conditions the treasury bill tender rate tends to be lower than bank rate, *inter alia* because the tender rate is a discount rate. The discount rate, called the treasury bill tender rate, is higher when translated to a yield basis, while bank rate is already a yield rate, and has been a yield rate ever since 1993. A positive margin can however be

tolerated for a short time as long as the gap between the treasury bill tender rate and bank rate remains relatively small. If this positive gap increases excessively, banks would be able to borrow at bank rate from the Reserve Bank and invest at a higher rate in the money market, i.e. the so-called "round tripping" phenomenon.

The three-month bankers' acceptance rate

A bankers acceptance (BA) is a bill of exchange that is drawn on and accepted by a bank. The BA is established in terms of a letter of credit (LoC) to meet the specific short-term financing needs of a business enterprise regarding the movement of goods in domestic trade. It is therefore seen as an unconditional order in writing, addressed by a company (drawer) to a bank (drawee), requiring the bank to pay, at a fixed or determinable future date, a sum of money to the holder of the BA (SARB, 1999: 19). The BA is discounted in the market for the borrower's benefit and is honoured by the bank on the due date with funds that have been provided for by the borrower. This BA can also be traded in the secondary market.

The BA originates from a bill of exchange, and is a credit instrument designed to finance the shipment and/or storage of merchandise by manufacturers. This bill of exchange is defined as an unconditional order in writing, addressed by one person to another, signed by the person giving it, requiring the person to whom it is addressed, to pay a stated amount on demand at a given future period (SARB, 1999: 20).

The bank endorsing a BA receives a commission from the borrower. The first step in the process leading to the creation of the BA is that the accepting bank has to be satisfied with the financial standing (creditworthiness) of the client applying for credit. Once satisfied, the bank will issue a LoC, setting out the terms and conditions under which it is prepared to accept the bills drawn on it. The BA rate refers to the rate, for a particular day, at which institutional participants in the money market agree to discount BA's (i.e. the rate at which

domestic banks are willing to discount three month bankers' acceptances (91 day)), and is regarded as one of the most important indicators of prevailing short-term money market rates.

The general rule to maximise return is to buy the BA's at a high rate and sell at a low rate. This is usually quite difficult as the discount rate varies continually and reflects conditions in the money market. Usually a declining bankers' acceptance rate indicates an actual or expected easing of money market conditions. Conversely, tight money-market conditions are normally reflected in higher levels of the bankers' acceptance rate. However, over the longer term, the discount rate on bankers' acceptances of three-months shows a relatively close correlation to the repo rate.

Repo has hence been incorporated as the sole explanatory variable that influences a change in the three month bankers' acceptance rate. This yields the following identity:

$$R_{bar} = R_{rep} + res_{bar}$$

Where

R_{bar} = interest rate on three-month bankers' acceptance;

R_{rep} = repo rate; and

$res_{bar} = R_{bar} - R_{rep}$ for ex post simulation purposes.

During the earlier periods in which the rate of Reserve Bank accommodation was referred to as bank rate, the average gap between bank rate and the bankers' acceptance rate (res_{bar}) seemed to change markedly over time, i.e. having been quite high during the 1970's and the early 1980's. The gap then tapered off towards the end of the 1980's to yield a bankers' acceptance rate that was lower than bank rate during the first half of the 1990's. The larger gap observed during the 1970's and early 1980's can partly be attributed to accommodation procedures of the Reserve Bank, which at that time differed somewhat from

the current procedures¹⁸.

The gap between the three-months bankers' acceptance rate and bank rate therefore reflects the following three characteristics: first, the intrinsic risks associated with the issue of an acceptance to an applicant; secondly, the current expectations of the next movement in bank rate; and thirdly, the technical changes associated with the extension of accommodation at bank rate and the acceptability of bankers' acceptances as collateral for accommodation purposes and liquid asset requirements. Recently the gap between bank rate and the discount rate on bankers' acceptances has narrowed and is expected on average to tend towards zero, i.e. after converting the bankers' acceptance rate to a yield basis.

The banks' prime overdraft lending rate

The prime overdraft rate is probably the most significant interest rate in the money market and is defined as the lowest rate at which a bank will lend money to an individual or business enterprise in the form of an overdraft facility. In setting their prime overdraft lending rates, South African clearing banks have for many years observed certain conventional margins above the Bank's bank rate (now repo rate). Prime rates were accordingly set at 2½ per cent above bank rate between 1967 and 1975. Since July 1975, the Reserve Bank entered into a formal agreement with the clearing banks in terms of which the banks were to quote a prime rate only (defined as the lowest rate at which a clearing bank will lend on an overdraft). The prime rate was consequently set to be announced individually by each bank, at a level that would exceed bank rate by no less than 2½ per cent, and by no more than 3½ per cent (Meijer et al, 1991: 151).

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Up to 30 April 1993 bank rate was seen as the rediscount rate on treasury bills. Thereafter, bank rate referred to the accommodation rate for overnight loans against collateral of treasury bills, short-term government stock, Land Bank bills or Reserve Bank bills with an outstanding maturity of less than 92 days: (SARB(QB), March 1996 : S-26)

In the general climate of rapidly rising interest rates during the early 1980's, the banks were released from this undertaking to maintain their prime rates within specified upper and lower limits above bank rate with effect from 16th February 1982. The conventional, mechanically maintained link between the commercial bank key lending rate and the Bank's accommodation lending rate is useful if the Reserve Bank wishes to be assured of a quick and reliable effect of its own actions on the cost of credit in the financial markets. Meijer (1991) expressed reservations to the bank rate/prime rate convention in that even if it was only a loose one, it runs contrary to the spirit of a policy approach in which the movement of market interest rates are meant to inform the authorities of shifts in the supply-demand situation in the financial markets. This may prevent the prime rate from assuming its properly aligned position within the general structure of market interest rates and could foster dis-intermediation (Meijer et al., 1991: 152).

This is partly the reason why a new method of Reserve Bank accommodation was sought, and the introduction of repurchase transactions (the repo rate) was set to become the main refinancing instrument in the management of the banking sector's liquidity requirements. In his discussion paper on monetary policy operational procedures, Van der Merwe (1997) agrees with Meijer and aptly notes that the change in the repo rate (and hence prime lending rates) should also be far more responsive to changes in the underlying market system than the interest rates in the current system of Reserve Bank accommodation (Van der Merwe, 1997: 21).

With regard to the link between prime and the repo rate, Stals (1998) mentions in his statement in the June Quarterly Bulletin that the Reserve Bank believes that daily changes in the repo rate should not lead to volatility in the prime overdraft rate, and particularly, not in the mortgage lending rates of banks. Banks should in future find a new base for these rates which could perhaps be linked to a moving average of the repo rate. Lending rates of banks should be linked to the average effective cost of their total funds, and every bank

will remain free to quote lending rates at its own discretion, based on its own internal cost structures and policy objectives. It should be pointed out however, that healthy financial market competition normally leads to the convergence of interest rates for the same type of loans offered by individual institutions operating in a competitive environment (Stals, 1998: 39).

The monetary model assumes that the formal link between the Reserve Bank accommodation rate and the bank's prime lending rates remains intact, so that any changes in the repo rate are automatically reflected in the same magnitude change to domestic bank lending rates. The relationship between the repo/bank rate and the prime overdraft rate is summarised in the model as follows :

$$R_{por} = R_{rep} + res_{por}$$

Where

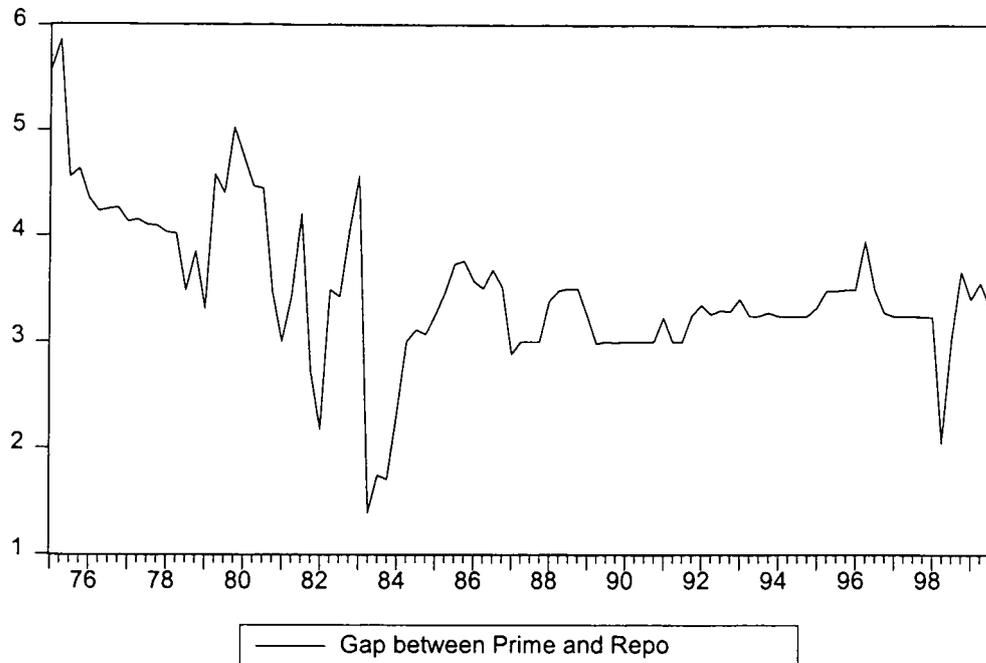
R_{por} = interest rate on prime overdraft facilities;

R_{rep} = the bank/repo rate; and

$res_{por} = R_{por} - R_{rep}$ for ex post simulation purposes.

The gap between bank/repo rate and the prime overdraft rate fluctuated fairly widely in the range between a high of 6,0 and a low of 1,5 percentage points until 1983. The pattern of this gap can also partly be attributed to the changing definition of bank rate. Figure 28 illustrated below shows that as from 1986 onwards, the gap has remained fairly stable in the 3,0 to 3,5 percentage point range.

Figure 28 : The gap between the prime lending rate and bank/repo rate



The model thus allows for the prime overdraft rate to always change in tandem with the bank/repo rate. Indirectly, through its relationship with the prime overdraft of the private banks, repo rate is able to play a pivotal role in the demand for credit, money growth and ultimately in the determination of the overall price level.

6.4.4.2 Short-term, medium-term and long-term deposit rates

A commercial bank is defined as a monetary institution that accepts deposits from any individual and/or business enterprise (i.e. the definition has recently been expanded to include various government organisations that hold deposits with these commercial banks as well). The depositor is entitled to withdraw these loaned funds by cheque at a later date. As profit-seekers commercial banks derive their profits from two major sources, namely , revenue from loan activities (i.e. the difference between income on the funds lent, and the cost of deposits), and secondly from commissions (i.e. fees recovered for financial services

rendered) (Fourie, L. et al, 1992: 68).

From this it is clear that banks accept deposits to primarily fund their loan activities. As the private banks are typical profit-maximising economic agents, there is good reason to expect that changes in the banks' lending rates will also be reflected in changes in the interest rates that banks are prepared to offer on their deposit liabilities. For this reason the prime overdraft rate has been incorporated as the single most important explanatory variable in determining the level of bankers' deposit rates.

The longer the maturity of any financial instrument, the higher the risk associated with investing in such an instrument. This necessarily means that longer term deposits should be compensated to a larger extent than their shorter term counterparts. These differences in risk profiles should be reflected in the interest rate structure of deposits with different maturities. Furthermore, because deposit interest rates usually respond to changes in the prime overdraft rate, it seems obvious to link the level of the banks' deposit rates to the level of their lending rates.

The following set of equations summarises the process of determining the levels of the interest rates that apply to various kinds of deposits:

$$R_{kkr} = R_{por} + res_{kkr}$$

Where

R_{kkr} = interest rate on short-term demand deposits (1 month);

R_{por} = interest rate on prime overdraft facilities; and

$$res_{kkr} = R_{kkr} - R_{por} .$$

$$R_{kmr} = R_{por} + res_{kmr}$$

Where

R_{kmr} = interest rate on medium-term deposits (6 months); and

$$res_{kmr} = R_{kmr} - R_{por} .$$

$$R_{klr} = R_{por} + res_{klr}$$

Where

R_{klr} = interest rate on long-term deposits (12 months); and

$$res_{klr} = R_{klr} - R_{por} .$$

The margins between the respective interest rates on different kinds of deposits and the prime overdraft rate, i.e. res_{kkr} , res_{kmr} and res_{klr} , tend to remain fairly constant over time. The constancy of these margins may be disturbed temporarily when the private banks have strong views on imminent changes in Bank rate and adjust their funding strategies in view of these expectations. It is conceivable that tighter or easier money market conditions may influence the margins to a significant degree, but money market sentiment is difficult to capture in the structure of the model and these margins are hence assumed to remain constant for "ex ante" simulation purposes.

6.4.4.3 Long-term or capital market interest rates

The capital market constitutes the long-term part of the financial system, acting as a source for funds with maturities of longer than three years (up to 5 years is generally regarded as short-term, between 5 and 10 years as medium-term and longer than that as long-term). The capital market can hence be seen as a complex system of institutions and mechanisms through which funds are pooled and made available to the private and public sectors (Fourie, L. et al, 1992: 130).

The capital market can be seen as the market for lending and borrowing long-term funds. In South Africa, the major issuers of securities in the primary capital market can be identified as the central government of South Africa, public corporations, public enterprises, local authorities and private companies. The main buyers of these securities include the Public

Investment Commissioners, insurance companies and pension funds. These same institutions are also active in the secondary market, but are supplemented by the banks, stockbrokers, the Reserve Bank (through its open market operations) and money brokers (Fourie, L. et al, 1992: 131).

The financial instruments traded in the capital market generally fall into four main categories, namely fixed-interest "gilt" securities (where the price of the bond fluctuates inversely to changes in the interest rate of the market), variable-interest securities, shares and long-term negotiable certificates of deposit. In South Africa, the public sector has embarked on issuing securities with variable interest rates by linking them either to the overdraft rate, the rate on long-term marketable Eskom stock or the 90-days bankers' acceptance rate (Fourie, L. et al., 1992: 134). Most long-term loans are subject to variable interest rates nowadays, particularly because the inflation rate (and therefore the real return for the investor) can fluctuate sharply¹⁹.

Most capital market instruments tend to move in unison over the long-term, so that the monetary sub-model need only incorporate the price formation process of one category of fixed-interest securities, namely the yield on Eskom stock. Mortgage loans remain essentially long-term, and the mortgage lending rate will be considered as a capital market rate in the South African Reserve Bank monetary sub-model (i.e. despite its strong link to money market rates in the form of the banks' prime overdraft rate).

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It is for this reason that the government mentioned (in the budget revue of 17th February 1999), the use of index-linked bonds. These variable interest securities would pay interest indexed to an appropriate measure of inflation. The issue of these index linked bonds resulted from the sharp increase in the cost of government debt due to the high rate of inflation and to minimise over the long-term the cost of meeting governments financing needs. Index linked bonds are furthermore designed to protect investors fully or partially from erosion by inflation of the principle and interest due on their bond investments (Venter, 1999: 69).

The yield on Eskom stock

In a market economy, the level of interest rates is ultimately determined by the demand for and supply of investable funds. Subsequent pressures exerted on the balance between this "demand for loanable funds" and the "supply of domestic savings" can either be alleviated or aggravated by cross-border capital flows. A net inflow of foreign capital, for example, will supplement domestic savings and alleviate the potential upward pressure on interest rates. Conversely, a net outflow of such capital will, in turn, erode the country's pool of savings and add to upward pressures on interest rates.

For virtually a decade, a combination of compulsory foreign debt repayments and politically motivated capital-flight resulted in a chronic net outflow of capital from South Africa. This net outflow seriously impeded capital formation in the economy. The domestic savings shortfall and the persistent outflow of capital put upward pressure on capital market rates, particularly since the latter half of 1985, and capital market rates moved well in excess of the contemporaneous rate of inflation. This meant that at least over the short-term, capital movements (CAPM) could be seen as a strong determining factor for the movement in long-term capital market interest rates. The capital flight seen towards the end of 1998 as a consequence of the global financial turmoil of that year, bears testimony to this fact in that the yield on Eskom stock rose with nearly 3½ percentage points within a matter of three months.

For estimating the price-formation process in the capital market, the supply-demand imbalance is approximated by the ratio of domestic saving to investment. Domestic saving (SAV) is defined as the sum of the personal, corporate and government saving, whereas domestic investment is defined as the level of nominal gross domestic fixed investment (INV).

Eskom was at times considered to be its own market-maker in that the yield on Eskom stock

was often influenced by the investment of internal funds in Eskom stock. This, in addition to disruptive occurrences such as domestic violence and political instability, significantly restricts the estimation of a consistent relationship between the yield on the long-term Eskom stock and other pertinent explanatory variables. This led to the incorporation of a dummy variable to expressly allow for the impact of such occurrences. The dummy variable explicitly provides for three distinct incidents which have been identified as having had a profound influence on the yield on Eskom stock. These are :

- the fourth quarter of 1985 which allows for the negative market sentiment arising from the debt standstill and the high occurrence of domestic violence;
- the second quarter of 1989 which marked the abolition of certain prescribed investment requirements that had been imposed on institutional investors;
- the market expectation of the removal of the financial rand mechanism as from the second quarter of 1994 to the first quarter of 1995; and
- the rapid increase in capital market rates associated with the global financial crises in the 3rd and 4th quarter of 1998.

The abolition of certain prescribed investment requirements for institutional investors warrants further explanation in that as from early May 1989, new regulations became effective which stipulated that pension funds and long-term and short-term insurers would henceforth no longer be required to hold a minimum percentage of their assets invested in public-sector securities. The general impact of these relief measures was to enable most of the institutions concerned, the opportunity to reduce their portfolios of public-sector securities, and to strengthen their holdings of fixed property and/or company shares. The termination of the captive market arrangements, and uncertainties about what the new restrictions would involve, contributed to an increase in public-sector stock trading activity in March and higher long-term stock yields during March and April of 1989 (SARB (AER), 1989: 49).

Market perceptions on inflation expectations and expectations of prospective changes in the policy stance of the monetary authorities also play a large role in the eventual price determination of capital-market yields. Effectively this means that, at least over the longer term, the repo rate also has the ability to influence the long-term yield on Eskom stock, i.e. by raising the short-end of a positive slope in the yield-curve (for example in a period of high inflation), inflation expectations can be duly thwarted so that the yield-curve becomes flat or even inverted (negatively sloped). The behavioural equation shown below illustrates that despite the strong link between inflation expectations and the rate of Reserve Bank accommodation, the repo rate was only found to be statistically significant in the short-run dynamics of the equation.

Capital market rates furthermore tend to reflect counter-active inflationary measures in short-term money market rates. This implies that money market interest rates also have the capacity to influence long-term yields in their efforts to reduce the threat of rising inflationary pressures emanating from factors such as a depreciating currency or rising oil prices for example. The close link between the exchange rate and inflation expectations means that the nominal effective exchange rate of the rand (NEXC) can be included in the function as a separate explanatory variable. Both the price expectations variable (\dot{P}_{exp}) and the exchange rate proved to be statistically significant, although the exchange rate was only found to be significant in the short-run dynamics of the equation.

The error correction cointegrated model that best defines the movement in long-term capital market rates is estimated and shown below. The static relationship or elasticity between price expectations and the level of the Eskom yield amounts to a value of 0,31 (i.e. from 0,041/0,127). This long-run relationship between the price expectations and the yield on Eskom stock indicates that for every one per cent increase in inflation expectations, roughly a third of the increase will be reflected in the yield on long-term capital stock. Eskom stock generally tends to reflect price expectations over the long-term, and this elasticity may be slightly on the low side.

Regression 7 :

Dependent Variable: $D(R_{esk})$

Method: Least Squares

Date: 02/22/00 Time: 18:10

Sample(adjusted): 1976:2 1999:3

Included observations: 94 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|--------------------------------|-------------|-----------------------|-------------|----------|
| $R_{esk}(-1)$ | -0.127035 | 0.041615 | -3.052643 | 0.0030 |
| $\dot{P}_{exp}(-1)$ | 0.040881 | 0.018329 | 2.230352 | 0.0284 |
| SAV(-2) / INV(-2) | -0.670510 | 0.478219 | -1.402097 | 0.1645 |
| DUMEVK | 1.118709 | 0.213172 | 5.247917 | 0.0000 |
| C | 1.462056 | 0.622540 | 2.348534 | 0.0212 |
| $D((SAV+CAPM) / INV)$ | -0.449459 | 0.340895 | -1.318466 | 0.1909 |
| $D(R_{rep})$ | 0.307400 | 0.058262 | 5.276185 | 0.0000 |
| $D(\dot{P}_{exp})$ | 0.186243 | 0.045713 | 4.074187 | 0.0001 |
| $D(((NEXC / NEXC(-1))-1)*100)$ | -0.019441 | 0.009712 | -2.001644 | 0.0485 |
| R-squared | 0.463352 | Mean dependent var | | 0.044468 |
| Adjusted R-squared | 0.412844 | S.D. dependent var | | 0.846910 |
| S.E. of regression | 0.648954 | Akaike info criterion | | 2.063937 |
| Sum squared resid | 35.79706 | Schwarz criterion | | 2.307444 |
| Log likelihood | -88.00506 | F-statistic | | 9.173826 |
| Durbin-Watson stat | 2.016071 | Prob(F-statistic) | | 0.000000 |

NB : The order of integration of the variables used in the regression are illustrated in Appendix 2 at the back of this study.

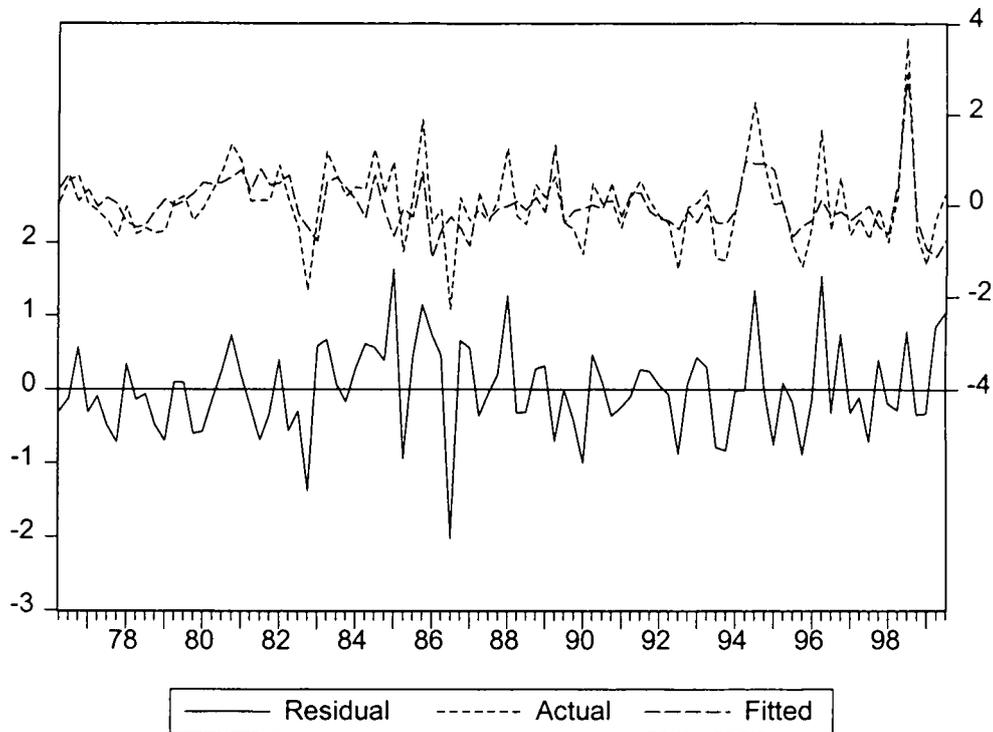
Liquidity in the market, whether it be initiated by a rising savings to investment differential or by increased capital movements also has a large role to play in the general movement of long-term capital market yields. The estimated equation suggests that the elasticity of the rate on Eskom stock to the savings differential amounts to 5,3 (i.e. from 0,671/0,127). However, this elasticity is fairly difficult to interpret as the savings differential (ratio) averages approximately 0,29 over the sample period, implying that savings comprise roughly a third of investment, while the yield on Eskom stock is seen as a rate in percentage points. In order to get an idea on the impact that this savings/investment ratio has on the yield on Eskom stock, the ratio was hypothetically raised with 10 per cent. The results of this

independent study suggest that Eskom rates can only be expected to change with approximately 0,1 per cent. This is low, considering the high implied elasticity, and could be attributed to the consistent low level of savings in South Africa, and the fact that the supply/demand differential is perhaps not the most important factor influencing the Eskom rate.

In a similar fashion, the short-run dynamics of the model imply that the movement in Eskom stock will be guided by the repo rate and the nominal exchange rate. The short run consequences of both these variables amount to 0,019 for the exchange rate and 0,307 for the repo rate. This furthermore indicates that for a one per cent change in repo, long-term capital market rates can be expected to move by 0,3 per cent over the immediate short-term, while the impact of the exchange rate is negligible. This relatively small elasticity for the exchange rate can be attributed to the inclusion of the financial crises dummy that partly negates the inflationary effect of the financial crises and the rapid depreciation of the rand.

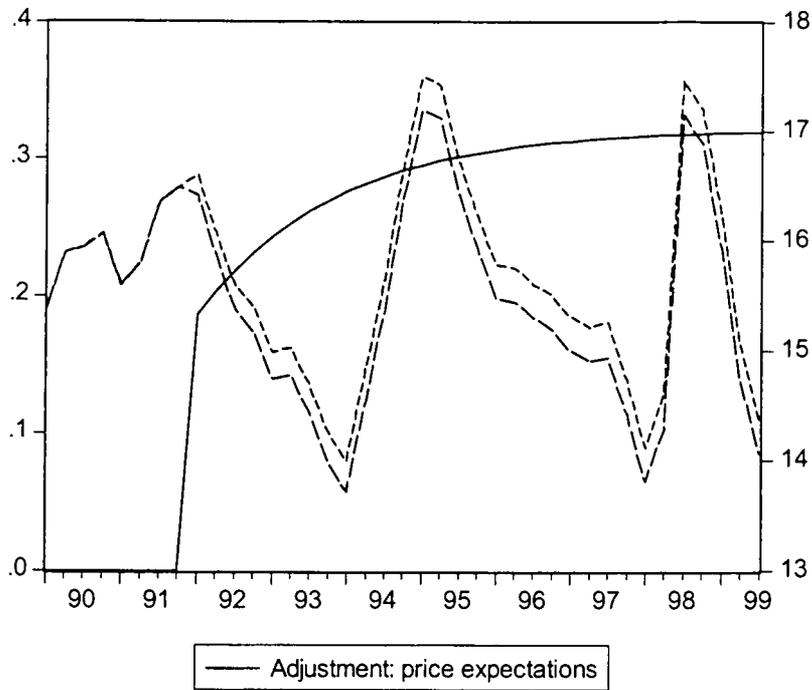
The single-step error correction model as shown above indicates a fairly high correlation coefficient of 0,46 per cent, which is suitable for an estimated regression in first differences. The fact that the lagged dependent variable is negative and statistically significant also suggests that these explanatory variables are indeed cointegrated. The graph depicting the relationship between the actual and fitted lines of the equation for Eskom stock are shown below in figure 29.

Figure 29 : Eskom stock (actual and fitted)



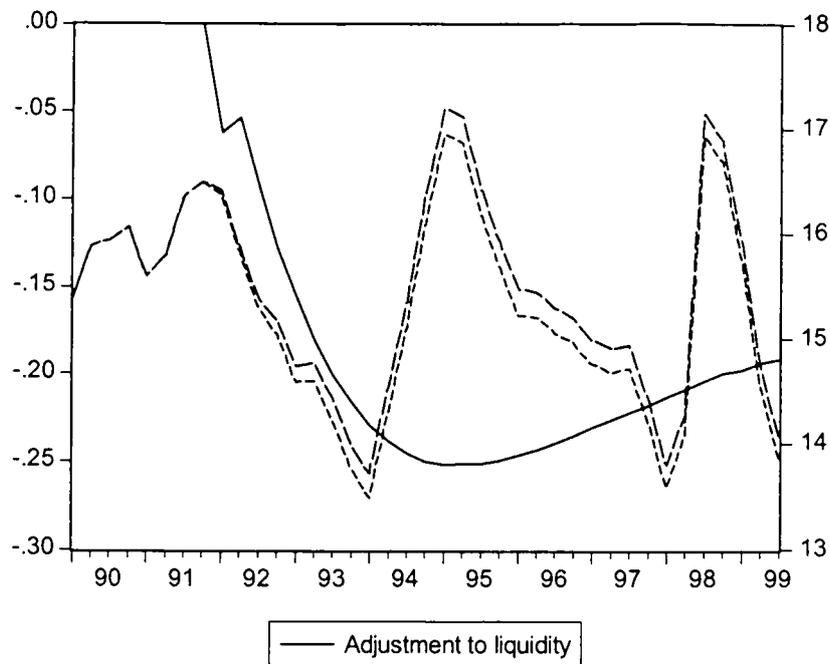
The results of the structural equation suggest that price expectations are fairly important in the determination of the rate on Eskom stock, and it hence becomes imperative to determine the long-run impact and speed of convergence to its long-run equilibrium level. To this end the price expectations variable has been hypothetically increased with a percentage point to see the impact on the capital market yield. The following graph in figure 30 suggests that by raising price expectations with 1 per cent, the long-run equilibrium of 0,32 is achieved fairly slowly, although the initial response is quick. The increase of the Eskom rate to slightly under 0,2 during the very first quarter is attributed to the short-run dynamics in which the elasticity of price expectations amounts 0,18. Hereafter, the rate of convergence to it's equilibrium state is fairly slow. The 0,3 long-run elasticity as depicted by the graph also confirms the elasticity calculated by means of the coefficients of the parameters of the model.

Figure 30 : The speed of adjustment to price expectations



Liquidity in the market, whether achieved by a raised level of savings in relation to investment, or by means of capital movements to South Africa can have the effect of lowering the rate on Eskom stock. In order to test this hypothesis by means of the estimated model, savings and capital movements were hypothetically increased with R1 billion. Figure 31 shown below suggests that with this increase in liquidity the yield on capital market rates can be expected to decline with nearly 0,25 per cent. This can be seen to constitute a fairly small impact when considering that the hypothetical R1 billion increase in savings and capital represents roughly 30 per cent of the level of the savings over the sample period.

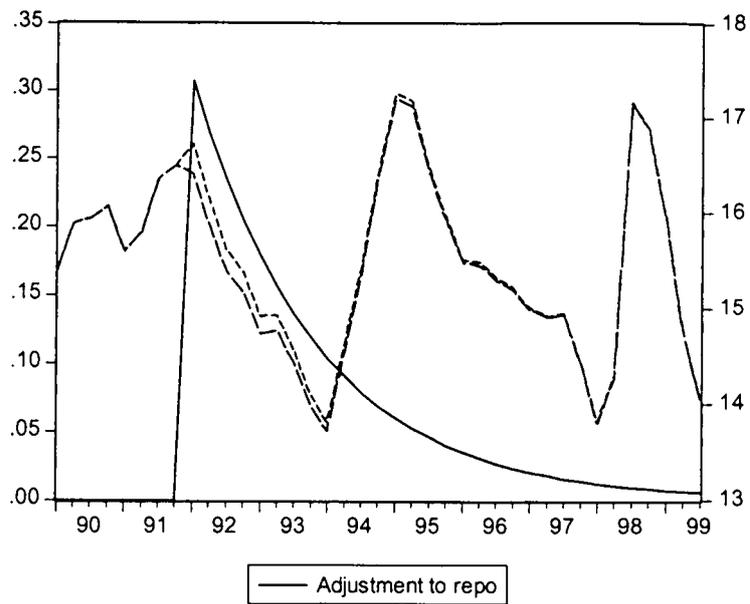
Figure 31 : The speed of adjustment to liquidity



The initial decline in the very first quarter is attributed to the yield reducing dynamic impact of the increased capital mobility component in the equation. The slight kink during the second quarter is hence ascribed to the trend in the short-run dynamics as it strives to return to its base state after the initial shock to the system. Hereafter, it is the long-run static elasticity of the raised level of savings to the domestic investment ratio that exacerbates the gradual reduction in the rate on Eskom stock towards the end of the sample period.

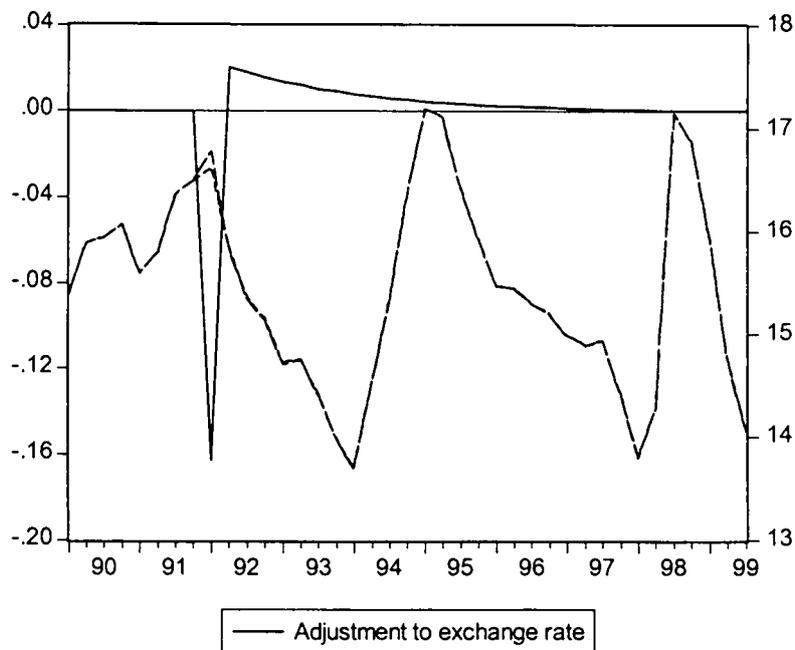
The short-run dynamics of the model with regard to the repo and the exchange rate are illustrated in figure 32 and figure 33 shown below . The graphs suggest that in both instances the impact on capital market yields is immediate, i.e. before it returns to its steady base level. The impacts of both these variables confirm the elasticities calculated in the regression in that if repo was hypothetically raised with 1 per cent, the short-run equilibrium level would amount to 0,31 per cent before it starts to return to its steady state.

Figure 32 : The speed of adjustment to the repo/bank rate



Similarly, figure 33 shows that if the exchange rate was to hypothetically depreciate with 10 per cent the impact would be approximately 0,18 (i.e. from the 0,018 elasticity implied in the regression No 7 for a 1 per cent depreciation of the nominal effective exchange rate of the rand).

Figure 33 : The speed of adjustment to the exchange rate



The following table illustrates the rate of convergence of the explanatory variables of the regression analysis :

Table 8 : The speed of convergence for the long-term yield on Eskom stock

| Adjustment after : | Price expectations | | Liquidity | | Repo | | Exchange rate | |
|--------------------|--------------------|-----|-----------|-----|---------|------|---------------|------|
| | (value) | (%) | (value) | (%) | (value) | (%) | (value) | (%) |
| 1 Quarter | 0,19 | 58% | -0,03 | 12% | 0,31 | 100% | -0,15 | 100% |
| 4 Quarters | 0,24 | 76% | -0,14 | 55% | 0,18 | 58% | 0,01 | - % |
| 8 Quarters | 0,28 | 86% | -0,22 | 88% | 0,10 | 34% | 0,01 | - % |
| 12 Quarters | 0,30 | 92% | -0,25 | 98% | 0,05 | 17% | 0,00 | - % |

6.5 Summary and conclusion

This chapter of the study refers to the process of data collection, selection and compilation of a relevant data base to be used for the estimation of the various components envisioned in the proposed monetary model. A brief description of the estimation technique is offered in which a single-step error correction mechanism is advocated. The generally accepted Engle-Granger two-step cointegration method is hence combined to incorporate the long-run static elasticities in the short-run dynamic equation. A benefit of this process is that instead of ensuring the stationarity properties of the lagged residual of the long-run equation (as devised by the Engle-Granger method), these cointegration properties of the model can now be deduced through the mere inspection of the lagged level of the dependent variable in the short-run estimation of the equation. The magnitude of his specific parameter also offers an indication of the pass-through (period in time) for the long-run impact to reach it's steady equilibrium state, i.e. after the explanatory variables of the estimated function have undergone a hypothetical magnitude shock.

The third step, once the data has been collected and the estimation method has been

selected, was to determine which of the selected monetary aggregates need to be estimated by means of a behavioural equation, and which should be deemed to be exogenous. These behavioural relationships need to be essentially based on monetary theory, in which an individual's demand to hold money balances depends on, or is influenced, by the level of income, a relative interest rate, a substitute interest rate and in some instances an opportunity cost for the holding of money. The specific components comprising the M1A, M1, M2 and the M3 monetary aggregates have hence all been estimated with these variables as the primary explanatory variables of the model. Specific reference is also made to the speed of convergence of these estimated variables to their long-run equilibrium states.

The term "M3 money balances" constitute a liability (deposit) component on the sectoralised balance sheet of the banking sector. In order to establish a monetary equilibrium in which both the asset and liability segments are in balance, it becomes imperative to make allowance for these remaining so-called "statistical counterparts" of the M3 money supply in the macro-model. To this end, provision has been made for the net claims on the government sector, the net foreign assets, the net other assets of the monetary sector as well as the claims of the monetary sector on the private sector. All of them, with the exception of the net claims on the private sector, are classified as exogenous in the model so that they have an impact on the results of the model, but are not in themselves affected by these results. The net foreign assets have been linked to the net and gross gold reserves. This means that any changes in the gold and foreign exchange reserves initiated by a change to the current account of the balance of payments, or fluctuating capital mobility to or from South Africa hence has the capacity to influence the net foreign assets of the monetary sector.

Interest rates in the model are essentially exogenous, so that all short-term or money market interest rates reflect the change in repo. In addition, the rates on demand and longer-term deposits are determined by the prime overdraft lending rates, but these are also

seen to be primarily determined by the repo rate. On the other hand, long-term or capital market interest rates are endogenous to the model, i.e. they are determined by price expectations, capital market liquidity variations brought on by changes to the savings/investment differential, capital movements (mobility), the repo rate and the exchange rate.

The final step in the model development phase is to integrate these estimated monetary equations in one model. In so doing, a policy instrument can be created that essentially tracks the behavioural patterns of the economic agents in the model, thereby reflecting the actions or reactions of these entities under various alternative monetary and other policy scenarios. In order to grasp the fundamental relationships of the model, it becomes crucial to understand the economic properties of the model that is to be used in these exercises (i.e. the main channels of the transmission mechanism). The following chapter aims to provide a brief description of the pertinent elasticities and pass-through properties of the key economic variables contained in the SARB macro-econometric model. This will not only elucidate the reaction properties of the model, but also provides a means to suitably evaluate and assess the proposed policy adjustments envisioned in the alternative scenarios to be implemented.

CHAPTER 7 THE SARB QUARTERLY MACRO-ECONOMETRIC MODEL

7.1 Introduction

During the 1960's attempts were made to combine two strands of modern economic analysis, namely the development of mathematical models and the quantitative measurement of macroeconomic aggregates. Hence, the evolution of the science commonly referred to as econometrics. Peter Westaway (1999) describes the use of econometric models as a simplified tool for thinking on economic problems. Well-selected (specified) models simplify and clarify economic problems by focusing on the factors judged most essential to their understanding. Crucially, models are also frameworks for empirical quantification - both on how the economy has on average behaved in the past, and of the degree to which its current or prospective behaviour may differ. For these general but practical reasons, monetary policy needs econometric models (Westaway, 1999: 3).

The South African Reserve Bank model can typically be described as a simultaneous multi-equation model that summarises the entire economic system in a set of empirically determined equations. The model itself can be distinguished in two subcategories, namely, a forecasting model and secondly a policy simulation model. The primary emphasis of this section is to elaborate on the structure of the model with specific reference to the policy simulation properties of the macro model.

Policy simulation models concentrate primarily on the economic (theoretical) soundness and internal consistency (i.e. the long-run properties) of the model, and not so much by the statistical fit of the equations that are incorporated in the model. The validation of the model is performed by means of evaluating the multiplier properties of the model structure (or response) to a predetermined system of alternative exogenous assumptions, otherwise known as shocks.

Model construction is both an art and a science in which clues and evidence are combined to construct a good model. The model at the SARB typically follows the national accounting structure in which all the income and product accounts are laid out in advance. With an abundance of accounting identities it hence becomes possible to see what is required to get a full explanation of the system. This pragmatic approach eventually guided model development towards the government finance statistics, balance of payments manuals and the various other accounting frameworks for monetary and financial aggregates (De Jager, 1998: 11).

The most recent version of the SARB quarterly model has 200 equations, of which 100 are stochastic behavioural equations. The model emulates a typical Keynesian income-expenditure approach where the circular flow of income and expenditure, as measured by the national accounts, relates to the spending and income variables. Final demand equations have been constructed and expressed in real terms, while final government expenditure and government capital expenditure are exogenous variables. A neo-classical or Cobb-Douglas production function relating output to the fully employed capital stock and potential work force is applied to determine the potential output volume of the economy. Value-added deflators, serving as production prices are estimated as an inverse function of the output gap between this potential and actual production level. Domestic fiscal policy instruments, such as tax rates, are assumed to be exogenous in the model, however, it does provide for the influence of inflation and "bracket-creep" on personal income tax scales (Smal, 2000: 2). As stated in the previous chapter, capital market rates are determined by the supply and demand for loanable funds, while the repo rate is the operational variable in the execution of monetary policy so that money market interest rates can be regarded as dependent on the repo rate.

Elucidation of the model's structure will commence with the estimation procedure of the potential gross domestic product, and commensurate supply-side constraints that eventually impact on higher levels of inflation. The price formation process with specific reference to

the importance of salaries and wages as an input cost will then be discussed briefly in section 7.3. The two most important expenditure components that can be expected to react to interest rates (i.e. monetary policy) are then described in sections 7.4 and 7.5, before moving on to the foreign sector and the primary determinants of the volume of merchandise imports and exports in section 7.6. The chapter is concluded with a brief summary of the public sector equations in section 7.7, and a final diagram in which all these major linkages of the model, as well as the transmission mechanism of monetary policy, are illustrated by means of a fairly basic but effective flow chart in section 7.8.

7.2 The potential gross domestic product of the South African economy

The supply side of the model was initially underdeveloped, with the main focus on the demand side of the economy. This shortcoming hence allowed real output growth to accelerate simply on account of an increase in aggregate demand, i.e. by raising government expenditure or by cutting tax revenues. The structure of the model was subsequently amended to incorporate a Phillips-type relationship in which there was an empirical relationship between the rate of wage-price changes and the rate of underutilisation of productive resources. The inclusion of this equation allowed for the exploitation of an inflation-unemployment trade-off in which policy makers could seek a lower rate of unemployment at the expense of higher inflation. However, during the 1970's output growth and employment slowed down despite accelerating inflation and continuous budget deficits, which meant that the so-called Phillips trade-off was at a loss. At this time consensus economists highlighted the fact that beyond the short-run, economic performance depends primarily on the economy's production capacity, and the model was amended once again to include an equation specifying the potential gross domestic product and paved the way for the age of supply-side economics (De Jager, 1998:14).

The potential gross domestic product is defined as the level of output that the economy is capable of producing under the condition that its productive resources are fully employed.

It also serves as an output target which ensures full employment of labour and the optimal input of capital resources. Potential output can be estimated in various ways. From an econometric perspective it can be approached by first estimating an aggregate production function using actual data on output Q and the production factor inputs utilised (usually L and K), and then by inserting into this function the total available quantities of the inputs (usually L_F and K_F), so as to calculate potential output Q_F (De Jager & Smal, 1984: 21). In some studies labour inputs are disaggregated by race or by skills categories (see P. Fallon & R. Lucas (1997), and P. Fallon & L.A. Pereira de Silva (1994)). These studies show that the limited supply of skilled and entrepreneurial labour seems to be an important impediment to the expansion of output, and that significant labour measurement problems are rife. Nevertheless, there are indications that near-full levels of employment of the highly skilled labour component co-exist with a high level of unemployment of unskilled labour in the South African economy.

The aggregate production function used in the Reserve Bank's quarterly model emulates the standard practice of estimating the functional relationship between output in the private business sector and two private sector production factors (namely labour and capital), with an assumed criterion that the function is homogenous to degree one. This "Cobb-Douglas" type of production function is hence defined as follows :

$$Q = A L^{\alpha} K^{\beta}$$

where α and β are homogenous to degree 1, (i.e. $\alpha + \beta = 1$) and represent the elasticities of output with respect to a change in labour and capital respectively (De Jager & Small, 1984: 22).

The production function is estimated for the private business sector and excludes real value added by agriculture, forestry and fishing, gold mining and the general government. The coefficient α can be seen as the output elasticity of labour which is also equal to the share

of output received by labour. The arithmetic average of the share of output received by labour during the estimated period from 1976 to 1999 was 0,58. There is no reason to reject the hypothesis that labour's share remained constant throughout the estimation period. Labour (L) reflects the actual number of people employed in the business sector, while capital (K) reflects the real capital stock of the business sector. Capital (K) also excludes the real fixed capital stock of private residential buildings.

Provision is made for improvements in technology and production efficiency by means of a time trend (Ae^t), which has been introduced into the production function as a substitute for the constant " A ". As currently estimated, the trend variable implies an efficiency gain of 0,4 per cent per annum. Upward shifts in the production function can also be induced by gains from foreign trade relations with the rest of the world. For this purpose, the so-called terms of trade, referred to as the exchange ratio of South African exports for imports of goods and non-factor services (P^δ), has been used as an approximation for the gains from international trade (De Jager & Small, 1984: 23).

The final production function, allowing for changes in the efficiency parameter due to technical progress and the gains from foreign trade, is consequently the following:

$$Q = Ae^t P^\delta L^\alpha K^\beta$$

The potential output is hence obtained by inserting values of the relevant capital stock, and estimated values of the total labour force. The labour force component excludes individuals already engaged in the gold mining and general government sectors, and the sector for agriculture, forestry and fishing. This potential output estimate is contrasted with actual output in the private sector to construct the output gap illustrated in the following graph:

Figure 34 : The trend in the output gap (potential/actual)

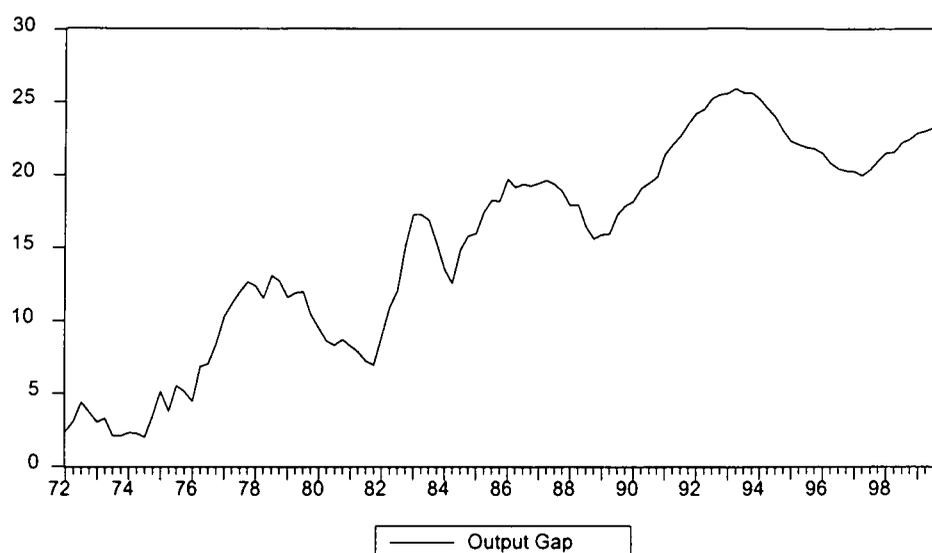


Figure 34 shows that over the long-term the potential is consistently higher than the actual level of the relevant sectors of the real gross domestic product. This is indicative of the broad divergence of the growth potential of the domestic economy, in relation to the somewhat lower actual rates of growth registered in South Africa over the forecast period (i.e. especially since the late 1980's). The rising trend is hence borne out by the fact that potential growth has been increasing at a rate of 2,7 per cent per annum, while the actual rate of gross domestic product growth has only been increasing at a rate of 1½ per cent since the early half of the 1980's.

Potential output curves can also be calculated by alternative methods such as the peak-to-peak technique, in which the highest points of the production curve are joined by a straight line, by means of a constant elasticity of substitution function (commonly referred to as a "CES" production function) and a time-trend smoothing process as advocated by a Hodrick-Prescott filter. However, the general trend of these potential output curves extrapolated from the alternative methods, broadly coincide with the results obtained from the OLS estimated "Cobb-Douglas" production function.

7.3 The price formation process in the macro model

The South African economy has been plagued by relatively high inflation since the beginning of the 1970's, and it was only since 1989 when the Reserve Bank announced its intention to deal effectively with the problem of inflation (through its mission statement of protecting the value of the rand) that inflation has slowly started to decline to less than 10 per cent, and come to within close proximity of the rate of inflation of our major trading partner countries.

The most important variables in the price formation process are hence of extreme importance in the context of the model, as it is the inflationary process and its determinants that is of primary concern to the governor of the Reserve Bank, especially in the new inflation targeting environment. The structure of the price formation process has remained essentially the same over the last few years, and it is merely the coefficients of the parameters of the model that have changed. In addition, new definitions to measure inflation (such as CPIX, and core inflation) have also come to the fore. However, the purpose of this section is to merely point out the factors that will impact on the inflationary process without delving too deeply on the estimated parameters of the model.

In an high inflationary environment, supply/demand signals become distorted so that the suppliers of scarce commodities are free to charge the price they perceive justifies the cost of their inputs. This essentially means that output prices are essentially determined as a fixed mark-up over input prices. When output prices are defined as value-added deflators, and output itself is defined as the value-added concept of the national accounts, labour cost becomes the most important single cost element. In accordance to this simplification, output cost is derived as a fixed mark-up over labour cost (Pretorius & Smal, 1987: 25).

The share of labour (α) can be expressed in mathematical terms as the following :

$$\alpha = WN / Py$$

where: W = nominal labour costs (wage) per unit of labour input ;
 N = number of units of labour input ;
 P = final product price per unit of output, and
 y = the physical volume of output

Rearranging this equation, output prices can be expressed as the product of a constant mark-up factor and the cost of labour per unit of output.

$$P = 1/\alpha * (WN / y) \quad \text{or :} \quad P = \mu * ULC$$

where μ equals the mark-up factor ($1/\alpha$), and ULC represents the cost of labour per unit of production (unit labour costs). Unit labour costs can be rewritten as the quotient of the nominal wage and the average productivity of labour :

$$ULC = W / (y / N)$$

where (y/N) is the average output per worker or labour productivity. If this equation was to be transformed in terms of percentage changes, final output prices would be equal to the net result of the change in wage rates less the percentage change in labour productivity. This implies that if nominal wage growth (W) exceeds productivity growth, output prices will begin to rise, and only when wage growth matches productivity growth will price stability prevail (Pretorius & Smal, 1987: 25).

A popular approach to changes in nominal wages finds its origin in the Phillips curve in which there is a direct negative relationship between the rate of increase in nominal wages and the unemployment rate. This curve was widely interpreted as a menu in which policy makers could choose between higher wage inflation and lower unemployment rates. The

break-down of this relationship between inflation and unemployment during the 1970's when inflation and unemployment was on the increase lead to the revision of the Phillips curve relationship in which an inflation expectations variable should be added to the link between wages and employment to account for the same level of unemployment to coexist with a variable rate of inflation, i.e the expectations-augmented version of the Phillips curve (Pretorius & Smal, 1987: 26).

Further insight was added when the so-called "full employment" was linked to some unutilised labour resources, in which a level of unemployment was fully compatible with equilibrium in the goods and labour markets. Expressed as a percentage of the total labour force, this equilibrium unemployment rate was commonly referred to as the natural rate of unemployment. The wage determining model based on the view that workers are remunerated according to productivity improvements and incorporating the original ideas of Phillips, inflation expectations and the natural rate hypothesis can hence be algebraically stated as follows :

$$W = \alpha_1(u-U^*) + \alpha_2 (\text{rate of productivity growth}) \\ + \alpha_3 (\text{rate of future price expectations})$$

where W refers to the rate of nominal wages, and $(u-U^*)$ is the deviation between the actual rate of unemployment and the natural rate of unemployment. From this relationship it follows that α_1 should be negative while α_2 and α_3 should be positive, i.e. for low levels of unemployment, or when the actual level of unemployment is less than the natural rate, nominal wage increases tend to be higher. Equilibrium in the labour market will hence be attained when the actual rate of unemployment matches the natural rate U^* .

Okun's law assumes a direct link between the unemployment rate and the difference or gap between potential aggregate production and actual aggregate production. Okun argues that there is a loss in aggregate output which is statistically associated with a given short-run

increase in unemployment, (i.e. at an estimated elasticity of approximately 3,0). This means that a crude estimate of the welfare cost associated with a temporary increase of 1 per cent in the unemployment rate would be roughly 3 per cent of real output (Pearce, 1992: 313). Okun's law implies the existence of a certain output level where the gap between potential production and actual production is consistent with equilibrium in the labour and goods market, i.e. the so-called natural output gap. It also means that the output gap and natural output gap can be substituted for the deviation between the actual and natural rate of unemployment ($u-U^*$) in the equation shown above. Thus, attempts to reduce the actual output gap below its natural level (potential), requires inflation to be consistently higher than the expected rate of inflation, and if expectations eventually adjust to actual inflation, a continuously higher rate of inflation would be required to ensure that the actual output gap is lower than its natural level. It hence becomes possible to encourage higher output and employment levels by merely allowing inflation to accelerate, but once inflation expectations adjust to actual inflation, the gap will widen again and return to its natural level;- ultimately leaving the economy with a higher rate of inflation, and without any improvement in the level of output and income (Pretorius & Smal, 1987: 26).

This forms the basis of the price formation process in the SARB macro-econometric model in that output levels rising above potential become price inflationary by virtue of rising wages. In addition to this, it can be argued that wage growth reflects labour productivity growth (output per worker) and that rising wages are in itself inflationary. Rational expectations suggests that price expectations in a specific period of time also have a large and lasting impact on current trends of inflation, and are based on all the relevant information available at that given point in time. This information may include the past performance of the economy, changes in selected key variables such as the growth rate in M3 money supply, the change in the exchange rate and the budget deficit. Import prices are perhaps the most volatile of all the explanatory variables in the inflationary process and primarily reflect the change in the exchange rate and dollar denominated oil prices.

Changes in labour cost are at the core of the inflation process in the SARB model and wage changes are largely determined by inflation expectations. However, it should also be noted that inflationary expectations react fairly slowly to conventional monetary policies specifically directed at reducing the growth in the domestic money supply. In order to influence expectations decisively, a conservative monetary policy will have to be pursued for an extended period of time (Pretorius & Smal, 1987: 26). This has been the case for most of the 1990's in which real interest rates were at a high level, and given this environment, it could be seen as the main contributing factor towards lower inflation during the latter half of the decade.

7.4 Final consumption expenditure of households (real private consumption expenditure)

Keynes's formulation of the consumption function can be regarded as an important milestone in the development of macro-economics. He postulated consumer behaviour on the observation that consumption increases when income increases, but not to the same extent, i.e Keynes assumes that aggregate consumption is a relatively fixed proportion of aggregate expenditure (Pearce, 1992: 230). Another important contribution consumption theory was Friedman's permanent-income hypothesis in which he postulated the proportionality between permanent consumption and permanent disposable income, i.e. families and/or individuals base their consumption decisions on their disposable incomes (Hall & Taylor, 1993: 278). Permanent income is defined as the income generated by an individual's total wealth and includes human capital or skills acquired through physical and mental capabilities, knowledge and training. The permanent income hypothesis suggests that the individual consumes a constant proportion of the present value of the income flow from his work and wealth while maintaining his holdings of wealth intact (Pearce, 1992: 328). Friedman argues that consumption has two components, a permanent or planned component and secondly a transitory or erratic component. The transitory component fluctuates around zero, while the permanent component of consumption is a constant

fraction of the households permanent income (Pretorius & Knox, 1995: 28).

In a national accounts context, remuneration of employees can be regarded as a more permanent source of income, while income from property of households reflects the characteristics of temporary or transitory income (Pretorius & Knox, 1995: 33). The final consumption expenditure of households (previously referred to as private consumption expenditure) in the SARB model are predominantly based on the permanent income hypothesis and all of these equations in the model include some sort of combination of the permanent income and transitory components (Pretorius & Knox, 1995: 40).

In the Reserve Bank's econometric model, final consumption expenditure of households is divided into 4 separate components, namely expenditure on durables, semi-durables, non-durables and services. The principle determinants for all four components remain essentially the same and consist primarily of the following explanatory variables :

- * A combined permanent and transitory income variable, i.e. where the permanent income component can be regarded as the remuneration of employees, and where the income from property of households reflects the characteristics of temporary or transitory income. This combined income variable also includes transfer payments received from the general government, and is adjusted for inflation by means of the private consumption expenditure deflator.
- * A combined tax variable, which consists of direct personal taxes and indirect taxes. An increase in the individual's tax burden reduces disposable income and thereby dampens private consumption expenditure. The tax variable is also deflated by the private consumption expenditure deflator in order to adjust it for inflation.
- * A representative interest rate variable which describes the trade-off between current and future consumption expenditure. Apart from the increased cost of consumption, the increase in the rate of return on accumulated savings also increases the opportunity costs associated with current consumption expenditure, thereby

potentially raising the domestic savings rate. The inverse relationship between the interest rate and private consumption expenditure also suitably illustrates the so-called "substitution effect" between current and future consumption via the interest rate.

- * A surcharge or personal loan levy rate which constitutes a statutory loan levy imposed by the general government on a temporary basis. The temporary loan levy is refundable at some later stage. Although no levy exists at the moment, it is important to add the variable to the behavioural equation to make specific allowance for alternative fiscal policy initiatives, as well as the fact that it may have distorted the consumption patterns of the past.
- * A measure of wealth variable seen as a combination of the total M3 money supply variable adjusted for inflation and the real capital stock of private residential buildings. Some models also include share prices in the wealth variable, but this would mean a new equation for share prices would need to be added to the SARB model. Share prices are anyway expected to reflect gross operating surpluses (i.e. linked to nominal GDP growths which are already included in the wealth variable to a certain extent).
- * A dummy variable allowing for the rising rate of population growth, and the increasing number of new consumers in the domestic market .

To summarise, the final consumption expenditure equations for households in the macro-econometric model of the Reserve Bank are predominantly based on the permanent income hypothesis, as all the disaggregated components include a permanent income variable (usually represented by a weighted average of past employee incomes), and a more volatile transitory income variable (represented by the income from property of households). Government taxes, whether direct or indirect taxes, can also be seen to impede personal disposable income, while rising interest rates imply an increase in individual debt burdens and hence a consequential decline in disposable income. It is primarily through this channel that the monetary transmission mechanism is felt on the economy, although the secondary

impact of rising interest rates could also impact negatively on domestic demand. This effect will ultimately result in a cut back in supply and hence domestic output, so that eventually employment opportunities also start to dry up. Once this happens, the remuneration of employees (the product of employment and wages) also starts to decline, leading to a deterioration of the permanent income component of the consumption expenditure equations.

7.5 Gross fixed capital formation in the private sector (real private investment expenditure)

Total gross fixed capital formation in the macro-econometric model of the SARB is disaggregated between the capital formation of the government, public corporations and the private sector. Real capital formation by the government sector and public corporations are seen as exogenous in the model, and hence only have the capacity to influence the results of the model, and will not be duly influenced by any changes to the results of the simulation scenario. Real capital formation by the private sector is estimated as a behavioural equation with the desired capital stock as the most important variable. The desired capital stock is approximated by assuming that it is proportional to the ratio of the value of output to the cost of input (i.e. the user cost of capital). This essentially means that decisions to increase real private sector capital formation are based on all future revenue possibilities (in the form of gross operating surpluses or the nominal GDP) in relation to the cost of new investment.

Pearce (1992) describes the user cost of capital as the implicit rental value capital services, or the price a firm should itself pay for the use of the capital stock it owns or is considering acquiring. It may also be considered as the price the firm would pay if it rented capital goods to obtain capital services, just as in the case of labour. Taxation and interest rate changes may be considered to affect real investment through the user cost of capital (Pearce, 1992: 444). Private sector capital formation in the model is primarily determined

by a cost moratorium on new investment, i.e. commonly known as the user cost of capital. The associated user cost of capital in the model is the implicit price of the costs of using capital in the production process and incorporates the cost associated with the acquisition of the asset, the financing cost related to the loan of capital and the depreciation of the capital over the period in use (less any capital gains accrued by the business during the period in use). It is therefore a much wider concept than a rudimentary interest rate and combines variables such as the general price level (as a proxy for the unit price of the new capital), interest rates, tax rates and depreciation rates (Pretorius, 1998: 37).

Tax concessions and other incentives lower the implicit cost of investment by increasing the after-tax rate of return on capital, thereby reducing the amount of taxes that need to be paid on income from assets. Tax concessions also help to reduce corporate tax liabilities so that cash flows and the funds available for investment are systematically increased.

Fixed investment usually takes place over a long period, and therefore net investment in the current period can be viewed as the result of changes in the capital stock and user cost over a number of preceding periods. Changes in net investment spending are likely to respond, with a time delay, to changes in the desired capital stock, past changes in investment expenditure and past changes in actual capital stock. Since the actual capital stock does not react immediately to changes in the desired level of capital it becomes customary to afford a rising weighted lag structure in the polynomial distributed lag to account for the negligible influence of current period changes in the net new investment (Pretorius, 1998: 37).

Pretorius (1998) states that the desired level of capital stock is obtained when the marginal production of capital equals the real user cost of capital, i.e. when :

$$\frac{\partial Q}{\partial K} = \frac{c}{p}$$

Where (∂) denotes the first differential of output (Q) to capital stock (K).

In order to derive an expression for the demand for capital, a specific demand function, like the Cobb-Douglas production function is assumed :

$$Q = Ae^t L^\alpha K^\beta$$

Where Ae^t , α and β are constants and α represents the elasticity of output with respect to labour and β represents the elasticity of output with respect to capital. Optimisation decision rules indicate that profit maximisation occurs when :

$$K = \beta * (pQ/c)$$

The desired capital stock can thus be approximated by assuming that it is proportional to the ratio of the value of output and the user cost of capital.

The desired capital stock then equals $K^* = (pQ/c)$, where pQ is the value added in a specific sector, and c represents the user cost of capital in that sector (Pretorius, 1998: 38). It is primarily this explanatory variable in the model that influences the level of the gross fixed capital formation in the private sector. The actual user cost of capital, as an explanatory variable for private investment, is divided by the value added deflator for the private sector in order to adjust it for inflation. The unit price of new capital is represented by the derived price deflator for fixed investment, while the long-term bond yield is used as an approximation of the long-term interest rate at which firms borrow money to finance investment. Statutory corporate tax rates, in the region between 20 and 25 per cent over recent years, have been used to represent the corporate tax rate.

To summarise, the desired capital stock is defined as the ratio of output to input costs and follows a polynomial distributed lag function with start restrictions (so that later periods have

a higher weight). The desired capital stock constitutes the most important explanatory variable in the investment function, and is primarily influenced by the ratio of nominal output to the user cost of capital. The macro-econometric model of the SARB defines the user cost of capital as a cost of investment variable incorporating company tax rates, long-term interest rates and an inflation adjustment deflator. Monetary policy effects such as rising domestic interest rates hence impact negatively on the user cost of capital making it more expensive to invest, while fiscal policy measures aimed at influencing tax revenues from the introduction of higher corporate tax rates also deter the individual's desire to invest. Rising rates of inflation have the added impetus of raising the user cost denominator c in the desired capital stock so that the desired level of capital stock is reduced. These are the three main channels in which policy adjustments, i.e. whether it be monetary or fiscal adjustments, impact on the results of the model with specific reference to a change in real gross fixed capital formation.

A further criticism of the model is that it does not include a pure or free market structure, in that many of South African companies are monopolies or oligopolistic, i.e. they pay no attention to the rising trend in the user cost of capital and merely pass this on to the end consumer. This may well be true, but a recent study by Valentine (2000) indicates that the only reason a firm undertakes long-term investment is because it feels confident about the future growth pattern of domestic economy. This implies that firms and companies will only be able to pass these costs on to the consumer if they are "confident" and guaranteed of sufficient return on their investment. Valentine contends that it is this confidence that plays the prominent role, and that business are not particularly worried about the trend in interest rates (i.e. there is a definite link between business confidence indices and the level of real private sector capital investment) (Valentine, 2000: 2). However, one might argue that the current level of interest rates is sure to influence business confidence in the future. This would seem to justify the inclusion of the interest rate (or the user cost of capital) in the behavioural equation for private sector fixed capital formation, even if it only constitutes the secondary impact on overall business confidence.

7.6 The foreign sector in the Reserve Bank model

Since the successful election process of 1994 and the accompanying cessation of statutory international sanctions and boycotts, the South African economy has enjoyed a much higher degree of international competitiveness and trade liberalisation. Trade policies were also increasingly aimed at export promotion as the domestic economy was heavily dependent on the economies of the rest of the world. This meant that there had to be change in emphasis from a traditional import-substitution framework with strong elements of protectionism and intervention, to policies aimed at the efficient allocation of the country's scarce resources to develop a dynamic competitive export sector.

The high degree of openness not only left the economy vulnerable to exogenous shocks, but the high propensity to import imposed a balance of payments constraint on the economy's growth capacity. As soon as domestic spending began to rise, the demand for imports increased, widening the deficit on the current account of the balance of payments. This disequilibrium soon becomes unsustainable and compels the monetary authorities to tighten domestic policies in order to prevent the balance of payment difficulties from changing into a major payments crises. The tightening of monetary policies usually tends to cool the economy down cyclically (Smal, 1996: 31).

Domestic and international economic developments hence have a pronounced effect on the demand for goods and services to and from South Africa. Rising international demand can be seen as a stimulus to domestic exports, while rising domestic demand can be seen as a stimulus to imports. However, these income effects are not the only effects impacting on the volume of exports or imports, as they are also largely driven by changes in price competitiveness as well. Since export and import prices are highly sensitive to changes in the exchange rate, and export and import volume respond to relative price changes, the monetary authorities policy stance with specific reference to the exchange rate also becomes crucially important. Perhaps this is why calls are frequently made on the

authorities to allow a downward adjustment of the exchange rate so as to provide an added incentive to invest for the export market, and thereby increase the growth potential of the economy (Smal, 1996: 31).

For a policy of currency depreciation to have the desired effect, certain preconditions have to be satisfied. The successful implementation of this kind of policy rests on the reaction of export and import volumes to a change in the real exchange rate, i.e. the price elasticities of the demand for imports and the demand for exports. Under normal conditions, it is generally accepted that the depreciation will increase the value of exports, and decrease the value of imports. However, it is still possible for the depreciation to be successful even if it leads to increased imports or lower exports, provided that these volume effects are outweighed by a favourable export or import price effect. The Marshall-Lerner condition states that this will be true, and that the current account of the balance of payments will improve, if and only if, the sum of the price elasticities of domestic demand for imports and foreign demand for exports exceed unity (Pearce, 1992: 270).

The depreciation effect has obvious benefits for the balance of payments, but these price effects need to be offset in the wake of the depreciation, or they could and most probably will lead to higher domestic inflation. Smal (1996) remarks that a depreciation increases the cost of imported goods, and inflates domestic production costs. This in turn raises money wages, necessitating further depreciations to maintain international competitiveness. Eventually these real gains will be nullified once the spiral of rising prices erodes the benefits from the initial depreciation of the rand. The end result could even result in lower growth, lower employment, higher inflation and eventually lower international competitiveness than would have been if the exchange rate remained unchanged (Smal, 1996: 31). The monetary authorities hence face a dilemma, and need to maintain a constant vigil on the trend in the value of the rand (i.e. the Reserve Bank's mission statement), especially in the aftermath of a rapid depreciation of the rand that usually follows an unforeseen exogenous shock.

The model is in typical Keynesian tradition, and primarily driven by changes in aggregate demand. Rising export volumes have the added benefit of increasing domestic production levels to satisfy foreign demand, and in so doing could stimulate an increase in South Africa's dwindling employment levels. However, supply-side constraints are also included in the model to make allowance for rising domestic price pressure once the critical level of capacity utilisation (the output gap) is exceeded. The foreign sector in the Bank model is furthermore characterised by endogenous functions for the volume of imports and exports, as well as behavioural equations for the respective import and export price indices. The value of exports and imports is hence calculated as the product of the price index and the volume amount.

The volume of imports is disaggregated into two categories, i.e. the import volume of oil and volume imports excluding oil. The importation of crude oil is assumed to be a predetermined exogenous variable, while the other import component is determined by the various economic forces described in the model. Import volumes (excluding oil) are hence explained by an income and a price variable, in which the income variable constitutes the weighted sum of the gross domestic expenditure components, while the price variable represents the ratio between the prices of imported goods and locally produced prices. The respective income and price elasticities that are currently estimated in the model are fairly similar to those calculated in the study by Smal (1996), with the exception that the income elasticity is slightly higher than the 1,5 in this study. This implies that a 1 per cent increase in aggregate domestic demand leads to a percentage change in imports that is closer to 2 per cent. The price elasticity remains less than unity at roughly the same as the 0,8 mentioned in the study.

The volume of exports are disaggregated between three sectors, namely, the export of gold, manufactured goods and commodities. The relative importance of gold has declined considerably over time and now constitutes roughly 12 per cent of the total volume exports of goods and services in 1999, where it amounted to approximately 55 per cent during the

early 1960's. Net gold exports can be seen to follow the trend of gold production in the model and is consequently assumed to be a predetermined or assumed trend path. Manufactured exports constituted between 35 and 40 per cent of the total exports of goods in 1999, with the remaining 60 to 65 per cent taken up by the export of commodities. Both these two export sectors are modelled as demand equations and are determined by international economic activity or income, and relative prices.

The income elasticities for manufactured products in the model remains fairly close to unity, which is somewhat lower than the previous income elasticity of 1,9 estimated in the study undertaken by Smal (1996). Income elasticities for commodity exports, on the other hand are much higher than those estimated by Smal and are calculated at slightly under 2. The price elasticities for the two components remain essentially the same as the previous study, and are estimated at slightly more than unity for manufactured goods and at slightly under 0,5 for the export of commodities. The combined price elasticity for the total export of goods (taking their respective weights into consideration) amounts to roughly 0,6 which is precisely the same as the total price elasticity indicated in the study by Smal. The implied Marshall-Lerner condition in which the sum of the absolute price elasticities is used to determine whether a depreciation of the rand is beneficial to South Africa's current account of the balance of payments, is satisfied and amounts to approximately 1,4.

It is also worth noting that the calculated income elasticities furthermore indicate that the income elasticity for imports is higher than the combined income elasticity for the export of goods. This indicates that South Africa's trade balance will deteriorate in the long run if the domestic economic growth rate corresponds to that of the country's major trading partner countries.

To summarise, the volume of exports and imports in the model not only influence the current account of the balance of payments, but have the capacity to influence the real sector of the economy as well. This essentially means that an increase in domestic

economic activity has the ability to increase the volume of imports, while an increase in foreign economic activity has the ability to increase the volume of exports to foreign countries. The increase in export volumes have other positive spin-off's in that production and employment levels can also be stimulated, and an increase in the current account of the balance of payments could lead to an increase the level of the gold and foreign exchange reserves. On the other hand, rising import levels indicate that the economy may be overheating and raise concerns of a deterioration to the current account of the balance of payments (i.e. implicitly the gold and foreign exchange reserves). Imports as a result of the rising levels of economic activity also has the ability to show early warning signals of inflationary pressures, in that as real output grows relative to potential output, inflation tends to rise in accordance to the vertical Phillips curve doctrine.

The structure of the model is hence conducive for the analysis of alternative monetary policy scenarios, in that rising interest rates should slow down the rate of growth in domestic economic activity (specifically consumption and investment expenditure). This ultimately leads to lower import volumes, which has obvious beneficial consequences for the balance of payments position and reserves of the country. In addition, rising levels of domestic price inflation lowers the price competitiveness of South African exports, in that the initial price benefits of the real exchange rate depreciation are annulled as domestic inflation rises in relation to foreign inflation *vis a vis* purchasing power parity theory.

7.7 The public sector equations of the model

The government's deficit before borrowing is determined once the exchequer issues have been subtracted from the exchequer receipts. Exchequer issues comprise the consumption expenditure and investment expenditure of the general government, subsidies and transfers from the general government and the interest paid on government debt. Government's revenue receipts comprise direct taxes and indirect taxes. The direct tax revenues consist of the direct taxes paid by individuals (i.e. pay- as-you-earn "PAYE" and provisional income

tax) and direct taxes paid by companies, while indirect taxes consist of value-added tax receipts, customs and excise duties and other indirect taxes of the general government. The accumulation of government debt is approximated in the model by adding the deficit before borrowing (exchequer revenues - exchequer issues) to the level of government debt in the previous quarter.

From a tax revenue perspective, the revenues are primarily determined by a statutory tax rate (or proxy thereof) and a tax base. If the tax rate is unavailable, or if the tax base is incompatible, then the effective tax rate can be estimated by merely dividing the revenues received by the tax base, so that this so-called "effective" tax rate reflects the statutory tax rate, the revenue recovery rate and any discrepancy between the utilised tax base, and the true tax base (Smal, 1995: 1). Exchequer issues are primarily exogenous in the model, with the exception of the interest paid on government debt which reacts to long-term capital market interest rates, the level of government debt, and the deficit before borrowing (i.e. the public sectors' borrowing requirement, PSBR).

Direct personal taxes (PAYE and provisional taxes) make use of the total remuneration of employees as the tax base, with the exception that the income from property of households is added to the remuneration of employees in the case of the tax base for provisional taxes. The remuneration of employees is considered a suitable tax base in the context of the model, as income tax is paid on the amount of remuneration received by individuals. The income of property of households is added to the tax base in the case of provisional taxes to allow for the fact that individuals pay provisional taxes on income received from sources other than salaries and wages, i.e. dividend and interest receipts, other profits and rent receipts (Smal, 1995: 4).

The effective tax rate on persons (the average personal tax rate) comprises a weighted tax rate calculated from the tax received in rand millions, and the amount of tax payers within a specific tax bracket. The South African Revenue Service (SARS) publishes the number

of tax payers in the different income categories, as well as the total amount of tax revenue received for each income category. The taxable income in each income bracket is computed as the mean of the lower and upper limit of that specific bracket, which can then be multiplied by the number of persons within that income bracket. The average tax rate for each income category is then calculated by merely dividing the income tax (revenue) collected by the total amount of income received by the individuals in each income tax bracket. The calculated average tax rate is then computed by multiplying the tax rate for each income bracket by the weight of the number of tax payers of that specific tax bracket relative to the total number of tax payers (Smal, 1995: 3).

In the same fashion, direct tax revenues from companies are influenced by the statutory tax rate for companies, which currently stands at 30 per cent on taxable income (RSA Budget Revue, 2000: 68), and a proxy for corporate profits as the tax base. Corporate profits, i.e. the gross operating surplus, is calculated as the total nominal gross domestic product at factor costs, excluding the value added in the agricultural, government and gold mining sectors, less the remuneration paid and depreciation allowances of these sectors (Smal, 1995: 6). Any external effects impacting on the gross domestic product from a monetary or fiscal impulse, hence has the ability to influence company profits (operating surpluses) as the tax base.

All taxes that have been imposed on goods, services and transactions are classified as indirect taxes. The indirect taxes in the model essentially comprise value-added taxes, customs and excise taxes and other government and provincial taxes. Value-added tax (VAT) revenues are influenced by a constantly changing tax base in the model. The tax base in this instance is calculated using a weighted system of expenditure components on which value-added tax is payable (primarily the final consumption expenditure of households) (Smal, 1995: 9). The statutory VAT tax rate is specified exogenously in the model so that an estimate for the effective tax rate can be derived from the parameter of the product of the VAT tax rate and VAT tax base. Customs and excise duties make use of the

value of merchandise imports as the tax base, due to the fact that custom duties are payable on imported goods. As there are a wide range of duties on imports, an effective tax rate is determined via the estimated coefficient of the tax base. The effective tax rate is multiplied by a dummy in order to manipulate the tax rate and determine the outcomes of various alternative tax rate scenario's in the model (Smal, 1995:11).

To summarise, the main linkage of exogenous exchequer issues is manifested in a change to the public expenditure of the model. This means that final consumption of the general government has the ability to influence domestic production levels, employment and inflation levels, provided that the economy is not at full production capacity. If the economy is running at full capacity, any further increase in government expenditure will only lead to higher inflation. On the other hand, tax revenues (essentially from changes to the tax rate), influence current and disposable incomes in the model, so that any changes to the purchasing power capacity of the economic agents leads to corresponding change in domestic expenditure. The changing expenditure environment has further secondary implications in that exchequer revenues change in accordance with the altered purchasing capacity of the economy. Perhaps this bears further testimony to the fact that increased revenues cannot merely be attained by raising the level of the tax rate, as this effect essentially leads to lower levels of income which tend to erode the tax base. The ultimate impact of a rising level of the tax rate may hence lead to the same amount of revenue collections, or even less, so that there is a fine balance between the tax rate and the tax base for optimal state revenue collections.

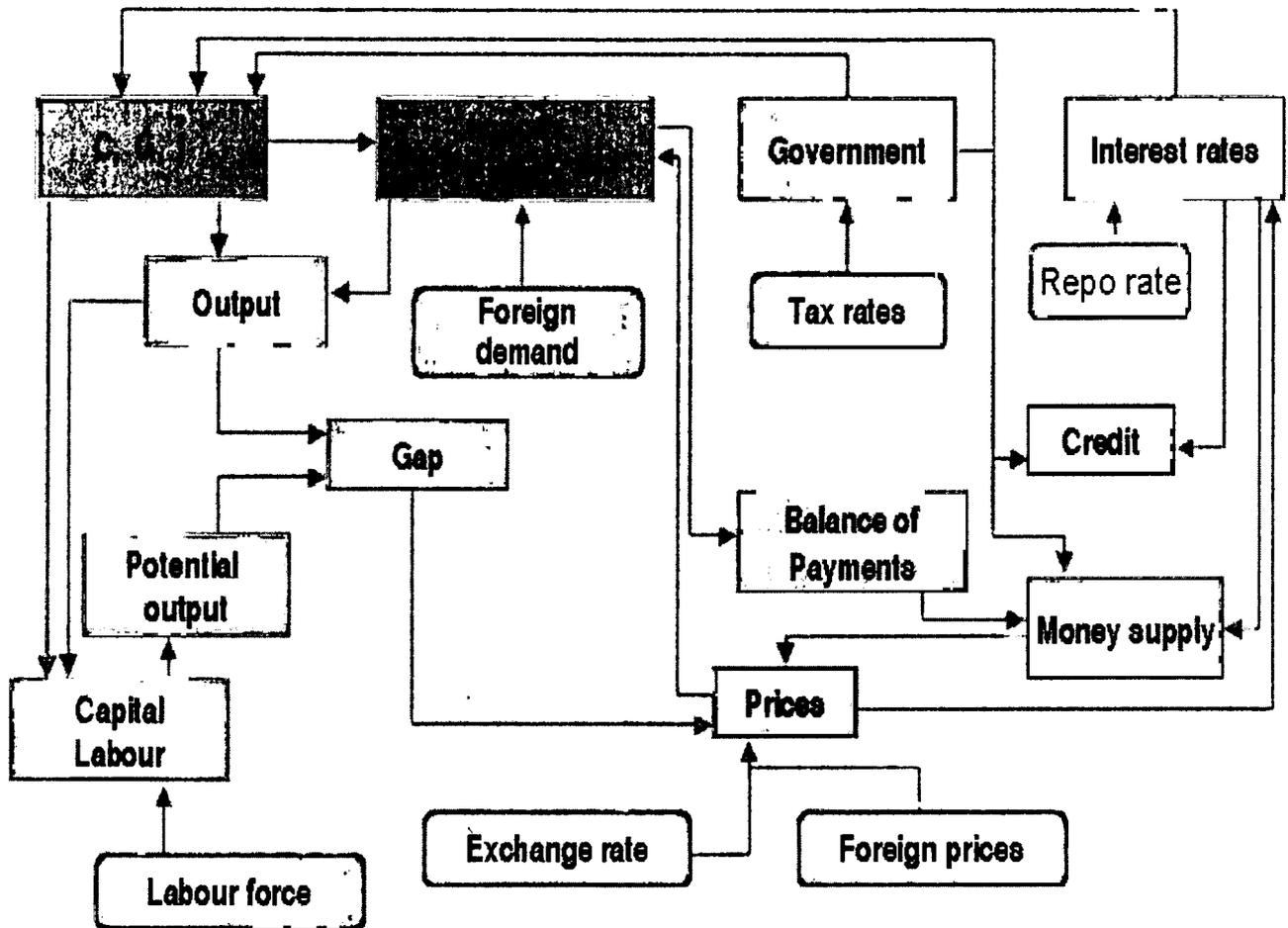
7.8 The flow chart of the macro model of the SARB

The previous sections of this chapter illustrate the main sub-structures of the model with regard to the inflationary process, capacity constraints originating from the output gap, the two main expenditure components (private consumption and investment), the foreign sector and finally the public sector equations. All these sectors are combined to generate a model

in which the effects of various monetary policy initiatives can be analysed by means of the monetary sub-model. The purpose of this section is hence to give a summary of linkages between these various sectors with specific reference to the repo rate as the operational variable for monetary policy implementation.

Macroeconomic policy measures are aimed at fostering economic growth, creating employment opportunities and improving the living standards of all the people of the country. Monetary policy and its objectives of creating and maintaining a stable financial environment, play an integral role in achieving the overall goals of macroeconomic policy. The single most important instrument that the monetary authorities have at their disposal for influencing monetary conditions in the interest of overall financial stability is the repo or "bank rate". Repo hence plays a central role in the model, and constitutes the main channel through which monetary impulses influence the creation of income and spending in the economy. Any change in the real income of economic agents would inevitably lead to changes in the level and composition of aggregate domestic spending.

Figure 35 : The flow chart of the linkages between the monetary model and the macro model



The flow chart of the SARB macro model in figure 35 shows that the repo rate influences the overall level of domestic interest rates and thereby has the ability to change the various demand components, specifically the final consumption expenditure of households "C" and the gross fixed capital formation "I". These demand components then impact on the level of production "output", which when taken in context of the potential output, changes the level of the output gap, or "gap". Per definition, potential output is always higher than actual output, so that once the gap between the two starts to decline (actual output grows in

relation to potential output) inflationary pressures start to rise.

The secondary influence of a rising repo rate is that as demand weakens, the volume of imports will start to decline on account of a deterioration in the expenditure components. This decline in imports then leads to a steady improvement in the current account of the balance of payments, thereby alleviating pressure on the level of the country's gold and foreign exchange reserves. As the level of the gold and foreign exchange reserves improves, there will be less pressure on the level of the nominal effective exchange rate of the rand so that imported inflationary pressures cease to become an issue. The opposite is, of course, also true in that if capital outflows start to increase rapidly (such as in 1998 with the Asian financial crisis), and the current account deficit remains problematic, there will be increasingly more pressure on the level of gold and foreign exchange reserves to maintain the level of the exchange rate of the rand at a given level. A low level of foreign exchange reserves implies that the value of the rand will then have to bear the brunt of the capital exodus, and it is this process of rising input costs from the depreciation of the rand that fuels the inflationary process. This is also perhaps why the SARB is so concerned about the current account of the balance of payments.

The level of domestic interest rates and the link between the prime overdraft lending rate and the repo rate has further impacts for inflation. Although the direct link, and time frame between the M3 money supply and inflation is somewhat ambiguous, there is still the strong conviction that inflation remains a monetary phenomenon (see Meijer et al., 1991: 179). The model allows for changes in the repo/prime rate to influence both the level of credit extension to the private sector, and the level of the M3 money supply - perhaps not so much by the interest rate itself, but more so by the secondary impact that these interest rates have on an individual's income. This means that the demand for real money balances starts to decline once interest rates rise and start to impact on real income.

Inflation expectations in the model are modelled as a function of the money supply per unit

of production so that as money supply declines in relation to real output, inflation expectations start to decline as well. Inflation expectations are inherent in the inflationary process and accordingly influence wage demands through the average level of salaries and wages paid to employees. As salaries and wages start to decline in relation to real output (i.e. the unit labour cost), inflation will start to fall as this component constitutes the major explanatory variable in the inflation equation.

From a fiscal point of view, interest rates influence the expenditure components of the tax base, so that any change in the repo impacts on the level of tax revenues received by government. Exchequer issues are also influenced by a change in the interest rate in that as domestic interest rates start to rise, the interest paid on government will rise as well. However, this is not the only effect and cognisance will also have to be taken of the secondary impact of a rising PSBR (public sector borrowing requirement). The secondary impacts relate to a lower level of government saving (or raised level of government dissaving) as it is this decline in liquidity from the associated crowding out effect of government, that eventually puts pressure on the domestic savings/investment differential. Once savings start to deteriorate, long-term capital market interest rates start to react to the lower level of liquidity and accordingly begin to rise. Rising capital market rates in conjunction to the raised level of the money market rates (the prime and repo) hence have a significant impact on the expenditure components of the economy as illustrated in the model.

The flow chart is used as a means to illustrate these and the other major linkages between the repo/bank rate and the real side of the economy. It also suitably illustrates the importance of the foreign and labour sectors of the economy in the price formation process and makes specific reference to the output gap and commensurate capacity constraints in the inflationary process.

The lightly coloured blocks of the flow chart essentially indicate variables that are

exogenous to the model, i.e. they have the ability to impact on the results of the model, but are not in themselves affected by the results of the model. These exogenous variables include foreign demand, foreign inflation and the exchange rate which are all incorporated in the foreign sector. The exogenous variables of the government sector essentially comprise tax rates and the level of nominal consumption expenditure and real investment by the general government. The repo rate/bank rate and the exchange rate is initially treated as exogenous in the model, but these can be changed so that repo and/or the exchange rate reacts to the results of the model by means of an endogenous behavioural equation. The multiplier analysis of the next chapter will make reference to this policy reaction function in which repo is allowed to change, as a further means to illustrate the macro-economic intricacies in respect of the model.

The SARB's recent adoption of the inflation targeting framework calls for accurate forecasting and policy simulation models that are suitable for understanding the intricacies of the macro-economic environment. The following chapter is dedicated to the assimilation of various exogenous monetary policy shocks in an effort to determine how the full model (including the monetary sub-model) reacts to these monetary impulses. The results of these impulse shocks will not only give clarity on the transmission mechanism of monetary policy, but can also be used to ascertain if the model is robust and suitable for policy simulation or not.

CHAPTER 8 SIMULATIONS WITH THE SARB QUARTERLY MACRO-ECONOMETRIC MODEL

8.1 Introduction

The emphasis of this chapter is on the analytical interpretation of the results of the model now that the initial estimation of the behavioural relationships of the monetary model (i.e. structural analysis) has been completed. It therefore concerns the simulation of the model under various alternative scenarios or shocks (i.e. policy evaluation). There are various reasons for this form of testing of the model, and perhaps the most important one relates to the fact that a well specified model, or one that is structurally sound, is more likely to generate good forecasts and policy alternatives than a poorly specified one. This generally implies that once the model has been shocked with a monetary impulse, the results from these ex post or historical simulations can be compared to the actual (original) data of each endogenous variable to provide a useful test for the validity of the model that is under consideration (Pindyk & Rubinfeld, 1998 : 383).

Three separate simulation exercises were performed with the SARB quarterly econometric model in order to test the macroeconomic consistency and stability properties of the monetary sub-model. These tests consist of a series of dynamic simulations in which different time paths have been set for one or more of the exogenous variables of the model. Alterations to the repo rate has been used in all three instances to illustrate the reaction of the model to this monetary impulse. For this purpose, a baseline scenario was first determined by solving the model over a twenty-quarter period from the first quarter of 1995 to the fourth quarter of 1999. The actual values of the exogenous variables have been used, so that when the least squares residuals of the stochastic equations are added back to each equation, the model replicates the actual (original) value of the endogenous variables in the baseline scenario.

The results of these tests can hence be used to confirm the findings from the estimated structural equations, and secondly give further evidence in formulating an opinion of the monetary transmission mechanism. The first test or shock will be used to determine whether the model is in fact stable, while the next two will be used in an effort to determine whether the model reacts in accordance to the conventional monetary and economic theory as advocated in this study.

8.2 A test for model stability

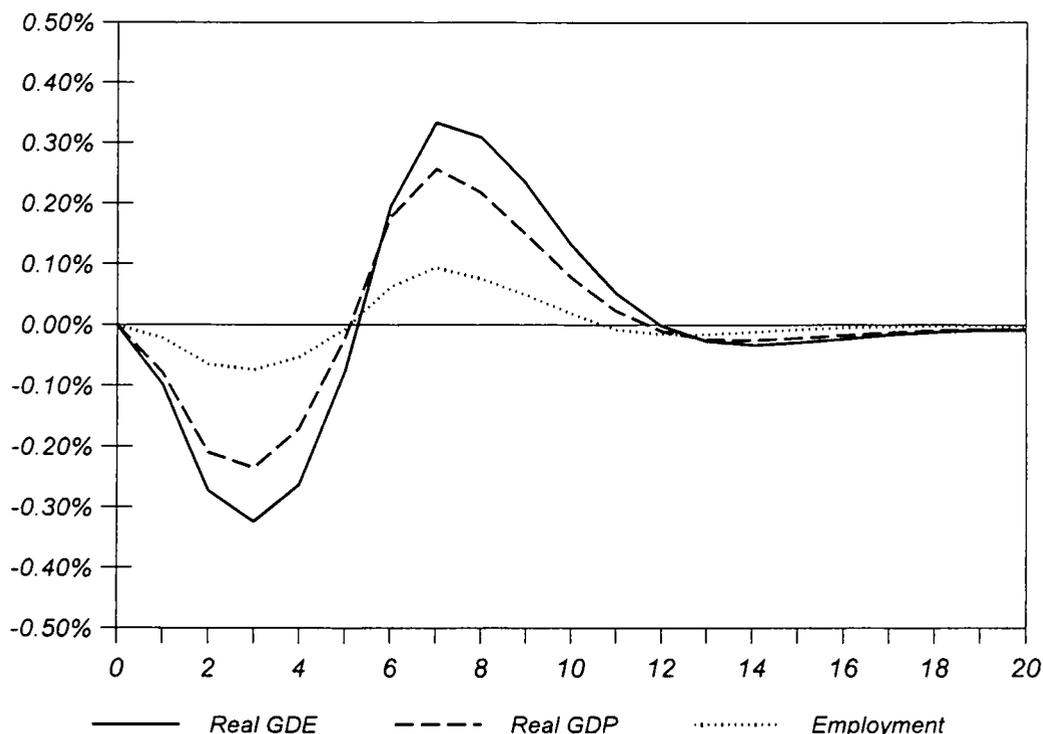
Kmenta (1971) offers a suitable method in order to test the stability of the model and to determine whether it is in fact robust or not. He suggests that this can be achieved by analysing the time paths of endogenously determined variables in response to shocks in the exogenously determined variables. The model can then be considered stable if, given a situation where the exogenous variables are held constant through time, the mean values of the endogenous variables tend to settle down at some constant level, and do not either explode or display a regular oscillatory movement over time (Kmenta, 1971: 592).

This essentially means that when the equilibrium solution of the model is shocked by a once-off change in an exogenous variable such as the repo rate, the values of those variables determined by the model should eventually return to their steady equilibrium state or level. For this purpose the repo was shocked by a once-off 10 per cent (or approximately 1½ percentage points) in the very first quarter of the twenty-quarter simulation period. The repo rate is assumed to maintain its normal time path for the remainder of the simulation period, so that it is merely the effects of the endogenous variables in reaction to this once-off monetary impulse that is measured.

Figure 36 illustrates the trend of three real sector variables, i.e. the real gross domestic product, the real gross domestic expenditure and the level of employment in the non-agricultural sector. For all three variables, the rates of growth seem to return to their normal

equilibrium state within a period of approximately 14 quarters. This suggests that the model is indeed stable and does not either explode or show a tendency to frequently oscillate around its equilibrium levels.

Figure 36 : The change in the real sector and employment



Once the model has been declared stable and robust, it becomes plausible to perform two alternative policy simulations. Intriligator (1996) describes policy evaluation as the use of an estimated econometric model to choose between alternative policies by simulating alternative policies and to make conditional forecasts of the future values of relevant variables under each alternative (Intriligator, 1996: 4). The first policy simulation is to test the macroeconomic impact of a sustained increase of 10 per cent in the repo rate (1½ percentage points) for a full year, while the second is to test the same scenario except that repo is now allowed to find its own equilibrium level after the initial shock.

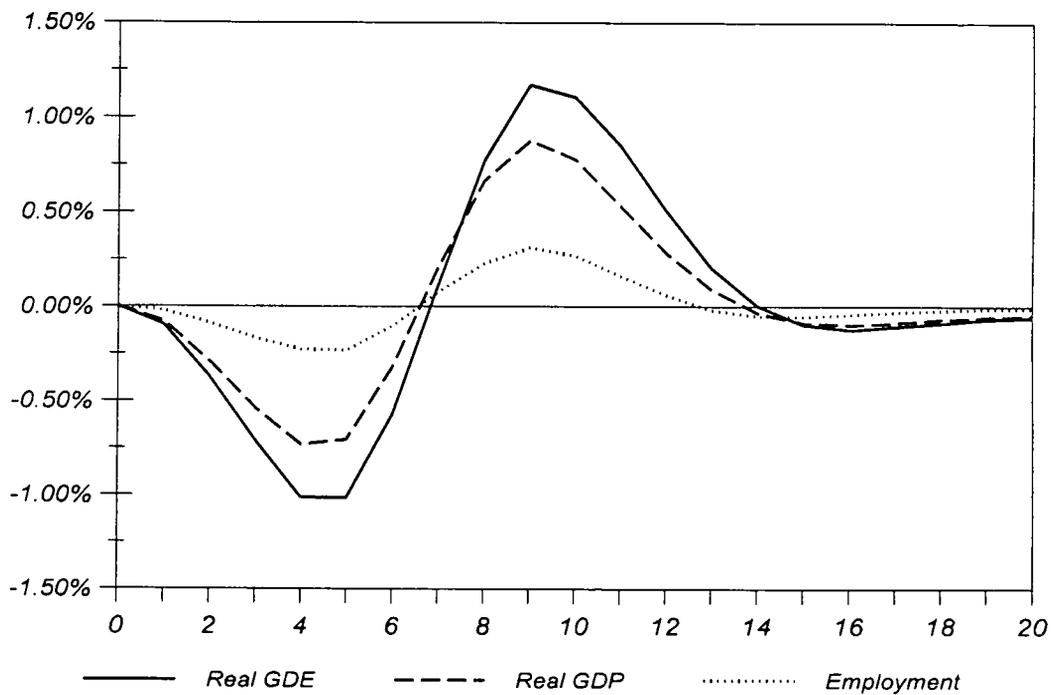
8.3 A sustained increase in exogenous repo rate for 1 year

Repo is exogenous in the model so that it has an influence on the various key macroeconomic variables, but is not in itself influenced by the magnitude changes of these variables. The alternative scenario assumes a new trend for repo over the very first year of the five year simulation period. Repo has consequently been raised with 10 per cent which is tantamount to a nearly 1½ percentage point increase in the repo over the first four quarters of the twenty quarter simulation period. Changes in the prime overdraft rate reflect the change in repo in the model, which essentially means that the level of the prime overdraft rate will increase simultaneously and to the same extent as the change in repo. The results of this simulation were then compared with the values of the endogenous variables of the baseline in order to determine the multiplier impact of this policy induced shock.

The increase in repo immediately reduces the level of personal disposable income in the model so that real final consumption expenditure of households starts to decline (see chapter 7.4 on the determinants of real final consumption expenditure in the model). In addition, the higher investment input cost component (user cost of capital) will also start to have an impact on the real gross fixed capital formation expenditure of the private sector (see chapter 7.5 on the determinants of real gross fixed capital formation in the private sector). The combined impact of these two real demand aggregates is set to significantly reduce the rates of growth in real gross domestic expenditure and the real gross domestic product during the first 6 quarters of the simulation period. The year-on-year rates of growth in real gross domestic expenditure for the very first year is hence expected to be approximately 0,55 percentage points lower than the growth rates of the baseline simulation. For the second year, these rates of growth are estimated to be only 0,18 percentage points lower. Positive real expenditure growth impacts can be expected during the third year of the simulation in which the year-on-year rates of expenditure growth are 0,91 per cent above those of the baseline scenario for the corresponding year.

Figure 37 depicts the time trend plot of the difference between the rates of growth in the real gross domestic expenditure of this alternative scenario, and that of the baseline scenario. In addition, the time trend plots of the real gross domestic product and employment in the non-agricultural sector have also been added to illustrate the effects repo has on the real side of the economy.

Figure 37 : The change in the real sector and employment



The graph shows that with the initial increase in repo, both real gross domestic expenditure and real gross domestic product decline immediately. As the generation of employment opportunities depends on real economic activity, the growth rate in employment tends to trace real output. The graph also shows a fairly similar trend to that of the model stability graph, and that it is merely the magnitude of the oscillation that differs, i.e. due to the fact that repo remains at the higher level for a full year and not just a single quarter.

Figure 38 : The change in the rates of inflation

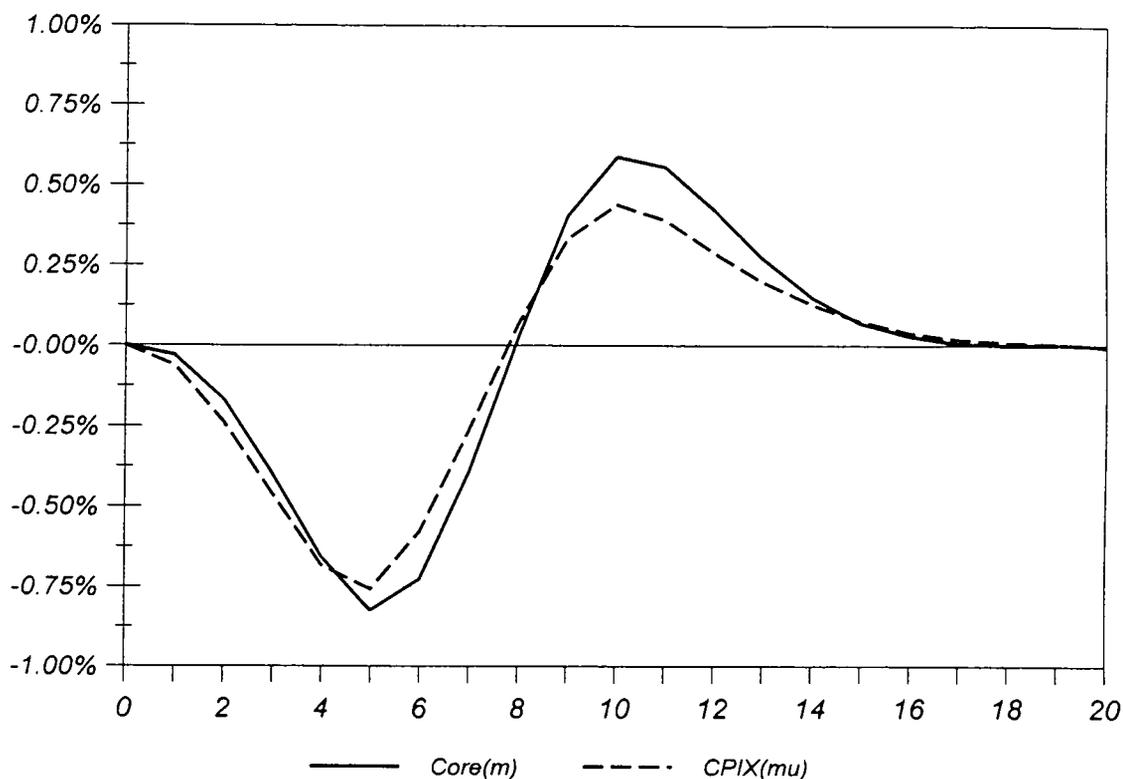


Figure 38 shows the reaction of the two most important inflation variables to the higher level of repo during the first year. Both the rates for core inflation in the metropolitan area and the rate of headline inflation excluding the impact of interest on mortgage bonds in the metropolitan and urban areas (i.e. the so-called CPIX(mu)) show an immediate but gradual decline to approximately $\frac{3}{4}$ of percentage point below the rate of inflation in the baseline scenario by the sixth quarter of the simulation period. The uptick in inflation between the tenth and twelve quarter can be ascribed to rising demand pressures, but even the highest point of this increase is still smaller than the greatest decline indicating that overall inflationary pressures can be expected to decline with a rising repo over the long-term.

The monetary model is an important addition to the macro-model and it is hence plausible to see how the M3 monetary aggregate and the claims on the domestic private sector react

to the raised level of repo. The following graph (figure 39) illustrates that the growth rates in M3 money supply and the claims on the domestic private sector follow a similar trend. However, it may well be worth mentioning that it is not the initial impact of interest rates that dictate the movement in these monetary aggregates, but rather the secondary impacts that the repo has on domestic demand and income. This is borne out by the fact that these trends track the trend in the real gross domestic expenditure and real gross domestic product of figure 37 fairly closely, and was also a contentious point alluded to when the estimation of the monetary aggregates and claims was undertaken in chapter 6.4.1 and chapter 6.4.2 of this study.

Figure 39 : The change in money supply and claims on the domestic private sector

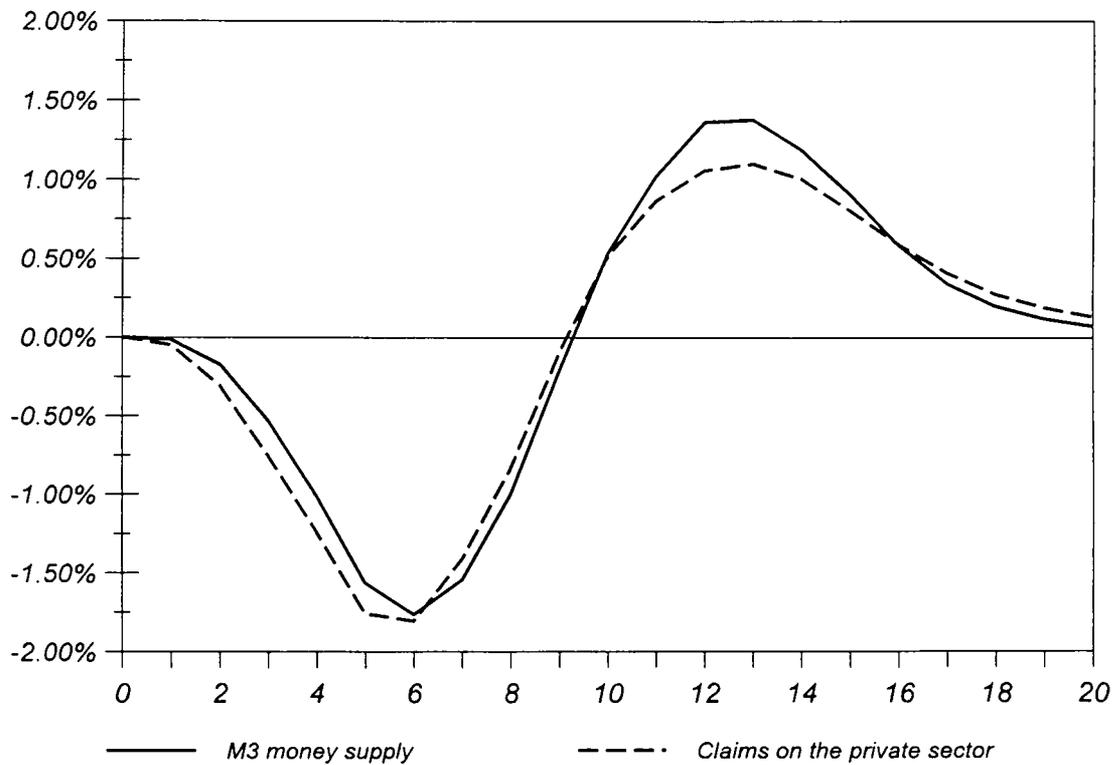


Table 9 gives a yearly representation of these trends in order to determine the overall impact of the increase in repo after the full 20 quarters.

Table 9 : The effect of a sustained 10 per cent increase (1½ percentage points) in repo over 1 year

| Year | Real GDE | Real GDP | Employment | Inflation CPIX(mu) | M3 money supply |
|------|----------|----------|------------|-----------------------|--------------------|
| 1 | -0,55 | -0,41 | -0,13 | -0,36 | -0,43 |
| 2 | -0,18 | -0,04 | -0,01 | -0,38 | -1,47 |
| 3 | +0,91 | +0,62 | +0,20 | +0,36 | +0,68 |
| 4 | -0,01 | -0,04 | -0,04 | +0,11 | +1,02 |
| 5 | -0,08 | -0,06 | -0,01 | +0,01 | +0,18 |
| Sum | +0,09 | +0,07 | +0,01 | -0,26 | -0,02 |

Table 9 illustrates the link between repo and its effect on domestic economic growth and demand, as well as these impacts on employment, inflation and the M3 money supply. The results of the model show an immediate impact on economic activity and employment during the very first year, whereas the impact on inflation and the M3 money supply seems to be spread over the first two years. The fact that inflation reacts to lagged effects of capacity surplus and constraints is perhaps the most important reason attributing to the trend in inflation over the five year period. As the impact of domestic inflation is first excluded in order to estimate the real M3 money supply balance equation in the monetary model, the mere fact that inflation is then added back to these real money balances in the model implies that nominal M3 money supply tends to track the trend in inflation fairly closely, albeit with a slight lag. Another interesting observation is that after three years, real growth and domestic demand would have recovered the losses incurred during the first two years. Inflation would also be largely reduced with nearly ½ a percentage point after the three years, i.e. despite the uptick during the third year.

8.4 A sustained increase in endogenous repo rate for 1 year

This alternative is similar to 8.3, but with the exception that repo is allowed to react and respond to the trend in the macroeconomic variables of the model in the subsequent five years of the simulation period. Exogenous repo has consequently been altered in the model to represent an endogenous policy reaction function. The policy reaction function is used to determine the initial macro economic impact of the change in repo, and secondly to determine the secondary effects of how endogenous repo responds to the changing trend in the major macro economic variables. As repo now represents a behavioural equation, the error term (residual) has hypothetically been increased with an additional 10 per cent (1½ percentage points) over the first year of the simulation period. The introduction of this policy reaction function can be seen as a further attempt to replicate as realistically as possible the likely macroeconomic impacts of a change in repo²⁰.

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The policy reaction function for the repo rate used in this study represents a combination of the most important (ex post) economic variables in the monetary policy formulation and implementation process. In his eclectic approach to monetary policy, the previous governor of the SARB (Dr Stals) would evaluate the significance and importance of each of these variables prior to announcing his stance on the adjustment to the repo. This essentially means that the relevance of each of these variables could change from time to time (depending on the prevailing economic conditions), and bears testimony to the futility of specifying the parameters of the policy reaction function in the context of this study. It is furthermore worthwhile mentioning that the policy reaction function has changed with the new inflation targeting framework adopted by the SARB since February 2000, and it is the (ex ante) forecast of inflation, and its deviation from the prescribed target that becomes the explicit anchor or ultimate objective for monetary policy implementation (see Mboweni, 2000: 62).

The policy-reaction function used to define the secondary macro economic impacts on repo consists of the following four key explanatory variables²¹ :

- the current account of the balance of payments as a ratio to nominal gross domestic product ;
- the growth rate in real gross domestic product ;
- the growth rate in the M3 money supply per unit of production ; and
- the actual rate of headline consumer price inflation, excluding the impact of interest rate costs on mortgage bonds, i.e. CPIX(mu).

Any improvement in the current account of the balance of payments tends to alleviate domestic liquidity pressures and helps replenish the level of the net gold and other foreign exchange reserves. Under this scenario where everything else remains the same, the build up of reserves not only alleviates domestic liquidity pressures, but also alleviates pressure on the level of the exchange rate of the rand. In the context of the model, once the rand starts to appreciate in relation to the baseline scenario, imported cost pressures from abroad will subside, leading to an overall lower rate of inflation. Inflation is also included as an explanatory variable in its own right in the policy reaction function, so that the initial impact of an improvement in the current account of the balance of payments has certain secondary effects as well.

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Various other variables can also be included in the policy reaction function such as foreign interest rates, salaries and wages, exchange rates, the output gap and the terms of trade etc. However, the four variables currently in the endogenous repo equation essentially incorporate all the main effects that need to be taken into consideration. For example, foreign interest rates are exogenous in the model, and as a constant will not influence the movement of repo during the simulation. Other factors such as salaries and wages and exchange rate movements will eventually feed through to inflation (which is included in the reaction function), while pressures from the output gap is partly reflected by the growth rate in real GDP. The terms of trade affects the current account of the balance of payments, which is already an explanatory variable in the equation.

The real rate of economic growth offers a measure of the current state of domestic economic activity. If the monetary authorities are of the opinion that the current rate of growth is too excessive in relation to the long-term potential growth rate (i.e. that the economy may be starting to overheat which can lead to possible inflationary pressures associated with these capacity constraints), they may well be obliged to follow more restrictive monetary policy measures in order to ensure and maintain sustainable long-run economic growth.

Excessive money supply growth in relation to actual output levels inevitably aggravates demand-pull inflationary pressures over the long-term as there is now more money chasing the same amount of goods produced in the economy. The actual level of the inflation rate is also included in the monetary policy reaction function and under the new regime of inflation targeting, it will have the highest and only weight. However, for the purposes of illustration it was decided to also include these other variables in the policy reaction function as they are all interlinked and all have consequences for inflation. At any rate, it would be futile to think that you can merely raise repo to combat inflation, if you have not first considered from where these inflationary pressures have emerged.

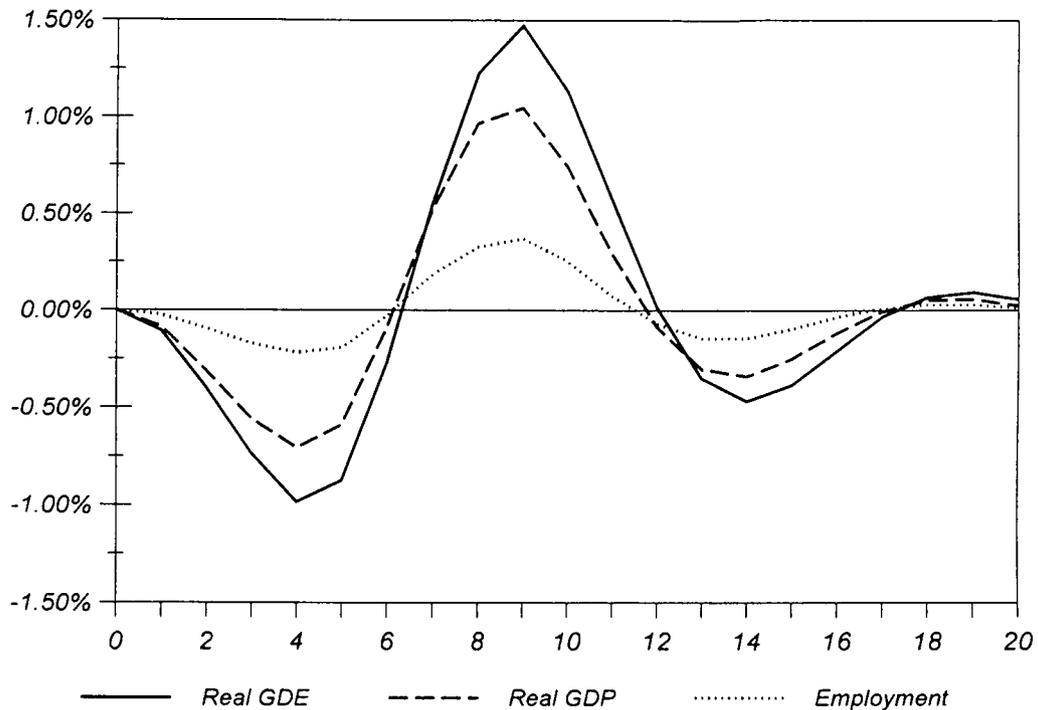
One could argue that monetary policy decision-making has changed markedly over the years. Under the new inflation targeting regime, the Bank in agreement with the Department of Finance, have opted to target the overall consumer price inflation excluding mortgage bond interest rate costs, i.e. as measured for the metropolitan and urban areas (CPIX(μ)). The inflation target has been specified in the governors statement on a new monetary policy framework as achieving an average rate of increase in CPIX(μ) inflation of between 3 and 6 per cent for the year 2002 (SARB, June 2000: 60).

The numerical inflation target becomes the ultimate objective, and the immediate focus on intermediate targets such as the growth in money supply falls away because an intermediate target can only be responded to when it is the dominating factor determining

inflation within a specified time frame. However, the governor of the Reserve Bank did mention in the same address that the growth in money supply will still be monitored closely together with other economic indicators. These include the level of international interest rates, the shape and position of the yield curve, changes in nominal and real salaries and wages, changes in employment, nominal unit labour costs, the gap between actual and potential output, money-market conditions, asset prices, the overall balance of payments position, the terms of trade, exchange rate developments and the public sector borrowing requirement (SARB, June 2000: 59). This essentially means that any one of these indicators, or combination thereof, can be included in the policy-reaction function. The four variables selected for the policy reaction function in this study can be seen to include the effects of most of these monitored economic indicators, i.e. with the exception of asset prices which are not provided for in the model. However, asset prices can be seen to reflect company profits (or gross operating surpluses), which are indirectly accounted for in the policy reaction function via the GDP variable.

The results of this scenario in which endogenous repo has been increased with 1½ percentage points are fairly similar to those of the one-off increase in repo over the very first year. Figure 40 shows the impact of the real sector to the change in endogenous repo. Both the real gross domestic product and real gross domestic expenditures tend to reflect the same magnitude change over the very first year, but during the outer years the peaks and troughs of the trend in economic activity are far more pronounced than those determined for the exogenous repo rate adjustment. Employment growth in the non-agricultural sector is primarily driven by the growth rate in real aggregate output and accordingly reflects the five-year cyclical trend set by the rate of growth in real gross domestic product.

Figure 40 : The change in the real sectors of the economy and employment



The rate of inflation measured by the core and CPIX(μ) inflation is also somewhat lower than the baseline scenario, and can partly be attributed to the immediate decline in economic activity over the first year, and to the lower inflation expectations over the first and second year of the simulation period. The rising trend in inflation during the third year are the direct consequence of capacity constraints arising from the higher levels of real domestic demand during the second and third year. The trend depicted by repo in figure 41 is the actual trend of endogenous repo once the initial addition of 1½ percentage points over the first year has been removed, i.e. how endogenous repo reacts to the initial decline in economic activity and inflation. Repo seems to react fairly slowly to the decline in real domestic demand, and only reaches its lower turning-point after 6 quarters, i.e. nearly two quarters after the lower turning-point in real growth, and one quarter after the lower turning-point in inflation. However, as domestic economic activity starts to increase, and inflationary pressures begin to rise, repo starts to increase as well, and accordingly reaches its upper

turning-point during the 11th and 12th quarter.

Figure 41 : The change in the rates of inflation

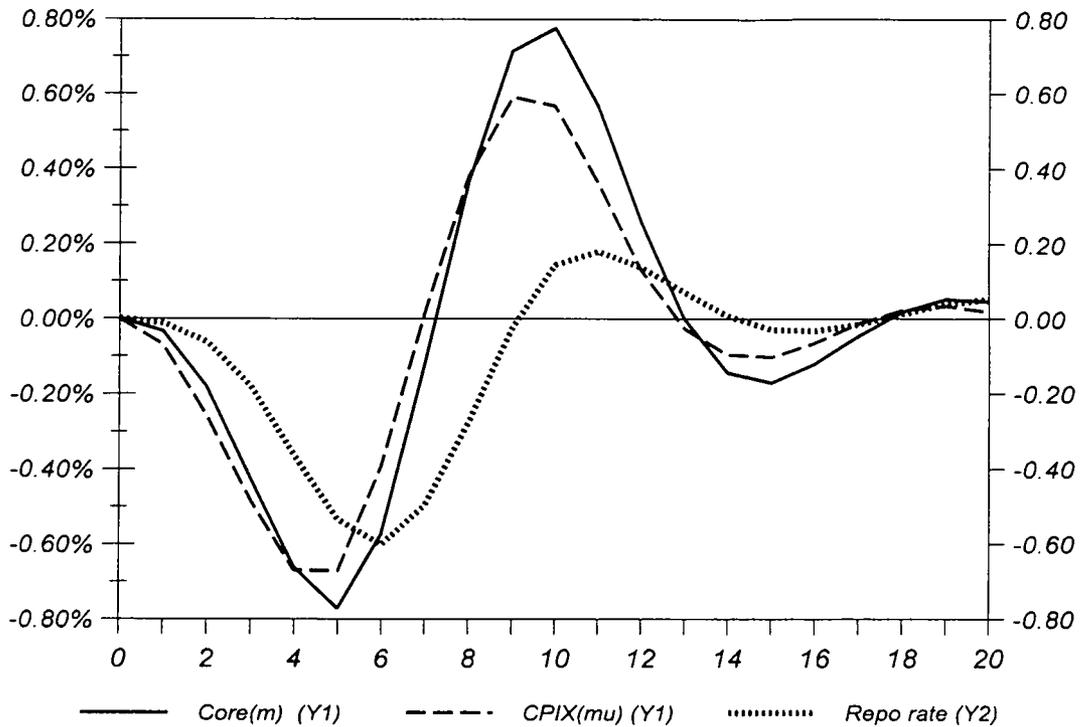


Table 10 gives a yearly representation of these trends in order to determine the overall impact of the increase in endogenous repo after the full 20 quarters.

Table 10 : The response of endogenous repo and key macroeconomic variables to an exogenous shock

| Year | Real GDE | Real GDP | Employment | Inflation CPIX(mu) | Repo |
|------|----------|----------|------------|-----------------------|-------|
| 1 | -0,56 | -0,42 | -0,13 | -0,33 | -0,15 |
| 2 | +0,16 | +0,21 | +0,08 | -0,17 | -0,48 |
| 3 | +0,80 | +0,50 | +0,16 | +0,41 | +0,10 |
| 4 | -0,36 | -0,25 | -0,11 | -0,07 | +0,01 |
| 5 | +0,05 | +0,03 | +0,02 | +0,01 | +0,02 |
| Sum | +0,09 | +0,07 | +0,02 | -0,15 | -0,13 |

The table illustrates the link between endogenous repo and its effect on domestic economic growth and demand, as well as these impacts on employment and inflation. The results suggest that endogenous repo declines with 0,2 percentage points during the very first year, and by 0,5 percentage points in the second year, i.e. in response to the 0,6 percentage point decline in real gross domestic expenditure during the first year of the simulation period. It is also interesting to note that the immediate decline in endogenous repo brings about an improvement in real domestic economic activity as early as the second year of the simulation (bearing in mind that real economic activity was still negative during the second year of the previous similar exercise in which exogenous repo was reduced with 1½ percentage points during the first year).

The model's response has certain implications for the implementation of monetary policy measures. If the full impact over the first two years is considered, i.e. where the initial impact of the 1½ percentage points increase in repo is added back to the endogenous trend in repo, it will amount to an approximate change of 0,8 percentage points (the sum of +1½, -0,2, and -0,5), while the corresponding change in CPIX(mu) inflation for the first two years amounts to 0,5 percentage points (the sum of -0,3, and -0,2). This essentially means that in order for the monetary authorities to change inflation by roughly a ½ percentage point, repo has to be increased with 0,8 percentage points, i.e. at a ratio of 1:1,6 between inflation and repo over the first two years. This ratio can also be calculated over the full five-year period of time²². The results suggest that in order to lower inflation by 0,2 percentage points, repo will have to increase by roughly 0,9 percentage points (0,8 per cent over the first two years, plus approximately 0,1 per cent for the last three years), i.e. at a ratio of 1:4,5 between inflation and repo. A true reflection of the ratio can safely be assumed to lie somewhere between these two extremes, but perhaps closer to the ratio obtained in the

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Although for practical reasons, it might be safer to concentrate mainly on the two-year scenario for the relationship between repo and inflation, as there are many other unrelated impacts that have the potential to distort the trend in inflation over such a long period of time (causing this result to become ambiguous over the longer-term).

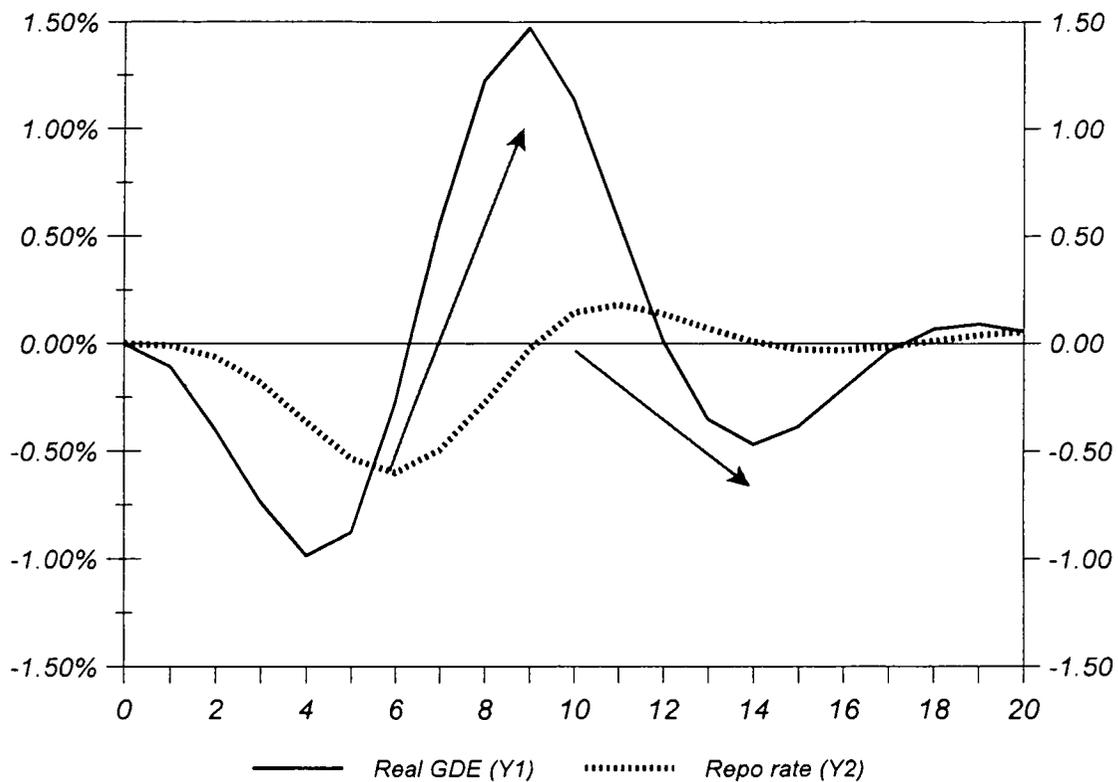
two-year scenario. This means that a ratio of between 1:2½ and 1:3 can reasonably be accepted, and implies that repo has to be increased with nearly 2½ to 3 percentage points to lower inflation by 1 percentage point. An unfortunate finding of this result is that the monetary transmission mechanism takes a fairly long period of time to cause a decline in inflation, and that the relationship between a change in repo and a change in CPIX(μ) can be approximately two years.

8.5 Possible implications for monetary policy and the transmission mechanism

The external shocks implemented in 8.4 have been used once again in an effort to illustrate the implications of monetary policy with specific reference to the transmission mechanism, and how repo affects the real sector of the domestic economy. In accordance hereto, endogenous repo was increased with 1½ percentage points over the first year of the simulation period (i.e. by adding 1½ percentage points to the error term of the endogenous equation). The results of this simulation can then be used to track the real effects of monetary policy, and how repo can be used to lower domestic demand and ultimately inflation over the long-term.

Figure 42 illustrates the linkage between the interest rates and real domestic economic activity. The graph shows that there seems to be a definite relationship between the pass-through between the rising trend in the repo rate and the declining trend in real domestic demand, albeit with a lag. The indicator arrows point out the lag structure (in quarters) that a current change in repo has on the future growth rate of real domestic demand.

Figure 42 : The change in the real sector and the interest rate

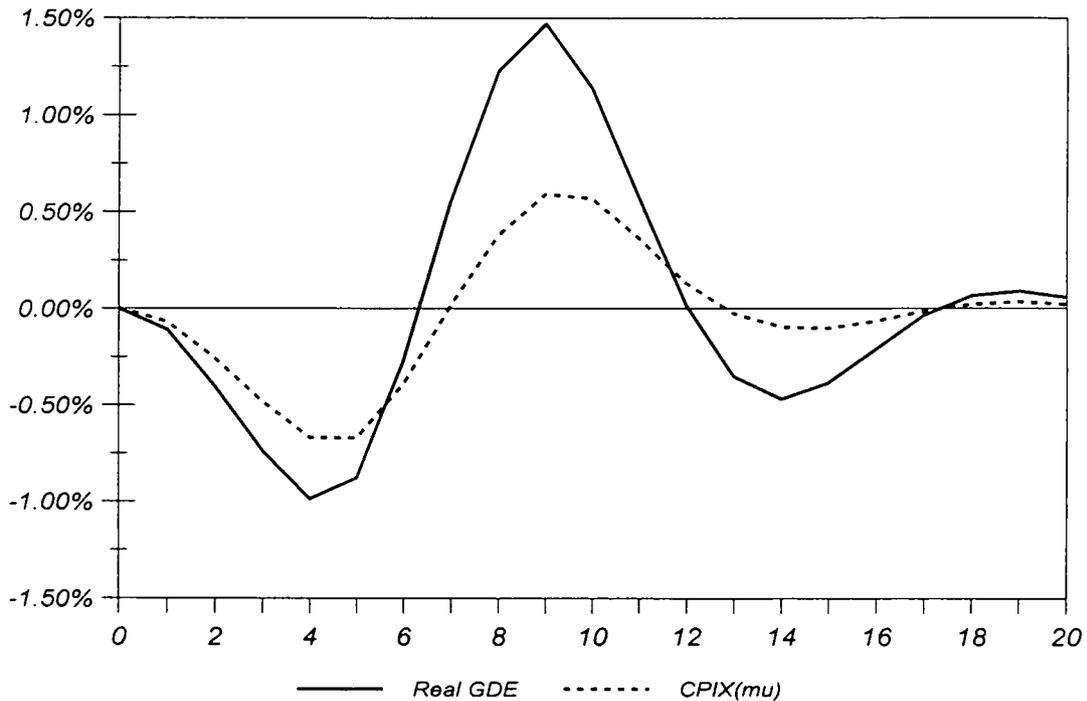


The first arrow indicates the lag structure between the lowest turning point of endogenous repo to the cyclical upper turning point of real domestic demand which amounts to nearly 3 quarters (6th quarter to the 9th quarter). The second arrow compares the upper turning point of repo and the lower turning point of real domestic demand which is also in the region of 4 quarters (10th quarter to the 14th quarter). This would seem to indicate that it takes between three and four quarters for a monetary policy shock to have a maximum effect on the domestic demand of the economy.

Figure 43 shown below illustrates how inflation reacts to the change in real aggregate domestic demand. It can therefore be used as a suitable measure to signify the lag-structure between these two key economic variables, so that the relationship can easily be

identified by the mere inspection of the two trends. The graph indicates that the lag between real output and CPIX(mu) inflation is fairly quick at approximately one quarter, i.e. the lower turning point in the real gross domestic expenditure (4th quarter) is succeeded by the lower turning point in CPIX(mu) inflation after a single quarter (5th quarter). This phenomenon is also true for the upper turning point in which real domestic demand (9th quarter) is succeeded by the upper turning point in inflation after one quarter.

Figure 43 : The change in the real sector and CPIX(mu) inflation

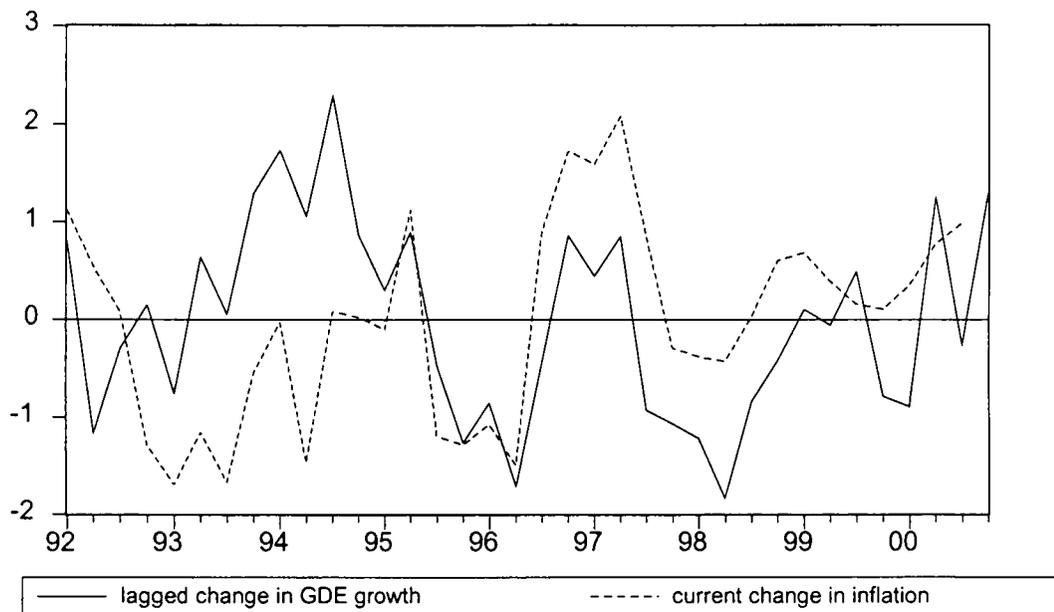


Historical evidence should be able to validate this hypothesis that there is indeed a fairly quick pass-through from the real sector to inflation. In an effort to test this hypothesis, actual rates of CPIX(mu) inflation and the real rates of growth in the gross domestic expenditure (GDE) have been superimposed to illustrate the possible linkage between the two. However, as these two rates are fairly volatile it was decided to rather smooth them over a period of 1 year, i.e. to analyse their respective long-term trends. As the hypothesis states that a change in the GDE growth rate should lead to a change in the CPIX(mu) rate

of inflation within one quarter, a graph depicting the first difference (change) of these two long-term trends should help to clarify if there is a quick pass-through between the real sector and inflation. Although there seems to be inconclusive evidence prior to 1992, the following graph shows that there is indeed evidence of a one quarter relationship after 1992. This seems quite plausible due to the fact that this period constitutes a large portion of time in which the model has been estimated.

Figure 44 depicts the first difference of both the long-run growth rate in GDE and the long-run CPIX(μ) inflation rate, i.e. with the exception that the change in GDE growth is lagged by one quarter so that the current change in the inflation rate is linked to the previous change in long-run economic activity.

Figure 44 : The link between real economic activity and inflation



This has the desired effect that the current change in the rate of growth in GDE growth can be linked to the trend in the rate of inflation during the very next quarter. The change in both these variables have been normalised around their means to make it easier to analyse and interpret the results. Rising trends in the time series therefore indicates that long-run

GDE growth rates and long-run inflationary pressures are consistently rising, while falling trends in the time series indicate the contrary. The graph remarkably shows that the peaks and troughs of the lagged change in the long-run rate of growth in GDE clearly coincide with the peaks and troughs of the change in long-run inflation (specifically during the period 1992q3 and 1999q3). This provides some evidence that changes in long-run economic activity leads long-run inflation by a period of one quarter. Although this is perhaps a rather crude method of illustration, it should be emphasised that results obtained during the period prior to 1992 proved to be inconclusive.

The structure of the econometric macro model therefore suggests a quick follow-through between real aggregate demand and inflation, but a fairly slow follow-through between interest rates and real domestic demand. The combination of these two trends imply that it will take just over a full calendar year for interest rates to have a maximum impact on inflation. The result in this exercise differs to the previous result in which the lag was longer and is probably attributed to the fact that this analysis is based on the maximum impact of the actual quarterly trends (i.e. the actual peaks and troughs) in the data, while the previous analysis was based on annual aggregate figures. As this exercise only attempts to elucidate the quarterly trend or lag structure between interest rates and real economic activity, it might be safer to accept the results of the aggregate annual figures when making predictions concerning the impact of inflation from a change in repo.

8.5.1 M3 money supply, income and interest rates

M3 money supply is the most important monetary aggregate in the model and the hypothesis has been made that the demand for money balances are rather determined by the level of income, and not so much by the change in interest rates (see the estimation of the M3 money demand function in chapter 6.4.1.4). This implies that money demand is income elastic and interest rate inelastic. The same simulation was used in which endogenous repo has been increased with 1½ percentage points over the first year of the five year simulation period in order to test this hypothesis. The following graph illustrates the subsequent change in M3 money supply balances, the change in the endogenous repo rate as well as the change in the growth rates of real gross domestic expenditure from the baseline simulation from this impulse shock.

Figure 45 : The change in the real sector and the M3 money supply

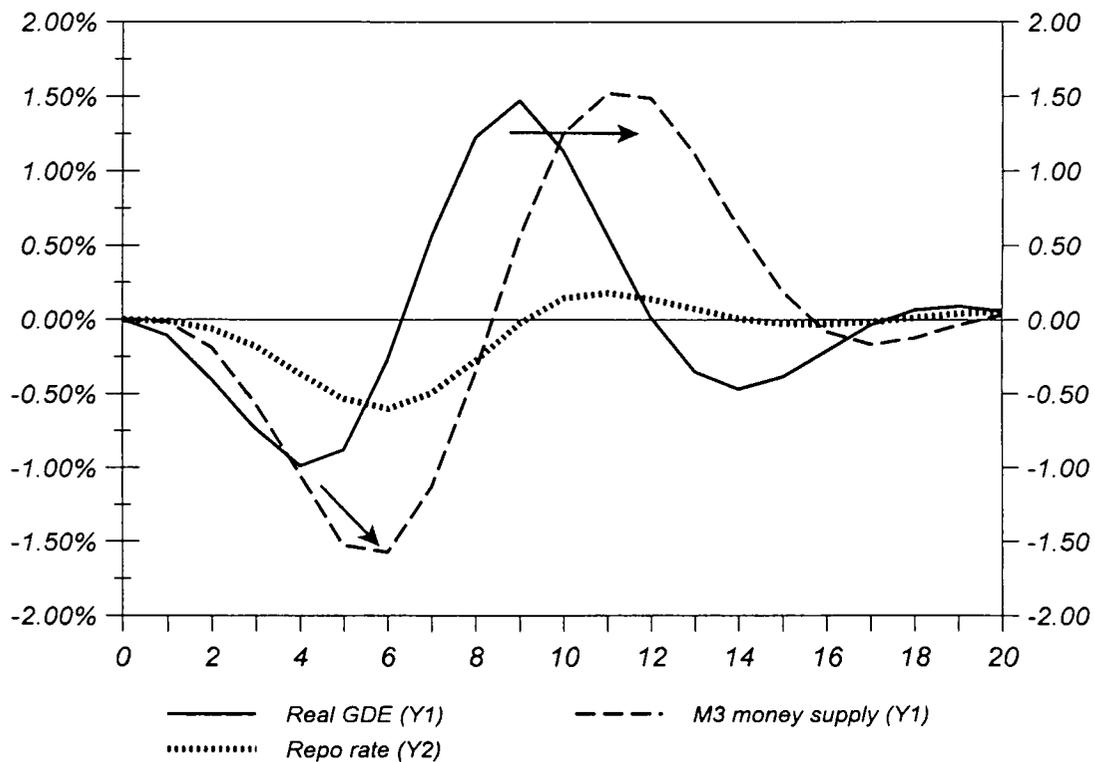


Figure 45 shown above depicts the strong correlation between income and the M3 money

supply balances, it furthermore illustrates a lag structure of between two and three quarters as indicated by the arrows. The magnitude of the change during the first trough is also of importance in that a one percentage point decline in real gross domestic expenditure is tantamount to a 1½ percentage point decline in M3 money supply after 2 quarters. The magnitude of the second cyclical peak indicates a 1:1 ratio so that a one percentage point increase in real domestic demand results in a one percentage point increase in money supply after 3 quarters. The results as illustrated in the graph lend further support to the hypothesis that money supply balances are predominantly determined by the secondary impacts of real domestic demand to the change in interest rates, and not so much by the initial increase in the interest rate itself.

8.6 Summary and concluding remarks on the results of the model

This chapter essentially forms the analytical section of the study in which the monetary sub-model is tested for authenticity in the context of the macro model of the South African Reserve Bank. Three alternative simulations were performed in order to assess the reaction of the model to alternative monetary policy impulse shocks.

The first shock analyses the effects of an increase of ten per cent (roughly 1½ percentage points) in the repo during the very first quarter of the five-year or twenty-quarter simulation period. Repo is assumed to be exogenous so that it has the ability to illustrate the once-off affect on the magnitudes (variations) of various key macro economic variables. The model's stability properties can hence be deduced by monitoring the trend in these variables. The results of this alternative scenario suggest that these trends do not display regular oscillatory movements or explode (increase exponentially) towards the end of the simulation period. Hence, the model (inclusive of the monetary sub model), can be declared robust and stable for alternative macro economic policy assessment purposes.

The second shock analyses the effects of an increase of 1½ percentage points in the

exogenous repo rate over the first year of the simulation period. The results of this impulse shock suggest that all the real macroeconomic variables react according to economic theory so that there is an inverse relationship between rising levels of domestic interest rates and the level of economic activity and growth. It was also found that employment tends to track the cyclical movement in output growth, so that the inverse relationship is also applicable to the rate of growth in non-agricultural employment. Capacity surpluses and constraints proved to have a strong impact on the trend in inflation, so that as soon as the economy starts to perform above its long-run potential, inflationary pressures would accordingly start to increase. These trends confirm the fundamental economic and theoretical reasoning of the structure of the macro model and render the model a useful tool in alternative monetary policy evaluations. Another interesting aspect of the results of the model was that conservative monetary policy measures applied consistently over time is absolutely essential in stabilising the overall price level and ensuring long-run sustainable growth. This was borne out in the results of the model in which it was shown that the initial short-term losses, i.e. in the form of reduced growth and employment opportunities, were more than compensated for in an environment of lower or reduced levels of inflation. In fact, long-run growth and employment actually increased to greater extent over the longer-term with the reduced level of domestic inflation.

The third scenario involves the use of a policy-reaction function to determine the effects of an impulse shock of a 1½ percentage point increase in endogenous repo over the very first year of the simulation period. These results were used to illustrate how repo can be expected to react to the change in growth and inflation. They also provide suitable insight into the change in magnitude and the lag structure of the effect of interest rates on these key macro economic variables, i.e. the transmission mechanism of monetary policy. The results suggest furthermore that lower rates of domestic inflation from the raised level of interest rates can only be expected to be realised after a long period of time (at least one year), while a fairly large increase in interest rates (2½ to 3 percentage points) would be required to bring inflation down with 1 percentage point. Economic activity is only expected

to react to the change in interest rates after a period of three to four quarters, while the reaction of inflation to the change in real domestic demand was found to be fairly quick.

The model has the added advantage that it indicates a lag structure of roughly 3 to 4 quarters between real incomes and the interest rate, i.e. where the lowest rate of repo is related to the highest peak in economic activity. This implies that it takes approximately one year for the monetary policy shock (change in repo) to have a **maximum** impact on real domestic demand. Inflation, on the other hand, was found to react fairly quickly to domestic demand (approximately one quarter). This reaction between inflation and real GDE was also corroborated by the trend in the actual historical figures during the period 1992 to 2000. The combination of these two trends imply that it will take slightly more than one year for interest rates to have a full impact on inflation. The difference between this conclusion and the result of the previous exercise (in which the lag is longer), reflects the fact that this analysis is based on the maximum impact of the actual quarterly trends (i.e. the actual peaks and troughs) in the data, while the previous analysis was based on annual aggregate figures.

The results of this scenario were also used in a further test to graphically confirm the hypothesis that broad money supply balances primarily react to the secondary impacts of domestic demand (i.e. after the level of interest rates have been raised), rather than the interest rate itself (see chapter 6.4.1.4 of this study). The graph shows that as the trend in M3 money supply traces the change in income fairly closely over the entire five-year simulation period (i.e. despite the increase in interest rates during the very first year), it was rather the change in incomes that influence the trend in broad money supply and that the interest rate was fairly inelastic in the function.

The results of the model therefore confirm the practical use of the macro-econometric model (incorporating the monetary model), as a suitable means to analyse the monetary transmission mechanism in South Africa. It also proves that the curtailment of domestic

money supply growth is absolutely essential to ensure price stability (even if it may mean short-term sacrifices), as it is essentially this price stability that eventually leads to sustainable higher economic activity (output) and employment in the long-run. The findings of this study therefore bear testimony to the Reserve Bank's mission to protect the value of the rand, and hence its relentless pursuance of a credible inflation targeting framework.

CHAPTER 9 CONCLUSION

The primary purpose of this study was to develop and estimate a monetary econometric sub-model with specific reference to the fundamental and theoretical factors that have relevance to the supply of, and demand for money in South Africa. The ultimate aim was then to incorporate this monetary econometric sub-structure in the existing macro-econometric model of the South African Reserve Bank, and to see how it performs. The reaction of the full model to certain pre-specified exogenous shocks was then firstly used in a multiplier analysis to determine whether the model was stable (robust), and secondly, to ascertain whether the results confirm fundamental "a priori" economic theory and reasoning. This process not only elucidated the dynamic linkages between the key economic variables of the model, but also gave valuable insights into the transmission mechanism of monetary policy in South Africa.

It becomes futile to discuss the intricacies of the links between the real and monetary sectors of the economy without commencing with a thorough study of the variables contained in the monetary analyses of the South African monetary sector. The study therefore entailed a gradual process in which the consolidated balance sheet of the South African monetary sector was elucidated. Specific reference has been made to the endogeneity of the money supply process in South Africa, and how the monetary authorities adjust domestic interest rates in order to achieve a desired effect on the stock of broad money supply and ultimately inflation (which is ultimately the primary goal of the authorities in an inflation targeting environment). The asset and liability structures of the consolidated balance sheet were also analysed in order to illustrate how broad M3 money supply can be derived from its statistical counterparts in the monetary analyses. After deriving broad money supply, it became necessary to determine the factors that are capable of influencing the trend (or growth pattern) in this monetary aggregate.

Money demand theories, as discussed in chapter 3, have evolved considerably over time,

originating from the direct and proportional relationship between the quantity of money and the price level advocated by Fisher's equation of exchange and the Cambridge approach. Fisher's equation of exchange relates the quantity of money in circulation to the volume of transactions and the price level by a proportionality factor called the "transactions velocity of money". The equation is not an identity but rather an equilibrium condition where money is held simply to facilitate the effectuation of transactions. Cambridge economists relate the quantity of money to nominal income and emphasise the effect of individual choice (i.e. what determines the amount of money an individual wishes to hold, given his desire to conduct a certain amount of transactions). The Cambridge formulation provided a more satisfactory description of monetary equilibrium by focussing on the public's demand for real money balances as the most important factor influencing the equilibrium price level. They also saw money as a store of value (i.e. not only as medium of exchange as Fisher did), and furthermore pointed out the role of wealth and the interest rate in determining the demand for money balances.

However, it was Keynes who provided a convincing explanation of the importance of the interest rate variable affecting money demand, when he emphasised his liquidity preference theory. Keynes postulated that individuals hold money with three motives, namely for transactions, precautionary and speculative purposes. The transactions motive is similar to the emphasis quantity theorists placed on the medium of exchange to conduct transactions, while the precautionary motive is also seen to create a demand for money as it was linked to unscheduled expenditures related to unforeseen circumstances. The speculative demand for money is what Keynes referred to as "liquidity preference" and focussed on the future level of interest rates (specifically bonds). Keynes argued that there is an interest rate range that could be seen as normal, and if the rate is above this normal rate, there is a tendency for people to expect it to fall and vice versa. Thus the interest rate is formally introduced in the demand for money function and could now be represented as an equation where the demand for real money balances is dependent on real income and the interest rate.

Friedman's neoclassical reformulation of demand for money states that an all inclusive definition for wealth should be employed, and that the rate of inflation also influences the demand for financial assets. He postulates that there will be a substitution from money to real assets as inflation starts to rise, and that the change in the price level therefore has an important impact on the individuals demand for holding money balances. Friedman hence emphasises that money is not only demanded as a medium of exchange for transaction purposes, but also as a store of value in times of high or rising inflation.

The evolution of money demand functions evolved to the inventory theoretic models used by Baumol and Tobin, and portfolio buffer stock models. Inventory models choose to ignore the motives for holding cash balances, and essentially view money demand as an inventory held for the conduct of transactions, i.e. where there is a lack of synchronisation between an individual's receipt and expenditure patterns. The buffer stock money approach produced a new variation in which money balances serve as a shock absorber for unexpected variations in income. The buffer stock approach therefore considers money to be the buffer until the individual or business is able to make an appropriate adjustment to bring their overall portfolios into equilibrium once again (i.e. a disequilibrium approach to money demand).

Portfolio adjustments advocated by buffer stock disequilibrium approaches are difficult to introduce in the context of the macro-econometric model. It was hence decided that the demand for money functions used in this study will be based to a large extent on the functions of money as a medium of exchange and a store of value. The demand for money functions proposed in this study are an extension of the work done by Contogiannis and Shahi (1982) in which a number of income and interest rate variables were considered for the estimation of the stable South African demand for money equations. Money demand functions estimated in this study primarily incorporate a hybrid of scale variables for transaction purposes (i.e. income), an interest rate cost of finance variable in the form of a dis/re-intermediation differential, the interest rate on substitute assets, and an inflation

variable allowing for the eroding impact of rising domestic prices. Incomes in the form of real economic activity best served the function as a medium of exchange, while inflation and interest rates (either own or substitute interest rates) helped address the store of value function. Inflation as an opportunity cost variable was also incorporated in many of the money demand functions of the econometric model.

The estimated money demand functions were then incorporated in the quarterly macro-econometric model of the SARB. The full model was found to be robust in that the shock impulses of a once-off adjustment to an exogenous variable did not induce the key variables of the model to either explode or oscillate indefinitely. This meant that the model was suitable for monetary policy simulation purposes and the assessment of how the real economic variables and inflation react to a change in repo, i.e. the transmission mechanism of monetary policy.

In order to test the model and see whether the results made fundamental economic sense, exogenous repo rate was adjusted with a hypothetical ten per cent (or 1½ percentage points) during the very first year of a five year simulation period. The results of the model suggested that economic activity declined in tandem to the rising level of domestic interest rates, and that the growth rate in real gross domestic expenditure (GDE) was nearly one per cent below the growth rate in the standard simulation after five quarters. Employment levels tracked the level of domestic output (GDP) so that employment losses were generated during the first year in line with the decline in GDE. Rates of inflation, as measured by the CPI for the metropolitan and urban areas (CPIX(mu)) also reflected trends in domestic capacity and consequently showed a similar pattern (albeit with a lag) to the decline in GDE. CPIX(mu) inflation was consequently approximated at 0,8 percentage points lower than the baseline after a year and a half. As repo was only shocked during the first year, the return to the baseline level for the remainder of the simulation period constituted a decline in repo. A further interesting phenomenon of the model was that the short-term disadvantages of the raised repo rate were fully compensated over the entire simulation period, and that there

were benefits to economic activity and employment over the long-run. In addition, the long-run benefits from a declining rate of inflation were also prominent in affecting the increase in real output and GDE. It is because of these long-run advantages that it is possible to infer that a small sacrifice in terms of the higher interest rates might be detrimental to the economy and employment over the short-term, but that there are definite advantages to be obtained from lower levels of inflation and the subsequent sustainable levels of real output and employment over the longer-term.

A further simulation was performed in which endogenous repo was increased with ten per cent (or 1½ percentage points). These results compared favourably and were fairly similar to the results of the alternative simulation in which the exogenous repo was changed by the same magnitude. However, this simulation had the added advantage that by tracking the trend in repo and CPIX(μ) inflation, it was possible to make a few deductions on the conduct and impact of monetary policy implementation. The results of this simulation suggested that by changing repo by 0,8 percentage points over the first two years, inflation could be lowered by a ½ percentage point (at a ratio of 1:1,6). If the full spectrum of time was considered, by changing the repo rate by 0,9 percentage points, inflation could be lowered by 0,2 percentage points (at a ratio of 1:4,5). On the assumption that the true ratio can be expected to lie somewhere between these two extremes (but possibly closer to the 2 year scenario), a ratio of 1:2½ or 1:3 can be expected. This signified that repo has to increase with nearly 2½ to 3 percentage points in order to lower inflation by 1 percentage point, but even this impact can only be expected to take place after a lag of 2 to 5 five years (but possibly closer to 2 years).

The model also has the added capacity to indicate the lag structure between real incomes and the interest rate. The results suggested that there is a lag of between 3 and 4 quarters between the lowest repo rate and the highest peak in economic activity, and indicated that it takes slightly less than one year for a monetary policy shock to have a maximum impact on domestic demand. Inflation in this model reacted fairly quickly to domestic demand

(approximately one quarter), and is corroborated by the trend in the historical figures during the period 1992 to 2000. The combination of these two trends implied that it will take slightly more than one year for interest rates to have a full impact on inflation. This result differed from the previous result in that this analysis was based on the maximum impact of the actual quarterly trends (i.e. the actual peaks and troughs) in the data, while the previous analyses were based on annual aggregate figures.

The policy simulations suggested a close link between real aggregate domestic demand and inflation, but that there was a fairly long lag structure between the interest rate and domestic economic activity. This essentially means that policy measures implemented by the monetary authorities to combat inflation will only bear fruit (i.e. lower inflation) after a period of at least one year has lapsed. However, it is often argued that there is a trade-off between inflation and real output growth, and that growth can be stimulated through an expansionary monetary policy, albeit at the price of some higher rate of inflation. The simulation exercises suggested on the other hand that this may well be true over the short-term, but over the longer-term, monetary policy measures aimed at curbing inflation will eventuate in higher levels of real income and employment growth. This is also perhaps why the primary objective of South Africa's monetary policy implementation (i.e. the mission of the SARB) is to protect the value of the currency. In so doing, the Reserve Bank will be able to obtain a stable financial environment that will be conducive for balanced and sustainable long-term economic growth that eventually benefits the country and its population as a whole.

The estimation and specification of this model can hence be seen as a further advancement in making the implementation of monetary policy more effective and even more transparent to the respective market participants of the South African economy. The results of the full model relate closely to the elasticities obtained from previous studies on the demand for money functions in South Africa, i.e. despite and ever changing environment. It is important to note that this model, as in the case of any other model, is uniquely specified. This would

suggest that the results of the alternative simulations of the model (plus the various conclusions concerning the lag for the pass-through of the transmission mechanism of monetary policy), should essentially only be seen as the starting point for further research. The model's results should accordingly not be seen in isolation, and these results (i.e. with specific reference to the actual lag structure, and magnitude changes between the real sector, inflation and the repo adjustments), should also be verified with different types of models such as the impulse response functions made available in the vector-autoregression (VAR) and structural VAR estimation techniques.

SUMMARY

Monetary policy essentially reflects monetary theory. As the financial system is complex and intricate in nature, it becomes virtually impossible to conceive without a theory to simplify its structure. This simplified structure should ideally be geared towards the generation of a transparent financial environment in order to enhance the effectiveness of monetary policy initiatives. To this end, a new monetary policy framework was adopted by the SARB in the year 2000, and is based on achieving a pre-determined inflation target over a specific period of time. The mission of the SARB to protect the value of the domestic currency hence remains the primary objective of the monetary authorities, and any assistance in increasing the transparency of the Bank's monetary policy initiatives will no doubt increase the overall effectiveness of monetary policy.

Inflation basically remains a monetary phenomenon and the rates of growth in domestic money supply and bank credit extension are important factors in the new inflation targeting environment. Accordingly, the Bank's actions are aimed at adjusting the repo rate to influence economic expansion and the demand for credit. It is essentially for this purpose that the monetary macro-econometric model has been estimated in this study, and furthermore to elucidate the links between the financial and real sectors of the economy. The model has been structured to reflect money demand theory and how the various domestic economic agents interactively react to a monetary policy impulse. Various alternative monetary policy simulations were performed on the model to determine if the model was robust, and whether it suitably reflected the intricate links between the various key sectors of the economy. The results of the model suggested that it was stable and suitable for policy simulation purposes, and that the monetary transmission mechanism in South Africa is fairly long. In addition, it was found that there was a close relationship between real economic activity and inflation, while the lagged impact on real output growth from a hypothetical change in interest rates was approximately one year.

The primary objective of the newly adopted inflation targeting framework is to achieve price and financial market stability over the long-term. As this framework is of a forward-looking nature, it becomes imperative to realise that monetary policy initiatives taken now, will result in (or influence) the possible outcome of the future. This process will even more importantly determine whether the SARB will achieve its inflation target or not. However, the sole purpose of this study was to develop a model that suitably illustrates the key links in the transmission mechanism, and not specifically to determine a model geared towards forecasting the future rate of inflation.

The structure and theoretical foundation of the model is not a guarantee for successful monetary policy implementation, but its importance in illustrating the links between the key sectors of the economy cannot be denied. This characteristic makes the model a useful tool in the wide arsenal of operational instruments at the Bank's disposal, and in the process induces an environment in which the monetary policy implementation process becomes more transparent. After all, it is the credibility and transparency of the monetary authority that enhances the various stake holders ability to interpret the signalling intentions of the central bank, and it is this that ultimately determines the effectiveness of monetary policy.

APPENDIX 1 : Variable codes and description

| <i>Code Name:</i> | <i>Description of variable</i> |
|----------------------|---|
| CABOP _{nsa} | Current account of the balance of payments, not-seasonally adjusted |
| CABOP _{sa} | Current account of the balance of payments, seasonally adjusted |
| CAPM _{nsa} | Capital movements, not-seasonally adjusted |
| CAPM _{sa} | Capital movements, seasonally adjusted |
| DEP _{ct} | Cheque and transmission deposits |
| DEP _{lt} | Long-term deposits |
| DEP _{odd} | Other demand deposits |
| DEP _{sm} | Short-term and medium-term deposits |
| DEP _{trn} | Total interest-bearing deposits |
| DUMEVK | Dummy variable for disruptive occurrences, (yield on Eskom stock) |
| GGFOR _{nsa} | Gross gold and foreign exchange reserves, not-seasonally adjusted |
| INV | Domestic investment variable, gross domestic fixed investment |
| LARBO _{sa} | Net other assets of the monetary sector |
| LRR _{nsa} | Liabilities related to reserves, not-seasonally adjusted |
| M1 | M1 monetary aggregate |
| M1A | M1A monetary aggregate |
| M2 | M2 monetary aggregate |
| M3 | M3 money supply |
| M _{cn} | Notes and coin in circulation outside the banking sector |
| MC _{govt} | Net claims of the monetary sector on the government sector |
| MC _{priv} | Net claims of the monetary sector on the private sector |
| NGFOR _{nsa} | Net gold and foreign exchange reserves, not-seasonally adjusted |

| <i>Code Name:</i> | <i>Description of variable</i> |
|----------------------|--|
| NGFOR _{sa} | Net gold and foreign exchange reserves, seasonally adjusted |
| \dot{P} | Inflation rate, defined as $((P_{pc}/P_{pc(-4)})-1)*100$ |
| P _{spi} | Consumer price index, (Index 1990=1) |
| \dot{P}_{exp} | Inflation expectations, defined as $((P_{exp}/P_{exp(-4)})-1)*100$ |
| P _{exp} | Price expectations, (Index 1990=1) |
| P _{pc} | Deflator for private consumption expenditure, (Index 1990=1) |
| R _{bar} | Interest rate on three-month bankers' acceptances |
| R _{esk} | Yield on long-term Eskom stock |
| R _{kkkr} | Interest rate on short-term demand deposits, (31 days) |
| R _{klr} | Interest rate on long-term deposits, (12 months) |
| R _{kmr} | Interest rate on medium-term deposits, (6 months) |
| R _{mlr} | Interest rate on mortgage advances |
| R _{por} | Interest rate on prime overdraft facilities |
| R _{rbd} | Bank rate |
| R _{trn} | Combined weighted interest rate on interest-bearing deposits |
| R _{ttr} | Treasury bill tender rate |
| SAV | Domestic savings, (personal, corporate and government savings) |
| TT | Time trend, escalating with 1 as from the first quarter 1960 |
| VASDR _{nsa} | Special drawing rights and valuation adjustments |
| Y _{dem} | Aggregate domestic final demand, at constant 1990 prices |
| Y _{exp} | Gross domestic expenditure, at constant 1990 prices |
| Y _{fk} | Gross domestic product at factor cost, at constant 1990 prices |
| Y _{pdm} | Aggregate private sector demand, at constant 1990 prices |

APPENDIX 2 : Augmented Dickey-Fuller tests for the order of integration

Regression 1 : Coins and banknotes in circulation

| Variable | I(0) | I(1) | ADF critical regions | |
|-------------------------|---------|---------|----------------------|-------|
| Log(M_{cn}/P_{cpi}) | -0.39 | -5.17** | 1% Critical Value** | -3.54 |
| Log(Y_{mp}) | 0.01 | -3.13* | 5% Critical Value* | -2.91 |
| \dot{P} | -4.24** | | 10% Critical Value | -2.59 |

Regression 2 : Cheque and transmission deposits

| Variable | I(0) | I(1) | ADF critical regions | |
|--------------------------|-------|---------|----------------------|-------|
| Log(DEP_{ct}/P_{pc}) | 1.56 | -4.85** | 1% Critical Value** | -3.52 |
| Log(Y_{mp}) | -0.68 | -4.47** | 5% Critical Value* | -2.90 |
| $R_{tm} - \dot{P}$ | -2.17 | -3.85** | 10% Critical Value | -2.59 |
| \dot{P} | -0.89 | -3.91** | | |

Regression 3 : Short-term and medium-term deposits

| Variable | I(0) | I(1) | ADF critical regions | |
|---------------------------|--------|---------|----------------------|-------|
| Log(DEP_{sm}/P_{cpi}) | -1.69 | -3.99** | 1% Critical Value** | -3.55 |
| Log(Y_{exp}) | -0.34 | -5.13** | 5% Critical Value* | -2.91 |
| $R_{kmr} - R_{esk}$ | -3.28* | -3.26* | 10% Critical Value | -2.59 |
| $R_{por} - R_{tm}$ | -2.07 | -7.08** | | |
| \dot{P} | -0.77 | -4.46** | | |

Regression 4 : Long-term deposits

| Variable | I(0) | I(1) | ADF critical regions | |
|--------------------------|-------|---------|----------------------|-------|
| Log(DEP_{lt}/P_{pc}) | -1.71 | -6.88** | 1% Critical Value** | -3.57 |
| Log(Y_{mp}) | -0.26 | -2.97* | 5% Critical Value* | -2.92 |
| $R_{klr} - R_{esk}$ | -2.48 | -3.77** | 10% Critical Value | -2.60 |

** : Mac Kinnon critical values for rejection of the null hypothesis of a unit root at the 1% level.

* : Mac Kinnon critical values for rejection of the null hypothesis of a unit root at the 5% level.

Regression 5 : M3 money supply

| Variable | I(0) | I(1) | ADF critical regions | |
|------------------------------------|-------|---------|----------------------|-------|
| Log (M3 / P _{cpi}) | 0.14 | -3.06* | 1% Critical Value** | -3.52 |
| Log (Y _{exp}) | -0.80 | -4.04** | 5% Critical Value* | -2.90 |
| R _{por} - R _{tm} | -1.60 | -6.13** | 10% Critical Value | -2.59 |
| R _{esk} - R _{tm} | -2.78 | -3.88** | | |
| \dot{P} | -0.83 | -3.67** | | |

Regression 6 : Claims of the monetary sector on the private sector

| Variable | I(0) | I(1) | ADF critical regions | |
|--|--------|---------|----------------------|-------|
| Log (MC _{priv} / P _{cpi}) | 0.32 | -3.74** | 1% Critical Value** | -3.57 |
| Log (Y _{pdm}) | -1.10 | -2.33 | 5% Critical Value* | -2.92 |
| R _{por} | -3.07* | -3.93** | 10% Critical Value | -2.60 |
| R _{por} - R _{tm} | -1.12 | -4.52** | | |
| \dot{P} | -1.04 | -4.00** | | |

Regression 7 : Yield on long-term Eskom stock

| Variable | I(0) | I(1) | ADF critical regions | |
|-----------------------------|---------|---------|----------------------|-------|
| R _{esk} | -2.14 | -6.87** | 1% Critical Value** | -3.50 |
| \dot{P}_{exp} | -1.12 | -4.18** | 5% Critical Value* | -2.89 |
| SAV / INV | -2.32 | -7.56** | 10% Critical Value | -2.58 |
| (SAV+CAPM) / INV | -2.75 | -8.68** | | |
| R _{rep} | -2.61 | -4.59** | | |
| (((NEXC / NEXC(-1))-1)*100) | -4.90** | | | |

** : Mac Kinnon critical values for rejection of the null hypothesis of a unit root at the 1% level.

* : Mac Kinnon critical values for rejection of the null hypothesis of a unit root at the 5% level.

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