

**BANK CREDIT EXTENSION TO THE PRIVATE SECTOR AND  
INFLATION IN SOUTH AFRICA**

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## ABSTRACT

This study investigates the contribution of bank credit extension to the private sector to inflation in South Africa, covering the period 1970:1-2006:4. The long-run impact of bank credit on inflation is investigated by means of the Johansen co integration model. The short-run dynamics of the inflation is subsequently modelled by means of the Vector Error Correction Model (VECM).

Using the Johansen methodology, the study identifies two co integrating equations linking inflation and its determinants. The results suggest that the long-run relationship between inflation and bank credit to the private sector is negative and statistically significant at 10% level. The determinants that are significant at 5% level are: money supply, real gross domestic product, the money market rate, rand/dollar exchange rate and imports. The results are consistent with previous findings. The speed of adjustment in response to deviation from the equilibrium path was found to be negative at 10.56% per quarter, which is consistent with findings by Ohnsorge and Oomes (2003) for Russia. Both the signs and the magnitude of the coefficients suggest that the co integrating vector describes a long-run inflation equation. The impulse response functions confirm the theoretical expectations except for the import prices. The most persistent and significant shocks observed are on impulse response functions of money supply and bank credit to the private sector. The variance decomposition results also suggest that inflation responds quicker to innovations from money supply and the money market rate.

The overall results provide evidence that the surge in inflation is associated with an increase in money supply as well as the instability in exchange rate. The effects of exchange rate fluctuation on inflation are reflected through changes in import prices. Based on the results we conclude that an increase in bank credit during the period 1970:1-2006:4 had a negative impact on inflation in South Africa.

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Lastly, I greatly appreciate the opportunity afforded to me by Rhodes University to complete my Masters degree at such a prestigious institution.

## DECLARATION

This masters thesis represents my own work and due acknowledgement is given in the references whenever information is derived from another source. No part of this master's thesis has been or is being concurrently submitted for another qualification at any other university.

Signed... 

Date: 7 January 2008

# BANK CREDIT EXTENSION TO THE PRIVATE SECTOR AND INFLATION IN SOUTH AFRICA

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## CHAPTER ONE

### INTRODUCTION

#### 1.1. CONTEXT OF THE RESEARCH

Most economists agree that monetary policy should be primarily concerned with the pursuit of price stability (Mboweni, 2000:1, van der Merwe, 2004:1, Genberg, 2002:4, White, 2006:6). However, there is no consensus as to how this objective can be achieved effectively. Even though the debate continues, a number of countries have adopted inflation targeting as their monetary policy framework. New Zealand was the first country to adopt inflation targeting in 1990 as part of economic reforms following a period of poor economic performance (World Bank, 2004: 296-297). After New Zealand, inflation targeting was the buzzword of the decade in countries that suffered high inflation (Powers, 2005:3). By 2005 a total of 22 countries had explicitly adopted the inflation-targeting strategy and 39 others were evaluating the possibility of implementing the framework (Powers, 2005:4).

South Africa formally introduced the inflation-targeting policy in 2000 (Garcia, 2006:6). Research on inflation targeting in developed and developing countries indicates that this framework has played a vital role in reducing inflation and stabilizing interest rates. Benefits enjoyed by inflation targeting regimes include: lower inflation rates and lower inflation expectations; lower nominal interest rates as a result of the lower inflation expectations; and credible monetary policy (Bernanke *et al.*, 1999: 297).

While previous studies have analysed the impact of several macroeconomic variables on inflation (for example, Smal, 1998; Bernanke *et al.*, 1999 and Goohoon *et al.*, 2006), the impact of bank credit or credit extension to the private sector has not received much attention. In recent years, bank credit to the private sector has increased rapidly in a number of Central and Eastern European (CEE) countries including those that are implementing inflation targeting (Gergely *et al.*, 2006:1). Private sector debt is a macroeconomic issue in the sense that it increases the economy's vulnerability to external financial pressures, where a change in the terms

of trade such as a fall in anticipated exports prices can impair the capacity of local firms to service their debt. Debelle (2004) points out that uncontrolled bank credit to the private sector may give rise to inflationary pressures that will undermine the effectiveness of monetary policy. In the studies done for the UK, Nordic countries and the Netherlands, Debelle (2004:27) has found that high private sector debt may result in inflation. This argument is further supported by a number of economists (for example Huang and Xu, 1999 and Corsetti *et al.*, 1999).

Studies by Antzoulatos (1996) and Ludvigson (1999) on OECD countries<sup>1</sup> show that an increase in credit extension to private sector is positively related to an increase in consumption. These two studies provide evidence that there is a negative relationship between inflation and bank credit to the private sector. Their argument is further supported by Bacchetta and Gerlach (1997), who concluded that tightening credit extension appears to be inversely related to the growth of consumption.

In the case of South Africa, total credit extended to the private sector rose by 28 per cent in the late 1980s and by 18,7 percent per annum in the mid 1990s. These episodes were followed by an increase in national inflation (Stals, 1997:5). Furthermore, in the period between 2002 and 2006 credit extended to the private sector increased by to 66.9 percent (Hawkins, 2006:6). Despite tentative signs of moderation in consumer demand, private sector credit maintained a significant high rate since August 2006 up until the end of the year (South African Reserve Bank, 2006:2). This indicates that there is a need to monitor bank credit extension to the private sector to maintain confidence in the financial sector in South Africa. A major concern regarding this outcome in the era of inflation targeting is that bank credit to the private sector may require severe adjustments (such as an increase in interest rates) in the future that might trigger inflation (South African Reserve Bank, 2006:1). Thus, given the recent rapid growth of private sector debt and the concern raised by the South African Reserve Bank (SARB) over this development, it is important to investigate the effect of bank credit on inflation empirically.

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<sup>1</sup> OECD countries include Mexico which is still considered as developing country or emerging market (Chandler *et al.*, 2002).

No study has yet been done on South Africa with a similar focus. This research will also shed light on whether the increase in private sector credit signals future failure of inflation targeting in South Africa. The study will also assist academics and policymakers in understanding bank credit dynamics and its importance in estimating inflation. Finally, this thesis aims to add to the existing literature on inflation and bank credit extension to the private sector.

## **1.2 GOALS OF THE RESEARCH**

- To investigate the impact of private sector debt growth on inflation in South Africa empirically.
- To make policy recommendations based on the results obtained from the empirical analysis.

## **1.3 METHODOLOGY FOLLOWED<sup>2</sup>**

To achieve the above stated objectives, SARB quarterly data (inflation, bank credit to private sector, prime rate, money supply and other relevant data) will be used, covering the period 1970 to 2006. This period is selected because it covers the required number of years and observation for the econometric model that will be used.

Trend analysis will be done to illustrate how these variables behave under different monetary regimes. The Johansen cointegration technique will be used to examine empirically the long-term relationship between inflation and the selected variables. This model provides a unified framework for the estimation and testing of cointegration relations in the context of vector auto regressions (VARs) as described by Brooks and Tsolacos (1999:146). The short-run relationship will be determined using the Vector Error Correction Model (VECM), which has proven to be effective in capturing the short-run relations between endogenous and explanatory variables (Brooks and Tsolacos, 1999:146).

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<sup>2</sup> A detailed methodology followed is provided in chapter four.

Policies will be recommended based on the results obtained when examining the empirical relationship of inflation and selected variables.

#### **1.4 STRUCTURE OF THE STUDY**

Following this chapter, this study consists of five chapters. The subsequent chapters are planned and organized as follows:

*Chapter 2:* gives an overview of monetary regimes together with the behaviour of inflation and bank credit over the past three decades.<sup>3</sup> This chapter also provides a summary on monetary policy transmission in order to provide an exposition of how the SARB controls inflation.

*Chapter 3:* reviews the theoretical and empirical work done on bank credit demand and inflation.

*Chapter 4:* describes the econometric methodology used in this study. This chapter also provides justification for the period selected and the methods to be used in chapter 5.

*Chapter 5:* provides the estimated results of short-run and long-run models of inflation respectively.

*Chapter 6:* provides conclusions and policy recommendations as well as areas for further research.

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<sup>3</sup> From 1970:1-2006:4.

## CHAPTER TWO

# INFLATION AND BANK CREDIT DYNAMICS UNDER DIFFERENT MONETARY POLICY REGIMES IN SOUTH AFRICA

## 2.1 INTRODUCTION

Monetary policy in South Africa has been under the control of several different regimes since the 1960s. Since the early 1970s inflation and bank credit behaviour have been amongst the variables of greatest concern to monetary authorities. This chapter provides an overview of the role of inflation and bank credit to the private sector over the past three decades. It also discusses monetary policy transmission to provide an exposition of how the SARB controls inflation.

This chapter is organised as follows: section 2.2 provides an overview of monetary regimes since the 1960s including changes in bank credit and inflation, while section 2.3 describes the transmission of monetary policy. Section 2.4 concludes this chapter.

## 2.2 INFLATION AND BANK CREDIT BEHAVIOUR UNDER DIFFERENT MONETARY POLICY REGIMES

The first monetary policy regime to be introduced in 1960 was a *liquid asset ratio-based system* involving quantitative controls on interest rates and credit. This regime operated until the early 1980s. As a result of dissatisfaction and technical changes in assets requirements as well as the redefinition of the role of the discount rate, South Africa moved towards a *cash reserves-based system* which was enacted in the early 1980s following the recommendations of the de Kock Commission Reports (1978, 1985) (Aron and Muellbauer, 2006: 2 and Gidlow, 1995).

Under the cash reserves system, the discount rate influenced the cost of overnight collateralised lending and hence market interest rates. The supply of credit was

influenced by open market operations and other policies acting on overall liquidity. By creating a persistent money market shortage and setting the discount rate at a relatively high level, the commercial bank rates were usually closely linked to the discount rate. Monetary control was deemed to operate indirectly through the slowing of the demand, with an estimated lag for its ultimate effect on inflation of over twelve months (Aron and Muellbauer, 2006: 3).

The third regime to be instituted was a *formal money supply target* for a broad definition of money (M3) that was introduced in 1985 following the recommendations of the de Kock Commission. The use of targets was based on the assumption that there is a stable relationship between changes in money supply and inflation. Monetary policy was therefore aimed at controlling the rate of expansion in total money supply as an intermediate objective, while the supportive objective involved influencing the amount of bank credit extension in order to achieve the ultimate objective of protecting the value of the rand (Aron and Muellbauer, 2006:5). Target ranges were set yearly using a three-month moving average of M3 growth, and were announced in the March Budget to cover the period from the fourth quarter of the preceding year to the fourth quarter of the current year. Although the procedure used to choose the target was not transparent, target setting was aimed at accommodating anticipated real GDP growth and containing inflation (Aron and Muellbauer, 2006:5). Moreover, the SARB occasionally breached targets with good motivation, for instance in the face of external trade and financial shocks. There was no penalty for violating targets; nor was public explanation legally required under these circumstances. Monetary targeting contributed significantly to reduction of inflation from the double-digit levels of between 12% and 20% from 1972 to 1992 to an average of below 10% from 1994 to 1999 (Stals, 1999).

However, the usefulness of money supply targets as an indicator of inflation was later undermined by extensive financial liberalization from the beginning of the 1980s which led to an increase in the volume of financial market transactions and a more open economy that increased capital flows from 1994 onwards. These developments caused instability in the relationship between money supply, bank credit and inflation (Stals, 1999).

From 1990 to 1999, an *eclectic approach* to monetary policy was implemented whereby a diverse set of indicators, including the yield curve, interest rates, actual and expected movements in inflation, exchange rate, asset prices, output gap, balance of payments, wage settlements, bank credit extension, and the fiscal stance were used to supplement the money supply targets (Stals, 1997b:1). During this period, monetary policy was unclear and this reduced the accountability of the SARB (Aron and Muellbauer, 2006). The episode from the first quarter of 1994 to the third quarter of 1996 when bank credit extension to the private sector escalated to 18,7 % per annum followed by an increase in inflation raised the concern of the monetary authorities in South Africa (Stals, 1997:5).

In March 1998 the use of the repurchase (repo) interest rate as a system of monetary accommodation was introduced. Initially, the repo rate was market-determined in daily tenders of liquidity-in auctions. Various changes to the system which increased market participation occurred between September 2001 and May 2005. The repo rate is now fixed to eliminate uncertainty about SARB policy signals. Since May 2005, an estimate of the average daily market liquidity requirement is announced before the auction to assist tendering. Further types of auctions may be held at the SARB's discretion to accommodate liquidity requirements and stabilize interbank rates. A daily benchmark is provided by the SARB for money market interest rates (Aron and Muellbauer, 2006:5).

The repo rate directly influences the prime overdraft by affecting the marginal cost of funding for banks, which in turn affects loans afforded to clients (Gidlow, 2001:57). It is worth noting that due to competition in the commercial bank sector all banks are affected: even those that were able to obtain funds from other banks at interbank rate.

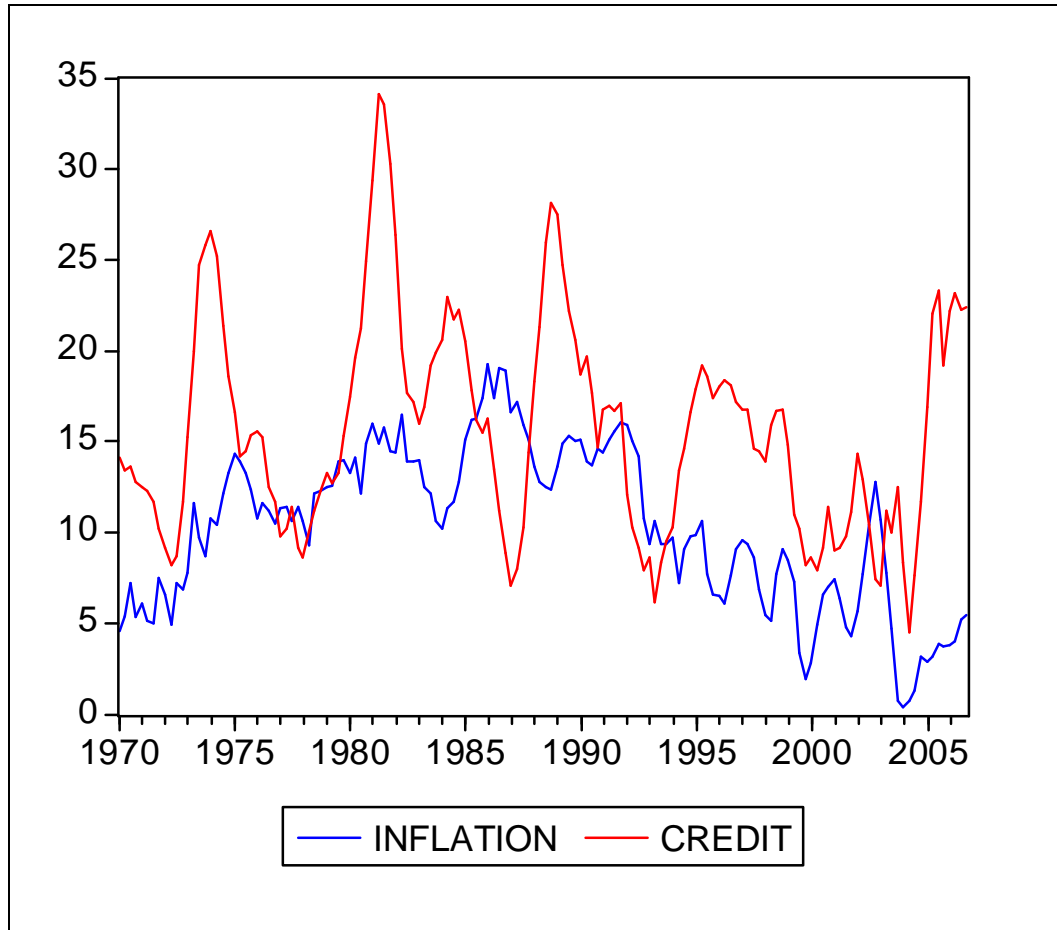
In February 2000, South Africa formally introduced the inflation-targeting as a monetary policy framework to control inflation and the target range set as 3-6%. According to the Powers (2005) the rationale for the adoption of inflation-targeting in South Africa is related largely to the ineffectiveness of the money supply guidelines and the eclectic approach of the 1990s. The reasons for the new strategy include:

- The fact that money supply targeting in the eclectic approach did not work well partly because the velocity of the circulation of M3 fluctuated significantly due to financial innovations;
- The objective of monetary policy was not clearly defined;
- There was no clear accountability of the SARB under the eclectic approach;
- Although an informal inflation target range of 1-5% was stated, there was no specified time frame in which this target was to be achieved; and
- The eclectic approach caused a high degree of real interest rate variability.

Other reasons that necessitated the move to inflation-targeting include the need for creation of financial stability to promote economic growth and employment and the fact that by February 2000 South Africa had met most of the pre-requisites of inflation targeting (SARB, 2005:7). Furthermore, as Van der Merwe (2004:5-6) argues, inflation-targeting improves the co-ordination between monetary policy and other economic policies because the target is consistent with other goals.

The reduction in interest rates in the period between 2002 and 2006 caused the accumulation of debt in the private sector: a phenomenon that became more significant from the first quarter of 2004. This resulted in an increase in consumer spending. Bank credit extended to the private sector also grew from R739 billion in the first quarter of 2004 to R1 233 billion in September 2006: an increase of approximately 66.9 percent (Hawkins, 2006:6). This episode was also followed by an increase in inflation. The relationship between inflation and bank credit to the private sectors in South Africa in the past three decades is presented in Figure 2.1.

**Figure 2.1: Inflation and bank credit to the private sector from 1970:1-2006:4**



Source: I-Net Bridge and Quoin Institute (Pty) Limited (2007)

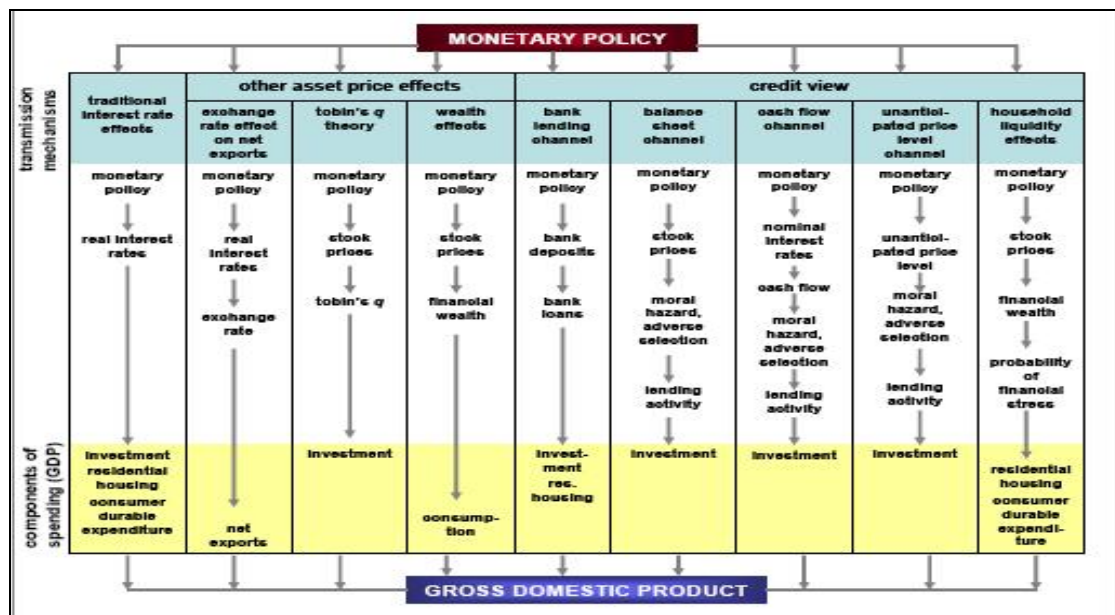
It is worth noting that since the inception of the repo rate the SARB has been able to maintain its credibility especially in era of inflation targeting. The repo rate is a crucial instrument for controlling inflation because it is central to the transmission of monetary policy (Lehobo 2006:40). Much literature on the transmission of monetary policy (i.e. the interest rate channel, exchange rate channel, other assets and the credit channel) has been produced in the past three decades. The next section of this chapter presents the interest rate and credit channels which are relevant to this study.

## 2.3 THE REPO RATE AND THE TRANSMISSION OF MONETARY POLICY

### 2.3.1 Introduction

Faure (2006:13) noted that “*The repo rate represents the cost of money at the margin and exerts a powerful influence in the first instance on the other interbank market, the bank-to-bank interbank market and from here on to the other money market rates and on to the longer rates, asset prices, the exchange rate, and so on to, ultimately, price developments*”. This implies that the sequence of economic activities begins with the adjustment of the repo rate. This implies that a sequence of economic activities begins with the adjustment of the repo rate. Mishkin (1995:3) summarizes the series of economic changes into five broad channels namely the interest rate channel, the exchange rate channel, other assets and the credit channel. This discussion is limited to the credit channel, which is depicted in Figure 2.2. To put our discussion into context we first provided theory on interest rate channel.

Figure 2.2: Monetary policy transmission



Source: AP Faure (2005)

### 2.3.2 Interest rate channel

The Keynesian view of the monetary transmission mechanism has been used by many banks over a long period of time as the main channel that transmits monetary policy to the economy. Keynes described this channel as operating through businesses' decisions about investment spending, while later researchers established that consumer decisions about housing and consumer durable expenditure are also investment decisions (see for example Obstfeld and Rogoff, 1995; Clarida *et al.*, 1999; and Woodford, 2003).

A contractionary monetary policy stance leads to a decline in the net worth of firms because it causes interest rates to rise. As a result of the increase in interest rates, it becomes expensive to service outstanding debt. When firms realise that the real cost of borrowing has increased they reduce their investment expenditures. In the same manner, households facing higher real borrowing costs respond by cutting back on their purchases of houses and durable goods (Mishkin, 1995:4).

An important feature of the interest rate channel is the extent to which a change in the SARB controlled policy interest rate affects the term structure of interest rates – especially the short-term money market rates and long-term rates. The propagation mechanism of monetary policy decisions along the yield curve depends on institutional factors. The schematic diagram below summarizes the interest rate channel of monetary transmission (Mishkin, 1995:4).

$$M \downarrow \Rightarrow i \uparrow \Rightarrow I \downarrow \Rightarrow Y \downarrow$$

**Schematic diagram [2.1]**

### 2.3.3 Credit channel

Bernanke and Gertler (1995) provide a broader description of the credit channel that includes the effect of financial market imperfections (i.e. how asymmetric information and costly enforcement of contracts generates agency problems in financial markets). As a result of agency problems in credit markets two basic channels of monetary transmission are established: the bank lending channel and the balance-sheet channel.

### 2.3.3.1 Bank lending

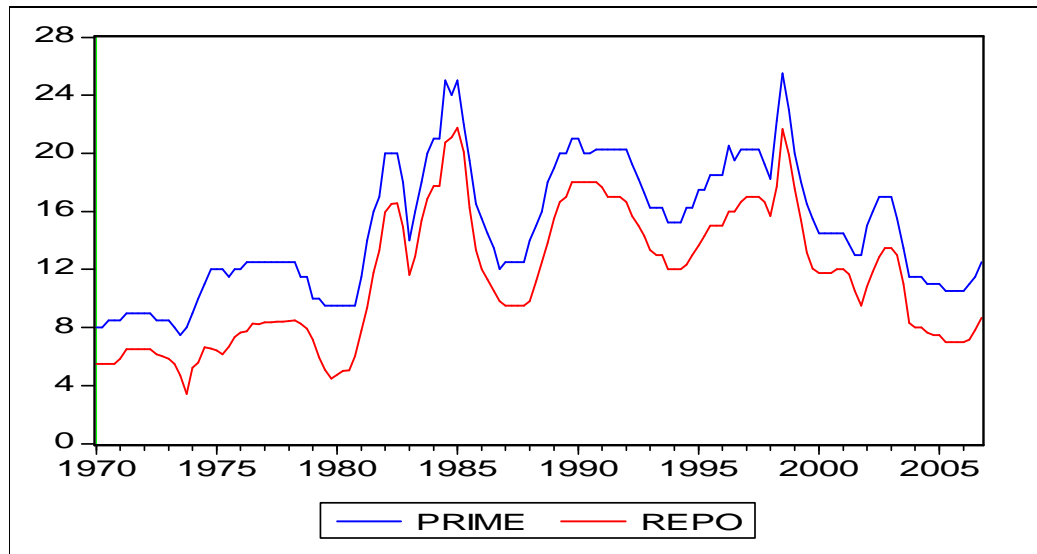
Banks play a vital role in the financial system because they deal with certain types of borrowers, especially small firms where the problems of asymmetric information can be especially pronounced. Banks possess assets in the form of bank loans for which few substitutes exist. According to De Angelis (2005:37), deposits represent the principal source of funds for lending especially for small firms who require bank loans for expansion purposes and investment. In this case a contractionary policy that reduces bank deposits compels banks to cut back on their lending, and firms that are dependent on bank loans respond by refraining from investment. Schematically, the effect of monetary policy in this channel is as follows:

$$M \downarrow \Rightarrow \text{bankdeposits} \downarrow \Rightarrow \text{bankloans} \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow \quad \text{Schematic diagram [2.2]}$$

However, an expansionary monetary policy which leads to an increase in banks' reserves and deposits increases the amount of credit available. The implication of the credit view is that monetary policy will have a greater effect on the expenditures of smaller firms that are more dependent on bank loans than on large companies that can access the stock and bond markets directly.

The increase in bank credit to the private sector in South Africa represents an accumulation of loans by both households and firms. If these loans are not secured through asset accumulation (i.e. houses) and investments, the vulnerability of the banking sector is very high when interest rates increase. In South Africa there is a close relationship between the bank lending rate and the repo rate, which suggests a stronger monetary transmission system via the interest rate and credit channels. This relationship is presented in Figure 2.3.

**Figure 2.3: The relationship between the repo rate and prime rate from 1970:1-2006:4**



Source: I-Net Bridge and Quoin Institute (Pty) Limited (2007)

### 2.3.3.2 Balance sheet channel

According to Bernanke and Gertler (1995: 29), the cost of credit for firms increases when the strength of their balance sheets deteriorates. This becomes more significant in the presence of financial market imperfections. A more direct effect of monetary policy on a firm's balance sheet is experienced when an increase in interest rates increases the payments that the firm must make to service its floating rate debt. The major problem with increasing the short-term interest rate is that it raises the cost of capital to firms through the balance sheet channel, thereby deepening and extending the initial decline in output and employment. Thus, if the balance sheet deteriorates more than the firm's expectation, firms are likely to default, resulting in bank crises and, in extreme cases, inflation.

The balance-sheet channel operates mainly through the net worth of business firms (Bernanke and Gertler., 1995:40-41). If the net worth is low, it implies that lenders have less collateral for their loans and so losses from adverse selection are bigger as the pool of high risk borrowers grows. A lower net worth among business firms also increase moral hazard because it means that owners have a lower equity stake in their firms, giving them more incentive to engage in risky investment projects. Thus, investors who undertake risky investment projects are more likely to default since a

decrease in business firms' net worth leads to a decrease in lending and hence in investment spending (Ballim, 2005: 32).

Figure 2.1 indicates that bank credit extension to the private sector in South Africa increased significantly from the first quarter of 2004. This is attributed to a fall in the prime rate. As noted above, the increase in bank credit to this sector if not monitored may pose a long-term risk to the banking sector, which may lead to bank crises and inflation.

## **2.4 CONCLUSION**

The dynamics of inflation and bank credit extended to the private sector can be traced from the 1970s. The behaviour of these two macroeconomic variables has been a major concern over the past three decades under different monetary policy regimes. Fluctuation in bank credit over the past three decades may be associated with changes in the repo rate during the pursuit of different monetary policy objectives geared to maintain financial stability in South Africa.

The credit and interest rate channels in South Africa are more prominent channels in the transmission of monetary policy. The bank-to-bank interbank market is the first to be affected by the repo rate, and thus it is considered as the genesis of monetary policy and a major influence on interest rates (Faure, 2006:12). Thus, the sequence of economic activities begins with the adjustment of the repo rate.

The next chapter provides the theory and empirical finding on bank credit extension to the private sector and inflation.

## **CHAPTER THREE**

# **LITERATURE ON INFLATION AND BANK CREDIT EXTENSION TO THE PRIVATE SECTOR**

### **3.1 INTRODUCTION**

This chapter provides both a theoretical and an empirical review of bank credit demand and inflation, respectively. As a result of limited literature on this topic, much of the literature is derived from empirical studies done on bank credit demand, bank crises and inflation, respectively. Literature on inflation has been covered to a large extent in international research, whereas in this study we review the literature that is relevant to our investigation. The approach adopted and the variables selected for this study are based on studies that estimate inflation, the demand for bank credit and investigate the relationship between the demand for bank credit and consumption. Apart from contributing to the limited literature on bank credit in South Africa, this chapter sheds light on the dynamics of bank credit extension to the private sector in emerging economies.

Section 3.2 of this chapter presents theories on bank credit to the private sector and inflation, respectively. Section 3.3 presents a review of the empirical literature on bank credit and inflation, and the model adopted to achieve the objectives of this research. In the last section a summary is presented to link the two sections. The summary provides a motivation for the selected variables and also link literature to the context and to the objectives of this research.

## **3.2. THEORETICAL BACKGROUND<sup>4</sup>**

### **3.2.1 Introduction**

The theories covered in section 3.2.2 on the determinants of the demand for credit are derived from the post-Keynesian and Fisher theories. Section 3.2.3 presents theories on inflation, which includes arguments from the post-Keynesian, Monetarist, Cost-push and Demand-pull theories.

### **3.2.2 Theory of demand for bank credit**

#### **3.2.2.1 The post-Keynesian theory of demand for credit**

The post-Keynesian analysis is based on the behaviour of the monetary policy authorities in terms of accommodating liquidity shortages and firms' production costs. The post-Keynesian suggest that the central banks always acts as the lender of last resort by providing funds to commercial banks at a certain rate of interest. According to Arestis (1992:184), failure to provide funds to the banks can easily result in a liquidity crisis.

According to Arestis and Eichner (1988:109), the central bank sets the policy rate at which it lends to commercial banks. The commercial banks, in turn, set the prime rate at which they are prepared to satisfy the firms' demand for credit to finance working capital. According to the post-Keynesian school of thought, the policy rate (repo rate) at which the central bank lends to banks plays a crucial role in the determination bank credit. The post-Keynesian theory is further supported by Maki (2001) who noted that when the central banks anticipate a healthier economy in the future they reduce the repo rate and the commercial banks, in turn, reduce the prime rate to encourage borrowing.

Furthermore, the post-Keynesian theory suggests that the major determinant of the demand for credit by firms is the firms' need for working capital finance. Arestis (1992, 190) points out that the need for working capital depends on the expected

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<sup>4</sup> Reviewed theory on determinants of bank credit and inflation, respectively.

transactions of the firm such as changes in the expected level of output and changes in the cost of production.

#### ***3.2.2.1.1 Changes in firms' expected output***

According to Howells (1995:90), if the firms experience increases in the demand for output, they will seek loans from the banks in order to finance the increased demand for factors of production. This implies that the increase in the demand for the firms' output will significantly influence its demand for loans. Davidson (1994:135) noted that the higher the expected level of output of the firms, the higher the demand for bank credit by the private sector.

#### ***3.2.2.1.2 Changes in firms' cost of production***

Arestis (1992:190) noted that if the firms incur an increase in the cost of production at some point in time, they are compelled to seek funds from the banks to cater for the increase. This is because the firms do not increase their prices instantly in response to higher costs of production, but only raise the price when the costs of production have increased the cost of finished products for sale (Moore and Smit, 1986:88).

#### **3.2.2.2 The Fisher's theory of demand for bank credit**

Irvin Fisher's theory analyses households' behaviour rather than that of firms. This theory suggests that the demand for credit by households emanates from the attempt to maximize utility. Fisher's theory postulates that permanent income received by an individual in return of his or her labour, is given and can be changed only by borrowing and lending (Lutz 1967:86).

Fisher's theory postulates that individual attempt to maximise utility by choosing a higher indifference curve. According to Fisher's theory, the individual will try to combine the present income with a higher future income, and future income with a higher present income.

The following section presents theory on inflation, which includes arguments from the post-Keynesian, Monetarist, Cost-push and Demand-pull theories.

### **3.2.3 Theory of inflation**

#### **3.2.3.1 The Monetarists' theory of inflation**

The monetarists argue that inflation is a domestic monetary phenomenon which results from the loosening of monetary policy by the central bank. If the central bank reduces the repo rate, the commercial banks also reduce their prime lending rate. The result of a fall in the repo rate is an increase in money supply which may exceed demand and cause a surge in inflation if not monitored (Weintraub, 1960).

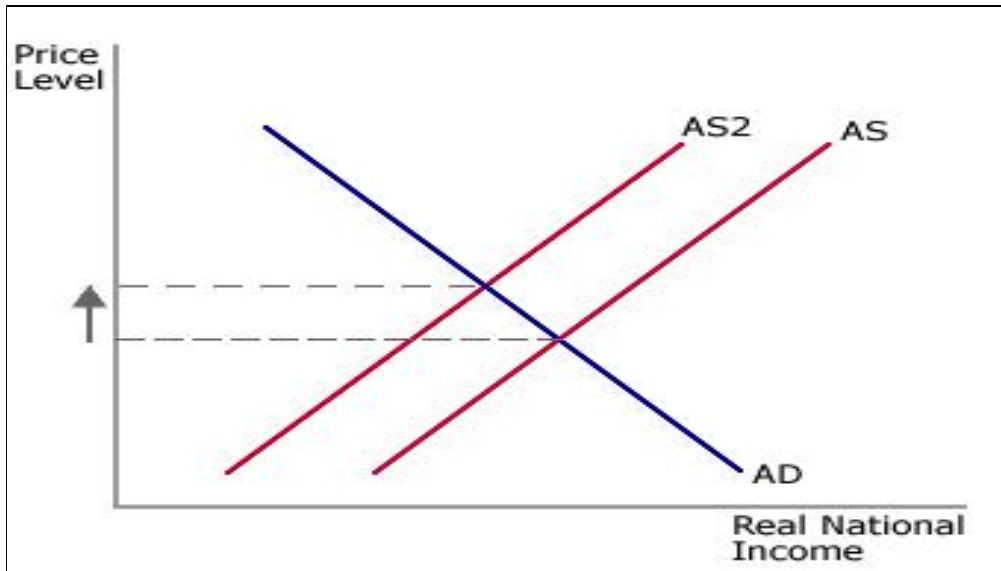
#### **3.2.3.2 The Keynesian theory of inflation**

This theory of inflation is based on the Keynesian saving-investment equilibrium condition that provides a direct approach to the question of inflation in terms of the demand for and the supply of goods. The Keynesian theory suggests that inflation occurs when demand exceeds the potential output of the economy. The difference between aggregate demand and the potential level of output at full employment is termed the inflationary gap. Another approach of Keynes to price determination emphasised the importance of wage and salary costs in influencing the price level (Weintraub, 1960).

#### **3.2.3.1 Cost-push theory of inflation**

The cost-push theory maintains that an increase in prices reflects an increase in the cost of the factors of production. This theory further suggest that prices of goods and services rise because wages are pushed up by trade unions' bargaining power, or by the pricing policies of oligopolistic and monopolistic firms with market power. Furthermore, labour market rigidities and changes in the cost of labour are considered a major cause of inflation in developed countries, although not considered a major cause of inflation in most developing countries (Kaldor, 1959:296). The cost-push theory of inflation is summarized in Figure 3.1.

**Figure 3.1: Cost-push inflation**



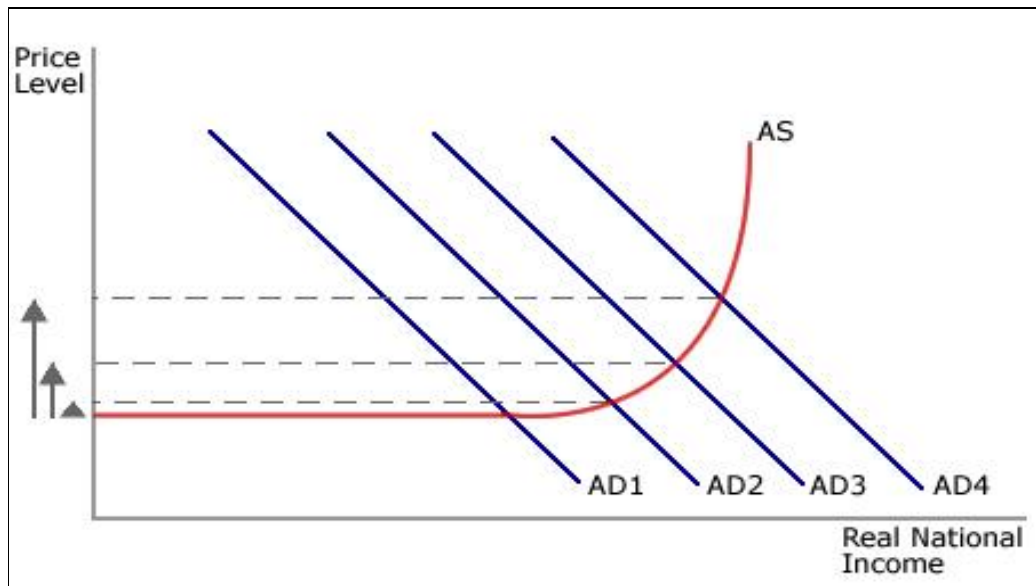
Source: Virtual Bank of Bizled (2007)

The supply curve shifts left because of the increase in costs, therefore pushing prices up.

### **3.2.3.2 Demand-pull theory of inflation**

This school of thought suggests that inflationary pressures emanate from excess demand for goods and services resulting from expansionary monetary and fiscal policies. The demand-pull theory maintains that an increase in aggregate demand could be because consumers are induced to spend more, interest rates have declined, taxes have been cut or there is a greater level of consumer confidence. In addition, the demand-pull inflation could be a result of firms that are investing more in the expectation of future economic growth (Kaldor, 1959:292-293). The demand-pull theory is summarised in figure 3.2 below.

**Figure 3.2: Demand-pull inflation**



Source: Virtual Bank of Bizled (2007)

As aggregate demand increases the aggregate demand curve (AD) shifts to the right and the price level also rises (inflation).

The following section presents a review of the empirical literature on bank credit and inflation, and the model adopted to achieve the objectives of this research.

### **3.3 EMPIRICAL STUDIES ON BANK CREDIT AND INFLATION<sup>5</sup>**

#### **3.3.1 Introduction**

This section reviews empirical literature on bank credit and inflation from developed and developing countries. This section also provides a motivation for the methodology to be used in the following chapter to investigate the effect of bank credit on inflation in South Africa.

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<sup>5</sup> Empirical studies from developed and developing countries.

### **3.3.2 Studies in developed countries on demand for bank credit**

A study by Pazarbasioglu (1997) indicates that inflation had a strong negative effect on credit demand in Finland during the period 1981-1986 and 1987-1995. Pazarbasioglu (1997:320) estimated credit demand for Finland to determine whether there was a credit crunch after the banking crisis. To analyse the effect of inflation on bank credit Pazarbasioglu (1997) used the maximum log likelihood approach. The explanatory variables were the bank lending rate, expected fixed investment, expected rate of inflation and industrial production.

Moore and Threshgold (1985:72) investigated the short-run dynamics of loans to the industrial and commercial companies in the United Kingdom. The explanatory variables in the model were components of the working capital of the firms and the data used covered the period from 1978-1981. A single short-run disequilibrium equation was used to analysis the short-run dynamics of loans. The Moore and Threshgold (1985) study also provides evidence of a negative relationship between bank credit and inflation.

Ghosh and Gosh (1999) also provide evidence of a negative relationship between inflation and bank credit to the private sector in a study on bank credit determinants. Ghosh and Gosh (1999: 5) estimated the demand for bank loans in Indonesia and Korea using the real lending rates, current output, and variance of growth in output, variance of growth in output, inflation and stock market. Data used covered the period from 1991:1 to 1998:3. The switching regression model and maximum likelihood estimation model was used to determine the relationship between inflation and bank credit. Their results indicate that a unit increase in inflation lead to a fall in bank credit extension to the private sector in Indonesia and Korea.

Backe and Zumer (2005) investigated the dynamics of bank credit extension to private sector in central and eastern European Union member states covering the period from 1999-2004. This study shed light on the determinants of demand for bank credit as well as their economic and financial implications. Backe and Zumer (2005:100-101) provide evidence that the growth of credit to the private sector is encouraged by macroeconomic stabilization, comprehensive reforms and privatization in the

financial sector and the introduction of market institutions and legal reforms. As a result, these systems were transformed from repressed to liberalized financial systems. Backe and Zumer (2005:105) concluded that the GDP growth had underpinned bank credit extension to the private sector, while the rise in income and profit expectations encouraged intertemporal substitution, thus further boosting domestic lending.

Calza and Sousa (2006) investigated whether in the euro area there are asymmetries in the response of output and inflation to credit shocks over the lending cycle. This was achieved by using the vector autoregressive (VAR) approach of Balke (2000). Calza and Sousa (2006) estimated a threshold model covering the period 1981:262002:3. This study analysed the response of inflation to credit shocks by using impulse responses. The results indicate that threshold effects are associated with credit conditions in the economy. The impulse response analysis indicates that there are asymmetric responses to shocks to real credit growth over the lending cycle. Shocks in this case had a significant impact on inflation. This was more evident when the economy was in the low lending growth regime.

Calza *et al.*, (2001) investigated the determinants of loans to the private sector in the euro area and the variables used were private sector loans, GDP (for economic activities), the real short-term and long-term interest rates covering the period 1980:1-1999:2. The Johansen technique was used to determine the long-term relationship and Vector Error Correction Model (VECM) captured the short-term dynamics. Based on the graphical analysis Calza *et al.*, (2001:11) suggest that there is a negative relationship between bank credit and inflation. Calza *et al.*, (2001:11) noted that the surge in credit from the second half of the 1990s was accompanied by a decline in inflation. The study does not provide evidence that there is a negative relationship between credit and inflation.

A study by Fase (1995) for the Netherlands shows that expected cash flow and deliberate decisions to borrow from the banks determines the demand for short-term bank credit by the private sector. Fase (1995:105) used a two-equation structural model-the cointegration and error correction models. Fase (1995) estimated with quarterly data for a period from 1970:1-1990:4. This study supports the shift in many

countries from monetary targeting to credit targeting with the loan rate as an effective tool of credit control which may imply that this variable is a source of inflation in Netherlands (Fase, 1995:113). Even though Fase (1995) calls for a shift from monetary targeting to credit targeting with the loan rate as an effective tool of credit control the study do not provide the ultimate goal<sup>6</sup> for the change. Fase's (1995) recommendation suggests that bank credit extension to the private sector is inflationary.

### **3.3.3 Studies in developing countries on demand for bank credit**

Qayyum (2002) estimated the demand for bank credit by the private business sector in Pakistan using three variables: the demand for bank lending by the private business sector, industrial output as proxy of output of business sector and the real rate of interest on bank advances and inflation. A three-step methodology used included a univariate analysis, multivariate cointegration analysis, and an error correction mechanism. Qayyum (2002:158) established a negative relationship between inflation and bank credit extension to the private sector and concluded that policies that are able to reduce inflation are those that are geared to promote credit extension to the private sector.

The above argument is further supported by Binswanger and Khandker (1995), Heidhues (1995) and Nwanna (1995), who noted that in developing countries credit extension to the private sector, is an essential instrument for improving the welfare of the people directly and minimizing their vulnerability to short-term income shocks. Thus, a proper investigation of private sector credit and inflation has implications that connect micro-level analysis with factors that determine long-term macro-economic performance (Binswanger and Khandker, 1995).

In Africa, Ikhide (2003) investigated whether there was a credit crunch in Namibia for a period from 1996-2000. The explanatory variables for bank credit were inflation as a proxy for macroeconomic activities, output gap, expected real income, unexpected inflation rate and the nominal lending rate. All variables in this case were expressed in log-linear format, except for the interest rate which is described in percentage form.

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<sup>6</sup> Whether the shift is geared to curb inflation or to boost consumption.

Ikhide (2003:284) concludes that inflation does not explain the variation in bank credit in Namibia.

A study by Sebastian (2005) for Lithuania on bank credit to the private sector revealed that credit expansion to this sector had a positive effect on GDP growth in the period between 2000 and 2004. Sebastian (2005:1) also notes that domestic credit amounted to approximately 30% on average between 2000 and 2002 and increased to over 40% in 2003 to 2004. This resulted in an increase in the domestic credit-to-GDP ratio from below 15% in 2000 to 30% in 2004 (Sebastian, 2005:1). To investigate this, Sebastian (2005:4) used quarterly observations from 1995:1-2004:4. Bank credit was specified as a function of the GDP, the consumer price index, the long-term interest rate and a dummy variable which captured a structural shift. This study suggested that within the private sector, household borrowing was increasing rapidly. Although the household indebtedness-to-GDP ratio was insignificant, the major concern regarding this development was that credit growth exceeded income growth. Sebastian (2005) further noted that the surge of loans to this sector averaged approximately 73% from 2001 to 2004, and credit denominated in foreign currencies increased by close to 100% and 170% in 2003 and 2004 respectively. Loans denominated in foreign currencies tend to increase the vulnerability of a country to external shock which may trigger inflation in extreme cases. Based on the analysis for this study one can conclude that an increase in bank credit to this sector may result in a surge in inflation in the long-run.

### **3.3.4 Studies in developed countries on inflation**

Balakrishnam and Ouliarisi (2006) investigated the United State inflation dynamics using annual data from 1960-2005 and separated structural from cyclical effects using frequency domain techniques. The traditional Phillips curve (TPC) and new Keynesian Phillips curve (NKPC) models were used. The results show that the impact on inflation occurred primarily in the case of the business cycle. Bayoumi (2006) concluded that the secular decline in inflation was an indication of an improved monetary policy and its credibility in the US.

Furthermore, Hoover (1991) investigated the causality direction between money and prices in the United States using quarterly data during the period 1950-1985. The

results suggest an absence of a direct causal linkage between money and prices, which is contrary to monetary theory. Hoover (1991) used the general-to-specific modelling technique proposed by Hendry and Richard (1982). This study was limited by the fact that Hoover (1991) partly investigated the linkages between interest rates, money and prices and ignored other determinants for inflation.

Eickmeier *et al.*, (2006) investigated the impact of bank lending to the private nonbank sector on macroeconomic fluctuations in Germany. The results from a vector auto regression (VAR) and the impulse response function indicate that there is no evidence that loans amplify the transmission of macroeconomic fluctuations. To achieve these results quarterly seasonally adjusted data for real GDP, the GDP deflator, the three-month money market rate and nominal loans to the private nonbank sector from 1985:12005:3 were used.

Studies by Antzoulatos (1996) and Ludvigson (1999) on OECD countries<sup>7</sup> show that an increase in credit extension to private sector is positively related to an increase in consumption. These two studies provide evidence that there is a negative relationship between inflation and bank credit to the private sector. Their argument is further supported by Bacchetta and Gerlach (1997), who concluded that tightening credit extension appears to be inversely related to the growth of consumption. Debelle (2004) notes that in 2001 household borrowing in the United States boosted consumption and housing investment despite the deterioration in the overall macroeconomic environment. Thus, the evidence from these studies suggests that bank credit extension to the private sector is negatively related to inflation.

The majority of recent studies have shown a negative relationship between inflation and economic growth in the medium to long-term (see Barro, 1991, 1995; Orden and Fischer, 1993; Ghosh and Phillips, 1998; and Khan and Senhadji, 2001). The findings of the studies cited above is that countries that are able to keep inflation low tend to experience higher rate of growth than countries that tolerate high inflation. High inflation rates are believed to interfere with price signalling mechanisms, thus resulting in the misallocation of resources in market economies (Hodge, 2006:163).

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<sup>7</sup> OECD countries include Mexico an emerging market (Chandler *et al*, 2002).

### **3.3.5 Studies in developing countries on inflation**

Price and Nasim (1999) estimated inflation for Pakistan using money market and purchasing power parity approaches. Price and Nasim (1999:88) acknowledged that the Johansen co integration technique is an ideal model but adopted a seemingly unrelated regression (SUR) approach to determine the long-term relationships due to insufficient data observations. Annual data set was used covering the period 1974-1994. The results showed that the purchasing power parity, exchange rate and money demand contributed significantly to inflation.

A similar study was conducted by Ubide (1997) in Mozambique, in which inflation was specified by combining the money market and purchasing power parity approach. Ubide (2007:17) used monthly data covering the period 1989:1-1996:12. The results reveal that both money and exchange rates had a positive significant impact on inflation. Hence, Ubide (1997) called for a tight monetary policy and stabilized exchange rate policy to curb inflation in Mozambique.

Nicolic (2000) and Ohnsorge and Oomes (2003) estimated inflation for Russia using different approaches but obtained similar results. The former applied the autoregressive distributed lag model of inflation with lags of money supply together with seasonal and policy shift dummies. Nicolic (2000) concludes that money growth significantly contributed to contemporary inflation in Russia. Ohnsorge and Oomes (2003) used a mark-up approach and a mixture of both mark-up and money market approaches and their findings were consistent with the previous study. The speed of adjustment in response to a deviation from the equilibrium path was 12% (-0.12). In addition, Ohnsorge and Oomes (2003) note that the nominal effective depreciation, unit labor cost and utility prices significantly affected inflation in Russia.

Vizek and Broz (2007) estimated inflation for Croatia using quarterly data from 1995-2006 to analyse the driving forces behind inflation in Croatia. A general-to-specific approach and structural-based modelling that involved a two step procedure was used. The consumer price index (CPI) was specified as a function of excess money supply, gross domestic product, GDP gap, import prices, narrow money, mark-up, nominal effective exchange rate, interest rate on foreign deposits, trading partners consumer price index, producer price index, unit labour cost, zagreb inter-bank offer rate and

*dummies* for structural breaks. The results indicate that that mark-up, excess money, output gap, the nominal effective exchange rate, import prices, interest rates and narrow money were essential for providing information on the short-term behaviour of inflation. Vizek and Broz (1998) concluded that in the short-term inflation is more responsive to exchange rate changes than to monetary conditions.

Mortaza (2006) investigated the source of inflation in Bangladesh using quarterly data on real GDP, money supply (M2), deposit rate of interest of scheduled banks, nominal exchange rate and CPI for the period July-September 1989 to April-June 2006. To establish the relationship between inflation and its determinants Mortaza (2006) used the unrestricted vector auto regressions (VARs) approach. This study provides evidence that money supply and exchange rates had a significant positive influence on inflation. Furthermore, the results suggest that there was a significant negative relationship between deposit rate of interest and inflation (Mortaza 2006: 17).

Maliszewski (2003) estimated inflation in Georgia using monthly data for the post-stabilization period 1996:1-2003:2. Inflation was specified as a function of the gross domestic product, exchange rate, money supply, fruit and vegetable prices and oil prices. Maliszewski (2003) used the aggregate demand aggregate supply (demand-pull) approach. Based on the results Maliszewski (2003:19) concludes that the exchange rate is the dominant factor in determining inflation and money supply was found to be second main determinant.

Hasan (1999) investigated the origin of inflation for China using aggregate demand and supply factors. Inflation was specified as a function of money stock, output gap as a proxy for excess demand pressure, wages, agricultural productivity, and a measure of industrial productivity. The results show that there was a strong long-term relationship between the price level and the money stock, and between inflation and monetary growth. In addition, a feedback relationship was found to exist between inflation and monetary growth (Hasan, 1999: 669).

The de Kock Commission (1985) investigated the causes of inflation in South Africa. The results show that salary and wage increases in excess of productivity growth, inadequate competition, tax increases and imported inflation are insignificant

in South Africa. These findings were later criticized by Mohr (1986) on methodological and analytical grounds. Mohr (1986) pointed out that the Commission's strong bias for monetarist views precluded an objective analysis of the determinants of inflation in South Africa, and that the model adopted by the Commission was not robust to estimate inflation. Thus, Moore and Smit (1986) revisited the analysis and provided evidence that wage increases had a significant impact on inflation in South Africa.

Pretorius and Smal (1994) estimated inflation in South Africa and established that changes in labour costs driven by inflation expectations is an essential variable in determining price fluctuation. Pretorius and Smal (1994) also noted that the cost of imported goods was also a contributing factor to inflation.

Furthermore, a recent study by Fedderke and Schaling (2005) for South Africa provides evidence for the influences of mark-up behaviour of output prices over unit labour costs. Fedderke and Schaling (2005:91) found the mark-up to be approximately 30%, which was three times as high as that in the United States. Fedderke and Schaling (2005:1) used an expectations-augmented Phillips curve framework to analyse the link between inflation, inflation expectations, unit labour cost, the output gap and the real exchange rate. Quarterly data was used covering the period 1963:4-1998:2.

Zavkiev (2005) estimated a model of inflation in Tajikistan using the Johanson cointegration approach and single equation error correction model. Zavkiev (2005:13) used monthly time series for the period 1996:01-2003:05. This study provides evidence that in the long-run inflation is determined by exchange rate, money, and real output and interest rates. The short-run results suggest that inflation is determined by past values of money growth and inflation, and current and past values of output growth and interest rate changes. The coefficient of adjustment of inflation to its long-run equilibrium was found to be 41% which is very high and significant (Zavkiev, 2005:32).

Contrary to the above studies, Younus (2007) investigated the relationship between economic growth (output), private sector credit and inflation in Bangladesh. To

establish the relationship a VAR approach and Granger Causality tests were used to estimate the model. Younus (2007) used data from 1990:4 to 2006:4. All data are in log form and the model was estimated using the consumer price index; the real gross domestic product; quarterly data for private sector credit; the industrial production. Based on the results Younus (2007:1) concluded that the private sector credit had no real effect on economic growth but was inflationary. These findings are further supported by a number of studies (see for example Tang, 2002; Huang and Xu, 1999; and Corsetti *et al.*, 1999).

Tang (2001) investigated the impact of bank credit on inflation in Malaysia using annual data from 1973 to 1997. In this study inflation was specified as a function of bank credit, money supply, real income, exchange rate, money market rate, import price index, wage per month and real gross domestic product. Tang (2001: 281) acknowledged the use of Engle and Granger (1987) and the Johansen approach (Johansen, 1988; Johansen and Juselius, 1990) to establish co integration, but argued that since their research involved a small sample (25 observations) the above approaches were inappropriate. Hence they adopted the unrestricted error correction model in Pesaran *et al.*, (2000). Tang (2001:285) concludes that the major causes of inflation in Malaysia were import price and real income, and the relationship was elastic. Even though variables such as money supply and bank credit were found to be insignificant, Tang (2001:285) established the existence of a co-movement between these two variables and inflation which showed a sign of an indirect effect on inflation. Thus, Tang (2001:285) argues that there was a long-term equilibrium relationship between inflation and bank credit, import price, money supply (M3), and real income.

### **3.4 CONCLUSION**

The theories reviewed fail to provide extensive and comprehensive theoretical grounds for the determinants of the credit demand and inflation, respectively. Much information on the determinants of the demand for bank credit and inflation is derived from the empirical literature.

Given the conflicting findings<sup>8</sup> of empirical literature on the relationship between bank credit and inflation, it would be imprudent to generalise the estimates of inflation and bank credit extension to the private sector in South Africa based on such studies. Thus, this study uses the literature and methods reviewed in this chapter as a guide to develop a model in order to investigate the effect of bank credit extension to the private sector on inflation in South Africa. It is worth noting that none of the studies done on South Africa include bank credit as an explanatory variable when estimating inflation. As noted in chapter one, there is no study done in South Africa with a similar focus, and literature is scanty in international research on this topic. Based on the literature reviewed<sup>9</sup> in this chapter, the Johansen (1988, 1991) and Johansen and Juselius (1990) co integration technique is chosen as an ideal approach to determine the impact of bank credit extension to the private sector on inflation. The short-run effect is captured using the vector error correction model (VECM). The next chapter describes the empirical framework followed in this study.

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<sup>8</sup> Younus (2007) argues that bank credit is inflationary. Tang (2001) also established that there is an indirect effect of bank credit on inflation.

<sup>9</sup> This study follows adopts the approach by Hendry (1995), Calza *et al.*, (2001), Zavrkiev (2005) and Eickmeier *et al.*, (2006). Since our model involved a large sample (148 observations) the Johansen cointegration approach is ideal as recommended by Tang (2001).

## CHAPTER FOUR

# METHODOLOGY AND ANALYTICAL FRAMEWORK

### 4.1 INTRODUCTION

This chapter provides a detailed description of the methodology used to achieve the objectives of this thesis. Several descriptive statistical tests and simple correlations were done before the actual estimation of inflation. As noted in Chapter 3 our analytical framework follows Hendry (1995), Calza *et al.*, (2001), Zavgkiev (2005) and Eickmeier *et al.*, (2006). Thus the Johansen (1988, 1991) and Johansen and Juselius (1990) cointegration approach was used to determine the long-run relationship between inflation and its determinants. This model provides a unified framework for the estimation and testing of cointegration relations in the context of vector auto regressions (VARs) as described by Brooks and Tsolacos (1999:146). The short-run relationship was determined using the vector error correction model (VECM). The block exogeneity Wald test was used to establish whether the exclusion of one variable results in statistically significant changes in another variable in the model. This chapter also provide impulse response functions and variance decomposition analyses. The former is able to provide information on the responsiveness of a dependent variable to shocks experienced by each of the other variables in the vector autoregressive (VAR) context. The latter splits the variations into component shocks in the VAR.

This chapter is arranged as follows: section 4.2 provides a description of the data used to achieve set objectives and also presents the specification of the model; section 4.3 presents the techniques used to identify the properties of the time series data; section 4.4 to 4.8 describes the methodology followed in examining both the long-run and short-run relationships between inflation and its determinants as well as the limitations of the approaches used in this study; section 4.9 explains the limitation of the Johansen co integration approach; and section 4.10 provides a summary of all the steps to be discussed in each section.

## 4.2 MODEL SPECIFICATION AND DATA DESCRIPTION

To estimate our model, quarterly data is used obtained from the South African Reserve Bank, I-Net Bridge and Quoin Institute (Pty) Limited covering the period 1970:1 to 2006:4. The period covered was chosen because it includes the required range of observations for the model used and because it demonstrates the dynamics of bank credit and inflation under different monetary regimes in South Africa. Our model is developed based on previous empirical research and the availability of data. This study estimates the relationship between inflation (CPI not CPIX), and its determinants.<sup>10</sup> Amongst other reasons CPI is used because of the lack of CPIX data for the period covered (1970:Q1 to 2006:Q4). The model is estimated as follows:

$$\begin{aligned} \ln \text{Inflation} = & \alpha + \beta_1 \ln M3 + \beta_2 \ln RBC + \beta_3 \ln RGDP + \beta_4 \ln USDZAR + \beta_5 \ln MMR \\ & + \beta_6 \ln Z + \varepsilon \dots\dots\dots [4.1] \end{aligned}$$

where the following notations denote:

<i>lnInflation</i>	The South African inflation rate is calculated from the consumer price index (CPI), which in turn is an average of prices weighted by the relative amounts spent on the different items by the South African population as a whole (measured monthly)
<i>lnM3</i>	the broad definition of money supply
<i>lnRBC</i>	bank credit extended to the private sector
<i>lnRGDP</i>	real gross domestic product
<i>lnUSDZAR</i>	the rand dollar exchange rate
<i>lnMMR</i>	the money market rate
<i>lnZ</i>	import prices
$\varepsilon$	the error term

To achieve mean reverting properties all variables used were expressed in natural logarithms. Zita (2007:8) supports the use of logarithms by arguing that they help to smooth the data and make it possible to interpret estimated coefficients in terms of elasticities.

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<sup>10</sup> See Table A1 for definition of variables and source.

### **4.2.1 Expected signs for variables**

A positive sign is expected in the long-run in the case of the money supply. As noted in chapter 3, if money supply increases faster than the rate of growth of national income then inflation will follow.

There is no consensus on the impact of bank credit (RBC) on inflation. As noted in Chapter 3, some researchers argue that there is a positive relationship between inflation and bank credit while others suggest that the relationship is negative.

Literature suggests that there is a negative relationship between inflation and the real gross domestic product (RGDP). This implies that an increase in RGDP will lead to a fall in inflation.

The exchange rate will be interpreted differently depending on whether the impact is perceived on the domestic or on the foreign side. On the domestic side, if the value of the local currency appreciates against the US dollar there is a negative relationship between inflation and the exchange rate, while from the foreign perspective the reverse is true.

A negative sign is expected for the money market rate because a contractionary monetary policy stance leads to a reduction in the growth rate of the money supply. Thus in this case an increase in the money market rate should lead to a fall in inflation.

In the case of import prices and inflation, positive signs are expected because an increase in import price reflects the depreciation of the local currency. The coefficient for import prices is expected to be positive and inflationary. This implies that an increase in import prices lead to an increase in inflation.

## **4.3 PROPERTIES OF DATA**

### **4.3.1 Graphical analysis**

The first step in data analysis is to plot all variables to be used in the model. A time series plot sheds light on the properties of the data and identifies whether or not it is stationary. A graphical plot is also used in selecting the correct assumption when estimating the vector error correction model. Graphical analysis does not, however, provide an accurate presentation of the data to achieve information on the unit root and stationarity. Hence the Augmented Dickey Fuller and Phillips-Perron (PP) test are used to test for unit root. Another test that is important before the unit root/stationarity test is the test for multicollinearity.

### **4.3.2 Multicollinearity test and Granger causality test**

Aron *et al.*, (1997:20) suggests that a co integration model that includes exchange rate and too many variables has always given researchers problems because it produce too many co integrating relationships, which are complicated if not impossible to interpret. To avoid this problem, a pair wise correlation matrix provides a better guide in the process of selecting variables to be used for single alternative models. According to Gujarati (2003:205), during data collection it is not easily possible to identify whether the series are correlated or not; thus the pair wise or correlation matrix is used to verify such relationship. Narayan and Smyth (2005: 233) argues that the correlation matrix is not efficient to capture the long-run dynamics between the dependent variable and its determinants, thus no conclusion can be made at this level. Instead of relying on the pair wise or correlation matrix's results to establish single alternative models, this study follows Hendry (1995), in estimating single alternative regression equations.<sup>11</sup>

Furthermore, the Granger causality test is utilised to identify possible patterns relating to the direction of causality between variables. Instead of relying on the commonly used Granger causality test for exogeneity and causality, the block exogeneity the Wald test is used to verify whether the exclusion of one variable results in statistically significant changes in another variable in the model.

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<sup>11</sup> The general to specific approach was used to come up with single alternative regression equations.

#### 4.4 THE JOHANSEN COINTEGRATION APPROACH

There are several approaches that are used to determine the relationship between two or more variables. Amongst other models, the Engle-Granger co integration approach is widely used to establish the relationship between inflation and several macroeconomic variables.<sup>12</sup> Due to several limitations in this approach, researchers have shifted to the Johansen co integration technique in recent years.

The quantitative analysis employed in this study is the Johansen (1988) and Johansen and Juselius (1990) co integration approach. Maddala and Kim (1998) and Aziakpono (2006) note that this approach applies a VAR model assuming that the errors are white noise. The advantage of using the Johansen cointegration procedure compared to other models when examining the long-term relationship is that it is able to capture more than one cointegrating vector and permits the identification of all cointegration vectors within a given set of variables as well as better asymptotic properties yielding more robust results (Brooks and Tsolacos 1999:146). Chakraborty and Basu (2002:1063) noted that this approach is dynamic because it avoids any loss of efficiency, and hence provides a robust model for the long-run. Furthermore, Chakraborty and Basu (2002:1063) suggest that the Johansen approach is ideal for long-run testing because of its flexibility in capturing structural breaks for unpredicted timing which result from monetary policy changes, transformation of institutional arrangements and severe economic crises. Gujaratie (2003:822) states that the Johansen model has been a robust model for modelling data following a trend since the mid-nineteen eighties. This model is generally specified as follows:

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^k \Gamma_i \Delta X_{t-i} + \rho z_t + \varepsilon_t \quad i=1, 2, k-1 \quad [4.2]$$

where

$\Delta X_{t-1}$  represents all  $I(0)$

denotes an  $n \times r$  coefficient matrix of linearity independent co integration vectors of  $\alpha$  and  $\beta$  such that  $\Pi = \alpha\beta'$  holds

$\alpha$  represents the speed of adjustment matrix

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<sup>12</sup> See Menon (1993) and Kim (19980).

$\beta$  is a matrix of long run coefficients

$z_t$  represents the vector of deterministic variables

$k$  is a finite autoregressive lag order used for the estimation

$\varepsilon_t$  is an error term.

As noted above several tests must be completed before the actual estimation of the long-run and short-run equations. The following sub-sections provide a review of all tests to be performed in Chapter 5.

#### 4.4.1 Testing for unit root/stationary

According to Gujarati (2003: 806), if a model is estimated using non-stationary data series, the estimation will generate spurious results. Thus, the first step in the process of determining the existence of a long-run relationship is to determine the stationarity of the series, also known as the order of integration. In order for co integration to exist, the variables must be stationary at level or first difference. There are numerous means of testing for stationarity, for example the unit root test, the autocorrelation function and the visual plots of data. This research utilized two unit root tests: the Augmented Dickey Fuller and the Phillips-Perron (PP) test. To test for stationarity the Kwiatkowski-Phillips-Schmidt-Shin test was used as suggested by Kwiatkowski *et al.*, (1992).

The Augmented Dickey-Fuller test (ADF) and the Phillips-Perron (PP) test the null hypothesis of a unit root; therefore the series is stationary if the null hypothesis is rejected, whilst the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test involves a null hypothesis for a stationary series. The standard ADF and PP tests have been criticised for their poor size and power properties.<sup>13</sup> This relates to the tendency to over-reject the null hypothesis of non-stationarity when it is true and under-reject it when it is false (Brooks, 2002:382). The KPSS has been observed to have stronger size and power properties<sup>14</sup> and this justifies its inclusion in this paper. In the case of the KPSS the series are assumed to be trend-stationary under the null hypothesis and the test is based on the residuals from the ordinary least square regression of the endogenous variable on the explanatory variables. The KPSS stationarity test is based on the

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<sup>13</sup> See Schwert (1989) and Aziakpono (2006:15).

<sup>14</sup> See Hobijn *et al.*, (1998); and Caner and Kilian (2001).

reversed null hypothesis of stationarity to ensure the consistency of ADF and PP unit root test results.

#### 4.4.2 Co-movement: the Johansen co integration and vector error correction (VECM) model

The Johansen approach requires the estimation of the VAR equation before the residuals are used to compute two likelihood ratios (LR) test statistics. The computed likelihood ratio (LR) test statistics values are used in the determination of the unique cointegrating vectors of  $X_t$ . To establish the presence or absence of a cointegrating relationship between the dependent and the explanatory variables, it is essential to identify the appropriate lag length to use. In this study the information criteria are used for the selection of the lag length. The most prominent information criteria are the Akaike (1974) information criterion (AIC), Schwarzø (1978) Bayesian information criterion (SBIC) and the Hannan-Quinn information criterion (HQIC). All the selected lag lengths were explored to establish an estimation that makes economic sense. The method used in this paper is to move from one lag to the next to identify the appropriate lag length.

The most important issue when performing the estimation is to use the correct deterministic assumption. In order to select the correct deterministic assumption, the graphical analysis, unit root/stationarity tests and economic theory should be utilized. The first step is to obtain a summary for all the assumptions to identify the possible number of cointegrating vectors. Table 4.1 presents these assumptions.

**Table 4.1: Deterministic trend assumptions**

Assumption	Description
1. No intercept or trend in CE or VAR	No deterministic trend in the data and no intercept or trend in the VAR and in the cointegrating equation
2. Intercept (no trend) in CE-no intercept in VAR	No deterministic trend in the data, but an intercept in the cointegrating equation and no intercept in VAR
3. Intercept (no trend) in CE and VAR	A linear deterministic trend in the data and an intercept in the cointegrating equation and test VAR
4. Intercept and trend in CE ó no trend in VAR	A linear deterministic trend in data, intercept and trend in the cointegrating equation and no trend in VAR
5. Intercept and trend in CE ó linear trend in VAR	A quadratic deterministic trend in data, intercept and trend in the cointegrating equation and linear trend in VAR

Notes: CE denotes the cointegrating equation

E-Views 5 manual (2004: 725) suggests that assumption 2 can be used if none of the series displays a trend. Assumption 3 is ideal if the series displays stochastic trends and, assumption 4 can be used if some of the series are stationary. Furthermore, E-Views 5 manual (2004:725) points out that assumptions 1 and 5 are rarely used by researchers. The selection of the deterministic trend assumption in this study is based on analyses of the graphical plot, unit root/stationarity tests and economic theory.

Using the appropriate assumption, all lag lengths selected by the information criteria were explored to obtain results that make economic sense. Once the correct VAR order ( $k$ ) and the deterministic trend assumption were chosen, the rank of the matrix was tested (Awokuse, 2005:230). This was done using two likelihood ratio (LR) test statistics, the trace statistic and maximum eigenvalues.<sup>15</sup> If the trace statistic ( $\lambda_{trace}$ ) and maximum eigenvalues ( $\lambda_{max}$ ) are less than their critical values at 5%, the number of cointegrating vectors present is indicated. The following formula for the trace statistic and the maximum eigenvalue holds:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^N \ln(1 - \hat{\lambda}_i) \quad [4.3]$$

and

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad [4.4]$$

where

$r$  represents the number of cointegrating vectors under the null hypothesis

$\hat{\lambda}_i$  represents the estimated value for the  $i^{\text{th}}$  ordered eigenvalue from the matrix.

$T$  denotes the number of observations used for estimation.

According to Dritsakis (2004:115), the number of co integrating vectors under the null is  $r = 0, 1, 2, k-1$ .

Harris (1996:14) pointed out that the shortcoming of the trace test ( $\lambda_{trace}$ ) is manifested when incorporating a dummy variable in the deterministic component of

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<sup>15</sup> See Belton and Cebula (1995), Haug (1996) and Aziakpono (2006).

the multivariate model and when the sample size of the observation in  $z_t$  is small. The latter result has a limit regarding the power and size of the trace when asymptotic critical values are used. The trace test ( $\lambda_{trace}$ ) is a joint test where the null hypothesis is that the number of cointegrating vector is less than or equal to  $r$ , as opposed to an unspecified alternative that there are more than  $r$  denoted by  $k$  (Brooks, 2002: 405). The hypothesis below holds for the trace test:

$H_0$ : the number of co integrating relations is  $r$

$H_1$ :  $k$  co integrating relations

where

$k$  denotes the number of endogenous variables.

The maximum eigenvalue ( $\lambda_{max}$ ) is based on the greatest eigenvalue and conducts a separate test on the eigenvalue. The  $\lambda_{max}$  tests the null hypothesis that the number of cointegrating vectors is  $r$  against the alternative of  $r+1$ . Here, the null hypothesis is rejected if  $H_0: r = 0$  (Brooks, 2002: 405). Thus the following hypotheses for the maximum eigenvalue test holds:

$H_0$ : there are  $r$  co integrating vectors

$H_1$ :  $r+1$  co integrating relations

According to Brooks (2002:405), by increasing the value of  $r$  the null hypothesis is finally not rejected. If the null hypothesis is not rejected it can be concluded that there is no co integrating vector, hence the test is completed or comes to an end. In addition, if the test statistic is greater than the critical value, the null hypothesis that  $r=0$  is rejected, it can be concluded that there are co integrating vectors (Brooks, 2002: 405).

Once the number of co integration is established, normalization is done to identify the true cointegrating vectors and to establish whether they indicate the existence of structural relationship underlying the long-run model. To normalise, this study

follows the approach recommended by Brooks (2002:429).<sup>16</sup> Chakraborty and Busu (2002:1069) note that this is achieved by interpreting  $\alpha$  and  $\beta$  coefficients obtained when estimating the Johansen model. The maximum likelihood estimator of  $\alpha$  and  $\beta$  is a function of the residuals. Thus this estimator also provides asymptotically efficient estimates of the co integrating vectors (betas) and the adjustment of the parameters (alphas) (Chakraborty and Busu, 2002:1069).

The trace and the maximum eigenvalue statistics may give different numbers of co integrating equations. According to Harries (1995:89), the trace test presents better results relative to the max-eigenvalue test in terms of skewness and kurtosis. When the trace and maximum eigenvalue statistics provide different numbers of cointegrating equations, it is recommended that the estimated co integrating vector be examined and one's choice be based on the interpretability of co integrating relations (E-Views 5 manual:728).

Once the number of cointegrating vectors in the model is identified, the vector error correction model (VECM) is estimated to provide an impression of the short-run and long-run dynamics (Brooks and Tsolacos, 1999:146). The VECM framework restricts the long-run behaviour of the endogenous variables to converge at their cointegrating relationships and allow for short-run adjustment dynamics. Calza *et al* (2001a:13) pointed out that the VECM also allows for the testing of the weak exogeneity to establish whether the dependent variable is endogenous or not. The results obtained from the VECM indicate how each variable adjusts itself in response to a random shock. As noted in section 4.3.2 we also use the general-to-specific approach to establish a parsimonious model for the short and long-run. The advantage of this approach is its ability to present results based on underlying economic theories of inflation, which are also consistent with the properties of the data. This approach involves dropping the insignificant coefficients and performing the diagnostic tests (Hendry 1995).

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<sup>16</sup> The normalisation is done with respect to the first variable given in the list of variables.

Furthermore, it is necessary to verify whether the model is correctly specified. The following sub-section provides a review of diagnostic checks which is an ideal approach to verify whether the model is correctly specified.

#### **4.5 BLOCK EXOGENEITY WALD AND CAUSALITY TEST**

Weak exogeneity test establishes the legitimacy of specification of the variation for inflation as a single equation model instead of a system through the general to specific approach. As noted above instead of using the commonly used Granger causality test for exogeneity, the block exogeneity Wald test is used to verify whether the exclusion of one variable results in statistically significant changes in another variable in the model. Like the Granger causality test, the block exogeneity Wald test identifies the variables in the model that have statistically significant influences on the future values of each of the variables in the system but it fails to capture the sign in a value of a given variable (Brooks, 2002: 340). The probabilities of the chi-square are used to determine whether or not a variable has a significant impact. Furthermore, the vector error correction (VEC) Granger causality/ block exogeneity Wald test was used to identify which of the determinants are exogenous and which ones are endogenous in our model.

#### **4.6 DIAGNOSTIC CHECKS**

This involves testing for autocorrelation, heteroscedasticity, the Bera-Jarque normality test and structural break test/chow test. The diagnostic checks are important to ensure that the VAR is correctly specified.

##### **4.6.1 Residual normality test**

The normality test used in this study is the Jarque-Bera (JB) residual normality test. This test compares the third and fourth moments of the residuals to those from the normal distribution. The residual test has a null hypothesis for a normally distributed series. Non-normality is not a problem if some of the variables are weakly exogenous (see Harris, 1995:83; Islam and Ahmed, 1999:105)

#### 4.6.2 Serial correlation test

In the case of serial correlation the Lagrange Multiplier (LM) test is used. As noted by Harris (1995:82) the lag order when testing for residual serial correlation should correspond to the VAR lag length. The null hypothesis for this test is no serial correlation as opposed to autocorrelated residuals.

#### 4.6.3 Heteroscedasticity test

The heteroscedasticity test helps to ascertain if the variance of the error term is constant. In this study an extension of White's (1980) test was used, as suggested by Doornik (1995, in E-Views 5:712). The null hypothesis is that residuals have a constant variance. The standard estimation techniques become inefficient if the error term varies. The presence of heteroscedasticity in a model may be the result of omitting important variables that explain the dependent variable. To rectify the problem of heteroscedasticity, E-Views 5 provides a *White* option which is capable of eliminating it.

#### 4.6.4 Structural break test

The Chow test is used to establish whether the underlying regression model has remained unchanged across various monetary policy regimes. The null hypothesis in this case is that there is no structural break (Kennedy, 2003). The sample in the first test include the money supply target regime (1985 ó 1989:4); the second test for structural change covers the period of the *eclectic* approach (1990:1 to 1999:4), and the third entails the sample for the current period of inflation targeting (2000:1 to 2006:4). The procedure in Calmes (2004) and Dahiya (2008) for applying the Chow test is summarised below:

- Estimating the regression using all the data, including the period before and after the structural break, obtain  $RSS_c$ .
- Estimating two separate regressions on the data before and after the structural break, obtaining the RSS in both equations, giving  $RSS_1$  and  $RSS_2$ .
- Thus the formula for the *F*-test holds:

$$F = \frac{RSS_c - (RSS_1 + RSS_2) / k}{RSS_1 + RSS_2 / n - 2k}$$

#### 4.7 VARIANCE DECOMPOSITION ANALYSIS<sup>17</sup>

Takaendesa *et al.*, (2006:93) suggest that generalized variance decomposition illustrates the influence of each random innovation on the variables in the VAR. Papapetrou (2001:4) notes that the forecast-error of generalized variance decomposition analysis provides information about the proportion of the movements in sequence as a result of its own shocks as opposed to shocks from other variables. Papapetrou (2001:4) further suggests that if shocks provide information concerning the forecast error variance of  $Y_t$  (dependent variable) at all forecast horizons,  $Y_t$  is an endogenous variable and *visa versa*.

#### 4.8 IMPULSE RESPONSE FUNCTIONS<sup>18</sup>

The effects of unanticipated shocks on inflation, money supply, bank credit, real gross domestic product, exchange rate, and the money market rate and import prices are ascertained from the impulse response functions of a reduced form VAR model. There are two commonly used techniques when performing impulse response functions: the generalised impulse response proposed by Koop *et al* (1996) and Pesaran and Shin (1998:17), and the Cholesky decomposition proposed by Sims (1980). What sets apart the former technique from the latter is the fact that it requires orthogonalization of innovations and it does not vary with the ordering of variables in the VAR. This study uses the generalised impulse response proposed by Koop *et al* (1996) and Pesaran and Shin (1998). The impulse response functions trace out the responsiveness of the dependent variables in the VAR to shocks to each of the explanatory variables in the model (Brooks, 2002:341).

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<sup>17</sup> Brooks (2002:342) notes that the variance decomposition provides information on how much the s-step-ahead forecast error variance for a variable is influenced by innovations to each independent variables for  $s = 1, 2, \dots, k$ .

<sup>18</sup> Impulse response provides information on the responsiveness of the dependent variables in the VAR following shocks to each of the variables (Brooks, 341).

## **4.9 LIMITATIONS OF THE JOHANSEN COINTEGRATION**

### **APPROACH**

According to Harris (1995:77), like other models the Johansen has certain limitations. The most significant constraint is that each step must be rigorously performed and interpreted, and results are sometimes difficult to interpret. Aron *et al* (1997:20) recommends that few variables should be used when applying a Johansen co integration approach to improve its efficiency.

## **4.10 CONCLUSION**

This chapter outlines the empirical framework to be used in chapter 5 for analysing the relationship between inflation and its determinants. To establish the long-run and short-run dynamics the Johansen co integration approach and the vector error correction model (VECM) are used in the following chapter. The former provides a unified framework for the estimation and testing of cointegration relations in the context of vector auto regressions (VARs) as noted by Brooks and Tsolacos (1999:146). This approach is unique compared to other co integration models because it is able to accommodate more than one cointegrating vector and permits the identification of all co integration vectors within a given set of variables as well as better asymptotic properties yielding more robust results (Brooks and Tsolacos, 1999:146). Harris (1995:103) also provides a list of steps that should be covered when using the Johansen cointegration model. In addition the study employs the generalized impulse response analysis and variance decomposition to illustrate the influence of each random innovation on the variables in the VAR.

## CHAPTER FIVE

# EMPIRICAL ANALYSIS AND RESULTS

## 5.1 INTRODUCTION

This chapter responds to the question posed in Chapter 1: whether the increase in bank credit extension to the private sector signals the future failure of inflation-targeting in South Africa by using the Johansen cointegrating model to establish the relationship between inflation and its determinants.

This chapter is presented as follows section 5.2 provides graphical and multicollinearity analyses; section 5.3 presents the results for unit root/stationarity test; section 5.4 provides the Johansen co integration and vector error correction models analysis; section 5.5 presents the diagnostic checks; section 5.6 provides the analysis of the variance decomposition; section 5.7 presents the impulse response functions; and section 5.8 provides a summary of all tests performed in this chapter.

## 5.2 GRAPHICAL AND MULTICOLLINEARIY ANALYSES

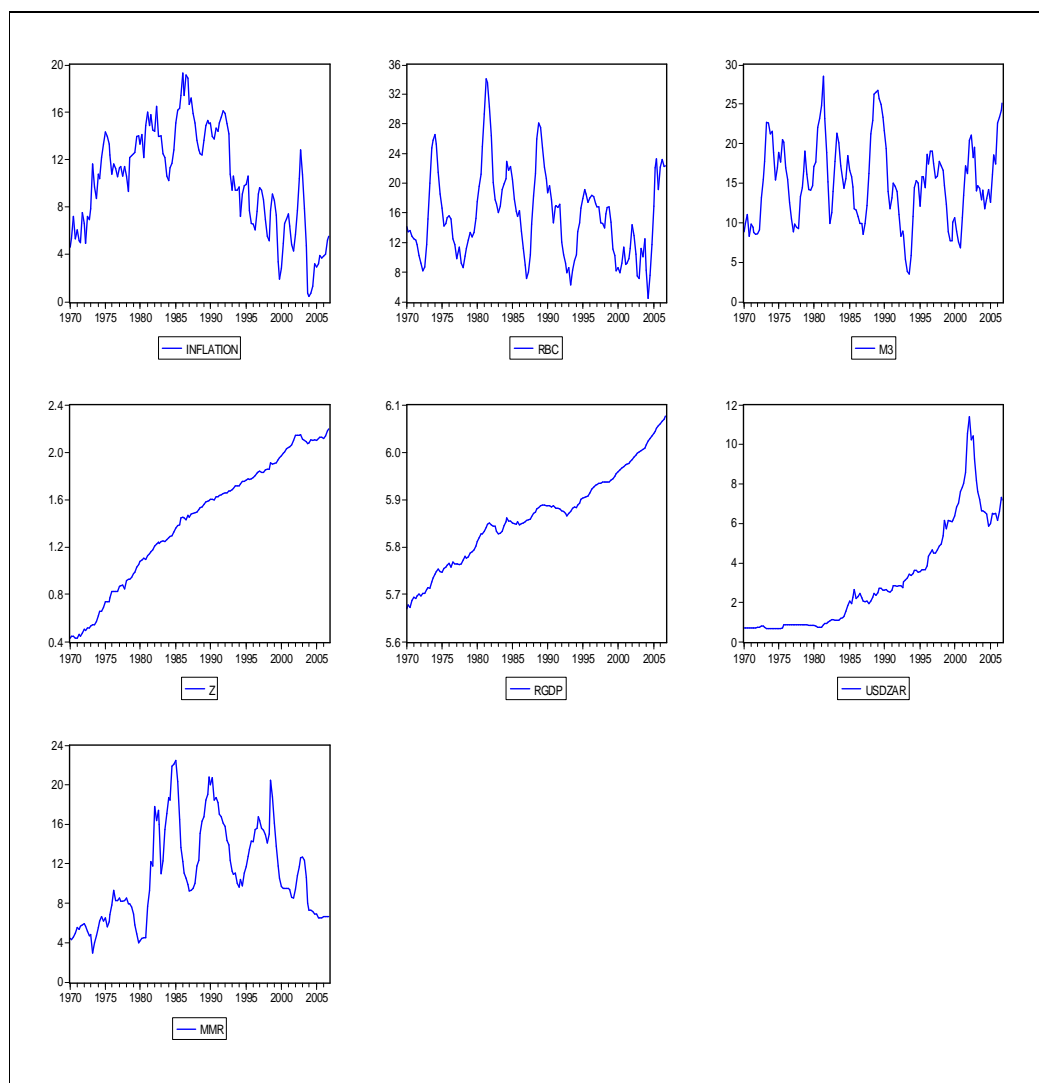
### 5.2.1 Graphical analyses

All relevant variables were first plotted on a time series graph to identify whether the data is stationary and to assist in the selection of the correct assumption for estimating the vector error correction model. In this study all series were converted to logarithm form.<sup>19</sup> Figure 5.1 (next page) plots the seven variables used in this study.

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<sup>19</sup> All presented in percentages.

**Figure 5.1: Plots of inflation and its potential determinants, 1970:1-2006:4**



Source: I-Net Bridge, the South Africa Reserve Bank statistics database and Quoin Institute (Pty) Limited

The real GDP, USDZAR and import prices (Z) have an upward trend. Inflation (CPI) and the money market (MMR) plots have downward trends. Money supply (M3) and bank credit (RBC) plots fluctuate with significant drops in 1994 and 2002.

### **5.2.2 Multicollinearity analysis and Granger Causality**

Before the unit root test was applied, correlations between variables in the model were noted. The pair wise correlation matrix was used to identify variables that are significantly correlated to inflation and those that have low correlations with the dependent variable (see Table A2 in the appendix). Surprisingly none of the variables

were significant.<sup>20</sup> Gujarati (2003:359) suggests that although high pair wise correlations may indicate co linearity but it is not necessary that the regressors be high to have multicollinearity. Narayan and Smyth (2005: 233) suggest that correlation provides information on the short run linkages, but it fails to capture the long-run dynamics.

The Granger causality test was also performed to identify possible patterns relating to the direction of causality between variables. Table A2 in the appendix also presents the Granger causality test results (for M3 and RBC). The results suggest that an increase in the money supply leads to a surge in bank credit to the private sector. This confirms what is noted in Chapter 3 that an increase in money supply contributes to an increase in loanable funds.

A detailed analysis on correlation is established when performing the diagnostic checks (i.e. the serial correlation test). We thus proceed to test for unit root/stationarity of all the variables.<sup>21</sup>

### **5.3 UNIT ROOT/STATIONARITY TEST**

The three formal tests that were employed in this study are the Augmented Dickey-Fuller test (ADF), the Phillips-Perron (PP) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS). Since some of graphical plots of the time series<sup>22</sup> were trending, the tests were done using the  $\tau$ -intercept and trend $\phi$ deterministic trend assumption.<sup>23</sup> The ADF and PP test the null hypothesis that the series have a unit root, while the KPSS tests the null hypothesis that the series are stationary. If the null hypothesis of the first two tests (ADF and PP) is rejected that would imply that the series does not have a unit root. In case of the KPSS, if the null hypothesis is rejected this indicates that the series is non-stationary. The unit results are presented below in Table 5.2.

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<sup>20</sup> All variables were below 0.8, this suggest that multicollinearity is not a problem hence a need to infer this from other empirical tests.

<sup>21</sup> Variables that were initially selected for our model.

<sup>22</sup> See Fig 5.1.

<sup>23</sup> All tests were done using assumption 4.

**Table 5.1: Unit root/stationarity test results**

SERIES	ADF		PP		KPSS	
	<i>Level</i>	<i>1<sup>st</sup> Difference</i>	<i>Level</i>	<i>1<sup>st</sup> Difference</i>	<i>Level</i>	<i>1<sup>st</sup> Difference</i>
Inflation	-1.134749	-9.939976***	-1.769869	-10.76828***	0.313765	0.121277***
RBC	-0.473079	-4.728311***	-0.734082	-6.119068***	0.156104	0.045748***
Z	-1.036001	-12.71749***	-0.991526	-12.72784***	0.330607	0.048086***
USDZAR	-2.466637	-8.833092***	-2.430483	-8.950632***	0.231327	0.046776***
RGDP	-1.044603	-9.398207***	-1.412901	-9.579088***	0.178227	0.165888***
M3	-0.357965	-8.062911***	-0.622333	-8.365121***	0.057683	0.041632***
MMR	-1.605534	-9.165221***	-2.22505	-9.165221***	0.274666	0.026892***

Notes: The MacKinnon (1996), 1% critical value= -3.485 and the KPSS (1992) 1% critical value = 0.216. Thus\*\*\* denotes the rejection of the hypothesis of a unit root/non-stationarity for the three tests used. The lag order was determined by the Schwarz information criterion whilst the spectral estimation method is Bartlett Kernel for all tests.

Based on the significance level of 1% the results shown in Table 5.2 for the three tests indicate that all series were non-stationary at level. All series are stationary after being differenced once. This indicates that all the series are integrated of order 1 (i.e. they are all  $I(1)$ ). In addition, a linear combination of  $I(1)$  series could be  $I(0)$  only if the series are found to be co integrated. The following section presents the Johansen co integration analysis as it is applicable in this case.

## 5.4 THE JOHANSEN COINTEGRATION ANALYSES

According to Kennedy (2003:327), there should be a linear combination between the estimated variable (dependent) and its explanatory variables for co integration to exist. As noted in Chapter 4, in the case of more than two cointegrating vectors the Johansen procedure (1988, 1991) is used to identify the number of cointegrating vectors. The Johansen technique is ideal in this case because the model used includes seven variables.

It is important to identify the appropriate lag order and deterministic trend assumption for the vector auto regression (VAR) order before the actual estimation is done. Since the series are quarterly, the selection of the lag length was drawn from a maximum of 8 lags. Table 5.3 shows the results of the lag length selection for the (VAR) by different information criteria.

**Table 5.2: VAR lag order selected using information criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1493.784	NA	4.828961	21.43977	21.58685	21.49954
1	-75.09887	2675.235	1.54E-08	1.872841	3.049498*	2.350999*
2	-0.291155	133.5852	1.07E-08	1.504159	3.710391	2.400706
3	36.62842	62.23586	1.28E-08	1.676737	4.912544	2.991672
4	87.03804	79.93525	1.29E-08	1.656599	5.921981	3.389923
5	158.0837	105.5535	9.80E-09*	1.341662*	6.636618	3.493374
6	198.9019	56.56247	1.17E-08	1.458544	7.783075	4.028644
7	252.5517	68.97823*	1.20E-08	1.392119	8.746225	4.380608
8	282.3314	35.31023	1.77E-08	1.666694	10.05038	5.073572

\* indicates lag order selected by the criterion  
LR: sequential modified LR test statistic (each test at 5% level)  
FPE: Final prediction error  
AIC: Akaike information criterion  
SC: Schwarz information criterion  
HQ: Hannan-Quinn information criterion

From the table above it can be noted that different information criteria selected different appropriate lags. Lags 1, 5 and 7 were selected by the information criteria. Based on the lag lengths selected above, we proceeded to apply the Johansen maximum likelihood procedure, the vector error correction model (VECM) and the diagnostic checks.

A cointegration test using all the assumptions was performed to identify the possible number of co integrating vectors. Table 5.4 presents the summary of assumptions.

**Table 5.3: Summary of assumptions**

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	7	4	3	2	2
Max-Eigen	2	3	2	2	2

\*Critical values based on MacKinnon-Haug-Michelis (1999)

Assumption one suggests 7 co integrating vectors for the trace and 2 for the max-eigenvalue. In the case of assumption two, 4 co integrating vectors are captured by the trace and 3 by the max-eigenvalue. Assumption three indicates that there are 3 co integrating vectors for the trace and 2 in the case of max-eigenvalue. The last two assumptions suggest that there are 2 co integrating vectors for both trace and max-eigenvalue.

The next procedure involved the repetition of the cointegration test using assumption four together with appropriate lag lengths selected by the information criteria (i.e. lag lengths 1, 5 and 7). Assumption 4 was selected because it conforms to the stationarity tests performed with the trend and intercept. All three lag lengths were explored and it was found that lag length 1, as chosen by the Schwarz information criterion, produced economically meaningful results. To achieve this, we proceeded sequentially from the first lag upwards to determine the appropriate lag length, as opposed to randomly selecting a lag selected by the information criterion.

The next analysis involved the determination of the number of cointegrating equations using the trace and maximum eigenvalue. As noted in Chapter 4, for both tests, the null hypothesis is rejected when the probability is less than 5%. The results for the two tests are given in Tables 5.5 and 5.6.

**Table 5.4: Unrestricted cointegration rank test (trace)**

Null Hypothesis	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.364651	198.6799	146.7613	0.0000
At most 1 *	0.289313	132.4570	114.9011	0.0027
At most 2	0.171360	82.59458	87.3124	0.0981
At most 3	0.135827	55.15096	62.9931	0.1575
At most 4	0.119317	33.83758	42.4423	0.3446
At most 5	0.057229	15.28712	25.3233	0.5432
At most 6	0.044743	6.683139	12.2532	0.3448

Trace test indicates 2 co integrating equation(s) at the 0.05 level  
 \*denotes rejection of the hypothesis at the 0.05 level and  
 \*\*MacKinnon-Haug-Michelis (1999) p-values

**Table 5.5: Unrestricted cointegration rank test (maximum eigenvalue)**

Null Hypothesis	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.364651	66.22288	49.4201	0.0008
At most 1 *	0.289313	49.86244	43.9711	0.0199
At most 2	0.171360	27.44362	37.5230	0.4789
At most 3	0.135827	21.31337	31.4643	0.3873
At most 4	0.119317	18.55047	25.5432	0.3982
At most 5	0.057229	8.603979	18.9630	0.7403
At most 6	0.044743	6.683139	12.2504	0.3657

Max-eigenvalue test indicates 2 co integrating equation(s) at the 0.05 level  
 \*denotes rejection of the hypothesis at the 0.05 level  
 \*\*MacKinnon-Haug-Michelis (1999) p-values

Table 5.5 shows that at none and at most one, the null hypothesis of no co integrating vector is rejected because the trace statistic values are greater than the critical values ( $198.6799 > 146.7613$  and  $132.4570 > 114.9011$ ). The trace statistic for at

most 2 co integrating vectors is 82.59458, which is less than the critical value at the 5% level (87.3124); hence the null hypothesis cannot be rejected. The max-eigenvalue test statistics also indicate that there are two co integrating vectors present and this is confirmed by the max-eigenvalue of 27.4436 which is less than its critical value at the 5% level (37.5230). According to Harries (1995:89), the trace presents better results relative to the max-eigenvalue test in terms of Skewness and the Kurtosis test, but in this case both the trace and max-eigenvalue tests indicate 2 co integrating equations at 0.05 level.

An error correction estimate was then established to determine whether inflation is the true co integrating vector in the model. The procedure involved the determination of the true cointegrating vector for the purpose of normalization. This process illustrates the behaviour of the coefficient of error correction term in the VECM ( $\alpha$ ) for each variable. The next section presents the results of the long-run relationship.

#### **5.4.1 Long-run relationship**

All tests performed above were taken into consideration to specify the vector error correction model. The lag lengths selected by the information criteria above were explored to come up with a model that makes economic meaning. The results for lag lengths 5 and 7 are presented in Table A2 and A3.<sup>24</sup> The results<sup>25</sup> for assumption 4 and lag length 1 are reported in Table 5.7.

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<sup>24</sup> See Table A2 and A3 in the appendix.

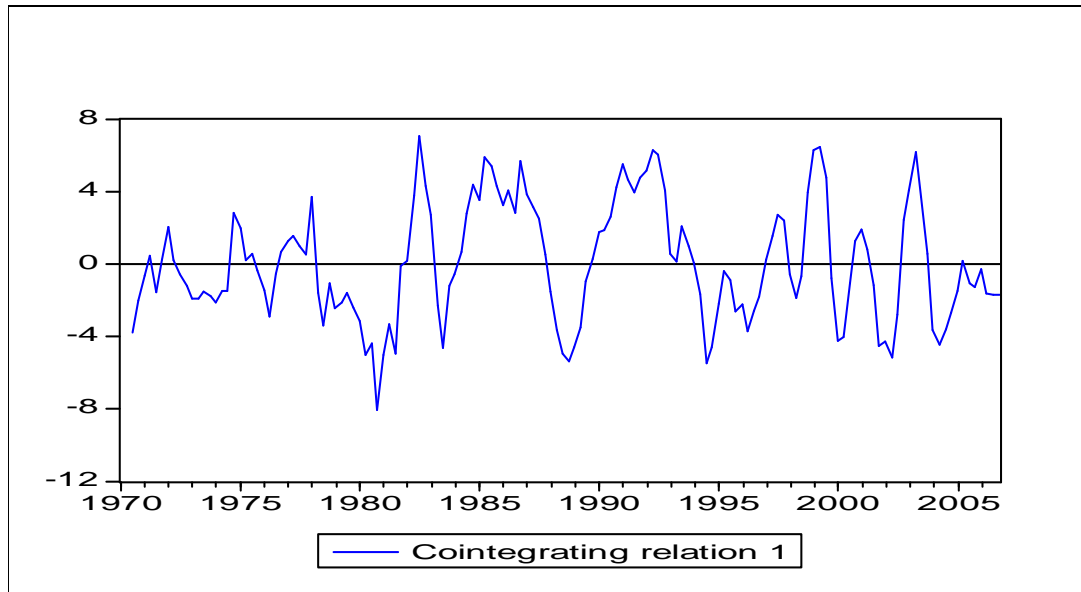
<sup>25</sup> Without imposing restriction.

**Table 5.6: Vector error correction model (VECM) results before normalization**

Date: 10/01/08 Time: 18:35							
Sample (adjusted) 1970Q3 2006Q4, 146 observations after adjustments, Standard errors ( ) & t-statistics [ ]							
Co integrating Eq:	CointEq1	CointEq2					
Inflation(-1)	1.000000	0.000000					
M3(-1)	0.000000	1.000000					
RBC(-1)	-0.654381 (0.09189) [-7.12096]	-1.483350 (0.16511) [-8.98397]					
RGDP(-1)	63.28198 (24.2733) [ 2.60706]	48.64755 (43.6127) [ 1.11545]					
USDZAR(-1)	-0.469916 (0.35701) [-1.31626]	-2.765634 (0.64145) [-4.31155]					
MMR(-1)	0.488135 (0.12701) [ 3.84320]	-0.172110 (0.22821) [-0.75418]					
Z(-1)	-51.16656 (6.00185) [-8.52513]	-8.036964 (10.7837) [-0.74529]					
@TREND(70Q1)	0.528182 (0.08316) [ 6.35127]	0.123509 (0.14942) [ 0.82659]					
C	-341.6708	-264.5470					
Error Correction:	D(Inflation)	D(M3)	D(RBC)	D(RGDP)	D(USDZAR)	D(MMR)	D(Z)
CointEq1	-0.14154 [-2.89074]	0.063588 [ 0.77261]	-0.015543 [-0.00673]	-0.000531 [-3.81989]	-0.01874 [-1.69312]	-0.21329 [-4.68686]	-0.00044 [-0.71319]
CointEq2	-0.03981 [- 1.37122]	0.027438 [ 0.56227]	0.2052 [ 5.42980]	-0.000332 [-4.03042]	0.001274 [ 0.19415]	-0.058023 [- 2.15046]	-7.44E-05 [-0.20236]

The coefficients of the error correction terms (cointegrating equation 1) in the table above indicate that inflation, the real gross domestic product (GDP) and the money market rate (MMR) are significant. The coefficient of inflation is negative 0.14154 and the t-value is significant (-2.89074). This indicates that inflation values are determined inside the model. The speed of adjustment in response to deviation from the equilibrium path is 14.2% per quarter. In addition, the results confirm that inflation is endogenous. The real GDP is significant, with a t-value of negative 3.81989. The MMR is also significant, with a t-value of negative 4.68686. In the case of the second cointegrating equation, inflation is insignificant. Therefore, inflation has a true cointegrating relationship in the first cointegrating vector. These results are further supported by the co integration plot for the first vector in Figure 5.2.

**Figure 5.2: Co integration graph for equation 1**



The second equation indicates that the real GDP and money market rate are negative and statistically significant. As noted above inflation for the second cointegrating equation is insignificant. Thus we normalised but the results obtained after normalising did not provide a clear picture of the co integration both for the long-run relationship and short-run, hence the results are not reported in this study. Normalisation in this study was done to the first variable<sup>26</sup> given in our list as recommended by Brook (2002:428). As indicated in Chapter 4, this study follows the backward regression approach in estimating single alternative regression equations. The models obtained using the pair wise correlation results in Table A2 did not provide a clear picture on the variation of inflation; hence the results are not discussed in this study. As noted in Chapter 3, an increase money supply also contributes to an increase in loanable funds, thus the first alternative equation present a model that excludes bank credit (RBC) and the second model provides results for a model that excludes money supply (M3). This was achieved by applying the backward regression approach. As noted in Chapter 4, this approach involves dropping the insignificant coefficients and performing the diagnostic tests. The results for the main VECM model and the two alternative equations are shown in Table 5.7.

<sup>26</sup> Normalisation was done on M3.

**Table 5.7: Alternative single equation equilibrium correction model for inflation**

Regression equation:	(1)	(2)	(3)
<b>Long-run terms</b>			
Inflation(-1)	1	1	1
Constant	-222.4168	-237.3767	-301.3991
M3(-1)	0.450786 (0.0040)	0.460709 (0.0003)	
RBC(-1)	-0.014293 (0.7325)		0.559006 (0.0259)
RGDP(-1)	-41.35236 (0.0005)	-44.02677 (0.0001)	-55.93117 (0.0012)
USDZAR(-1)	-0.776793 (0.0000)	-0.793271 (0.0000)	0.235148 (0.0000)
MMR(-1)	-0.565720 (0.0349)	-0.593955 (0.0333)	-0.469990 (0.0623)
Z(-1)	47.54361 (0.0000)	47.70851 (0.0000)	50.19037 (0.0001)
<b>Short-run dynamics<sup>27</sup></b>			
$\hat{\epsilon}$ Inflation(-1)	0.203109 (0.00123)	0.199751 (0.0014)	0.181793 (0.0011)
$\hat{\epsilon}$ M3(-1)	-0.119594 (0.0040)	-0.117206 (0.003)	
$\hat{\epsilon}$ RBC(-1)	-0.000485 (0.7325)		-0.044522 (0.8254)
$\hat{\epsilon}$ RGDP(-1)	36.14668 (0.0613)	37.03232 (0.9132)	52.03723 (0.78564)
$\hat{\epsilon}$ USDZAR(-1)	1.126358 (0.0001)	1.130914 (0.0001)	0.957003 (0.0002)
$\hat{\epsilon}$ MMR(-1)	0.086887 (0.0749)	0.087916 (0.0502)	0.069932 (0.0623)
$\hat{\epsilon}$ Z(-1)	-4.571581 (0.0834)	-4.391747 (0.0813)	-5.612959 (0.0411)
Speed of adjustment ( $\alpha$ )	-0.131340 [-2.74269]	-0.123170 [-2.70080]	-0.115242 [-2.62325]
Weak exogeneity test for CPI	0.0165***	0.0153***	0.0237***
R-squared	0.540983	0.540601	0.513071
<b>Diagnostics:</b>			
Serial correlation LM	47.80247 {0.5217}	41.98017 {0.2276}	34.75608 {0.5277}
Normality (Jarque-Bera)	620.8692 {0.0000}	653.3724 {0.0000}	738.9311 {0.0000}
Heteroskedasticity	510.1512 {0.0222}	324.4876 {0.1068}	342.4025 {0.0272}

Notes: Figures within parenthesis ( ), are marginal  $P$ -values (marginal significance level) of likelihood ratio tests under the null hypothesis that coefficient under construction is zero. \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10% respectively. Figures within [ ] are  $t$ -ratios for significance of dynamic terms and those in { } are  $P$ -values for the residual diagnostic checks under the null of no serial correlation, no heteroscedasticity and normally distributed residuals for the LM, heteroscedasticity and normality test respectively.

<sup>27</sup> Variables discussed in the short-run are those that are statistically significant except for bank credit (RBC) the variable of concern in this study. Standard error results are presented in

The results from the regression equation (1) in Table 5.7 indicate a positive relationship between money supply and inflation in South Africa. In this case, a percentage increase in money supply results in 0.450786% increase in inflation in the long-run. These results are consistent with the monetarist theory which postulates that a constant increase in money supply tends to increase the demand for goods (i.e. demand greater than supply of goods and services) hence inflation. Moreover, the  $p$ -value is 0.004 for this coefficient, which is statistically significant at 5% level. Thus we conclude that an increase in money supply led to an increase in inflation in the long-run in the period 1970:1-2006:4 *ceteris paribus*. These results are consistent with findings by Malizewski (2003) for Georgia, and Ohnsorge and Oomes (2003) for Russia.

The coefficient for bank credit indicates that in South Africa an increase in bank credit to the private sector led to a decline in inflation in the period 1970:1-2006:4. These results are consistent with Antzoulatos (1996), Ludvigson (1999) and Calza *et al.* (2001:15). The coefficient for bank credit is insignificant ( $p$ -value = 0.7325). From the perspective of consumption, the negative coefficient for bank credit had a positive impact. This implies that a unit increase in bank credit extension to private sector resulted to an increase in consumption in the period 1970:1-2006:4. Therefore bank credit extension to the private sector does not signal the future failure of monetary policy in controlling inflation and meeting inflation targets. Since its coefficient is insignificant, we conclude that bank credit extension to the private sector contributes minimally in reducing inflation. These results may also be attributed to the fact that there is a positive relationship between money supply and bank credit; hence in South Africa the increase in money supply explains the variation in inflation better than bank credit to the private sector. However, this variable cannot be excluded from the model since it is a variable of interest in this study. These results are in line with findings by Tang (2001) for Malaysia who demonstrated that there is a co-movement between inflation and bank credit to the private sector.

The real GDP coefficient in Table 5.7 indicates that there is negative relationship between this variable and inflation in South Africa. These results illustrate that a percentage increase in real GDP led to a fall in inflation by 41.35236% during the period 1970:1-2006:4. In addition, the  $p$ -value (0.0005) is statistically significant at

5% level. This indicates that the variation in inflation is largely explained by real GDP or output in South Africa. The results are consistent with economic theory as a fall in output tends to slow down economic growth and trigger inflation in extreme cases. The results for real gross domestic product are consistent with Zavkievø (2005:35) finding in Tajikistan.

The exchange rate (USDZAR) also enters the long-run equilibrium relationship with a negative sign, as expected. The results indicate that when the rand appreciates against the dollar, inflation in South Africa is reduced. This is also consistent with economic theory and implies that if the rand appreciates importers will be able to buy import goods at lower prices. The coefficient of the USDZAR is negative 0.776793 and its *p*-value is zero, which is statistically significant at 5% level. The null hypothesis can therefore be rejected. This implies that a percentage increase in the value of the rand led to a fall in inflation by 0.776793% in the period from 1970:1 to 2006:4 *ceteris peribus*.

The money market rate (MMR) is statistically significant ( $p=0.0349$ ). The coefficient of this variable indicates that there is negative relationship between the money market rate and inflation in South Africa. This also implies that a percentage increases in money market rate (MMR) resulted to a fall in inflation by 0.565720% in the period 1970:1-2006:4 *ceteris peribus*. Furthermore, this indicates that through manipulation of the money market rate (i.e. the repo rate) the monetary authorities were able to influence all channels and to control economic activities in all sectors that are potential to inflation triggers in South Africa.

The import prices coefficient in Table 5.7 indicates that there is a positive relationship between import prices and inflation in South Africa. A percentage increase in import prices resulted in a 47.54361% increase in inflation in the period 1970:1-2006:4 *ceteris peribus*. This parameter is significant at 5% level and its *p*-value is zero. This suggests that import prices were inflationary in South Africa in the period 1970:1-2006:4.

As stated in Chapters 3 and 4, we followed a backward regression approach to develop single equations for inflation. The backward regression model with all

variables that were initially incorporated in the model indicates that all the variables in the model are significant except for RBC. The backward regression approach suggests that a parsimonious equation is obtained by eliminating the insignificant variable. In this case our variable of concern is insignificant. Thus the next step was to eliminate RBC from the model which led to the derivation of the second model in Table 5.7.

The results from the regression equation (2) in Table 5.7 indicate a positive relationship between money supply and inflation in South Africa. In this case, a percentage increase in money supply results in 0.460709% increase in inflation in the long-run. These results are consistent with the monetarist theory which suggests that a constant increase in money supply tends to increase the demand for goods hence inflation. In addition this parameter is significant at 5% level and its  $p$ -value is 0.0003. The real gross domestic product and money market rate maintain a negative relationship with inflation in equation (2) and both parameters are significant at 5% level. The model that excludes RBC (regression equation 2) indicates that there was a negative relationship between exchange rate and inflation in the period 1970:1-2006:4 *ceteris paribus*. The coefficient for USDZAR suggests that the more overvalued the exchange rate, the more competitive pressure acts on domestic producers to prevent price increases. This is consistent with the economic theory.

The literature reviewed in this study postulated that there is a strong relationship between bank credit and money supply. Thus this study also explores a model that excludes M3 to determine the effect of bank credit extension to the private sector on inflation. The third model suggests that the coefficient for bank credit is positive and significant at 5% level. This indicates that bank credit can be inflationary in the long-run if not monitored. The coefficient for bank credit in the third model suggests that a percentage increase in bank credit to the private sector resulted to a surge in inflation by 0.559006% in the period 1970:1-2006:4 *ceteris paribus*. Thus we conclude bank credit to the private sector is inflationary in the long-run. We also conclude that a model that includes both the M3 and bank credit to the private sector is not robust because the M3 captures the influence of latter on inflation in South Africa.

In the third equation, the real gross domestic product and money market rate coefficients were significant and their coefficients had negative signs. The real gross

domestic product coefficient is negative 55.93117 in Table 5.7 indicating that there is a negative relationship between the real gross domestic product and inflation in South Africa. This parameter is significant at 5% level and its  $p$ -value is zero. As noted in Table 5.7, the money market rate is only significant at 10% level and its coefficient indicates that a percentage increase in the money market rate resulted to a fall in inflation by 0.469990% in the period 1970:1-2006:4 *ceteris paribus*. The exchange rate and imports price also enter the long-run equilibrium relationship with a positive sign and both parameters are significant at 5% level.

Overall, the results from the regression equations (2) and (3) in Table 5.7 indicate that bank credit extension to the private sector was inflationary in the period 1970:1-2006:4 and its effect was via money supply. These results are in line with the findings by Malizewski (2003) for Georgia, Ohnsorge and Oomes (2003) for Russia and Aron *et al* (2004) for South Africa.

#### **5.4.2 The short-run relationship**

According to Calza *et al* (2001:1130), the short-run relationship represents the process of adjustment towards equilibrium in response to a deviation. In this case, the short-run is used to demonstrate the process of adjustment of inflation in the case of a shock and to illustrate the behaviour of the determinants over a short period of time. The results for the short-run dynamics are also reported in Table 5.7 above. The lag of inflation, M3 and USDZAR are significant at 1% level. This indicates that the lagged first difference of inflation, M3 and USDZAR have a short-term influence on inflation. The real GDP and MMR are significant at 10% level which indicates that the impact of the two variables on inflation is not as significant as in the long-run. The second regression equation indicates that the lagged first difference of inflation, M3 and USDZAR have a significant impact on inflation ( $p$ -values are less than 0.01). In the third equation, the lagged first differences of inflation and USDZAR have a short-run effect and they are significant at 1% level. In the first and third regression equation the lagged first difference for bank credit to the private sector is not significant even at 10% level. Thus we conclude that bank credit to the private sector was not inflationary in the short-run.

The most important parameter when estimating the VECM is the speed of adjustment. Here only the results from the first three equations will be discussed because the other two equations did not provide a clear picture of the impact of the variable of concern on inflation. Table 5.7 shows that for the regression equation (1) the speed of adjustment in response to a shock or a deviation from the equilibrium path for inflation is 13.13% (-0.131340) per quarter and the t-ratio is [-2.74269]. This also indicates that without external pressures gaps between inflation and its equilibrium are eliminated in approximately one year in South Africa. Thus we conclude that inflation is endogenous and its values are determined inside the model. Other variables that adjusted perfectly were RGDP [-4.18278] and MMR [-4.39738].<sup>28</sup> These findings substantiate the results suggested by the trace and the max-eigenvalue above indicating that there are two co integrating vectors in the model. In the second equation, the speed of adjustment is around 12.32% (-0.123170) percent per quarter and the t-ratio is [-2.70080]. These results are in line with the findings by Ohnsorge and Oomes (2003) for Russia and Aron *et al* (2004) for South Africa. The results for speed of adjustment in the third model indicates that any deviation from the equilibrium path for inflation is 11.52% (-0.115242) per quarter and the t-ratio is [-2.62325]. Thus we conclude that when M3 is excluded in the model the speed of adjustment is reduced. Furthermore, the standard error and t-statistics for the coefficients in the short run confirms the results obtained using the p-values in the short run (see appendix A10). More information concerning the behaviour of the incorporated variable is obtained from the variance decomposition and impulse response, which were performed after the diagnostic test (see sections 5.6 and 5.7).

### 5.4.3 The block exogeneity Wald and causality tests

Tests for weak exogeneity were performed to confirm the endogeneity of inflation. The block exogeneity Wald test was performed by imposing a restriction on the inflation variable in the vector error correction model. The probability of the chi-square test statistic is significant. As shown in Table 5.7, for all the first three models the null hypothesis is rejected at 5% level that inflation is exogenous; therefore we concluded that inflation is truly endogenous in this model.

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<sup>28</sup> See Table A5 in the appendix.

The results obtained from the block exogeneity Wald test were further substantiated by the results obtained from the vector error correction Granger causality/block exogeneity Wald tests shown in Table A6 in the appendix. All the determinants have a significant influence on inflation at 1% level. These further justify the inclusion of all the variables in our model. Furthermore, the USDZAR is the most exogenous factor in the model. This suggests that inflation pressure emanates from exchange rate fluctuations.

As noted in Chapter 4, the block exogeneity Wald test is only able to capture the set of variables that are significantly affecting the endogenous variable when a zero restriction is applied on the lag of the explanatory variable. In order to determine whether changes in the value of a given variable have a negative or positive effect on the other variables in the system, the impulse response and variance decomposition will be utilised in this study.

Before the impulse response and variance decomposition was applied, the diagnostic checks were done.

## **5.5 DIAGNOSTIC CHECKS**

The results from this test are presented in Table 5.7. This test helps to verify whether the model is correctly specified. If the model is incorrectly specified the results will be spurious. Residuals are supposed to be well behaved: that is, serially uncorrelated, homoscedastic and normally distributed. Serial correlation and normality tests capture statistical limitations that are a result of model misspecification.

In the case of autocorrelation the null hypothesis is no serial correlation up to the specified lag order. If the probability of the LM-statistic is low the null hypothesis is rejected, and if the probability of LM-statistic is high we fail to reject. The residual test has a null hypothesis of a normally distributed series. The chi-square distribution and the corresponding probability value are used to reject the null hypothesis when the  $p$ -value is less than 10% and fail to reject when the  $p$ -value is greater than 10%. The heteroscedasticity test helps to ascertain whether the variance

of the error term was constant. The null hypothesis in this case is that residuals have a constant variance.

The results for serial correlation test in the first equation indicate that there is no serial correlation in the model and the  $p$ -value is 0.5217. Thus we fail to reject the null hypothesis and we concluded that the residual series do not suffer from autocorrelation. The  $p$ -value of the second equation is  $0.2276 > 0.1$ , therefore we fail to reject the null hypothesis. The results for serial correlation test in equation (3) indicate that there is no serial correlation in the model. Thus we fail to reject the null hypotheses for all the three models in Table 5.7 hence we concluded that the residual series do not suffer from autocorrelation.

When considering Jarque-Bera test for normality, the chi-squared value obtained in equation (1) is 620.8692, 653.3724 for equation (2) and 738.9311 for equation (3). The probability of the chi-squared values in the first three equations is zero. Thus the null is rejected, and we conclude that the residuals are not normally distributed. As noted by Harris (1995:83), non-normality in the residuals is acceptable if some of the variables are weakly exogenous, as is the case in the models used.

The  $p$ -value for the heteroscedasticity test in the first model is 0.0222, which suggests that there is a problem of heteroscedasticity. Regression (2) passes the heteroscedasticity test, since the test ( $p$ -value = 0.1068) fails to reject the null hypothesis. In regression (3), the  $p$ -value is 0.0272 and this indicates that the null hypothesis is rejected, showing that the residuals from this model are not well-behaved. The availability of heteroscedasticity in the models (1) and (3) is attributed to the limitation of the Johansen procedure in studies with exchange rate data. Maddala and Kim (1998: 241) pointed out that the Johansen procedure assumes that the error terms are homoscedastic, which is rarely the case with exchange rates because of volatility clustering. In addition, the problem of heteroscedasticity is related to omission of variables that also explain the dependent variable. The R-square value (0.540983) also suggests that there are other factors that are not included in the model. This is also confirmed in equations (2) and (3). To rectify the problem of heteroscedasticity the *White* option in E-Views 5 was used. It is essential to correct this problem for the purposes of economic forecasting. To confirm if the two models

were corrected, we compared the first results regression with the heteroscedasticity consistent covariance results. The coefficients were the same but the uncorrected standard errors were reduced, which indicates that the heteroscedasticity consistent covariance has reduced the size of the t-statistics for the coefficients. As the aim of this study is to explore the determinants of inflation, the process of correcting this model is not discussed in detail.

As indicated in Chapter 4, the Chow test is used to establish whether the underlying regression model has remained unchanged across various monetary policy regimes.<sup>29</sup> The null hypothesis in this case is that there is no structural break. The sample in the first test include the money supply target regime (1985 ó 1989:4); the second test for structural change covers the period of the *eclectic* approach (1990:1 to 1999:4), and the third entails the sample for the current period of inflation targeting (2000:1 to 2006:4). The equations carried out over different samples confirm parameter stability. As noted in Tables A7, A8 and A9 in the appendix none of the Chow test forecast reject the null hypothesis of no structural break. Thus, the recursive forecasts are unlikely to change significantly from those based on full-sample parameter estimates.<sup>30</sup> Our results are consistent with findings by Aron and Muellbeuer (2000:12) for South Africa. The results also suggest that our estimation is not affected by different monetary policy eras.

## **5.6 VARIANCE DECOMPOSITION ANALYSIS**

As noted in Chapter 4, variance decomposition separates the variations in the endogenous variable into component shocks in the VAR. This implies that it determines the percentage of error variance in the system that is explained by the dependent variable and its determinants. Table 5.8 presents the variance decomposition results for inflation.

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<sup>29</sup> See the results in Tables A7, A8 and A9 in the appendix.

<sup>30</sup> Since the results for the Chow test were not indicating a significant change, we concluded that all parameters were stable in the period 1970:1-2006:4.

**Table 5.8: Variance decomposition of inflation<sup>31</sup>**

Period	S.E.	Inflation	M3	RBC	RGDP	USDZAR	MMR	Z
1	0.138598	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.187706	99.52852	0.163579	0.237404	0.007011	0.024058	0.038697	0.000728
3	0.220674	98.47784	0.679781	0.674696	0.023746	0.053492	0.089581	0.000861
4	0.245282	96.90936	1.648343	1.196362	0.048593	0.071464	0.125166	0.000708
5	0.264781	94.91602	3.086710	1.707854	0.078174	0.073980	0.135856	0.001403
6	0.280899	92.62068	4.929133	2.143303	0.108306	0.067185	0.127516	0.003880
7	0.294640	90.16223	7.047404	2.467679	0.135057	0.063112	0.116187	0.008328
8	0.306593	87.67692	9.283159	2.673273	0.155579	0.075162	0.121765	0.014144
9	0.317109	85.28188	11.48018	2.772297	0.168528	0.114451	0.162443	0.020220
10	0.326393	83.06530	13.50836	2.788235	0.174069	0.187653	0.251012	0.025371

The second column labelled S.E. presents the forecast of error of the variable at the given forecast horizon. The S.E. shows the variation in current and future values of innovations to each endogenous variable in the VAR.

It is interesting to note that a significant percentage of the variation in inflation is accounted for by its own innovations in the tenth quarter. As shown in Table 5.8 the error variance in the tenth period for inflation is 83.07%. The tenth period shows very low results with regard to explanatory variables, recording the lowest percentage for import prices. This confirms that inflation is an endogenous variable.

Furthermore, the variance decomposition results<sup>32</sup> also show that money supply in South Africa is over 90% from the first period until the sixth period and noticeably high in the tenth period. The percentage of the error variance for bank credit extension to the private sector is 23.93286%, 52.83490% in the case of real GDP, 44.48437% for the money market rate, 77.08331% for the exchange rate and 78.25540% for import prices. The results from the variance decomposition show that the import price, exchange rate and real GDP had significant effects on inflation in the period 1970:1-2006:4. This also provides evidence of the results obtained in the long-run.

## 5.7 IMPULSE RESPONSE FUNCTIONS<sup>33</sup>

In this section we explore the response-period of inflation to innovation. As noted in Chapter 4, impulse response functions trace out the responsiveness of the dependent

<sup>31</sup> See Table B1-B6 for the other variables in the appendix.

<sup>32</sup> See Tables B1-B6 in the appendix.

<sup>33</sup> See Figure C1 in the appendix.

variable in the VAR to shocks in each of the explanatory variables and to itself (Brooks, 2002:341). The generalised impulse response function proposed by Koop *et al* (1996) and Pesaran and Shin (1998:17) was used to identify the effects of unanticipated shocks and results are shown in Figure A1 in the appendix.

The response of inflation to its own innovations starts at a high level and declines steadily, but does not fall to zero, instead becoming constant over time. In the case of cross innovation, inflation responds rapidly to innovation in the money supply (M3), bank credit extension to the private sector (RBC), RGDP and import prices. With regard to innovation to M3 it starts slightly above zero, and increase steady then remain constant overtime. In reaction to changes in the bank credit extension to the private sector, inflation also increases steadily for a certain period of time, but later declines steadily, never settling at zero, but reaching a constant state. The results in Figure C1 indicate that a negative shock on the USDZAR that leads to a depreciation of the rand is followed by an increase in inflation while an appreciation of the rand reduces inflation. The increase in a case of negative shock takes more than two quarters before it declines steadily back to zero. A negative shock to RGDP results in domestic price increases but the increase is not significant overtime. The impulse response function for import prices (*Z*) suggests that inflation remain almost constant over a long period of time with insignificant fall each quarter. The response of inflation to innovation in the import prices takes a period of about a quarter and is at a declining rate but do not settle at zero. Furthermore, the response of inflation to innovation in MMR starts by increasing and after two quarters it drops steadily to zero.

The overall response of inflation to innovation takes less than a quarter. Inflation responds quickly to innovation in money supply and bank credit. In conclusion, the response of inflation to money supply is more significant than that of the other variables.

## **5.8 CONCLUSION**

This chapter analyses the relationship between inflation and its theoretical determinants. The first step was to determine the properties of the data in order to

select the appropriate assumption when performing the VECM. When performing the unit root analysis all variables were found to be integrated of order  $I(1)$  (i.e. stationary at first difference) for all tests employed. The results obtained using assumption 4 indicated that there are two cointegrating equations in the model, and this was further confirmed by the trace and maximum-eigenvalue results. Based on the appropriate assumption and lag length the Johansen co integration and the VECM were performed to establish the short-run and long-run relationships. The variable of concern in this study is bank credit extension to the private sector. The first model suggests that the parameter of bank credit extension to the private sector enters the long-run with a negative sign. The  $p$ -value indicates that the relationship is insignificant even at 10%. In the case of model (2) that excludes bank credit, the M3 coefficient became more significant as compared to the first model that includes the variable of concern. The  $p$ -value for bank credit to the private sector in the third model is 0.0259, which is statistically significant at 5% level. The coefficient for bank credit indicates that there is a positive relationship between this variable and inflation in the third equation. The behaviour of M3 and bank credit to the private sector in models (1), (2) and (3) suggests that RBC have an indirect effect via M3. Thus we conclude that bank credit to the private sector had an indirect positive influence on inflation in South Africa. The money supply, the real GDP, the money market rate, USDZAR and import prices were also found to be significant in the long-run.

The coefficient of the dependent variable in the VECM is also statistically significant at 5% level. The estimate of inflation in the first model in Table 5.7 indicates that the speed of adjustment to equilibrium is about 13.13% per quarter and the t-ratio is [-2.74269]. In the second equation, the speed of adjustment is 12.32% percent per quarter and the t-ratio is [-2.70080]. The speed of adjustment for inflation in the third model is 11.52% per quarter and the t-ratio is [-2.62325]. These results are in line with the findings by Ohnsorge and Oomes (2003) for Russia and Aron *et al* (2004) for South Africa.

Furthermore, the VECM results suggest that the money supply and exchange rate were significantly inflationary in the short-run. A clearer picture of the short-run dynamics was obtained from the impulse response which confirmed that the impact of

bank credit extension to the private sector is not significant in the short-run. In the first and second equations, the results indicate that M3 is significant in the short-run. This implies that the short-term variation in inflation was largely determined by money supply in the period 1970:1-2006:4. A model that includes both the M3 and bank credit to the private sector is not robust because the M3 captures the influence of latter on inflation in South Africa.

Our findings in this study are in line with Ubide (1997) for Mozambique, Broz (1998) for Croatia, Tang (2001) for Malaysia, Maliszewski (2003) for Georgia, Ohnsorge and Oomes (2003) for Russia, Aron *et al* (2004) for South Africa, Zavkiev (2005) for Tajikistan, Mortaza (2006) for Bangladesh, and Fedderke and Schaling (2005) for South Africa.

## CHAPTER SIX

# SUMMARY OF FINDINGS, POLICY IMPLICATIONS, RECOMMENDATIONS AND AREAS FOR FURTHER RESEARCH

### 6.1 SUMMARY OF FINDINGS AND CONCLUSIONS

This study explores the behaviour of inflation in South Africa using theoretical determinants. What sets this study apart from other studies done in South Africa is that, in addition to the commonly used variables, bank credit extension to the private sector was used as an explanatory variable for estimating inflation. Our model for estimating inflation includes seven variables: inflation, bank credit to the private sector, money supply, the real GDP, USDZAR, import prices and the money market rate.

Unit root tests indicated that all variables were integrated to the order  $I(1)$ , for all the techniques used. To establish the short-run and long-run relationship, the Johansen co integration approach was used. This model provides evidence that there is co integration between inflation and its explanatory variables. Since the second cointegrating equation for the VECM results was insignificant (i.e. not adjusting) and the normalised results were not making economic sense, the general to specific approach was used to develop the second regression equation.

Finally, three single alternative models for the long-run were developed: the first one involves all the variables; the second excludes the variable of concern (RBC) and the third excludes M3 to establish the effect of bank credit to the private sector on South African inflation. The third model is developed based on literature reviewed in this study that postulates that there is a strong relationship between the M3 and RBC. The behaviour of the M3 and bank credit extension to the private sector in equations (1), (2) and (3) suggest that RBC has an indirect<sup>34</sup> effect on inflation via M3. Thus we conclude that bank credit extension to the private sector is potential to cause inflation

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<sup>34</sup> The effect of bank credit extension to the private sector on inflation is via money supply.

if not closely monitored. Our results are consistent with previous studies<sup>35</sup> for developing countries including studies on South Africa.

The results in the VECM also confirm that inflation is an endogenous factor. The speed of adjustment in response to deviation from the equilibrium path is 13.13% for the first regression equation. In the second equation, the speed of adjustment is 12.32% percent per quarter. The third model suggests that the speed of adjustment for inflation is 11.52%. The adjustment coefficients are slightly below and above 12% found by Ohnsorge and Oomes (2003) in Russia. The short-run dynamics of the VECM indicate that RBC is insignificant both in models (1) and (3). The exchange rate and money supply were found to be significant at 1% level in model (1). The second model suggests that M3 and the exchange rate had a positive effect on inflation and the t-ratios are statistically significant at 1% level. In the case of model (3), only the exchange rate was found to be significant.

Overall, the results from this study indicate that bank credit extension to the private sector is not inflationary in South Africa for the short-run. The results for the long-run in Table 5.7 provide evidence that there is a positive relationship between RBC and inflation and the effect is via M3 in the long-run. The results from model (1) particularly for RBC indicate that the repo rate is still a credible instrument in South Africa for influencing economic activities via different channels.

The block exogeneity Wald test results show that inflation is influenced by the variables in the model, and this confirms that it is endogenous. The variance decomposition results show that of all the variables included in the model, money supply explains most of variations in SA inflation. The second variable that significantly explains the variation in SA inflation is import prices followed by exchange rate. The impulse response functions results show that inflation responds steadily (upward direction) to innovation from the bank credit but in a period of about two quarters it becomes constant. In response to innovation from money supply, inflation starts by increasing steadily and become constant after two quarters. In

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<sup>35</sup> See for instance Ubide (1997) for Mozambique, Broz (1998) for Croatia, Tang (2001) for Malaysia, Maliszewski (2003) for Georgia, Ohnsorge and Oomes (2003) for Russia, Zavkiev (2005) for Tajikistan, Mortaza (2006) for Bangladesh, and Fedderke and Schaling (2005) for South Africa.

addition, the response of inflation to innovation from money supply is higher than that of bank credit. This confirms the results obtained from the variance decomposition.

Thus the surge in demand for credit by the private sector may be associated with a stable macroeconomic environment, privatization in the financial sector, comprehensive reforms and well developed market institutions in South Africa. Financial liberalization comes with advantages and disadvantages as well as negative spillover effects that are difficult to identify at a glance. The process of moving from a repressed to a liberalized financial system in South Africa may be occurring too rapidly for the economy to remain stable. This study identifies that money supply and import prices are the main source of inflation in South Africa. The results suggest that these two determinants have the potential to undermine the credibility of the current monetary policy framework (inflation-targeting). In addition the behaviour of bank credit extension to the private sector and exchange rate in the long-run suggests that there is a need to closely monitor these variables to supplement the inflation targeting framework in South Africa.

The next section of this study presents policy implications and recommendations that are crucial at this stage to curb inflation and to increase the probability of meeting targets.

## **6.2 POLICY IMPLICATIONS AND RECOMMENDATIONS**

The results of the estimated model for inflation provide a number of important policy implications for the South African monetary authorities. Even though the first model provides little evidence on the relation between bank credit and inflation, the behaviour of RBC in the third model suggests that the variable pose risks to achieving or maintaining inflation stability.

The money used for different projects in South Africa is credit issued by banks. A surge in bank loan increases the money supply but does not increase net wealth. In this study, the behaviour of bank credit to the private sector implies that through the money market rate (i.e. the repo rate) the SARB is able to influence economic

activities in different channels. Thus we recommend that the SARB should continue to use the repo rate. This tool should be used together with other policies designed to support the inflation-targeting framework such as price, income and import controls measures. Thus aggressively tightening the policy stance does not necessarily curb inflation in South Africa. Instead, it may lead in crowding-out and a shift to borrowing abroad which may be a threat to the South African economy because the private sector will be exposed to external shocks.

The results suggest that an increase in money supply result in a surge in inflation both in the short-run and long-run. Money supply in South Africa has been increasing each year over the past 10 years and it is expected to increase further to finance new projects for the 2010 World Cup. According to the monetarists, if the money supply continues to expand, prices begin to rise, especially if output growth reaches capacity limits. Therefore, while the increase in money supply is considered as an ideal structural development, the policymakers should evaluate its macroeconomic and financial stability implications carefully.

The findings of this study suggest that there is a positive relationship between inflation and import prices. According to Billmeier and Bonato (2004:427), by changing the relative price of domestic and foreign goods, the exchange rate affects inflation indirectly through changes in economic activity. The effects of exchange rate fluctuation on inflation are reflected through changes in import prices. The exchange rate volatility, particularly the rand depreciation, is absorbed at the intermediate stage of production, and that shocks to producer prices have a significant impact on consumer prices. Therefore, it is essential for the policymakers to investigate the extent to which inflation is affected by changes in prices and exchange rates. This will improve the effectiveness of all administrative measures<sup>36</sup> geared to promote domestic producers and policies designed to supplement the inflation-targeting framework in South Africa.

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<sup>36</sup> Policies designed to keep domestic prices low.

### **6.3 AREAS OF FURTHER RESEARCH**

As a result of the limitations of the Johansen co integration technique, we have not included some of the variables that explain the variation in inflation. Further research in this area may use a different model that will incorporate more variables and compare the results with ours.

This study also used bank credit to private sector as a whole without separating loan afforded to firms and households. A further research in line with this study should also consider separating the two, in order to get the impact of each sub-sector on inflation.

**APPENDICES**  
**APPENDIX A: VARIABLES USED AND VECM RESULTS**

**Table A1: Variables used covering the period 1970:1-2006:4**

<b>Variable</b>	<b>Description and source</b>
<b>Inflation</b>	The South African inflation rate that shows an average of prices weighted by the relative amounts spent on the different items by the South African population as a whole. Sourced from I-Net Bridge and the South Africa Reserve Bank statistics database.
<b>M3</b>	The money supply for South Africa. M2 plus long term deposits held by domestic private sector. <i>Source:</i> South Africa Reserve Bank statistics database
<b>RBC</b>	Bank credit extension to the private sector. Amount of credit extended by commercial banks to the private sector (firms and households). <i>Source:</i> Cape Town: Quoin Institute (Pty) Limited.
<b>RGDP</b>	The real gross domestic product for South Africa. Real gross domestic product in this study is used as a proxy for economic performance. <i>Source:</i> South Africa Reserve Bank statistics database.
<b>USDZAR</b>	The rand/dollar exchange rate used as a proxy for South African exchange rate. <i>Source:</i> I-Net Bridge
<b>MMR</b>	The money market rate for South Africa. <i>Source:</i> South Africa Reserve Bank statistics database.
<b>Z</b>	Import prices as a measured by a weighted import price index. It is used as the most important supply shock. <i>Source:</i> South Africa Reserve Bank statistics database.

Notes: To achieve mean reverting properties all variables used were expressed in natural logarithms as noted by Zita (2007:8).

**Table A2: Pair wise correlation matrix and Granger Causality test results**

<b>Pair wise correlation matrix</b>							
	Inflation	M3	RBC	RGDP	USDZAR	MMR	Z
Inflation	1.000000	0.163167	0.379927	-0.534030	-0.732845	0.354600	-0.743368
M3	0.163167	1.000000	0.743341	0.143632	-0.008437	0.092946	0.044301
RBC	0.379927	0.743341	1.000000	-0.044251	-0.276512	0.235881	-0.199987
RGDP	-0.534030	0.143632	-0.044251	1.000000	0.875651	0.233253	0.964757
USDZAR	-0.732845	-0.008437	-0.276512	0.875651	1.000000	0.126356	0.946344
MMR	0.354600	0.092946	0.235881	0.233253	0.126356	1.000000	0.072249
Z	-0.743368	0.044301	-0.199987	0.964757	0.946344	0.072249	1.000000
<b>Granger Causality test</b>							
Null Hypothesis	Observations		F-Statistics		Probability		
M3 does not granger cause RBC	147		15.6853		0.00012		
RBC does not granger cause M3			1.05514		0.30605		

**Table A3: VECM using assumption 4 and lag length 5**

Vector Error Correction Estimates							
Date: 10/01/08 Time: 18:45							
Sample(adjusted): 1971:3 2006:4							
Included observations: 142 after adjusting endpoints							
Standard errors in ( ) & t-statistics in [ ]							
Co integrating Eq:	CointEq1	CointEq2					
Inflation(-1)	1.000000	0.000000					
M3(-1)	0.000000	1.000000					
RBC(-1)	0.215105 [ 0.66515]	0.629617 [ 1.03216]					
RGDP(-1)	-21.27043 [-0.32921]	-87.23522 [-0.71580]					
USDZAR(-1)	0.597763 [ 0.57762]	0.665485 [ 0.34092]					
MMR(-1)	-1.235522 [-3.11893]	-2.803142 [-3.75149]					
Z(-1)	21.05150 [ 1.21703]	116.2907 [ 3.56424]					
@TREND(70:1)	-0.257714 [-1.19034]	-1.376012 [-3.36946]					
C	112.1245	452.5535					
Error Correction:	D(Inflation)	D(M3)	D(RBC)	D(RGDP)	D(USDZAR)	D(MMR)	D(Z)
CointEq1	0.194043 [2.94582]	-0.448596 [-4.06366]	0.108731 [ 1.02129]	-0.000242 [-1.14583]	-0.004047 [-0.22786]	-0.119880 [-1.77832]	0.000677 [ 0.79273]
CointEq2	0.099818 [ 2.93425]	-0.206694 [-3.62552]	-0.046779 [-0.85080]	0.000113 [ 1.03972]	-0.002139 [-0.23315]	0.120668 [ 3.46607]	-0.000106 [-0.24099]

**Table A4: VECM using assumption 4 and lag length 7**

Vector Error Correction Estimates							
Date: 10/01/08 Time: 18:59							
Sample(adjusted): 1972:1 2006:4							
Included observations: 140 after adjusting endpoints							
Standard errors in ( ) & t-statistics in [ ]							
Co integrating Eq:	CointEq1	CointEq2					
Inflation(-1)	1.000000	0.000000					
M3(-1)	0.000000	1.000000					
RBC(-1)	1.075169 [ 4.47972]	2.274116 [ 4.81053]					
RGDP(-1)	-115.0469 [-2.81009]	-293.3009 [-3.63718]					
USDZAR(-1)	1.991164 [ 2.86747]	2.897551 [ 2.11850]					
MMR(-1)	-1.685047 [-5.75471]	-3.765194 [-6.52838]					
Z(-1)	23.85060 [ 1.97482]	119.0322 [ 5.00378]					
@TREND(70:1)	-0.069705 [-0.49634]	-0.853867 [-3.08685]					
C	631.3292	1596.303					
Error Correction:	D(Inflation)	D(M3)	D(RBC)	D(RGDP)	D(USDZAR)	D(MMR)	D(Z)

CointEq1	0.128383 [1.24434]	0.719887 [ 4.18789]	0.124587 [ 0.75482]	-0.000481 [-1.46963]	-0.044482 [-1.61895]	-0.048938 [-0.48880]	0.002366 [ 1.76054]
CointEq2	0.021633 [ 0.41182]	-0.386581 [-4.41703]	-0.101131 [-1.20340]	0.000323 [ 1.93798]	0.012046 [ 0.86109]	0.101138 [ 1.98408]	-0.001263 [-1.84621]

**Table A5: Error correction for the single regression equation**

Error Correction:	D(Inflation)	D(M3)	D(RBC)	D(RGDP)	D(USDZAR)	D(MMR)	D(Z)
CointEq1	-0.131340 [-2.74269]	0.039745 [ 0.49208]	-0.087562 [-1.22865]	-0.000571 [-4.18278]	-0.015690 [-1.44557]	-0.197083 [-4.39738]	-0.000389 [-0.64359]

**Table A6: VEC Granger causality/block exogeneity Wald tests**

VEC Granger causality/block exogeneity Wald tests				
Date: 10/06/08 Time: 14:25				
Sample: 1970Q1 2006Q4				
Included observations: 146				
Dependent variable: D(Inflation)				
<b>Excluded</b>	<b>Chi-sq</b>	<b>df</b>	<b>Prob.</b>	
D(M3)	4.203108	1	0.0703	
D(RBC)	0.01655	1	0.9935	
D(RGDP)	1.372798	1	0.2413	
D(USDZAR)	8.872614	1	0.0029	
D(MMR)	1.111692	1	0.2917	
D(Z)	0.407667	1	0.5232	
<b>All</b>	<b>19.46363</b>	<b>6</b>	<b>0.0034</b>	

**Table A7: Chow test for the money supply regime**

Chow Forecast Test: Forecast from 1985:1 to 1989:4				
F-statistic		0.053972	Probability	0.817769
Log likelihood ratio		0.067411	Probability	0.795144

**Table A8: Chow test for the eclectic approach regime**

Chow Forecast Test: Forecast from 1990:1 to 1999:4				
F-statistic		0.130866	Probability	0.719914
Log likelihood ratio		0.163252	Probability	0.686180

**Table A9: Chow test for the inflation targeting regime**

Chow Forecast Test: Forecast from 2000:1 to 2006:4				
F-statistic		0.532884	Probability	0.473861
Log likelihood ratio		0.736274	Probability	0.390857

**Table A10: Short run dynamics of the CPI function – standard error results**

Variables	Equations		
	(1)	(2)	(3)
ECM(-1)	(0.04789)	(0.04561) [-2.48652]	(0.04393) [-2.62325]
$\hat{\epsilon}$ M3(-1)	(0.05833) [ 2.52031]	(0.05431) [-2.15825]	
$\hat{\epsilon}$ RBC(-1)	(0.05980) [-2.05015]		(0.05391) [-0.82585]
$\hat{\epsilon}$ RGDP(-1)	(30.8507) [-0.00810]	(30.3462) [ 1.22033]	(29.1421) [ 1.78564]
$\hat{\epsilon}$ USDZAR(-1)	(0.37814) [ 2.97869]	(0.37686) [ 3.00091]	(0.39029) [ 2.45201]
$\hat{\epsilon}$ MMR(-1)	(0.08241) [ 1.05437]	(0.08129) [ 1.08157]	(0.08375) [ 0.83505]
$\hat{\epsilon}$ Z(-1)	(7.16001) [-0.63849]	(7.07567) [-0.62068]	(7.13872) [-0.78627]

**APPENDIX B: VARIANCE DECOMPOSITION RESULTS****Table B1: Variance decomposition of M3**

Period	S.E.	Inflation	M3	RBC	RGDP	USDZAR	MMR	Z
1	2.250596	0.574252	99.42575	0.000000	0.000000	0.000000	0.000000	0.000000
2	3.058041	0.450111	98.93596	0.048729	0.011815	0.091857	0.458162	0.003362
3	3.589742	0.379806	97.65039	0.193088	0.049077	0.287635	1.434018	0.005981
4	3.966127	0.343495	95.68998	0.453503	0.122724	0.559690	2.824613	0.005992
5	4.239524	0.331369	93.19508	0.831924	0.242098	0.874803	4.519365	0.005358
6	4.441219	0.340001	90.32662	1.311973	0.413336	1.197991	6.400948	0.009134
7	4.592960	0.368799	87.26096	1.861881	0.637951	1.496677	8.349421	0.024312
8	4.710763	0.417015	84.17759	2.440014	0.911996	1.744882	10.25019	0.058318
9	4.806416	0.481762	81.24143	3.002236	1.226218	1.926600	12.00434	0.117409
10	4.888254	0.557340	78.58470	3.509510	1.567302	2.037403	13.53843	0.205317

**Table B2: Variance decomposition of RBC**

Period	S.E.	Inflation	M3	RBC	RGDP	USDZAR	MMR	Z
1	1.935002	0.050256	20.84004	79.10970	0.000000	0.000000	0.000000	0.000000
2	2.655040	0.302522	32.35665	65.93181	0.003874	0.654907	0.689176	0.061062
3	3.191336	0.526954	41.21640	53.88005	0.029598	1.989279	2.213272	0.144442
4	3.629601	0.643431	46.72988	44.21736	0.100456	3.738689	4.361620	0.208568
5	3.995170	0.654577	49.24630	37.04413	0.237360	5.673787	6.905381	0.238463
6	4.300743	0.601829	49.46220	31.98771	0.455227	7.617400	9.638380	0.237261
7	4.556883	0.536849	48.10698	28.56487	0.760992	9.433098	12.37899	0.218221
8	4.773897	0.505729	45.83477	26.32210	1.152320	11.01698	14.96897	0.199137
9	4.961385	0.540306	43.18904	24.87808	1.617493	12.29765	17.27927	0.198163
10	5.127399	0.654161	40.58569	23.93286	2.136999	13.23976	19.22006	0.230480

**Table B3: Variance decomposition of RGDP**

Period	S.E.	Inflation	M3	RBC	RGDP	USDZAR	MMR	Z
1	0.003591	6.950270	0.808903	2.611932	89.62889	0.000000	0.000000	0.000000
2	0.005086	8.985328	0.874622	2.185864	86.45772	0.009745	1.353218	0.133505
3	0.006352	10.53748	2.096112	1.617042	81.09649	0.044978	4.240500	0.367399
4	0.007549	11.55115	3.259388	1.151659	75.21669	0.104742	8.097093	0.619277
5	0.008715	12.10063	3.842208	0.913575	69.75316	0.175031	12.37775	0.837650
6	0.009856	12.29573	3.818788	0.922877	65.04913	0.238295	16.67473	1.000457
7	0.010972	12.23755	3.399399	1.140047	61.12630	0.280713	20.71177	1.104225
8	0.012064	12.00739	2.855650	1.500369	57.87512	0.295741	24.31068	1.155051
9	0.013132	11.66824	2.428557	1.935001	55.15447	0.284844	27.36578	1.163108
10	0.014179	11.26880	2.288684	2.382880	52.83490	0.256393	29.82876	1.139576

**Table B4: Variance decomposition of MMR**

Period	S.E.	Inflation	M3	RBC	RGDP	USDZAR	MMR	Z
1	1.244967	0.194887	0.053042	1.496576	0.483205	0.229870	97.54242	0.000000
2	1.717412	0.112795	2.729573	2.754309	0.782706	0.200051	93.33249	0.088081
3	2.070584	0.082971	7.786476	3.790046	1.076409	0.143705	86.83385	0.286545
4	2.368656	0.090845	14.27077	4.433734	1.323723	0.125961	79.18677	0.568198
5	2.632650	0.113388	21.20855	4.684422	1.504096	0.204431	71.38809	0.897019
6	2.869629	0.131371	27.84990	4.633061	1.614624	0.414006	64.11749	1.239554
7	3.081426	0.135418	33.73338	4.396157	1.663531	0.765640	57.73554	1.570330
8	3.268293	0.126737	38.64266	4.077530	1.664068	1.251774	52.36473	1.872506
9	3.430537	0.115043	42.53062	3.753754	1.630501	1.852750	47.98100	2.136331
10	3.569148	0.115561	45.45185	3.473086	1.576045	2.541897	44.48437	2.357196

**Table B5: Variance decomposition of USDZAR**

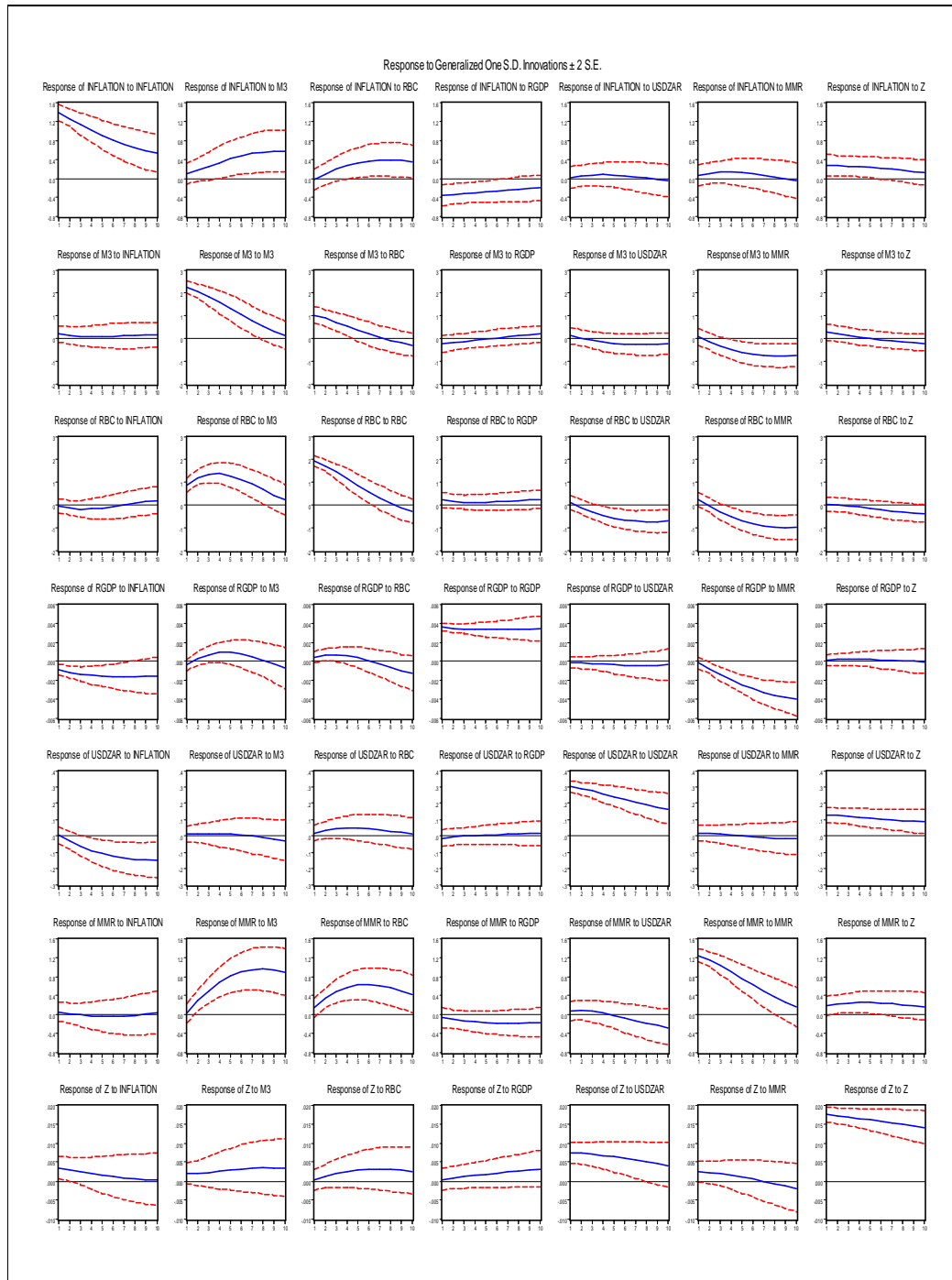
Period	S.E.	Inflation	M3	RBC	RGDP	USDZAR	MMR	Z
1	0.304499	0.016525	0.174839	0.211246	0.191217	99.40617	0.000000	0.000000
2	0.423565	0.587543	0.226382	0.673756	0.312313	98.12893	0.005088	0.065983
3	0.511233	1.923990	0.287357	1.126414	0.442096	95.98102	0.022260	0.216863
4	0.582375	3.792716	0.338884	1.476681	0.569317	93.32479	0.054884	0.442729
5	0.642660	5.983186	0.364890	1.699948	0.686219	90.43373	0.102348	0.729676
6	0.694949	8.321280	0.359551	1.808388	0.788365	87.49951	0.160278	1.062625
7	0.740955	10.67216	0.330396	1.829409	0.873999	84.64508	0.221783	1.427165
8	0.781847	12.93728	0.296754	1.792663	0.943286	81.94029	0.279153	1.810576
9	0.818512	15.04896	0.284928	1.723458	0.997614	79.41718	0.325561	2.202296
10	0.851666	16.96481	0.321992	1.640371	1.039033	77.08331	0.356423	2.594053

**Table B6: Variance decomposition of Z**

Period	S.E.	Inflation	M3	RBC	RGDP	USDZAR	MMR	Z
1	0.017444	3.965692	0.991601	0.057660	0.899979	17.82362	1.383831	74.87762
2	0.024459	3.500134	1.074989	0.074605	0.994769	17.75077	1.260115	75.34461
3	0.029724	3.066836	1.244377	0.208665	1.099373	17.47767	1.106289	75.79679
4	0.034075	2.681286	1.485028	0.380708	1.218433	17.05091	0.942368	76.24126
5	0.037834	2.349310	1.775840	0.542534	1.356453	16.51427	0.789413	76.67218
6	0.041166	2.070150	2.089294	0.669381	1.517749	15.90718	0.667055	77.07920
7	0.044170	1.839066	2.395507	0.752826	1.706360	15.26345	0.591572	77.45122
8	0.046909	1.649383	2.667119	0.794712	1.925905	14.61045	0.574733	77.77770
9	0.049429	1.493948	2.883168	0.802390	2.179401	13.96889	0.623378	78.04883
10	0.051762	1.366052	3.031214	0.785294	2.469081	13.35333	0.739627	78.25540

# APPENDIX C: IMPULSE RESPONSE FUNCTIONS

**Figure C1: Impulse response functions**



Sourced: I-Net Bridge, South Africa Reserve Bank statistics and Quoin Institute (Pty) Limited.

## 7.0 LIST REFERENCES

- AKAIKE, H., 1974. A new look at the statistical model identification. **Automatic Control, IEEE Transactions.** 19, 6: 716-723.
- ANTZOULATOS, A. A., 1996. Consumer credit and consumption forecasts. **International Journal of Forecasting.** 12, 4: 439-453.
- ARESTIS, P. and EICHNER, A.S., 1988. The post-Keynesian and institutionalist theory of money and credit. **Journal of Economic Issues.** 22, 4:1003-1020.
- ARESTIS, P., 1992. **The post-Keynesian approach to economics: an alternative analysis of economic theory and policy** (1ed). Aldershot: Edward Elgin Publishing Company.
- ARON, J. and MUELBAUER, J., 2006. Review of monetary policy in South Africa since 1994. Available: [www.csae.ox.ac.uk/workingpapers/pdfs/2006-07text.pdf](http://www.csae.ox.ac.uk/workingpapers/pdfs/2006-07text.pdf). [Accessed 10 October 2007].
- ARON, J., ELBADAWI, I. A. and KAHN B., 1997. **Determinants of the real exchange rate in South Africa.** Oxford: CSAE. [online]. Available: [www.csae.ox.ac.uk/resprogs/smmsae/pdfs/smmsae-2002-13.pdf](http://www.csae.ox.ac.uk/resprogs/smmsae/pdfs/smmsae-2002-13.pdf). [Accessed 27 September 2007].
- AZIAKPONO, J. M. 2006. **Financial and monetary autonomy and interdependence between South Africa and the other SACU countries.** Department of Economics. Rhodes University. [Online]. Available: <http://www.csae.ox.ac.uk/conferences/2004-GPRaHDiA/papers/3m-Aziakpono-CSAE2004.pdf> [Accessed 13 August 2007].
- AZIAKPONO, M. J. 2006. Financial integration amongst the SACU countries: evidence from interest rate pass-through analysis. **Studies in Economics and Econometrics.** 30(2): 1-23.

- AWOKUSE, T.O., 2002. **Is the export-led growth hypothesis valid for Canada?**  
 Department of Food and Resource Economics, University of Delaware.  
 [Online]. Available: <http://www.udel.edu/FREC/PUBS/SP02-01.pdf>  
 [Accessed 19 August 2007].
- BACCCHETTA, P and GERLACH, S, 1997. "Consumption and credit constraints: international evidence". **Journal of Monetary Economics**. 40, 2: 207-238.
- BACKE, P and ZUMER, T., 2005. **Developments in credit to the private sector in central and eastern European Union member states: emerging from financial repression — a comparative overview**. [Online]. Available: [http://www.oenb.at/de/img/feei\\_2005\\_2\\_special\\_focus\\_2\\_tcm14-33488.pdf](http://www.oenb.at/de/img/feei_2005_2_special_focus_2_tcm14-33488.pdf).  
 [Accessed 16 September 2007].
- BALAKRISHNAM, R and OULIARISI, S., 2006. U.S. inflation Dynamics: What drives them over different frequencies? **International Monetary Fund Working Paper**. WP/06/159. Washington: International Monetary Fund.
- BALKE, N.S., 2000. "Credit and economic activity: credit regimes and nonlinear propagation of shocks". **Review of Economics and Statistics**. 82, 2: 344-349.
- BALLIM, G.H., 2005. **Interest rate behaviour in a more transparent South African monetary policy environment**. Thesis, Rhodes University. Grahamstown.
- BARNARKE, B. S. and GERTLER, M., 1995. Inside the black box: the credit channel of monetary policy transmission. **Journal of Economic Perspectives**, 9,4: 27-48.
- BARRO, R., 1995. Inflation and economic growth. **Bank of England Quarterly Bulletin**. 35: 166-176.

- BELTON, W.J. and CEBULA, R.J., 1995 A brief note on thrift failures: a more rigorous analysis of causal factors. **Southern Economic Journal**. 62, 1: 247-252.
- BERNANKE, B.S., LAUBACH, T., MISHKIN, F AND POSEN, A., 1999. **Inflation targeting: lessons from the international experience**. Princeton: Princeton University Press.
- BILLMEIER, A. and BONATO, L., 2004. Exchange rate pass-through and monetary policy in Croatia. **Journal of Comparative Economics**. 32: 426-444.
- BINSWANGER, H.P. and KHANDKER, S.R., 1995. The impact of formal finance on the rural economy of India. **Journal of Development Studies**. 32, 2: 234-262.
- BROOKS, C., 2002. **Introductory econometrics for finance**. Cambridge: Cambridge University Press.
- BROOKS AND TSOLACOS., 1999. The impact of economic and financial factors on the UK property market. **Journal of Property Research**. 16 (2) 139-152.
- CALMES, C., 2004. **Financial market imperfection, overinvestment and speculative precaution**. [Online]. Available: <http://dsp-psd.pwgsc.gc.ca/Collection/FB3-2-104-27E.pdf>. [Accessed 16 October 2008]
- CALZA, A., GARTNER, C. and SOUSA, J., 2001a. **Modelling the demand for loans to private sector in euro area**. [Online]. Available: <http://www.ecomot.net/conferences>. [Accessed 9 June 2007]
- CALZA. A., and SOUSA, J., 2006 Output and inflation responses to credit shocks: are there threshold effects in the euro area? **Studies in nonlinear dynamics and econometrics**. 10, 2: 3.

- CANER, M. and KILIAN, L., 2001. Size distortions of tests of the null hypothesis of stationarity evidence and implications for the PPP debate. **Journal of International Money and Finance**. 20: 639-667.
- CHAKRABORTY, C. and BASU, P., 2002. Foreign direct investment and growth in India: a cointegration approach. **Applied Econometrics**. 34, 9: 1061-1073.
- CHANDLER, W., SCHAEFFER, W., DADI, Z., SHUKLA, P.R., TUDELA, F., DVIDSON, O. and ATAMER, S.A., 2002. **Climate change mitigation in developing countries**. [Online]. Available: [http://www.pewclimate.org/docUploads/dev\\_mitigation.pdf](http://www.pewclimate.org/docUploads/dev_mitigation.pdf). [Accessed 24 June 2007]
- CLARIDA, R., GALI, J. and GERLER, M., 1999. The science of monetary policy: a new Keynesian perspective. **Journal of Economic Literature**. 37: 1661-1707.
- CORSETTI, G., PESENTI, P. and ROUBINI, N., 1999. Paper tigers? A model of the Asian crisis. **European Economic Review, Elsevier**. 43, 7: 1211-1236.
- COTTARELLI, C. G., DELL, A. and VLADKOVA, H. I., 2003. Early birds, late risers, and sleeping beauties: Bank credit growth to the private sector in central and eastern Europe and the Balkans. **IMF Working Paper WP/03/213**. Washington D.C.: International Monetary Fund.
- DAVIDSON, P., 1994. **Post-Keynesian macroeconomic policy**. Aldershot: Edward Elgar.
- DAHIYA, D., 2008. **Empirical testing of the Lucas Critique for the U.S. economy, 1986 – 2005**. [Online]. Available: [http://mpira.ub.uni-muenchen.de/10677/1/MPRA\\_paper\\_10677.pdf](http://mpira.ub.uni-muenchen.de/10677/1/MPRA_paper_10677.pdf). [Accessed: 17 October 2008].

- DE ANGELIS, C., 2005. **The transmission of monetary policy under the repo system in South Africa: an empirical analysis.** Thesis, Rhodes University. Grahamstown.
- DEBELLE, G., 2004. Macroeconomic implications of rising household debt. **BIS Working Papers**, No 153.
- DE KOCK, G., 1985. **Commission of inquiry into the monetary system and monetary policy in South Africa.** Final Report, Government Printer, Pretoria.
- DE KOCK, G., 1978. **Commission of inquiry into the monetary system and monetary policy in South Africa.** Interim Report, Government Printer, Pretoria.
- DOORNIK, J.A., 1995. **Testing general restriction on cointegrating space.** Unpublished paper. Oxford: Nuffield College.
- DRITSAKIS, N., 2004. Cointegration analysis of German and British tourism demand For Greece. **Tourism Manangement**. 25: 111-119.
- EICKMEIER, S., HOFMANN, B. and WORMS, A., 2006. Macroeconomic fluctuations and bank lending: evidence for Germany and the euro area. **Deutsche Bundesbank Series Economic Studies**. No 34/06.
- ENGLE, R. F. and GRANGER, C.W.J., 1987. "Cointegration and error correction: representation, estimation and testing" **Econometrica**. 55: 251 ó 276.
- E-VIEWS 5 MANUAL., 2004. **Help system.** [Online]. Available: [www.eviews.com](http://www.eviews.com) [Accessed: 28 September 2007].
- FASE, M.M.G., 1995. The demand for commercial bank loans and the lending rate. **European Economic Review**. 39: 99-115.

- FAURE, A. P., 2005. **Money, interest and monetary policy**. Cape Town: Quoin Institute (Pty) Limited.
- FAURE, A. P., 2006. **Money, interest and monetary policy**. Cape Town: Quoin Institute (Pty) Limited.
- FEDDERKE, J. AND SCHALING, E., 2005. **Modelling inflation in South Africa: a multivariate cointegration analysis**. Research Paper No. 0010. Johannesburg: Rand Afrikaans University, Department of Economics.
- GARCIA, M., 2006. **Inflation targeting in Brazil: evaluation and policy lessons for Latin American countries**. Online]. Available. [http://www.econ.puc-rio.br/Mgarcia/Artigos/Infl\\_Targ\\_Brazil\\_MGarcia60113%2002.pdf](http://www.econ.puc-rio.br/Mgarcia/Artigos/Infl_Targ_Brazil_MGarcia60113%2002.pdf). [Accessed: 28 April 2007].
- GARNER, C., 1996. "Can measures of the consumer debt burden reliably predict an economic slowdown?" **Federal Reserve Bank of Kansas City Economic Review**. 81, 4: 63-76.
- GENBERG, H., 2002. **Inflation targeting - the holy grail of monetary policy**. Graduate Institute of International Studies, Geneva.
- GERGELY K, MARTON N and BALAZS V., 2006. **Credit growth in central and eastern Europe: trend, cycle or boom?** [Online]. Available: [www.iue.it/FinConsEU/ResearchActivities/DevelopingCreditJune2006/G%20Kiss%20Trend\\_cycle\\_boom\\_June06.pdf](http://www.iue.it/FinConsEU/ResearchActivities/DevelopingCreditJune2006/G%20Kiss%20Trend_cycle_boom_June06.pdf). [Accessed: 6 April 2007].
- GIDLOW, R.M., 1995. **South African Reserve Bank Monetary Policies under Dr. Gerhard De Kock, 1981-89**. South African Reserve Bank.
- GIDLOW, R.M., 2001. "The Reserve Bank's refinancing system and the workings of the interbank market". Pretoria: South African Reserve Bank.

- GOOHOON, K., LAVENRN, M., and WAYNE, R., 2006. Public debt, money supply, and inflation: a cross-country study and its application to Jamaica, **IMF Working Paper**. Washington D.C.: International Monetary Fund.
- GHOSH, S.R. and GHOSH,R.A., 1999. East Asia in the aftermath: was there a credit crunch? **IMF Working Paper**. 99/38. Washington D.C.: International Monetary Fund.
- GHOSH, A. and PHILLIPS, S., 1998. Warning: Inflation May Be Harmful to Your Growth: **IMF Staff Papers**. 45, 4: 1-5.
- GUJARATI, D.N., 2003. **Basic econometrics** (4e). New York: McGraw-Hill Inc.
- HASAN, M. 1999. "Monetary growth and inflation: A Re-examination". **Journal of Comparative Economics**. 27: 669-685.
- HARRIS, R., 1995. **Using co integration analysis in econometric modelling**. London: Prentice Hall.
- HAUG, A.A., 1996. "Test for co integration: a Monte Carlo comparison". **Journal of Econometrics**. 71, 89-115.
- HAWKINS, P., 2006. **Feasibility, Credit extension to households**. Report mandated by the National Credit Regulator. Johannesburg.
- HEIDHUES, F., 1995. Rural finance markets ó an important tool to fight poverty. **Quarterly Journal of International Agriculture**. 34, 2: 105-108.
- HENDRY, D.F., 1982. The role of econometrics in macroeconomic analysis. **UK Economic Prospect**, 3, 26-38.
- HENDRY, D.F., 1995. **Dynamic Econometrics**. Oxford University Press, New York.

- HOBIIJN, B., FRANSES, P., OOMS, M., 1998. **Generalizations of the KPSS-test for stationarity**. Discussion Paper 9802, Econometric Institute, Erasmus University Rotterdam.
- HODGE, D., 2006. Inflation and growth in South Africa. **Cambridge Journal of Economics**. 30, 2:163-180
- HOWELLS, P. G.A., 1995. The demand for endogenous money. **The Journal of post-Keynesian economics**. 18, 1: 89-106.
- HOOVER, K. D., 1991. "The causal direction between money and prices: an alternative approach". **Journal of Monetary Economics**. 27: 381-423.
- HUANG, H. and XU, C., 1999. "Financial institutions and the financial crisis in east Asia". **European Economic Review**. 43, 6: 903-914.
- IKHIDE, S., 2003. Was there a crunch in Namibia between 1996-2000? **Journal of Applied Economics**. 6, 2: 269-290.
- ISLAM, A.M. and AHMED, S.M., 1999. The purchasing power parity relationship: causality and cointegration tests using Korea ó U.S. exchange rate and price. **Journal of Economic Development**. 24, 2: 95 ó 111.
- JOHANSEN, S., 1988. Statistical analysis of cointegration vectors. **Journal of Economic Dynamics and Control**. 12: 231-54.
- JOHANSEN, S. and JUSELIUS, K., 1990. The full information maximum likelihood procedure for inference on cointegration ó with applications to the demand for money. **Oxford Bulletin of Economics and Statistics**. 52: 169-210.
- KALDOR, N., 1959. Kaldor, N., 1959. 'Economic growth and the problem of inflation: part 2'. **Economica**. 26: 287-98.

- KARORO, T., 2007. **Exchange rate pass-through and inflation in South Africa.** Thesis, Rhodes University. Grahamstown.
- KENNEDY, P. 2003. "**A guide to econometrics**", Fifth Edition, UK: The MIT Press Cambridge.
- KHAN, S. and SENHADJI, A., 2001. Threshold effects in the relationship between inflation and growth. **International Monetary Fund Staff Papers.** 48, 1: 16 21.
- KIM, K., 1998. US inflation and the dollar exchange rate: a vector error correction model. **Applied Economics**, 30: 613-19.
- KING, M., 1994. "Debt deflation: theory and evidence". **European Economic Review.** 38:419-45.
- KOOP, G., PESARAN, M.H., POTTER, S.M., 1996. Impulse response analysis in nonlinear multivariate models. **Journal of Econometrics.** 74: 119-147.
- KWIATKOWSKI, D., PHILLIPS, P. C. B., SCHMIDT, P. and SHIN, Y., 1992. Testing the null hypothesis of stationary against the alternative of a unit root. **Journal of Econometrics.** 54: 159-178.
- LEHOBO, L., 2006. **Monetary policy transmission in South Africa: the prime rate-demand for credit phase.** Thesis, Rhodes University. Grahamstown.
- LUDVIGSON, S., 1999.  $\delta$ Consumption and credit: a model of time-varying liquidity constraints $\delta$ . **The Review of Economics and Statistics.** 81, 3: 434-447.
- LUTZ, F.A., 1967. **The theory of interest.** Reidel: Dordrecht.
- MADDALA G.S. and KIM, I.M. 1998. **Unit roots, cointegration and structural change.** Cambridge University Press.

- MAKI, D. M., 2001. "The growth of consumer credit and the household debt service burden". **Board of Governors of the Federal Reserve system finance and economics discussion series working paper: 2000-2012.**
- MALIZEWSKI, W., 2003. Modeling inflation in Georgia. **International Monetary Fund Paper. WP/03/212.**
- MBOWENI, T.T., 2001. **A new monetary policy framework.** [Online]. Available:  
<http://www.reservebank.co.za/internet/publication.nsf/0/be269eff442e95542256b4400504bdd?OpenDocument&AutoFramed>. [Accessed: 4 May 2007].
- MENON, J., 1993. Exchange rate pass-through: Australian imports of motor vehicles. **International Economic Journal**, 7: 1-17.
- MISHKIN, F. S., 1995. The symposium of the monetary transmission mechanism. **Journal of Economic Perspectives**. 9, 4: 3-10.
- MOHR, P.J., 1986. The de Kock Commission and inflation. **South African Journal of Economics**. 54, 1: 22-40.
- MOORE, B.J. AND SMIT, B.W., 1986. Wages, money and inflation. **South African Journal of Economics**. 54, 1: 80-93.
- MOORE, B.J and THREADGOLD, R.A., 1985. Corporate bank borrowing in the U.K, 1965-81. **Economia**. 52:65-78.
- MORTAZA, G. M., 2006. **Sources of inflation in Bangladesh: recent macroeconomic experience.** [Online]. Available:  
<http://www.bangladesh-bank.org/research/workingpaper/wp0704.pdf>.  
 [Accessed: 17 August 2007].
- NARAYAN K. P. and SMYTH R. 2005. Cointegration of stock markets between New Zealand, Australia and the G7 economies: searching for co-movement under structural change. **Australian Economic Papers**. Blackwell Publishing Ltd

- NICOLIC, M., 2000. "Money growth-inflation relationship in post-communist Russia". **Journal of Comparative Economics**. 28:108-133.
- NWANNA, G. I., 1995. Financial accessibility and rural sector development. **Savings and Development**. 19, 4: 453-491.
- OBSTFELD, M., and ROGOFF, K., 1995. Exchange rate dynamics redux. **Journal of Political Economy**. 103: 624-660.
- OHNSORGE, F. and OOMES, N., 2004. "Inflation, money demand and de-dollarization in Russia", in "Russian Federation: selected issues". **IMF Country Report**. No.04/316, International Monetary Fund, Washington D.C.
- ORDEN, D. and FISHER, L. A., 1993. Financial deregulation and the dynamics of money, prices, and output in New Zealand and Australia, **Journal of Money, Credit, and Banking**. 25, 2.
- PAPAPETROU, E., 2001. Oil price shocks, stock market, economic activity and employment in Greece. **Energy Economics**. 23, 5: 511-532.
- PAZARBASIOGLU, C., 1997. A credit crunch? Finland in the aftermath of the Banking crisis. **IFM Staff Papers**. 44, 3:315-328.
- PESARAN H. H. and SHIN Y., 1998. Generalized impulse response analysis in linear multivariate models. **Economics Letters, Elsevier**. 58, 1: 17-29.
- PESARAN, H., SHIN, Y. and SMITH, R.J., 2000. **Bounds testing approaches to the analysis of level relationships**. University of Cambridge, Revised 6 DAE Working Paper No.9907.
- POWERS, C., 2005. **Inflation targeting: a comparative assessment of South Africa's early experience**, Thesis, University of Johannesburg. Johannesburg.

- PRETORIUS, C.J. AND SMAL, M.M., 1994. A macro-economic examination of the price formation process in the South African economy. **South African Reserve Bank Quarterly Bulletin**. March: 25-37.
- PRICE, S. and NASIM, A., 1999. "Modelling inflation and the demand for money in Pakistan; cointegration and the causal Structure". **Economic Modelling**. 16: 87-103.
- QAYYUM, A., 2002. **Demand for bank lending by the private business sector in Pakistan**. Pakistan Institute of Development Economics. Pakistan [Online]. Available: <http://mpa.ub.uni-muenchen.de/084/> [Accessed: 19 September 2007].
- SEBASTIAN, L.F. 2005. **Is credit expansion in Lithuania a matter of concern?**, ECFIN country. [Online]. Available: [http://www.ec.europa.eu/economy\\_finance/publications/country\\_focus/2005/cf11\\_2005en.pdf](http://www.ec.europa.eu/economy_finance/publications/country_focus/2005/cf11_2005en.pdf). [Accessed 20 August 2007].
- SCHWARZ, G., 1978. Estimating the Dimension of a Model. **The Annals of Statistics**. 6, 2: 461-464.
- SCHWERT, W., 1989. Tests for unit roots: A Monte Carlo investigation. **Journal of Business and Economic Statistics**. 38:147-160.
- SIMS C., 1980. Macroeconomics and reality, **Econometrica**. 48: 1-48.
- SMAL, M., 1998. The cost of inflation. **Quarterly Bulletin**. South African Reserve Bank, September 1998, Pretoria, South Africa.
- SOUTH AFRICAN RESERVE BANK, 2006. **Annual Report**. Pretoria. South Africa.

- STALS, C.L., 1997. **The functions of the South African Reserve Bank**. Address by the governor of the SARB to the NEDLAC Executive Council, Johannesburg, 28 February. pp 1 ó 23.
- STALS, C., 1997. **Effects of changing financial environment on monetary policy in South Africa**. Address by Chris Stals, Governor of the South African Reserve Bank, at the Annual Dinner of the Pretoria Branch of Economic Society of South Africa Pretoria on 15 May. Pretoria: South African Reserve Bank.
- STALS, C., 1997b. Monetary policy challenges in South Africa. **Quarterly Bulletin**. South African Reserve Bank. November: 35-38.
- STALS, C. 1999. Statement on Reserve Bank Accommodation Procedures. **Quarterly Bulletin**. South African Reserve Bank, June: 62.
- TANG, T.C., 2001. Bank lending and inflation in Malaysia: assessment from unrestricted error-correction models. **Asian Economic Journal**. 15, 3: 275-289.
- TAKAENDESA P., 2006. **The behaviour and fundamental determinants of the real exchange rate in South Africa**. Thesis, Rhodes University. Grahamstown.
- TAKAENDESA P. TSHEOLE T. AND AZIAKPONO M. J., 2006. Real exchange Rate volatility and its effect on trade flows: new evidence from South Africa. **Studies in Economics and Econometrics**. 30, 3: 79-97.
- UBIDE, A. 1997. Determinants of inflation in Mozambique. **IMF Working Paper WP/97/145**, International Monetary Fund, Washington D.C.
- VAN DER MERWE, E., 2004. **Inflation targeting in South Africa**. Occasional paper No.19. Pretoria: South African Reserve Bank. [Online]. Available <http://www.reservebank.co.za>. [Accessed 21 August 2007].

- VIRTUAL BANK OF BIZLED, 2007. Monetary policy - inflation causes. [Online]. Available:  
<http://www.bized.co.uk/virtual/bank/economics/mpol/inflation/causes/theories1.htm>. [Accessed 9 June 2007].
- VIZEK, M. and BROZ, T., 2007. **Modelling inflation in Croatia**. Radni materijali EIZ-a EIZ Working Papers.EIZ-WP-0703. [Online]. Available:  
<http://www.eizg.hr/AdminLite/FCKeditor/UserFiles/File/radni%20materijali%20EIZ-a-working%20papers-0703.pdf>. [Accessed 21 September 2007]
- WEINTRAUB, S., 1960. The Keynesian theory of inflation: the two faces of Janus. **International Economic Review**. 1, 2: 143-155.
- WHITE, H., 1980. A heteroskedasticity-consistant variance covariance matrix and a direct test for heteroskedasticity. **Econometrica**. 48: 817-838.
- WHITE, W. R., 2006. Is price stability enough? **BIS Working Papers**, No 205, [Online]. Available:  
<http://www.bis.org/publ/work205.pdf> [Accessed: 28 April 2007].
- WOODFORD, M., 2003. **Interest and prices: foundations of a theory of monetary policy**. Princeton: Princeton University Press.
- WORLD BANK, 2004. Global economic prospects and the developing countries. Washington: **World Bank**. 20036 2273.
- YOUNUS, S. 2007. **Nexus among Output, Inflation and Private Sector Credit in Bangladesh**. [Online]. Available:  
<http://www.bangladesh-bank.org/research/policynote/pn0710.pdf>. [Accessed: 21 September 2008].
- ZAVKIEV, Z., 2005. Estimating a Model of Inflation in Tajikistan. **CAMA Working Paper**. 26/2005. [Online]. Available:  
<http://cama.anu.edu.au>. [Accessed: 17 October 2007].

ZITA, S and GUPTA, R., 2007. Modelling and forecasting the metical-rand  
Exchange Rate. University of Pretoria, **Department of Economics Working  
Paper Series.**