AN EMPIRICAL INVESTIGATION OF THE BALANCE SHEET CHANNEL OF MONETARY POLICY TRANSMISSION IN SOUTH AFRICA

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By

KELVIN MUDITA

SUPERVISOR: PROFFESSOR S. IKHIDE

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EXECUTIVE SUMMARY

The intention of this study is to outline an empirical framework of the balance sheet channel of monetary policy transmission in South Africa. Specifically, this study examines how monetary policy decisions are transmitted, through the balance sheet of business firms, to the real economy. The study is motivated by the fact that credit has now occupied an important role in the funding of new capital investment in South Africa. Thus, the balance sheet channel may become a relevant channel in the monetary policy transmission process.

This study augments the co integration and vector auto regression (VAR) analysis with impulse response and variance decomposition analyses to provide evidence for the balance sheet channel. The study employs quarterly South African data covering the period 1980 to 2008. For that purpose, The VAR model will contain the following variables, Bank rate (monetary policy effect), External finance premium (information asymmetry channel), stock market capitalization (to cater for the collateral channel), Changes in industrial and commercial inventories (cashflows channel), credit extension (to cater for the effect of credit demand), and gross domestic product (to cater for the aggregate shock).

The study finds evidence in support of the balance sheet channel of monetary policy transmission in South Africa. The channel is weak as proved by the results. Therefore, the balance sheet channel should not be neglected from both the policy perspective and academic literature point of view in South Africa. However, the findings may only pertain to idiosyncratic economic developments during the sample period, while not necessarily serving as a best guide as to how the South African economy would work in the future.

Keywords: Balance sheet channel, Vector Autoregression Analysis, South Africa, Monetary Policy Transmission, Impulse response and Variance decomposition Analysis.

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CHAPTER ONE

1.1 INTRODUCTION AND BACKGROUND

Credit plays an important role in the funding of new capital investment in South Africa. The corporate finance structure in South Africa has been characterized by strong bank-lending relationships. The size of the banking sectors' assets relative to GDP underlines the importance and potential influence of the banking sector to the South African economy. The size of the South African banking sectors' assets as a percentage of GDP has increased steadily. Since 2001, the value of banks' assets has been exceeding GDP. Banks' assets are predominately loans and advances to the private non-bank and government sectors.

The ease with which companies can access credit is an appropriate measure for the financial sector's contribution to economic growth. Which implies that the failure of the banking system brings with it host implications for the real economy. Firms may be unable to adjust their balance sheets as they are denied access to credit facilities. The emergence of a credit crunch as banks become risk-averse may cause or exacerbate a downturn in the economic cycle. As a result, a number of authors have proved that banks play a vital role in the policy transmission mechanism by assisting in the reduction of market imperfections and thus facilitating lending and borrowing.

The South African banking sector acts as a major intermediary between saving and investment. The sector allocates savings through funding various entrepreneurs in various sectors of the economy. Since 1994, the banking sector's loans and advances have grown from around 55% to 73% of GDP. This has been accompanied by rapid growth in the major sectors of the economy. The "big five" sectors from the year 2000 to 2009 where the financial sector (21%), manufacturing sector (17%), wholesale, retail, catering and accommodation (15%), general government services (14%) and transport, storage and communication (10%) The "small five" industries consist of mining and quarrying (6%), personal services (5%), construction (3%), agriculture, forestry and fishing (2%) and electricity, gas & water (2%). The main participants in these sectors are small and medium enterprises who are more bank dependant. More than 95 percent of businesses in South Africa are small and medium enterprises (SMEs) and collectively contribute approximately 35 percent of the country`s gross domestic product.

It is against this background that this study seeks to create a model for the balance sheet channel of monetary policy transmission for South Africa. The model would be used to examine whether the financial factors that affect credit demand are elastic or inelastic. That is: If the financial factors prove to be elastic, it would imply that the balance sheet channel plays an active role in the South African economy. If the financial factors prove to be inelastic, the implication would be that the balance sheet channel is of little importance in terms of explaining the propagation of monetary shocks.

1.2 STATEMENT OF THE PROBLEM

The intention of this study is to outline an empirical framework of the balance sheet channel of monetary policy transmission mechanism in South Africa. Specifically, this study examines how monetary policy decisions are transmitted through the balance sheet of firms into the real economy.

The significance of the balance sheet channel has been increasing in many economies (see for example Gilchrist, Hairault and Kempf (2002), Gertler, Gilchrist and Natalucci (2003), and Faia (2002)). Recent studies have shown a renewed interest in a real economy link that passes through the business sector. The balance sheet channel is now widely believed to play an important role in the conduct of monetary policy. The major question that has posed a dilemma to policy makers is how to model it. Therefore, this study seeks to examine the role of the borrowers in South Africa where credit plays an important role in the funding of new capital investment. If borrowers have an impact on the allocation of loans, then financial factors will play a key role in the propagation of monetary policy.

Empirical work on the role of credit has focused on either proving the existence of the balance sheet channel or the banking lending channel or both. This study intends to differ from previous works by focusing closely on the famous three sub- channels of the balance sheet channel. These channels are the cash flow channel, the collateral channel and asymmetric information channel. Thus, the main questions for this study are: Does South Africa has a balance sheet channel? If yes. Which sub channel(s) does it operate through? What is the strength of the various sub-channels in propagating monetary shocks?

Specifically, the study will develop a model that will test whether basic factors which affect the gap between credit and firm balance sheets such as external finance premium, net worth (collateral), cash flows, and information asymmetry can influence business cycles. Thus, this study argues that changes in monetary policy affect the market value and the cash flows of financial instruments. These changes will directly affect the balance sheet items of the accounts of companies. Therefore, the effect will be transmitted to investment, output and prices. To our knowledge this question has never been empirically tested in the South African context. Most studies (see for example Sichei (2005)) on this subject focus on bank lending channel to explain the impact of monetary policy on the performance of the real economy in the presence of information asymmetries. Therefore, this study intends to examine the effectiveness of the balance sheet channel of monetary policy in the South African economy.

1.3 JUSTIFICATION OF THE STUDY

The question of how monetary policy translates to the real economy through the credit channels has grown in importance in both developed and emerging economies. To date, much of the credit channel literature has focused on developed economies, which can be adequately modelled as large and closed economies. These models are clearly inappropriate for a developing and emerging economy such as South Africa. As an emerging economy, it is possible that the impact of monetary policy may be perverse. Thus, the most important innovation of this study is that it focuses on South African market, which has not previously been analyzed.

An understanding of the different channels of monetary policy transmission mechanism is critical for policy makers in designing and implementing a framework of economic policies. Such knowledge should result in policies that accommodate the corporate sector in achieving the major macroeconomic goals in the economy. Moreover, economic organization, regulation, and management could be improved by knowledge of how the balance sheet channel transports monetary policy into the real economy. Finally, the conclusions of this study will have implications for other areas of economics whose survival depends on the decisions of monetary policy.

Lastly, the African Banking Congress in a communiqué issued at its last conference in 2008 in Johannesburg recommended that research should begin to focus on how monetary policy affects and is affected by the whole gamut of the financial sector especially in South Africa. It is against this background that this study seeks to develop a pioneering model that will provide an articulation of how the balance sheet channel operates in South Africa.

1.4 OBJECTIVES OF THE STUDY

The broad objective of this study is to construct a model which explains how the balance sheet channel of monetary policy transmission operates in South Africa. This broad objective is explored through the following sub-objectives:

- To investigate, the extent to which innovations in monetary policy affect credit demand (borrowers' balance sheets) through our estimated model.
- To investigate, the impact of changes in credit demand (borrowers' balance sheets) on business cycles through our estimated model.
- To investigate the short and long run behavior of the balance sheet channel through our estimated models.
- To make policy recommendations based on our empirical results.

1.5 METHODOLOGY

By applying Structural Vector Autoregression (VAR) approach, this study empirically investigates the functioning of the balance sheet channel in South Africa. A structural VAR uses economic theory to sort out the contemporaneous links between the variables (Bernanke, 1986; Blanchard and Watson, 1986; Sims, 1992). Vector Auto regressions have generally been used to analyse the effects of monetary policy (see for example: Ikhide and Uanguta (2002); Dale and Haldane, 1993; Gertler and Gilchrist 1993; Bernanke and Gertler, 1995; Christiano et al. 1996). A VAR model is a system of linear equations, in which each endogenous variable in the system is a function of all endogenous variables in the system. It avoids the problem of specifying a

complete structural model of the economy. Moreover, it explicitly recognizes the simultaneity between monetary policy and macroeconomic developments (reaction function) as well as the dependence of economic variables on monetary policy.

The study will employ South African quarterly data for the period 1980 to 2008. This data set incorporates time periods prior to and after the introduction of various economic reform programmes in South Africa. VAR are very sensitive to sample size. Thus, we are going to collect 128 observations per variable. This sample size is large enough to accommodate the effects of differencing and lagging. The data for this study will be obtained from various sources which include and not limited to: the Department of Trade and Industry, the International Financial Statistics (IFS),the South African Reserve Bank, Statistics South Africa, Johannesburg Stock Exchange.

To provide answers to the first two sub objectives, impulse response and variance decomposition analyses will be used.. The study will follow the impulse response and variance decomposition analyses as developed by Lütkepohl and Reimers (1992) and Mellander et al. (1992). In impulse response analysis in VAR, a unit shock is given to each of the system equations, and the responses of all the variables for the future time periods are traced. Impulse response analysis is also used to determine the signs of the effects between the variables.

To provide answers to the third sub objectives the cointegration and vector error correction modeling (VECM) by Johansen (1991, 1995) is employed. This approach applies maximum likelihood estimation to a vector autoregressive (VAR) model to simultaneously determine the long run and short run determinants of the dependent variable in a model. This approach also provides the speed of adjustment coefficient, which measures the speed at which the dependent variable will revert to its equilibrium following a short term shock to each of the variables. Graphical analysis will be used to perform a preliminary examination of the data and to explain the behaviour or evolution of monetary policy over the study period.

EViews version 6 is the econometric package to be employed for this study. EViews includes a wide range of single and multiple equation estimation techniques for time series data. Specifications may include polynomial lag structures on any number of independent variables.

Vector Autoregression and Vector Error Correction models can be easily estimated by EViews. Once estimated, the impulse response functions and variance decompositions for the VAR or VEC may be examined. VAR impulse response functions and decompositions feature standard errors also calculated. EViews version 6 can also display a variety of graphical and tabular formats.

1.6 ORGANIZATION OF THE STUDY

This study is divided into seven chapters. Following this introductory chapter, Chapter 2 sets the conceptual framework and gives an overview of South African monetary policy. An overview of the monetary policy practice and monetary policy transmission in South Africa since 1986 is attempted here. Chapter 3 gives the structure and background of the South African economy. It highlights the role played by business firms and the financial sector. Chapter 4 presents the theoretical framework as well as the literature [illegible] theoretical and empirical. Chapter 5 presents the analytical framework for the study. This includes model specification and review of analytical tools. Chapter 6 presents the empirical findings. Finally Chapter 7 summarizes and concludes the study and suggests policy recommendations.

CHAPTER 2

MONETARY POLICY PRACTICE IN SOUTH AFRICA

2.1 INTRODUCTION

The aim of this chapter is to provide an overview of the monetary policy practice in South Africa over the study period (1980 – 2008). The importance of monetary policy practice in South Africa cannot be underestimated when analyzing the behavior of the Balance sheet channel. The knowledge of regime shifts and policy tools may assist in explaining structural breaks that may be observed in the data, thus important for modeling the Balance sheet channel. In addition, the knowledge of the background of monetary policy practice helps to make the right selection of policy variables to be used to model the balance sheet channel. This chapter is thus divided into six sections. The first section looks at the objectives of monetary policy. The second section covers the South African Monetary policy regimes during the study period. The third section turns to the effectiveness of the Repo Rate in Monetary Transmission process. An assessment of the view of Monetary Policy Transmission in South Africa is laid out in the fourth section. The fifth section looks into the monetary policy tools in South Africa. The last section concludes the chapter.

2.2 OBJECTIVES OF MONETARY POLICY IN SOUTH AFRICA.

The Constitution of the Republic of South Africa states that the Reserve Bank must perform its functions independently in the pursuit of its objective. The primary objective of monetary policy is to protect the value of the currency in order to obtain balanced and sustainable economic growth in the country. This monetary policy objective is primarily motivated by the desire to provide an anchor for monetary policy that can serve as an effective co-ordination device for the setting of prices of final products, production factors and financial assets.

The Reserve Bank stresses that inorder to achieve their objective financial stability and stable conditions in the financial sector are a prerequisite. Financial stability does not guarantee that the real economy will perform at maximum capacity; the Reserve Bank believes that it is an

important precondition for the attainment of the economic growth potential. However, many economic and non-economic factors will determine the actual economic growth performance. Instability in the financial sector is not favorable for economic growth. In other words, financial stability is obtained when people are not concerned about the rate of inflation or any systemic risks in the financial sector when important economic decisions are made.

However, as a result of the complexity of functional relationships between economic variables, the Reserve Bank feels that it cannot rely on only one single indicator under all circumstances. To achieve overall financial stability, the Reserve Bank accordingly strives to:

• restrict the rate of increase in the money supply to predetermined and publicly announced guidelines;

• maintain the rate of increase in domestic credit extension by the banking sector at a level consistent with the money supply objectives;

• promote a general level of interest rates (and a yield curve) in conformity with the aforementioned objectives;

• lend support to the foreign exchange market to promote orderly adjustments in the floating exchange rate of the rand, and a relatively stable real effective value of the rand;

• support the development of sound and well-managed private banking institutions; and

• encourage the development of efficient and well-functioning financial markets.

Monetary policy in South Africa goes without its challenges which include: - to find consensus on what the objective of monetary policy should be in South Africa, deciding on an appropriate framework for monetary policy and establishing an effective institutional framework for monetary policy.

2.3 MONETARY POLICY REGIMES IN SOUTH AFRICA SINCE 1985

The historical accounts of how monetary policies evolve and the operating procedures in South Africa have been given considerable attention in the literature (see for instance, Gidlow, (1998), Strydom (2000), Aaron and Muellbauer, (2000), [illegible] and de Jager (2001), and Van der Merwe (1999)). As in other areas of economic policy in South Africa, the framework for monetary policy formulation has changed substantially since 1985. South Africa has employed various frameworks to achieve low and stable inflation growth. This section reviews these approaches and details the purpose of monetary policy more generally. Over the study period, three monetary policy regimes have emerged , namely, cost of cash reserves based system with monetary targeting (1986 – 1998), repurchase agreement (repo) system with monetary targeting and informal inflation targeting (1998 to 1999), and repo system with formal inflation targeting (2000 to current), to reflect approximate times of major changes in the monetary policy.

2.3.1 Cash reserves-based system with monetary targeting (1986 – 1998)

This regime was enacted following the recommendations of the de Kock Commission Reports (1985). After the redefinition of the role of the discount rate, this regime was in full operation by 1985 (Gidlow, 1995). The rationale for using money supply as an intermediate objective of monetary policy was that the growth in money supply is a vital element in the process of inflation. The money supply aggregate that was used to state the intermediate objective of monetary policy in South Africa was M3. M3 consisted of all bank notes and coin in circulation

plus all deposits of the domestic private sector with banking institutions. The Reserve Bank decided to use M3 for this purpose because it was the money supply aggregate that has the most stable relationship with domestic demand and is unaffected by deposit shifts between different maturities.

Pre-announced monetary target ranges were used. Target ranges were set annually using a three-month moving average of broad money growth. Monetary targets for the year, were announced in the March National Budget. The setting of the target aimed both to accommodate projected real GDP growth and to contain inflation. These targets were intended as guidelines, rather than strict rules (Clarida and Gertler, 1997). The SARB had discretion to breach targets, for instance in the face of external trade and financial shocks. There was no penalty for breaching targets; nor was there a legally required public explanation when breaching targets.

In this regime, short-term interest rates became the main monetary policy instrument as the Bank's discount rate was employed to influence the cost of overnight collateralised lending and hence market interests. The Bank Rate was the lowest rate at which the SARB provided accommodation at the discount window to commercial banks. The Bank Rate featured as the principal operational variable in conducting monetary policy, and banks were allowed unlimited access to liquidity through the discount window by discounting eligible paper with the SARB. Various measures such as open-market operations were used to influence overall liquidity and credit extension to the private sector.

Figure 2.1 and Figure 2.2 below gives a comparison of the monetary targets and the actual targets achieved during the monetary targeting regime.

Figure 2. 1: Percentage change in Monetary Aggregates.

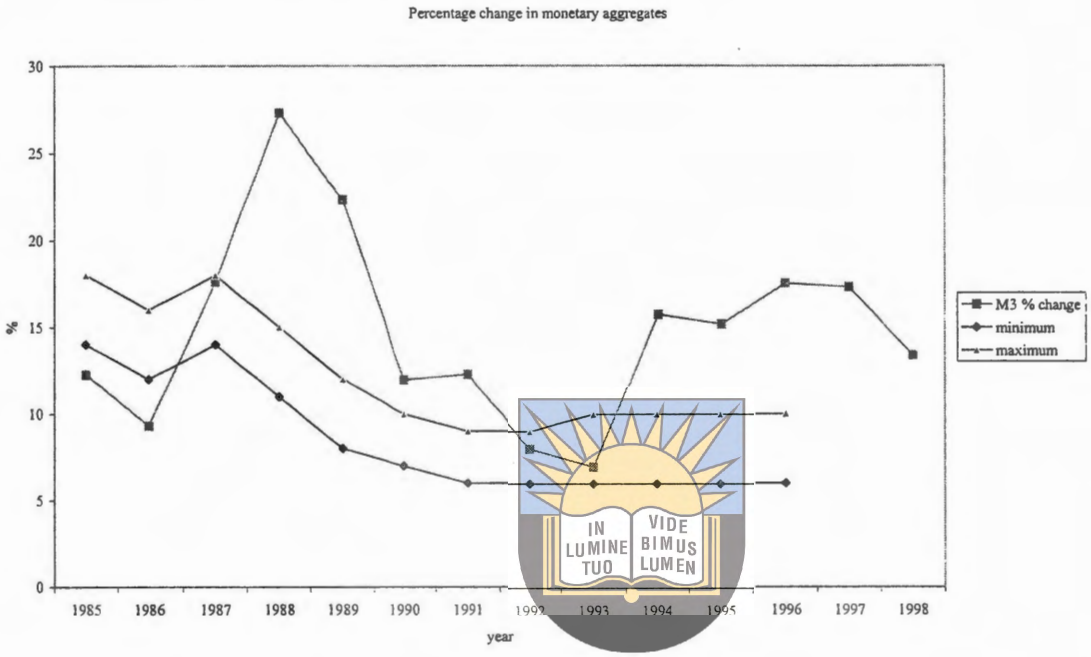
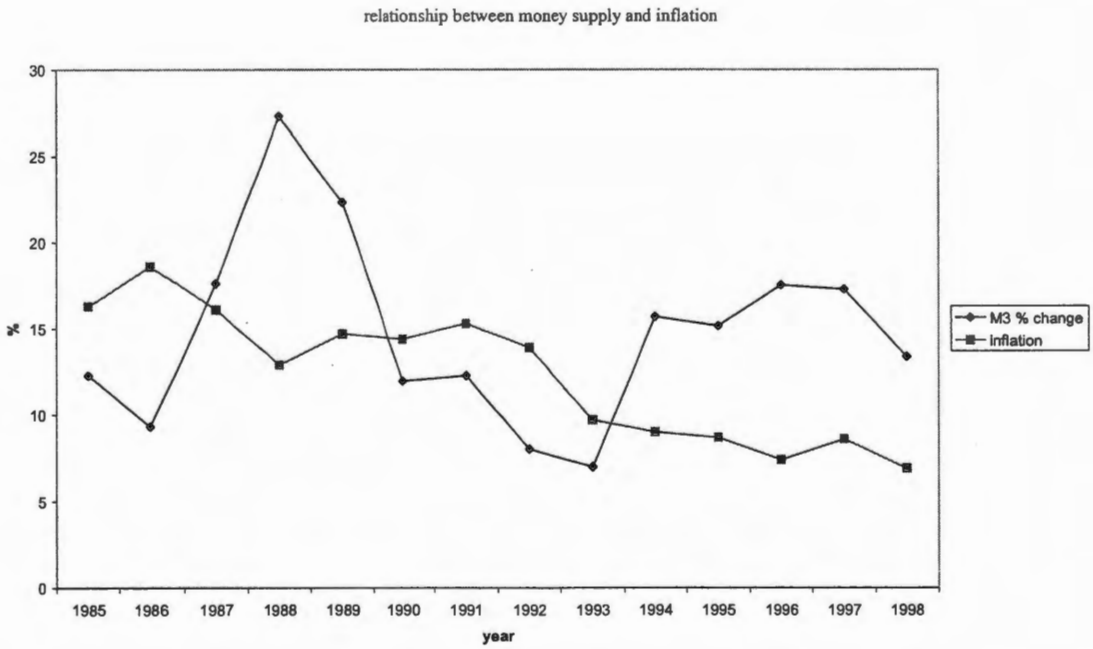


Figure 2. 2: Relationship between Money supply and Inflation



Source: South African Reserve Bank Quarterly Bulletin, various issues.

The target set by March 1986 was to keep the growth rate of the broadly-defined M3 money supply between 16 and 20 per cent (Gidlow, 1995: 25) . In the late 1980s and early 1990s, there was a lot of financial liberalization and structural changes in the South African economy. Over this period, the predictability of the relationship between growth in the money supply and other economic variables became less certain. Thus, M3 guidelines were supplemented by an eclectic set of indicators, including the exchange rate, asset prices, output gap, balance of payments, wage settlements, total credit extension, and the fiscal stance (Stals, 1997). In 1992 and 1993 the average annual growth in M3 exceeded the upper limit of 10 per cent of the money supply guidelines. The rate of increase in the broad money supply aggregate averaged 14,7 per cent from the beginning of 1994 up to the end of 1996. The year 1996 represented the third consecutive year in which the growth in M3 was considerably higher than desirable growth rates as indicated by the Reserve Bank. Even though the consumer price index continued to decrease from 1994 to 1998, money supply (M3) increased at rates higher than the pre-announced target range in the same years.

2.3.2 Repo system with monetary targeting and informal inflation targeting (1998 -1999)

The cash reserves based system was very opaque and diminished the accountability of the Reserve bank. In 1998, the Reserve Bank implemented a system of repurchase transactions (repos) as the main instrument of monetary policy. This is the rate at which the central bank lends funds to commercial banks and which directly influences the level of prime lending rates for consumers (Stals,1997). All other interest rates are benchmarked to this rate. The repo rate became the most important indicator for short-term interest rates. The South African Reserve bank announced an inflation target of 1-5 percent. Guidelines for growth in broad money supply (M3) and bank credit extension were announced

Under the system, the repurchase interest rate was determined at auction. The SARB signals its policy intentions on short-term interest rates to the market through the amount offered at the daily tender for repurchase transactions (SARB, 1999). Monetary growth guidelines were to be

announced on a three-year rather than an annual basis. Informal target ranges for core inflation were set. From the outset the Bank aimed at signalling its policy intentions for short-term interest rates through the amount offered at the daily tender for repurchase transactions (Guma, 1999:25). By providing more liquidity than would be needed, the SARB provided a clear signal to the banks that in terms of SARB policy objectives, interest rates should decline. By providing less liquidity than is needed, the signal is that interest rates must go up (Guma, 1999:25).

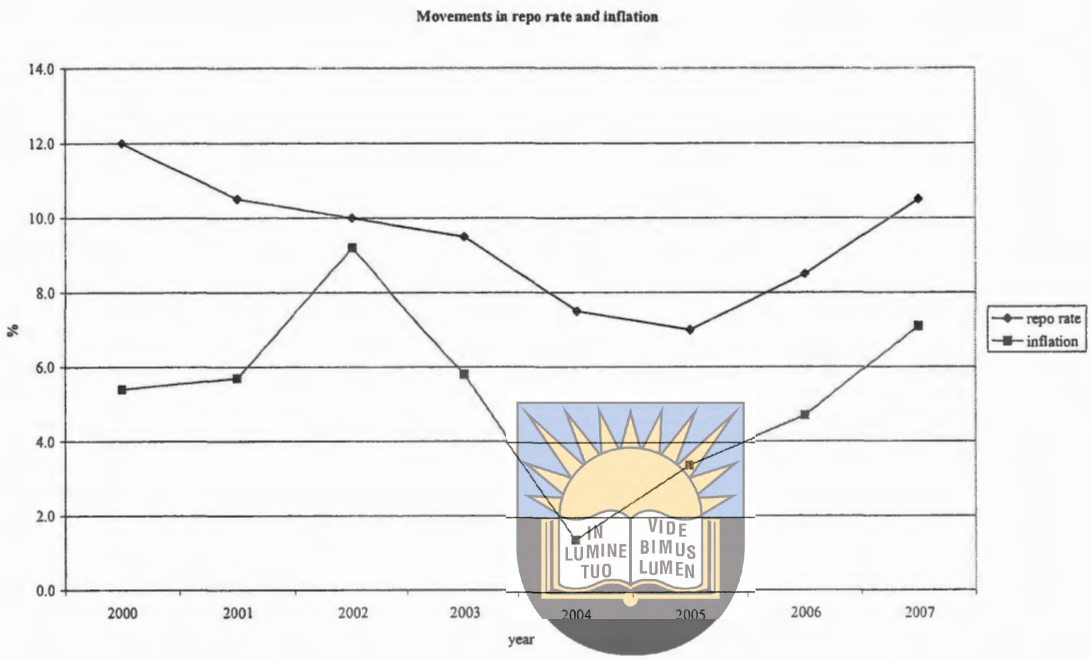
Given that the SARB did achieve success in bringing down inflation under an informal inflation targeting regime. This regime had its short comings. Van der Merwe (2004: 1) argued that the informal inflation targeting framework was not clear in conveying reasons for the monetary policy stance adopted by the authorities.

2.3.3 Repo system with formal inflation targeting (2000 – current)

South Africa introduced inflation targeting as a monetary policy framework in 2000. This marked a sizable shift in monetary policy management from the previous "eclectic" approach and the explicit focus on M3 money supply. Inflation targeting is a monetary policy framework characterized by the public announcement of a numerical target for the inflation rate that is intended to be achieved over a specific time period. The operational instrument the SARB chose for implementing the inflation targeting framework was the repo rate.

The SARB specifically targeted the CPIX. This is the Consumer Price Index excluding interest rates on mortgage bonds. A multi-year target approach was followed by specifying the target as an average annual rate of increase of between 3 and 6 per cent in the CPIX for the years 2002 and 2003 and an increase of between 3 and 5 per cent for the years 2004 and 2005. The target range for 2005 was increased from 3 to 5 per cent to 3 to 6 per cent due to a sharp depreciation in the external value of the rand and a number of other exogenous shocks. The annual average was then replaced by a continuous target of 3 to 6 per cent for the period beyond 2006.

Figure 2. 3: Movements in the Repo rate and Inflation.



In April 2000, South Africa followed the world-wide push towards greater price stability. Its conservative monetary was largely directed to curtailing inflation. CPIX accelerated during in 2000, from 7.0 percent to 8.2 percent 2002. This acceleration was caused by a rise in the domestic price of petrol and diesel and higher food prices. The monetary authorities increased the repo rate on four occasions in 2002. CPIX inflation slowed down to 6.6 percent in 2003. Figure 2.3 clearly illustrates how successful the inflation targeting framework has been at combating inflation from 2003 to 2006. CPIX remained within the target range of 3 – 6%. However, inflation moved out of the target range in 2007.

Formal inflation targeting does not mean that monetary policy must necessarily react if the inflation rate moves outside the target. If it is expected that the inflation rate will move into the target range within a short period of time, no reaction of monetary policy is required. However, if the inflation rate is expected to remain out of the target for an extended time period, then monetary policy will have to be adjusted.

Critics have leveled various criticisms against the framework. Mboweni (2000: 405) contends that an inflation targeting framework is a complicated approach to implement as it relies on forecasts in an uncertain economic environment. Ball and Sheridan (2003) find no evidence that inflation targeting improves a country's economic performance. The choice of such a short-term interest rate may not be appropriate for developing countries since their money markets may be insufficiently developed and insufficiently liquid. However, Mishkin (2000) and Stevens (2003: 26) concludes that inflation targeting has proved highly successful in keeping inflation under control and in promoting high economic growth.

Table 2.1 below gives a summary of the monetary policy regimes that South Africa has had over the study period 1985 to 2007.

Table 2. 1: Monetary Policy Regimes in South Africa.

Policy Regime	Period	Features
Cash reserves-based system with monetary targeting	1986-1998	• Pre-announced targets of money supply (M3) pursued indirectly through changes in the SARB's bank rate. • Monetary targets missed due to, among others, financial liberalization and other structural changes in the economy.
Repurchase agreement (repo) system with monetary targeting and informal inflation targeting	1998-1999	• Repo system coupled with pre-announced targets of money supply (M3) and Informal Targets of core inflation
Repo system with formal inflation targeting	2000- 2007	• Main instrument used is the repo rate, which is the interest rate that the SARB charges for accommodating the cash needs of commercial banks. • A monetary policy committee (MPC) of the SARB meets regularly to consider possible adjustments to the repo rate.

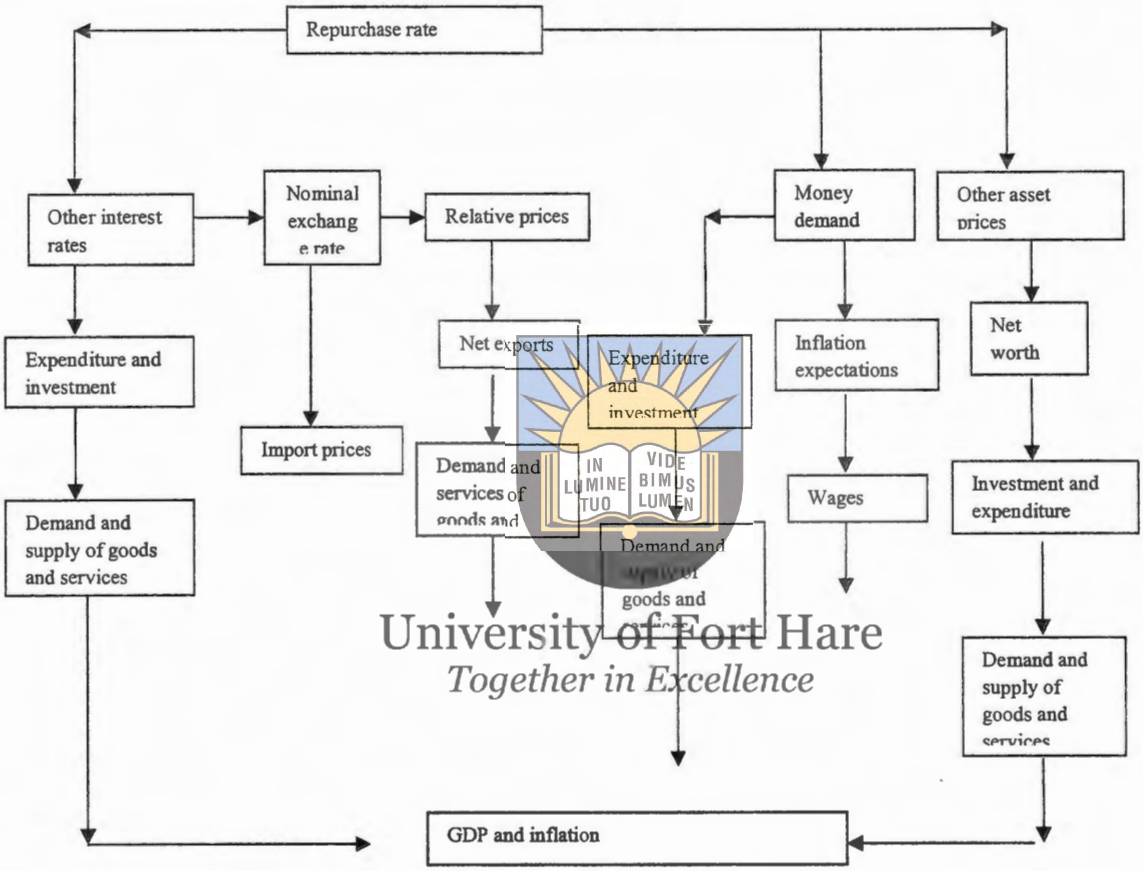
Source: Adapted from Mohr *et al.*(2004:373)

2.4 MONETARY POLICY TRANSMISSION IN SOUTH AFRICA

The purpose of this section is to give a description of how the monetary transmission mechanism has evolved in South Africa over the past two decades. Using the current monetary policy regime, there are a number of steps in the monetary policy transmission process. First, a change in the repurchase agreement rate (repo) by the SARB affects the market interest rates (rates for deposits and lending), asset prices, expectations and nominal exchange rates. Second, changes in these variables lead to changes in consumption (C) and investment (I) through their impact on the components of the domestic demand and net external demand (exports and imports).

The view of two researchers (Smal and Jager ,2001) at the South African Reserve Bank has been widely taken as the general view of the South African Monetary Policy Transmission Mechanism. Their view is presented in Figure 2.4 below.

Figure 2. 4 View of Monetary Policy Transmission Mechanism in South Africa.

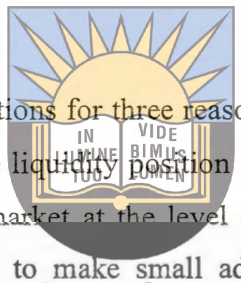


Source: Adapted from Faure AP (2005)

2.5 MONETARY POLICY TOOLS IN SOUTH AFRICA

2.5.1 Open market operations

Central banks are responsible for the stabilization of the money and capital markets by avoiding sharp changes in the interest rates and liquidity conditions. They practice this through Open Market Operations (OMO). OMO refers to the purchase or sale of any kind of asset that the central bank deals in. These operations are conducted on a variety of assets including treasury bills, Land bank bills, Land Bank promissory notes.



The SARB conducts Open Market Operations for three reasons: Firstly, to neutralize or smooth the influence of exogenous factors on the liquidity position in the money market. Secondly, to maintain a liquidity requirement in the market at the level of the cash reserve requirement in order to influence interest rates. Lastly, to make small adjustment in credit conditions and interest rates inorder to keep the banking system functioning properly. To inject cash reserves into the banking system (expansionary monetary policy), OMO will involve the purchase of securities by the central bank. In contrast, Open Market sales will be directed at draining cash reserves from the banking system. OMOs are flexible monetary policy tool because the involvement of individuals is on a voluntary rather than a compulsory basis. OMOs can also be performed frequently and on any quantities. Therefore, it is a technique suited to fostering financial competition and market development.

2.5.2 The Repo Rate

The repo rate is the main instrument that is used by the SARB. The repo rate is the rate at which the SARB charges for borrowed cash reserves. It is the most significant rate in the financial markets. The Bank's repo rate influences the interest rates charged by banks, the general level of interest rates in the economy and therefore other economic aggregates such as money supply, bank credit extension and ultimately the rate of inflation. The repo rate influences market rates in two ways: Firstly, it directly influences the banks' marginal cost of funding and, secondly, it

reflects the Bank's stance on monetary policy. Therefore, even the interest rates of banks which do not participate in the repo auctions are adjusted when the repo rate is increased or decreased.

In order to ensure that the repo rate is made effective, the SARB makes sure that the private sector banks are indebted to it at all times (Faure, 2005). It does this by creating a "money market shortage", which it then refinances at the repo rate. Banks in need of liquidity sell assets under repo to the Reserve Bank in exchange for borrowed cash reserves and pay the repo rate for this accommodation. Gidlow (2001:3) adds that the monetary authorities take the view that the money market would function more efficiently if changes to the repo rate had a more direct effect on the interbank rate. That is, changes in repo rate should first affect the interbank rates, which then transmit a similar effect to other money market rates and finally impact on the interest rates in the economy. This market is essentially the foundation of monetary policy and its transmission through the financial system.

2.5.3 Cash reserve requirements

Banks in South Africa are legally required to hold some percentage of their deposits in a non-interest earning account with the SA Reserve Bank. Cash reserve requirements were originally introduced partly for purposes of prudential banking requirements. They were therefore geared towards protecting the liquidity, solvency and safety of banks and other financial intermediaries, and were not regarded as a primary instrument of monetary policy. They have, however, come to be used as a supplementary instrument of monetary policy from time to time. The minimum cash reserve requirements nevertheless diminished in importance as an instrument of monetary policy because the South African monetary authorities placed a greater emphasis on open market operations. An increase in the cash reserve requirements against some or all of the liabilities of banks raises the banks' required minimum total cash reserves, thereby curbing the ability of banks to create more credit. Increases in cash reserve requirements are therefore likely to take effect only after a certain time lag, but nevertheless can be employed to squeeze the cash reserves of banks and curb the growth in the money supply.

There are several drawbacks to the use of cash reserve requirements as instruments of monetary policy. Firstly, they are slow to take effect. Changes in the requirements have to be announced through a notice in the Government Gazette. These changes become effective only after a time lag of a month or so. By that time, the need for the increase in the requirements may have fallen away. Variations in cash reserve requirements can also be a crude weapon, because even small changes in the requirements can release or bottle up amounts of cash that are disproportionately large in relation to existing shortages of liquidity in the banking system. There is yet another constraint on the use of cash reserve ratios. They are alleged to impose an unfair "tax" on banks that distorts their operations and aids non-bank competitors. Cash reserve requirements squeeze the interest margins of banks since, in South Africa; cash reserves held at the Reserve Bank attract no interest. Such requirements therefore put downward pressure on banks' deposit rates which would negatively affect already low levels of household saving. In view of these considerations, the manipulation of cash reserve requirements is not really a suitable way to manage day-to-day banking liquidity.

2.6 CONCLUSION

Monetary policy in South Africa is conducted by the South African Reserve Bank. Monetary policy in South Africa has witnessed several reforms both in target and operational procedures. Since the late 1980s the monetary policy framework has evolved from growth in monetary aggregates, to "informal" inflation targeting in the late 1990s and finally comprehensive inflation targeting since February 2000. The important dimensions of the South African monetary policy include: lower and stable inflation, stable real interest rates and positive GDP growth. The three main monetary policy tools used in South Africa are: cash reserve requirement, repo rate and the open market operations.

CHAPTER THREE

AN OVERVIEW OF THE SOUTH AFRICAN ECONOMY

3.1 INTRODUCTION

Monetary policy is an important part of macroeconomic policy which links the real and financial sectors of the economy. The financial sector is one of the most important sectors in the economy as it facilitates the movement of scarce financial resources from surplus to deficit economic units for investment. By facilitating lending and borrowing, the sector provides a catalyst to economic growth. This chapter intends to link the financial sector and the practice of monetary policy in South Africa. The chapter is also dedicated to linking the South African real economy to financial sector. The most important financial market where firms raise capital and invest is the JSE stock exchange. To that effect it is an important link between monetary policy actions and the decisions of firms. Therefore, a brief description of the JSE will be presented as well as an overview of the South African economy.

3.2 MONETARY POLICY AND THE FINANCIAL SECTOR

The financial sector in any economy plays a crucial role. Thus, monetary policy cannot be evaluated independently of the financial sector. The effect of policy choices depends on their impact on financial flows. These flows in turn depend on the structure and institutions of the financial sector. In South Africa, the nature of the development of the financial system is determined by common factors which underlie both the real and financial sectors. The South African financial system is a 'market-based' system, in which financial institutions have a strong relationship with their clients. Thus, customers can move relatively easily and costless between institutions. At the same time, the relatively developed capital market allows large established firms to raise equity finance, rather than borrowing. The financial services sector is supported by strong regulatory and legal framework. It consists of many local and overseas institutions offering a wide range of services. The services range from commercial banking and mortgage lending to insurance and investment.

Generally it is known that SA has a well regulated and sophisticated financial sector. It encompasses the banking, insurance and securities industries, and includes both those financial service providers seen as intermediaries (e.g. banks, insurance companies and pension funds) and those seen as facilitators (e.g. stockbrokers, securities underwriters, investment bankers, etc) (Hawkins, 2001). An independent regulatory authority regulates each of these semi- industries – the Registrar of Banks in the case of banking institutions and the Financial Services Board in the case of the insurance industry and the securities market.

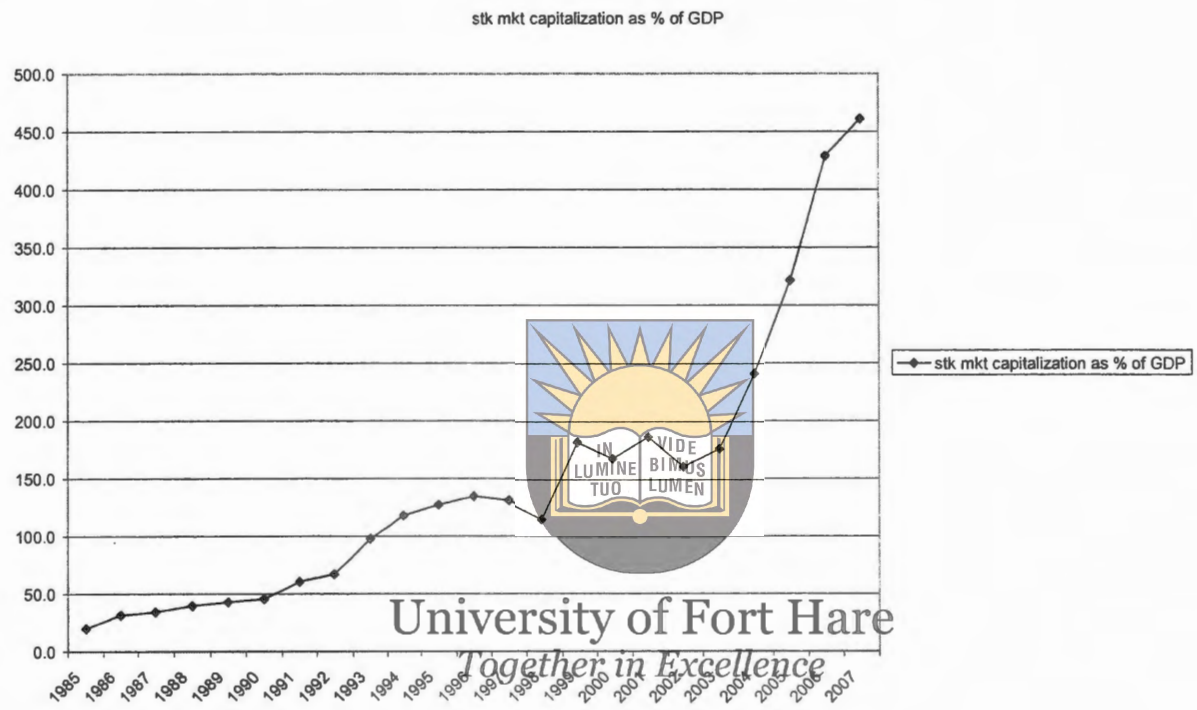
3.2.1 South Africa's banking sector

South Africa has a large, well developed and sophisticated financial sector. South Africa's banking sector has standards that perfectly suit those of industrialized countries. The banking legislations are sound making South Africa an attractive investment destination. In 2004, bank credit was equal to 87 percent of GDP not only greater than most countries in Sub-Saharan Africa (average of 47 percent), but also large compared to other middle-income countries (average of 78 percent) (World Bank, 2006). The banking industry in South Africa is largely concentrated by the 'big four' commercial banks: Absa, First National Bank, Standard Bank and Ned bank.

3.2.2 South Africa's non banking sector

The non-banking financial sector is also reasonably well developed. For example, in 2004, market capitalization ,the total value of shares of all listed companies,was equal to 214 percent of GDP (World Bank, 2006). In comparison, market capitalization was equal to only about 44 percent of GDP for the average middle-income country. Hawkins (2001) notes that market capitalization is higher in South Africa than in some high-income countries such as Australia (122 percent of GDP in 2004) and Spain (90 percent of GDP). The graph below shows the trend of the stock market capitalization of the JSE

Figure 3. 1: Stock Market Capitalization as a Percentage of GDP.



The capitalization ratio increased from 120 percent of GDP in 1990 to about 180 percent of GDP in 2004. The market capitalization peaked in 1999, at over twice the value of the economy's GDP. Though market capitalization dropped from the 2001 high of R1 770.7 billion, it still compares favorably to other emerging markets. By the end of May 2003, companies with a total market capitalization of R1 460 billion were listed on the JSE.

3.3 SECTORAL CONTRIBUTIONS IN SOUTH AFRICA

The government of South Africa identified a number of key sectors in the economy. These sector include tourism, mining and mineral, hi-tech industries and communications, and the chemicals. This section intends to give a brief overview of these sectors. Knowledge of the background of these sectors is important because many South African firms are largely concentrated in these sectors. Thus, the behavior of these sectors over time is worth knowing.

TABLE 1: SECTORS OF THE SA ECONOMY: CONTRIBUTION TO GDP 2008

Sector	Industry	%
	Agriculture, forestry and fishing	2.30%
Primary	Mining and quarrying	5.60%
	Manufacturing	16.20%
	Electricity, gas and water	2.10%
Secondary	Construction	3.40%
	Wholesale and retail trade, hotels and restaurants	14.10%
	Transport, storage and communication	9.90%
	Finance, real estate and business services	19.70%
	General government services	12.50%
Tertiary	Personal services	5.30%
	Total value added	**91.10%**
	Taxes less subsidies on products	8.90%
	GDP at market prices	**100%**

Source: Statistics South Africa

According to Statistics South Africa, in 2008 the finance, real estate and business services sector contributed the lion's share (19.7%) to the country's GDP. It was followed by manufacturing (16.2%), wholesale and retail trade, hotels and restaurants (14.1%), general government services (12.5%), and transport, storage and communication (9.9%).

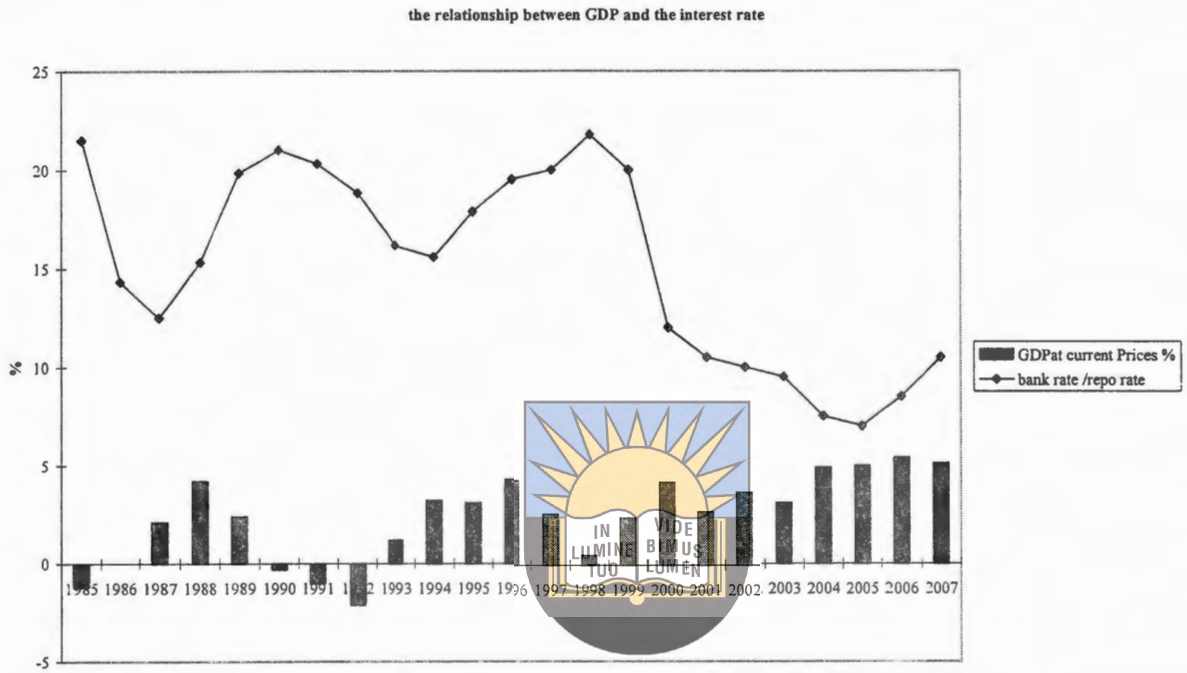
Mining and quarrying contributed 5.6% to GDP, personal services 5.3%, construction 3.4%, agriculture, forestry and fishing 2.3% and electricity, gas and water 2.1%.

Tourism is one of the fastest growing sectors of South Africa's economy, its contribution to the country's gross domestic product (GDP) increased from 4.6% in 1993 to 8.3% in 2006. Directly and indirectly, tourism constitutes approximately 7% of employment in South Africa. Thus, it has been earmarked by the government as one of SA's growth sectors. South Africa's automotive industry is well known for the manufacture and export of vehicles and components. The sector accounts for about 10% of South Africa's manufacturing exports, making it a crucial cog in the economy. Locally, the automotive sector contributes about 7.5% to the country's gross domestic product.

South Africa produces a significant proportion of the world's minerals. The country is a leading producer of minerals such as gold, platinum, coal and diamonds. Minerals contribute 65% of the export earnings. The mining sector directly contributes about seven-percent to the national GDP, although the indirect effects to the GDP are about 18.4%. The mining industry is the largest source of employment in South Africa. South [illegible] largest developer of information and communication technology in Africa. The ICT industrys' contribution to GDP has increased from 1.9% in 1992 to 6% in 2007

3.4 MONETARY POLICY AND THE REAL ECONOMY

Figure 3. 2: The relationship between GDP and the Interest Rate.



The 1989-93 economic downturns led to the tightening of monetary policy in response to inflationary pressures. In the same period, interest rate policy was changed under the hand of the new Governor of the SARB, Dr Stals, who favored a high interest rate policy to protect the value of the rand. Real GDP contracted to -0, 5% per annum. The SA economy commenced on an upward phase of the business cycle in 1993. The economic upswing phase from 1993 to 1996 came at a time when the economy embarked on key structural changes. Key growth-supporting factors were the end of financial and economic sanctions, the liberalization of exchange control and lower inflation. Both business and consumer confidence were bolstered as economic conditions improved. The recovery lost momentum during 1994 due to the elections. However, it gained stronger momentum thereafter. In 1995 inflation increased due to a sharp acceleration in bank credit extension and money supply growth. Fixed investment was also a strong component of the economic upswing, bolstered by mega investment projects. These public sector projects were an important catalyst in the fixed investment revival, which became broader based during 1996. Economic recovery, continued in 1999. The upswing was led by the decline in

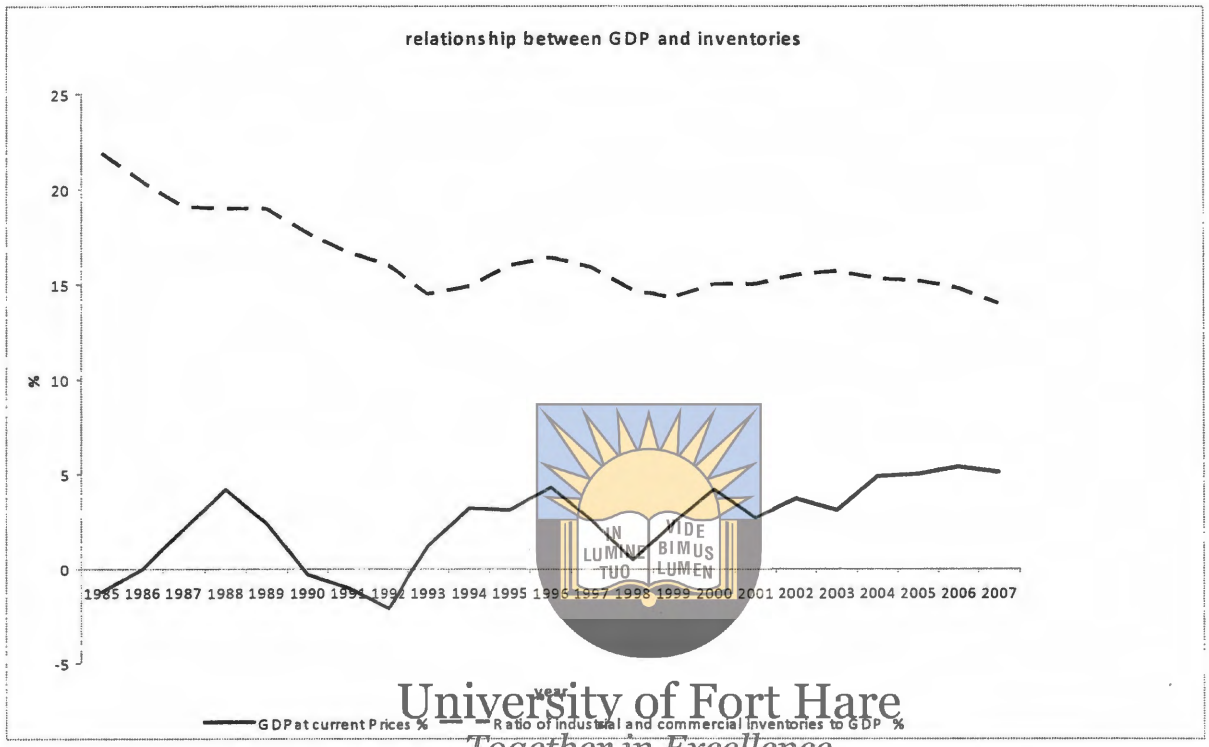
interest rates and a sharp improvement in world economic activity following the East Asian crises.

Inventory investments

Inventory investment contributes significantly to the changes in gross domestic expenditure and gross domestic product, not through its size, but as a result of its rate of change. An increase in the level of inventories implies that a part of production was not sold. Conventionally, inventory changes occur either as the outcome of planned action or as a result of exogenous shocks influencing the behaviour of producers (Kahn & McConnell 2002).

Inventory investment in South Africa is estimated by the South African Reserve Bank as part of gross capital formation. The change in inventories is calculated as the physical change in inventories from the end of the preceding p[illegible] end of the current period, valued at market prices prevailing during that period (Shrestha & Fassler 2003:6).The importance of inventory investment in the economy can be assessed by comparing the ratio of inventory investment and gross domestic product. Industrial and commercial inventories are the most important component of inventory investment in South Africa and they dominate the long-term movements in inventory investment. An analysis of inventory investment in South Africa and macroeconomic variables such as gross domestic product and monetary policy behavior is shown below.

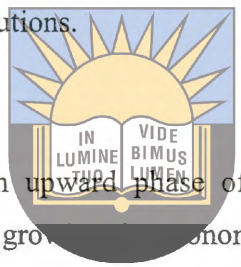
Figure 3. 3: The relationship between GDP and Inventory Investments.



The influence of inventory investment on the growth in gross domestic product is evaluated in this section. The time period under review is from 1985 to 2007. This is a period of unusual macroeconomic activity. It was coupled with the effects of major monetary policy changes, liberalization, and the effects of the Southeast-Asian financial crisis. National economic decline persisted until the end of 1992. Positive growth started in 1993.The recovery became strong in 1994, recording a growth of 2.6 percent. The recovery was persistent in 1995 and 1996 GDP growth exceeding the 4 percent mark. Real gross domestic product increased at an average annualized rate of about 1, 1 per cent from 1997 to 1999. Economic growth then accelerated sharply to an average annualised rate of about 3, 2 per cent from 2000 to 2003. Thereafter, it improved to averages of about 5.2%. During these periods inventory investment has also shown sharp fluctuations. The level of inventories decreased by about 12% during the downswing period 1985 to 1994. However, after this period, inventory investments improved to averages of about 15%. Over this period the fluctuations in inventory investment were moving together with fluctuations in GDP.

3.5 CONCLUDING REMARKS

This chapter reviewed the financial sector and the South African economy. It started by reviewing two major components of the financial sector: the banking and non banking sector. South Africa's banking sector has standards that perfectly suit those of industrialized countries. Moreover, it is strongly developed and efficiently regulated, comprising of large and small financially strong banks and investment institutions. The non- banking sector consist of the JSE, the Bond exchange of South Africa and other institutions which include insurers, fund managers and broking operations. However, the list excludes all the banks, which are under the supervision of the South African Reserve Bank. The Financial Services Board supervises the functioning of financial markets and institutions.



South Africa's economy has been in an upward phase of the business cycle 1994. Bold macroeconomic reforms have boosted the gro nomy. The key sectors in the economy of South Africa accommodate a large number of firms. The government of South Africa identified a number of key sectors in the economy. These sector include tourism, mining and mineral, hi-tech industries and communications, and the chemicals. This background on the South African financial sector and the economy together with the literature on the balance sheet channel to be covered in the next chapter will guide us in developing a model for the balance sheet channel of monetary policy transmission in South Africa.

CHAPTER FOUR

LITERATURE REVIEW

4.1 INTRODUCTION

The motivation behind this study is to analyze the balance sheet channel. Chapter 2 considered the conceptual framework of monetary policy practice in South Africa. Chapter 3 gave a brief overview of the South African financial system and the real economy. The aim of this chapter is to identify a set of variables that may be used to model the balance sheet channel. The chapter is divided into three sections. The first section covers the theoretical literature on the balance sheet channel, while the second section covers empirical findings on this subject. The last section concludes the chapter.

4.2 THEORETICAL FRAMEWORK

Monetary policy transmission mechanism is a process through which monetary policy triggers the changes which will propagate to real GDP and the inflation rate (Taylor; 1995). It describes how changes in policy transmit through the financial system, via financial prices and quantities, to the real economy. Basically, there are four channels of monetary policy transmission: the interest rate, exchange rate, credit and the other asset prices channels. Knoop (2008) identifies two important features of the above mentioned channels of monetary policy transmission. First, these channels are not mutually exclusive. This means monetary policy can operate through all the channels at the same time. Second, each of these channels operates through their effect on aggregate demand.

4.2.1 INTEREST RATE CHANNEL

The interest rate channel of monetary policy transmission works within an IS-LM framework. It is based on two assumptions. One: banks cannot perfectly shield transaction balances from changes in reserves. Two: bonds and money should not be perfect substitutes.

Interest rate increases reduces the commercial banks ability to extend credit. This leads to an increase in the demand of bonds whilst demand for money decreases. Assuming that prices are

slightly rigid, real money balances will decrease, pushing up interest rates, and increasing the cost of capital. This will lead to a decline in investment spending by economic agents. Eventually aggregate demand and output will decrease.

The traditional Keynesian ISLM view of the monetary transmission mechanism is characterized by the following schematic process showing the effects of a monetary expansion:

$MP\uparrow \rightarrow rir\downarrow \rightarrow I\uparrow \rightarrow Y\uparrow,$

where *MP*↑ is the expansionary monetary policy leading to a fall in real interest rates (rir↓). This leads to a reduction in the cost of capital, causing a rise in investment expenditure (I↑). A rise in aggregate demand and an increase in output (Y↑) will be the end result.

In the South African context, changes in the repo rate influence interest rates of domestic commercial banks. They adjust their lending rates but not necessarily by the same amount. Generally, a change in the repo rate would lead to a speedy change in lending rates of commercial banks. Furthermore, this will lead to the overall change in the overall liquidity position within the financial system. An econometric estimation by Mahadeva and Sinclair (2001) showed that SARB repo rates, the prime overdraft rate of commercial banks and the interest rate on fixed deposits moved together very closely. As liquidity within the financial markets is changed by alternations in SARB's repo-rate, firms and individuals respond by changing their spending and investment behaviour. Thus, output and prices will be affected.

The interest rate channel has been criticized for its ineffectiveness in countries with relatively high inflation. The interest rate channel is weakened by the volatility of inflation. When inflation is high, a tight monetary policy does not amount to high real interest rate since the volatility premium would be equally high. With a low inflation rate, volatility is low. This enhances the objective of the interest rate channel as a transmission mechanism of monetary policy.

4.2.2 EXCHANGE RATE CHANNEL

The integration of the world economy is growing mainly due to globalization. Thus, monetary authorities need to pay close attention to monetary policy transmission operating through exchange rate. In an open economy like South Africa, with a flexible exchange rate, the exchange rate affects the domestic price level directly by influencing net exports.

With a flexible exchange rate, a loose monetary policy would mean that real interest rates in South Africa will fall. This means local currency deposits becomes less attractive than deposits in foreign currencies. Thus, the local currency depreciates. The depreciation of the domestic currency makes the imported portion of inflation higher through the higher cost of imported goods. Hence, the general level of the inflation rate will increase. This can be schematically presented as follows:

repo rate↓ → interest rate↓ → ER ↓ → NX ↑ → y ↑

An expansionary monetary policy (MP↑) leads to a fall in real interest rates (rir↓). The domestic currency will be less attractive to deposits in other currencies. Thus, the currency will depreciate. The lower exchange rate (ER↓) of the South African currency makes foreign goods more expensive, causing a rise in net exports (NX) and hence aggregate output (y).

In a country with fixed exchange rate or crawling peg regime, the exchange rate channel is ineffective. This is due to the fact that only domestic interest rates adjust leaving the exchange rate unchanged. With a fixed exchange rate, the domestic interest rates are determined by the interest rates in the currency of the country to which the domestic currency is pegged. Thus, the exchange rate channel is clearly shut off.

However, the presence of an independent exchange rate channel is controversial. Friedman (1980) criticized the role of the exchange rate in the transmission of monetary policy. He argued

that monetary policy affects output and prices through changes in asset portfolios and in investment decisions. Thus, the movements in the exchange rate are a consequence of these changes in output and prices, either domestically or abroad.

4.2.3 OTHER ASSET PRICES CHANNEL

The Keynesian view of monetary policy concentrates only on one relative asset price, the interest rate. However, monetarists argue that monetary policy should concentrate on all relative asset prices and real wealth. Metzler (1995) argued that the asset prices effects extends beyond those operating thorough interest rates, exchange rates and equity prices. In Japan, monetary policy had an important impact on the economy through its impact on land and property values (Metzler; 1995).

In South Africa, two other assets, equities and bonds, are important in the transmission of monetary effects. Thus the other asset channel is divided into two: The Tobin q theory and the wealth effect. Tobin's *q* theory states that monetary policy can affect the economy through its effect on the value of equities. *Q is* the market value of companies divided by the replacement cost of capital. Companies are able to issue shares at a higher price and acquire capital goods cheaply for expansion of production. This can be schematically presented as follows:

$$MP\uparrow \rightarrow ir\downarrow \rightarrow PS\uparrow \rightarrow q\uparrow \rightarrow I\uparrow \rightarrow Y\uparrow$$

With an expansionary monetary policy (MP↑), rates fall (ir↓), leading to higher share prices (PS↑); this leads to a higher *q* and higher investment spending (I↑) that adds to output (Y↑).

When monetary policy is relaxed, agents have more disposable income for spending. One possible place to spend this money is stock markets. Higher spending in stock markets leads to rise in stock prices. The ultimate effect would be increased wealth of household through increase property and equity prices and therefore an improvement in the lifetime resources and eventually consumption. Thus, the wealth effect first described by Franco Modigliani holds that:

$MP\uparrow \rightarrow ir\downarrow \rightarrow PS\uparrow \rightarrow nw\uparrow \rightarrow CND\uparrow \rightarrow Y\uparrow.$

An expansionary monetary policy (MP↑) leads to a decline in interest rates (ir↓), that leads to an increase in share prices (PS↑); this increases the net worth (nw↑) of individuals, leading to an increase in consumption expenditure on non-durable goods (CND↑) that adds to output (Y↑).

4.2.4 THE CREDIT CHANNEL

The credit channel view of the monetary transmission mechanism emphasizes the availability of asymmetric information and adverse selection in financial markets. In other words, it examines the impact of asymmetric information and other credit market frictions on real spending and economic activity. Asymmetric information occurs because lenders do not have information about each potential borrower's investment project and therefore are not able to calculate the project's riskiness since they do not know the probability distribution of returns on the projects (Ikhide, 2003). But the borrowers do have more information about the project and are able to calculate the risk and expected returns on the project better than the lenders. Adverse selection sets in because at high interest rates enterprises with relatively low risk projects decide not to borrow while risky enterprises will attempt to borrow at the high interest rate (Ikhide, 2003).

The credit channel of monetary transmission consists of two sub channels: the bank lending channel and the balance-sheet channel. The balance sheet channel stresses the impact of monetary policy on the size of the external finance premium and on investment spending through the borrowers' financial position. The bank lending channel stresses the possibility that monetary policy may affect the supply of intermediated credit, particularly bank loans.

THE BALANCE SHEET CHANNEL

The balance sheet channel is based on the theoretical prediction that the external finance premium facing a borrower should depend on borrower's financial position. That is, the greater is the borrower's net worth, the lower the external finance premium should be. Since borrowers' financial positions affect the external finance premium and thus the overall terms of credit that they face, fluctuations in the quality of borrowers' balance sheets similarly should affect their investment and spending decisions.

The balance sheet channel of monetary policy arises because the shifts in policy affect the financial positions of borrowers, both directly and indirectly. A tight monetary policy directly weakens borrowers' balance sheets in at least two ways. First, rising interest rates directly increase interest expenses, reducing net cash flows. Thus, the borrower's financial position weakens. Second, rising interest rates are associated with declining asset prices. Thus, the value of the borrower's collateral will shrink. The indirect effect of tight monetary policy on net cash flows and collateral values is deterioration in consumer expenditure. The firm's revenues will decline. Firms' fixed costs do not adjust in the short run. Thus, the financing gap erodes the firm's net worth and credit worthiness.

Lower net worth means that lenders have less collateral for their loans. A decline in net worth raises the adverse selection problem. Thus, there will be less lending to finance investment spending. Lower net worth of business firms also increases the moral hazard problem. This is because owners have a lower equity stake in their firms. Thus, they gain an incentive to engage in risky investment projects. Taking riskier investment projects makes it more likely that lenders will not be paid back. Therefore, a decrease in business firms' net worth leads to a decrease in lending and hence in investment spending. Monetary policy can affect firms' balance sheets in several ways:

Equity Prices

Expansionary monetary policy can cause a rise in equity prices due to the negative relationship between interest rates and asset prices. The net worth of firms is raised. Adverse selection and moral hazard problems will decrease. Thus, this leads to higher investment spending and aggregate demand. This is presented schematically as follows:

$MP\uparrow \rightarrow ir\downarrow \rightarrow Pe\uparrow \rightarrow AS\downarrow \rightarrow MH\downarrow \rightarrow L\uparrow \rightarrow I\uparrow \rightarrow Y\uparrow.$

Expansionary monetary policy (MP↑) leads to lower interest rates (ir↓) and to higher share prices (*Pe*↑). This improves the balance sheets of many companies and leads to lower adverse selection (AS↓) and moral hazard problems (MH↓). Banks are more willing to lend (L↑), and companies are more willing to expand, leading to higher investment expenditure (I ↑) and higher output (*Y* ↑).

Cashflows

The balance sheet channel can work through its effect on cashflows. Expansionary monetary policy, which lowers interest rates, also causes an improvement in firms' financial position by raising cash flow. Adverse selection and moral hazard problems are reduced. This leads to the following schematic for an additional balance-sheet channel:

$MP\uparrow \rightarrow ir\downarrow \rightarrow$ cash flow$\uparrow \rightarrow AS\downarrow \rightarrow MH\downarrow \rightarrow L\uparrow \rightarrow I\uparrow \rightarrow Y\uparrow.$

Expansionary monetary policy lowers interest rates and improves cash flows. This improves the net worth of firms. The severity of adverse selection (AS↓) and moral hazard problems (MH↓) of companies and individuals is reduced. Banks are more willing to lend, leading to an increase in lending (L↑) . Thus in investment (I ↑) and economic activity (*Y* ↑) are boosted.

Unanticipated Inflation

A third balance-sheet channel operates through monetary policy effects on the general price level. Because debt payments are contractually fixed in nominal terms, an unanticipated rise in the price level lowers the value of firms' liabilities in real terms. The real value of the firms'

assets remains constant. Thus, the real net worth is raised. Adverse selection and moral hazard problems are lowered. Investment spending and aggregate output will increase. This is shown in the schematic below:

MP↑ → ir↓ → unanticipated P↑ → AS ↓→ MH ↓ → L ↑→ I↑→ Y↑.

A loose monetary policy can lead to inflation. Debt is usually of a fixed-rate nature. Thus, an unanticipated rise in the price level (P↑) will lower the value of liabilities of companies but not the value of assets. This condition raises net worth and thus lowers the adverse selection (AS↓) and moral hazard problems (MH↓) of companies. Banks will be keen to lend to companies (L↑). This will lead to a higher level of borrowing, an increase in investment spending (I ↑) and higher output (*Y* ↑).

THE BANK LENDING CHANNEL

The bank lending channel describes how monetary (or other) shocks to banks' balance sheets might affect the cost of finance for certain borrowers over and above the standard impact on finance costs of higher official interest rates. This channel may be potentially significant if increases in interest rates lead to a reduction in the supply of bank loans and if these loans are imperfect substitutes for other forms of finance.

Bernanke and Blinder (1992) gives three important conditions that must hold for the bank lending channel to work effectively:-

- Commercial bank loans are important and nearly the only sources of funds for companies. In this case bonds and loans must be imperfect substitutes. Thus, firms may not would be unable to offset a decline in the supply of loans by borrowing directly from the market.

- The Central Bank must be able to play the role of a lender of last resort by being able to influence the liquidity of financial intermediaries/commercial banks.

- There should be some form of price so that monetary policy actions are not neutral. If prices adjust smoothly, this will mean that changes in nominal reserves will be followed by changes in prices. Therefore, monetary policy will have no real effects.

Following a monetary tightening, banks may find that their ability to obtain external funds to fund lending, such as deposits (or traded liabilities like certificates of deposit), declines. This might happen, for example, if banks face the same restrictions on raising external finance as other firms, as described above. If banks cannot adjust their balance sheets simply by reducing holdings of short-term assets (such as government debt), this might restrict their ability to extend new loans.

Highly creditworthy borrowers—such as large firms—may be able to substitute readily other forms of finance for bank funds. For them, the change in interest rates following the monetary tightening is the same regardless of their source of finance, and can be summarised by changes in risk-free interest rates. But other borrowers—such as small firms and individuals—may be unable to switch readily from banks to alternative finance sources. It is possible that the cost of bank loans for these borrowers may overshoot changes in market interest rates as they compete for a smaller pool of bank loans. This may be associated with a rise in the actual price or spread demanded on the loan and/or a tightening in non-price conditions (such as covenants or collateral requirements). In addition, the quantity of credit may become (more) rationed, although this is not a strictly necessary component of the bank lending channel.

The resultant tightening in loan supply under the bank lending channel is often termed a 'credit crunch'. What matters in a 'credit crunch' is that changes in official interest rates no longer summarise changes in the cost of finance for certain borrowers. The credit channel effect here can be thought of as the additional adjustment in spending arising from the differential movement of bank loan rates to official rates (or from changes in the degree of quantitative loan rationing). For borrowers affected by a 'credit crunch', loan spreads and quantities of lending

will be important indicators of the cost and/or availability of finance. Non-monetary shocks might also lead to changes in bank loan supply. Lending capacity might be reduced by shocks to the financial health of the banking sector. For example, loan losses or a fall in bank equity prices might reduce bank capital.

Because of banks' special role, firms will not have access to the credit markets unless they borrow from banks. Given that there is no perfect substitutability of retail bank deposits with other sources of funds, the bank lending channel operates as follows:-

$MP\uparrow \rightarrow BD\uparrow \rightarrow BL\uparrow \rightarrow I\uparrow \rightarrow Y\uparrow$.

Expansionary monetary policy (MP↑) increases bank reserves and bank deposits (BD↑). This increases the quantity of bank loans available (BL↑). This increase in loans will cause investment spending (I ↑) to rise.

An important implication of the bank lending channel is that it has a greater effect on expenditure by smaller firms. These small firms are more dependent on bank loans than large firms. Large firms can directly access the credit markets through stock and bond markets, without going through banks. Doubts about the bank lending channel have been raised in the literature. Edwards and Mishkin (1995) gives evidence of the decline of the bank lending business which is occurring world-wide. This means banks are playing a less important role in credit markets. This renders the bank lending channel less effectictive.

4.3 THEORETICAL LITERATURE REVIEW

Kiyatoki and Moore (1997) model argues that lenders require that all loans they provide be fully backed by collateral, imposing a credit limit that is equal to the value of their assets. Therefore, under these conditions , it is not changes in cashflows or net worth that change the credit constraints that borrowers face, but it is changes in the price of the borrowers assets that tighten or loosen these constraints. Thus, the main implication of their model was that any shock that affects net worths, cashflows and asset prices can trigger a business cycle, regardless of

whether it is a shock that affects aggregate supply (such as a productivity shock) or aggregate demand (such as a change in money supply).

Stiglitz and Weiss (1981) elaborated how asymmetric information induces credit rationing problems. They argued that due to asymmetric information, banks are likely to raise the interest rates in order to cover the potential investment risks of borrowers' which cannot be measured. In the benchmark Stiglitz-Weiss model, there is rationing of all borrowers when rates are high, which is similar to the bank lending channel. In an extension of the model to include borrower groups, the authors show that lower quality groups only receive loans if credit is not rationed for higher quality groups. This is rationing of distinguishably low-quality borrowers, which is similar to the balance sheet channel. This will have two consequences. One: the borrowers with low risks will leave the markets. Two: Borrowers are forced to invest in high risk project. Therefore, Stiglitz and Weiss argue that banks would rather refuse some loan demand at lower interest rates than meet all of them at higher levels.

In their financial accelerator model, Bernanke and Gertler (1989) focuses on the costs that borrowers and lenders incur in financial transactions, which they refer to as the cost of credit intermediation. They argue that the cost of credit is not entirely determined by the interest rate. The cost of providing information is also important. Lenders incur monitoring costs and costs of periodically providing information over the life of a loan. Borrowers might also need to provide collateral. As a result, even small microeconomic changes in the balance sheets of firms, households , and banks can have a significant impact on macroeconomic behavior.

4.4 EMPIRICAL LITERATURE REVIEW

4.4.1 EMPIRICAL LITERATURE ON MONETARY POLICY TRANSMISSION.

This section reviews the empirical literature on monetary transmission mechanism from various countries (developed and developing countries). The idea is to examine how the theory on transmission mechanism outlined in the previous section matches with empirical evidence. There is a wealth of literature on the monetary transmission. These include studies done in other countries and also some literature relating to work done in South Africa.

Sims (1992) used VAR methods to estimate the transmission mechanism for Japan, France, UK and Germany. He used monthly data for the period 1957 to 1991.The variables included were industrial production, consumer prices, short-term interest rates, money supply, and exchange rate and price level. The results from this study were very much the same for all countries. A contractionary monetary policy shock led to a decline in output. In trying to provide a critic, Eichenbaum (1992) repeated the same exercise using US data. However, he used the narrow monetary aggregate (M1). The main aim was to see how different shocks bring about different results relative to expectations. He found that a positive innovation in M1 leads to an increase in the Fed fund rate and a decline in output. This would be of course contrary to economic theory considering that M1 was assumed as monetary policy shock. According to economic theory, money demand is inversely related to the nominal interest rate and this would mean that an increase in money supply would require a reduction in the nominal interest rate to restore money market equilibrium.

Ganev et al. (2002) examined the characteristics of interest rate channel and exchange rate channel for the following countries: Poland, Hungary, the Czech Republic, Slovakia, Slovenia, Romania, Bulgaria, Lithuania, Latvia and Estonia. First, they used the Granger test to prove that, in most countries, the exchange rate channel is stronger and more stable than the interest rate channel. Furthermore, using the impulse response function, the authors examined the effect of interest rate and exchange rate on output and prices. The results indicate that an increase in interest rates decreases inflation, while depreciation causes inflation and an increase in output.

In Thailand, Disyatat and Vongsinsirikul (2003) used the VAR approach with quarterly data from 1993 to 2001 to analyze the monetary transmission mechanism. Their basic model included real output, price level, and the fourteen-day repurchase rate, which they assumed to be the measure of monetary policy. They found that tightening monetary policy led to a decrease in output, which bottomed out after around 4–5 quarters and dissipated after approximately eleven quarters. The aggregate price level initially responded very little, but ultimately started to decline after about a year. Investment appeared to be the most sensitive component of gross domestic product (GDP) to monetary policy shocks. Their findings were consistent with those of other countries and with what monetary theory suggests.

In Jordan, Poddar, Sab, and Khatrachyan (2006) found no evidence of monetary policy affecting output. However, Jordan's monetary policy, which is measured by the spread between the three-month CD rate and the US Federal Funds rate, was effective in influencing foreign reserves. Other channels, like equity prices and exchange rate, were not significant channels for transmitting monetary policy to economic activity. The effect of monetary policy on the stock market also seemed insignificant.

In Singapore, Hwee (2004) used the real effective exchange rate as a measure for monetary policy and found that output reacted immediately and significantly to a contractionary monetary policy shock. He also found that the exchange rate channel was more effective in transmitting monetary policy to the economy than was the interest rate channel.

Nenovsky and Hristov (1999) studied the link between the monetary and the real sector in Bulgaria. Their variables included different monetary aggregates, consumer prices, exchange rate, interest rates, and real variables (industrial sales index and retail sales index). The statistical techniques used include univariate analysis, correlation analysis and unstructured VAR with impulse response and variance decomposition analysis. The authors find that the discretionary central bank regime (pre-1997) is associated with a strong negative relationship between monetary and real variables, which turns positive under a currency board (post-1997).

In Estonia, Pikkani (2001) uses a multi-equation structural model to study the monetary transmission. In the case of Estonia monetary shocks are represented by movements in the European Central Bank (ECB) official rate. Pikkani focuses on the interest rate and credit channels of transmission mechanism. He finds that the shocks in the ECB rate do affect bank rates and lending, but the effects are weak in the long run. The ECB rate shock is transmitted to private consumption and investment, to output and its growth and to inflation and current account balance, but these links are also weak.

In Slovakia, Dovciak (1999) studies the interest rate and the exchange rate channels for of monetary transmission. He finds the evidence for the transmission from short-run to long-run rates to be conflicting, and attributes it to the lack of competition between banks and the absence of other credit sources besides banks – no capital market or non-bank financial institutions, low

level of competition between banks, high fiscal deficits and crowding out effects. Dovciak also claims that high interest rates in Slovakia have not affected savings at the expense of consumption, and cannot confirm the existence of an exchange rate channel in either step of transmission. He explicitly suggests that recent progress in the reform process will probably strengthen and clarify the transmission mechanism in Slovakia.

In South Africa, a study by Smith and Du Plessis (2001) used a Structural Vector Auto Regression approach (SVAR) to identify the transmission mechanism. The variables for the study were real short-term domestic interest rate, monetary aggregate, aggregate price level, aggregate output, dollar oil price international interest rate, and exchange rate. Smith and Du Plesis found that innovation from the policy instrument leads to reduction in the price level but does not have significant effect on output. However their study had its shortcomings. Firstly, it does not include any credit variable in the SVAR model. Secondly, it used the prime overdraft rate of commercial banks as the policy instrument variables instead of the repo-rate.

4.4.2 EMPIRICAL LITERATURE ON THE CREDIT CHANNEL

Empirical evidence for the credit channel seeks to examine the co-movements in the stance of monetary policy, bank loans, firm's balance sheets and economic activity.. Thus, this section is divided into three sub sections. The first section looks at the empirical literature from developed countries. The second section focuses on the empirical literature from developing countries. The third section is dedicated to empirical literature from South Africa.

Empirical literature from developed countries

Ashcraft and Campello (2007) conducted a novel test of the credit channel of monetary policy in the US. They used quarterly data from 1976 to 1998. They used a structural VAR approach that draws on Bernanke and Blinder (1992) to study whether the strength of borrowers' balance sheets influences the response of bank lending to policy. The VAR system contained three variables: loans, real GDP, and the federal funds rate. They concluded that there was a negative response of bank loan growth to a monetary contraction. On the other side, borrowers with weak balance sheets obtain more new bank credit than other borrowers in monetary expansions. Their

conclusions suggest those borrowers' balance sheet strength accounts for a significant fraction of the credit channel of monetary policy.

Angelopoulou and Gibson (2007) examined the sensitivity of investment to cash flow (a balance sheet variable) in the UK. They used data for the period 1970 to 1991. Their variables of interest were gross investment, capital stock at replacement cost, average Q and cash-flow. They employed the narrative approach pioneered by Romer and Romer. The implications of their findings were that monetary policy was more effective at influencing the cycle through its effect on firms' net worth. Hence, proof of the existence of the balance sheet channel of transmission.

In Italy, Gallegati (2002), modified the augmented IS/LM model to suggest a different interpretation of the balance sheet channel. The data was taken at a monthly frequency over the period 1993 to 2001. He estimated a four variable VAR model. The variables included were a monetary policy instrument (the monetary base), financial variables (bank loans and the interest rate on bank loans), and a final policy objective (the index of industrial production). The conclusion was that the balance sheet channel affects firms' investment spending decisions through the quantity rather than the cost of borrowing. Thus, changes in borrowers' net worth can amplify and propagate output fluctuations. He argued that the effect was direct rather than indirect as claimed in the traditional interpretation of the balance sheet channel.

Kashyap and Stein (1994) surveyed the balance sheet channel for the period between 1977 and 1991. They used a sample of 7000 manufacturing firms. Kashyap and Stein divided the manufacturing firms into three categories: small, medium, and large. They looked at how the balance sheets of firms in each category have changed over the period. They observed that despite the rapid growth of non-bank financing loans and commercial paper, traditional commercial banks still are the most important source of finance. Although the results reinforces the conclusion that financing practices have not diminished the role of banks, this result does not reveal much about the change in the size distribution of these firms over that period. Oliner and Rudebusch (1996) challenged the credibility of this conclusion by arguing that it may be that during recessions, small firms are hurt badly, and hence have sharply reduced demand for credit, while large firms increase their demand for credit. Given that the majority of commercial paper

volume comes from the largest firms, this is indeed what Bernanke and Gertler (1995) called the balance sheet channel.

Bernanke (1986) provides empirical support on the existence of the lending channel. Bernanke examines the extent to which the money view of monetary policy transmission can account for the decline in U.S. output. He used data for the period between 1930 and 1933. He finds that a significant amount of the decline cannot be solely explained by the monetary mechanism. The disruptive effects of bank panics seemed capable of explaining the persistence of the depression. Additional evidence is provided by Bernanke (1986) using VAR models. The resulting instrumental variable estimates suggest that lending shocks do seem to have a significant effect on aggregate demand. This opens the possibility of a shift in loan supply along with a shift in loan demand. An extended work by Bernanke and Harold (1991) that included a sample of 24 countries finds the same results; during periods of large panics, the decline in output cannot be exclusively explained by standard factors such as real wages rates, interest rates, or fiscal policy.

Romer & Romer (1990) assessed the credit channel transmission mechanism. They focused on the bank lending channel in the USA during various periods of monetary tightening in the presence of credit market imperfections. In doing so, they split the credit channel into two broad views: the money view, similar to the balance sheet channel and the lending view. Using Ordinary Least Squares and Instrumental Variables techniques, Romer & Romer (1990) estimated the St. Louis equations covering periods of monetary tightening, and found little evidence of a Bank Lending Channel. Thus, the money view seems to play more of a role in the credit channel than the Bank lending channel.

In Italy, Conigliani et al. (1997) test the importance of the intensity of the relationship between banks and firms in the transmission of monetary policy. They collected data on 33,808 non financial firms in the year 1992. They investigated the link between banks-firms relations and the availability of credit after a monetary shock. As explanatory variables they use indexes of concentration and stability. A low concentration index signals the existence of mutiple banking relationships, while a high stability index is a proxy for long lasting customer relationship. The estimate of probit equations shows that firms with both high stability and low concentration indexes have a greater probability of being sheltered from the interest effects of restrictive monetary policy and smaller probability of incurring credit rationing. Since small Italian firms

display both characteristics, Conigliani et al. conclude that, in the case of the 1992 monetary restriction, their analysis does not confirm the prediction of the bank lending channel insofar as small firms are concerned.

Kakes (2000) uses the Johansen technique and a vector error correction model (VECM) analysis to estimate loan demand and supply equations for the Netherlands, thereby testing the validity of the Bank lending channel in that country. He found that the market for bank credit is dominated by demand rather than supply, and therefore, the bank lending channel is not an important monetary transmission mechanism in the Netherlands.

In Japan, Morsink and Bayoumi (2001) used VAR models with quarterly data from 1980 to 1998 to analyze the effect of monetary shock on the economy. In their basic model, they used economic activity, prices, interest rates, and broad money. They found that both interest rate and broad money significantly affect output. Then, after examining the basic model, they extended the VAR to examine different channels of the monetary transmission mechanism and concluded that both monetary policy and banks' balance sheets are important sources of shocks to output, that banks play a crucial role in transmitting monetary shocks to economic activity, and that business investment is especially sensitive to monetary shocks.

Buttiglione and Ferri (1994) used an unrestricted VAR to provide evidence for the bank lending channel in Italy. They used monthly data running from 1988 to 1993. Buttiglione and Ferri estimated a VAR that includes six endogenous variables, the overnight rate (used as the monetary policy index), the rate on government paper, the amount of credit granted by banks to customers (a proxy for credit supply) , the amount of credit actually drawn (a proxy for credit demand), the average interest rate on loans, and the index of industrial production. They also add four exogenous variables; the industrial production price index and three dummies intended to capture specific important regulatory interventions by Banca d'Italia in 1988 and 1989. Buttiglione and Ferris'analysis provide support for the existence of a bank lending channel in Italy.

Empirical literature from developing countries

In Egypt, Souria (2002) attempted to examine whether the stock market could be an alternate channel for transmitting monetary policy rather than the traditional money and credit channels. The empirical investigation was conducted using a five variable Bayesian VAR model. The study used monthly data for the period 1992 to 2000. His variables of interest were stock market returns, inflation rate, Credit to the private sector, Discount rate, money supply growth. The estimation results provided evidence that both the balance sheet and bank lending channels are well established and effective. Nevertheless, the results provided evidence that in future, the stock market could be an effective channel rather than the traditional credit channel.

In Malaysia, Tang (2006) investigated the relative strength of four monetary policy transmission channels. The VAR model estimated comprises 8 variables divided into two blocks: foreign and domestic. The foreign block comprises a commodity price index, the US consumer inflation rate, real GDP and the Federal Funds Rate. The domestic block comprises of two target variables of monetary policy: consumer price inflation and real GDP, a monetary policy instrument, the monetary aggregate M1 and the 3-month interbank interest rate. The study used monthly data which spanned from 1981 to 2004. The interest rate channel was found to be most important in influencing output and inflation in the horizon of about two years, and the credit channel beyond

that. Their evidence revealed the absence of the bank lending channel. The balance sheet channel was found to be important in the credit channel.

Izak (1998) uses a VAR framework to examine the transmission through the lending channel in the Czech Republic. He used data for the period between 1993 and 1997. He shows that the very first step of the transmission from CNB repo rate to the money market was efficient and had a relatively small time lag. The next step between money market rates and bank rates on newly granted credits was also efficient, the two rates are cointegrated, and the error correction mechanism is somewhat slower then between central bank repo rate and interbank rates. The relationship between interest rates on newly granted credit and the volume of credits and investments had the expected negative sign, but these relationships proved to be statistically insignificant. Investment Granger causes credit volume with a time lag of 3 and 4 quarters, but not vice versa. Izak also estimated the second step of transmission by testing whether credit volume had an effect on industrial production [illegible] that the two series are not cointegrated.

Alam and Waheed (2006) investigated the monetary transmission mechanism in Pakistan at a sectoral level. They used quarterly data spanning from 1973 to 2003 from seven different sectors. Their study estimated a VAR with three variables for the aggregate economy as well as for each sector: the level of output, the level of prices, and a monetary policy indicator. They concluded that the credit view explanation seems to be valid. This was due to the fact that the sectors that are affected most by monetary tightening were those sectors that were heavily dependent on bank loans and that are interest rate sensitive. Hence the existences of a balance sheet channel. However, they did not rule out other potential channels for monetary mechanisms.

Pelinescu and Scutaru (2000) used the VAR-VEC framework to analyze the interest rate and credit channels in Romania. They find that until 1997 central bank rates affected bank rates.Their findings revealed that both credit and money do not influence inflation and industrial production significantly, especially in the long run. A very interesting addition to this work is research done by Popa (1996) who finds in a cointegration framework an asymmetry of monetary transmission in Romania. Namely, interest rates do affect private firms' credit, but not state-owned ones. The relationship between interest rates and state-owned firms' demand for credits is even found to be positive, while the opposite is found for private firms. The same holds for the credit elasticity of

output. The observation that monetary transmission may be asymmetric for private and state-owned firms may be relevant for all transition countries.

In Namibia, Ikhide and Uanguta (2002) examined the two main channels through which monetary policy is transmitted into the domestic economy — namely the interest rates and credit channels. The results were deduced from two methods: the Cumulative Forecast Error and Vector Autoregressive (Impulse Response Analysis). Their study focused on the following variables: credit to the private sector, money supply, CPI, and private investment. Their results confirmed the operation of the bank lending channel, a version of the credit channel in the Namibian economy.

In Bulgaria, Nenovsky and Hristov (1999) used various unstructured VAR specifications with weekly data for 1997-1998. The results indicate that the variation in the government deposit as a quasi monetary policy instrument has an effect on the money supply (M3), and also a significant effect on domestic credit and on the behavi[illegible]anks. Credit rationing is accepted as a hypothesis with respect to the lending to the private sector by Bulgarian banks. This is accepted as a confirmation for the existence of a credit transmission channel in Bulgaria.

Empirical literature from South Africa

Ludi and Ground (2006) examined the bank-lending channel of the credit channel of monetary policy in South Africa. They used the structural vector auto regressions (SVAR). They employed quarterly data from 1987 to 2004. Their study estimated a VAR with three variables: the repo rate, GDP, Bank loans and bank deposits. They concluded that loans in South Africa are governed by consumer demand, and not by bank supply. This tends to disprove the fact that the bank-lending channel has effectively worked as a channel of monetary policy transmission in South Africa.

Sichei (2005) investigated the bank-lending channel of monetary policy in South Africa. He used quarterly bank-level data for the period 2000 to 2004. He used the generalized method of moments (GMM) technique. The variable used for the study were bank loans, the repo rate, real

GDP, bank deposits, bank size and capital adequacy. The study showed that the bank lending channel operates in South Africa.

To date no known empirical research has been undertaken to identify the balance sheet channel of monetary policy transmission in South Africa. Given that there is no empirical investigation in this area, this current study is important in generating new information. However, on the basis of empirical research by Sichei (2005) and Ludi and Ground (2006) which produced two contrasting views, it would seem that there is need to investigate the alternative channel of the credit channel, the balance sheet channel.

4.5 METHODS OF ANALYZING THE CREDIT CHANNEL

The credit channel has been empirically studied using different methodologies. Pedersen (2003) identified the following methods to have been widely used in modelling the credit channel.

- **Studies based on statistical (vector autoregressive) models** with the banks' total lending and other variables (Bernanke and Blinder (1992)). The effect of a monetary policy change on total lending is examined. The models also include variables for real activity, e.g. growth in the gross domestic product (GDP). A fall in lending following a tightening of monetary policy may indicate that the banks have tightened their credit policies. If GDP declines prior to or parallel with the fall in lending, this is, however, an indication that the development may also reflect a fall in the demand for loans.

- **Studies of corporate debt composition** (Kashyap et al. (1993) and Oliner and Rudebusch (1996). In addition to bank loans, corporate debt may comprise e.g. bond debt and trade credit. It is examined how a monetary-policy change affects the composition of corporate debt. If the proportion of bank loans falls following a tightening of monetary policy, this may indicate that the banks have tightened their credit policies. If this proportion does not decline when total debt is reduced, it is more likely to indicate a general fall in the demand for loans. In principle, though, this could also reflect that all lenders (i.e. not only banks) have tightened their credit policies.

- **Studies of business investments at enterprise level** (Fazzari et al. (1988) and Carpenter et al. (1994)). In these studies the significance of a cash-flow channel is examined. This is done by testing whether business enterprises' investments, in addition to a number of other variables (e.g. turnover and a capital-cost measure), depend on current profits or the cash flow (i.e. the difference between their ingoing and outgoing payments). If that is the case, and the business enterprises' profits or cash flow can be assumed to fall when interest rates increase, this indicates that a cash-flow channel is relevant. Some studies specifically examine whether corporate profits or cash flows decline when interest rates rise.

- **Studies of bank lending based on data on individual banks** (Kashyap and Stein (2000) and Kishan and Opiela (2000)). It is examined whether a monetary-policy change have different effects on bank lending depending on a number of characteristics of the individual banks. For instance, it is examined whether lending by small banks, banks with relatively small capital reserves, or banks with a small portfolio of liquid assets declines more than lending by other banks after a monetary policy tightening. Such differences between banks can hardly be explained by changes in the demand for loans, but rather indicate a reaction on the supply side in accordance with a credit channel.

4.6 CONCLUSION

The main objective of this chapter has been to investigate the potential variables that can be used to model the balance sheet channel. There are several theoretical models of the balance sheet channel of monetary policy transmission mechanism. These models combine several other models to come up with a unified dynamic framework for analyzing the balance sheet channel.

It is very difficult to summarize literature on the balance sheet channel. Previous researchers have empirically estimated these models, but only selecting variables that suit their different situations. From the vast literature covered in this chapter, the main variables used in investigating the balance sheet channel are monetary policy variables (the repo rate and money supply), Balance sheet variables (credit extend to the private sector, cashflows, average Q and loan demand) and activity variables (inflation rate [illegible] gross domestic product).

The review of literature has also exposed a number of different methodologies used to model the balance sheet channel. Some of them include the unrestricted VAR, structural VAR, Cointegration and VECM, VAR-VEC, and the Cumulative Forecast Error.

These variables and those that emerged from the previous chapter on the background of monetary policy in South Africa will be included in the empirical model of this study in Chapter 5. However, the inclusion of these variables will be dependent on data availability, among other factors.

CHAPTER FIVE

ANALYTICAL FRAMEWORK

5.1 INTRODUCTION

The preceding review of the literature and a background on the monetary policy practice in South Africa, have shed some light on the balance sheet channel. This chapter builds on that background to set the analytical framework that is used in this study. It is divided into five sections. Section 5.2 consolidates the literature and the background of the monetary policy practice in South Africa, covered in the last three chapters, to develop a model of the balance sheet channel in South Africa. Definition of variables and data sources follow in section 5.3. A review of estimation techniques for the investigation of the balance sheet channel are presented in section 5.4, while section 5.5 concludes the chapter.

5.2 MODEL SPECIFICATION

To test the existence of the balance sheet channel, the study will articulate a simple characterization of the link between monetary policy and the real economy that passes through borrowers' balance sheets. Thus, this study will employ the vector autoregressive (VAR) based co-integration and vector error- correction (VAR- VECM) models using the methodology developed in Johansen (1991, 1995). Vector Autoregressions have generally been used to analyze the effects of monetary policy because of the lack of consensus about a complete structural model of the economy, (see for example; Ashcraft and Campello (2007); Dabla-Norris and Floerkemier (2006) and Christiano et al. 1996).

The VAR model will contain the following variables, Bank rate (monetary policy effect), External finance premium (information asymmetry channel), stock market capitalization (to cater for the collateral channel), Changes in industrial and commercial inventories (cashflows channel) and gross domestic product (to cater for the aggregate shock). Therefore, the function can be represented in short as:

$$Y_t = f[\ monetary\ policy\ , information\ assymetry, collateral, cashflow, GDP] \ldots . (1)$$

Where Y_t a vector of endogenous variables in the model.

5.3 DEFINATION OF VARIABLES AND DATA SOURCES

The study will employ quarterly data for the period 1980 to 2008. VAR are very sensitive to sample size. Thus, we are going to collect 128 observations per variable. This sample size is large enough to accommodate the effects of differencing and lagging.

The bank rate will be used a measure of the changes in monetary policy conditions. We measure the bank rate variable as the change in the South African overnight interest rate between the previous quarter *t-1* and the current quarter *t*.

The external finance premium is going to be used as a proxy for information asymmetry. This is a balance sheet variable which intends to analyze the existence of the Asymmetric information sub-channel. Obtaining direct measures of the external finance premium is difficult. In numerous studies proxies or indicators of finance premium have been used. Therefore, we are going to define the external finance premium as the spread between the mortgage rate and the 10-year government bond rate following Iacoviello and Minetti (2008). The data is published quarterly by Statistics South Africa.

Changes in industrial and commercial inventories are going to be used as a proxy for cash flows. This is a balance sheet variable intended to analyze the existance of the cash flows sub-channel. Industrial and commercial inventories are the most important component of inventory investment in South Africa (Shrestha and Fassler 2003) and they dominate the long-term movements in investment. These figures are estimated by the South African Reserve Bank as part of gross capital formation.

Stock market capitalization is used as a proxy for collateral. This is included as a balance sheet variable to analyze the effect of collateral sub-channel. Market capitalization is the value of the share capital of a firm. Therefore, stock market capitalization is the sum of market capitalization

of all firms listed on a particular stock exchange. This will also enables us to take into account the movements in asset prices such as machinery, and non-residential buildings and structures and stocks. The figures are available from the Johannesburg Securities Exchange (JSE).

The real GDP is included as a measure of economic activity or aggregate shock as in Bernanke and Gertler (1995). The observations are obtained from various issues quarterly bulletins published by Statistics South Africa.

5.4 A REVIEW OF ESTIMATION TECHNIQUES

5.4.1 VECTOR AUTOREGRESSION ANALYSIS

The VAR approach considers several time series at a time. This approach regresses each current variable in the model on all the variables in the [illegible]gged a certain number of times. That is, each variable is expressed as a linear function of the past values of that variable and all other variables in the model. The term autoregressive is due to the appearance of the lagged value of the dependent variable on the right-hand side. The term vector is because a vector of two or more variables is dealt with in the same model. Thus, the VAR model can be consistently estimated by ordinary least squares. There are three types of VARs: reduced form, recursive, and structural.

A reduced form *VAR* expresses each variable as a linear function of its own past values, the past values of all other variables being considered, and a serially uncorrelated error term. Each equation is estimated by ordinary least squares regression. The number of lagged values to include in each equation can be determined by a number of different methods. The errors terms in these regressions are the "surprise" movements in the variables, after taking its past values into account. If the different variables are correlated with each other, then the error terms in the reduced form model will also be correlated across equations.

A recursive *VAR* constructs the error terms in the each regression equation to be uncorrelated with the error in the preceding equations. This is done by judiciously including some contemporaneous values as regressors.

A structural *VAR* uses economic theory to sort out the contemporaneous links between the variables. Structural VARs require "identifying assumptions" that allow correlations to be interpreted causally. These identifying assumptions can involve the entire VAR, so that all of the causal links in the model are spelled out, or just a single equation, so that only a specific causal link is identified. This produces instrumental variables which permit the contemporaneous links to be estimated using instrumental variables regression. The number of structural VARs is limited only by the inventiveness of the researcher.

ADVANTAGES OF THE VAR METHOD

- It is a very simple method. There is no need to determine whether a variable is endogenous or exogenous. All the variables in VARs are endogenous.

- Given that all the variables in the VAR are all stationary and each equation contains the same number of lagged variables in the system. The models can effortlessly be estimated by ordinary least squares. This makes the estimation procedure very simple.

- The forecasts obtained by VARs are often more accurate and better than other more complicated forecast methods.

DISADVANTAGES OF THE VAR METHOD

- Unlike other models, the VAR model is a-theoretical, because less prior information is used.

- VAR models are less suited for policy analysis because of their emphasis on forecasting.

- The choice of lag length is largely subjective.

- All the variables need to be stationary; if not, the relevant variables need to be transformed. Thus, the results from transformed data may be unsatisfactory and difficult to handle estimation-wise.

- The individual coefficients in the estimated VAR models are frequently tricky to interpret.

5.4.2 TESTING FOR STATIONARITY/UNIT ROOT

A series is referred to as stationary if its mean and variance are constant over time (Gujarati, 2003: 797). In the classical regression model, we deal with the relationship between stationary variables. However, most of the economic indicators usually follow a nonstationary path. Gujarati (2003: 806) shows that if the dependent variable is a function of a nonstationary process, the regression will produce spurious results. In such a case, the results will be meaningless. Significant t-ratios and a high r-squared will be obtained even though the trending variables are completely unrelated.

Therefore, unit root or stationarity tests should be done on all the variables before proceeding with any other test and estimation of parameters. There are several tests for stationarity. These include visual plots of the data, unit root test and those that directly test for stationarity. In this study we will use the Augmented Dickey-Fuller test (a unit root test) and Kwiatkowski *et al.*, 1992 (a stationarity test) in order to perform what Brooks (2002: 382) refers to as "confirmatory data analysis"

DICKEY-FULLER AND THE AUGMENTED DICKEY-FULLER TESTS

The stationarity of a time series can be tested directly with a unit root test. The Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) are the most frequently used unit root tests. The DF test estimates the following equation:

$$\Delta y_t = c_1 + c_2 + \omega y_{t-1} + v_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.5)$$

In (5.5), y_t is the relevant time series, Δ is a first difference operator, t is a linear trend and v_t is the error term. The error term should satisfy the assumptions of normality, constant error variance and uncorrelated error terms. If the error terms are uncorrelated in equation (5.5), results based on the DF test will be biased. The weakness of the DF test is that it does not take account of possible autocorrelation in the error term (v_t). To cater for this shortfall, the ADF can be used. The ADF test corrects for high-order serial correlation by adding a lagged differenced term on the right-hand side in the DF equation (5.5). Consequently, the ADF employs the following equation:

$$\Delta y_t = c_1 + c_2 t + \omega y_{t-1} + \sum_{i=1}^{p} d_i \Delta y_{t-i} + v_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.6)$$

Both equations (5.5) and (5.6) can also be estimated without including a trend term $c_2 t$ and without a constant, c_1. The null hypothesis is that there exists a unit root in the time series (nonstationary time series). That is Ho: ω =0 against the alternative hypothesis that the time series is stationary (no unit root), which is Ha: ω <0. If the calculated statistic is less than the MacKinnon (1991, 1996) values, the null hypothesis is accepted. This will therefore mean that there is a unit root in the series and the time series is not stationary. The opposite is true when the calculated statistic is greater than the MacKinnon critical value.

The Dickey-Fuller test has its own weaknesses. The test seems to give a precise answer about stationarity or nonstationarity. This is not always the case. The test is weak in its ability to detect a false null hypothesis. Brooks (2002: 381) and Gujarati (2003: 819) show that unit root tests have low power if the process is stationary but has a root close to the nonstationary boundary. This means that the Dickey-Fuller test fails to detect stationarity when the series follows a stationary process (Thomas, 1997: 410). There are several ways of solving this problem. These include increasing the sample size and using a stationarity tests among others. The former solution could be limited by data unavailability. The latter could be a good alternative since there is no change in sample size. Brooks (2002: 382) recommends using a unit root test together with a stationarity test. We consider one such test below.

The Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test

Stationarity tests have stationarity under the null hypothesis. This reverses the null and alternative hypotheses under unit root test, such as the ADF. The KPSS (1992) test differs from other tests in that the series is assumed to be trend-stationary under the null hypothesis. This test is based on the residuals from the ordinary least squares regression of the dependent variable (yt) on the explanatory variables (x_t):

$$y_t = x_t^i \partial + \mu_t \quad \ldots\ldots (5.7)$$

The LM (KPSS) statistic is defined as:

$$LM = \frac{\Sigma_t S(t)^2}{(T^2 f_0)} \quad \ldots\ldots (5.8)$$

Where, f_0 is an estimator of the residual spectrum at frequency zero and

$S(t)$ is a cumulative residual function calculated as:

$$S(t) = \sum_{\tau=1}^{t} \widehat{\mu_\tau} \qquad (5.9)$$

The calculated LM statistic is compared with the KPSS (1992) critical values in order to make a conclusion about the stationarity of a series. If the calculated LM statistic is smaller than the critical values, the null hypothesis is accepted. The conclusion will be that the series is stationary. The opposite will be true for a nonstationary time series.

5.4.3 LAG LENGTH AND DETERMINISTIC TREND SPECIFICATION

Brooks (2002: 334) argues that economic theory will often have little to say on what an appropriate lag length is for a VAR and how long changes in the variables should take to work through the system. Brooks recommends the use of multivariate versions of the information criteria, which includes the sequential modified likelihood ratio (LR), Akaike information criterion (AIC), Final prediction error (FPE) Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ). The Johansen procedure requires that the appropriate lag length for the VAR be estimated. This study employs two different criteria: the Akaike information criteria and the Likelihood Ratio (LR) test.

LIKELIHOOD RATIO (LR) TEST

$$LR = 2[\ln \ell_u - \ln \ell_r] \sim \chi^2(v) \qquad (5.10)$$

where,

$\ln \ell_u$ = Log of likelihood of the complete in coefficient (unrestricted) equation

$\ln \ell_r$ = Log of likelihood of the smaller in coefficient (restricted) equation

v = number of restrictions imposed

Given VAR (k) model with coefficients corresponding to the lagged variables of the matrix $A = [A_1, A_2, \ldots\ldots\ldots\ldots A_K]$, the test involves testing the following hypotheses in a sequence starting with the largest lag length k.

H_0: $A_k = 0$ vs. H_a: $A_k \neq 0$

H_0: $A_{k-1} = 0$ vs. H_a: $A_{k-1} \neq 0$ given that $A_k = 0$

H_0: $A_{k-2} = 0$ vs. H_a: $A_{k-2} \neq 0$ given that $A_k = A_{k-1} = 0$

.....

H_0: $A_k = 0$ vs. H_a: $A_k \neq 0$ given that $A_k = A_{k-1} = \ldots = 0$

The test terminates when the null hypothesis is rejected using the LR statistic. Thus, the VAR order q, for $k \geq q \geq 1$, is selected (Holden and Perman 1994).

The Akaike information criterion (AIC) and Schwartz criterion (SC)

Eviews 3 (2003) reports Akaike's information criterion as:

$$-2(l/t) + (k/T) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (5.11)$$

and the Schwartz criterion as:

$$-2(l/T) + \frac{k \log(T)}{T} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (5.12)$$

where l is the value of the log of the likelihood function with the k parameters estimated using T observations. The various information criteria are all based on -2 times the average log likelihood function, adjusted by a penalty function. It is likely that the different criteria mentioned may yield different optimal lag lengths. In this event the criteria yielding the highest lag length will be chosen. This is because the cost of over-parameterising by including more lag lengths in the ECM is small in terms of efficiency (Gonzalo, 1994:220). In the event that the largest lag length produces results that show signs of serial correlation. The next largest lag length will be used until serial correlation is removed.

Johansen (1995:80-84) outlines five deterministic trend assumptions available to the researcher. Various types of VARs can be estimated based on five deterministic trend assumptions, for example, with or without a constant and trend in cointegrating term and with or without a constant in the VAR equations. E-views 5 specifically provides the following deterministic trend assumptions: Case 1 assumes no deterministic trend in the data and no intercept or trend in the VAR and in the cointegrating equation (CE); Case 2 assumes no deterministic trend in the data, but an intercept in the CE and no intercept in VAR; Case 3 assumes a linear deterministic trend in the data and an intercept in CE and test VAR; Case 4 allows for a linear deterministic trend in data, intercept and trend in CE and no trend in VAR; and Case 5 allows for a quadratic deterministic trend in data, intercept and trend in CE and linear trend in VAR. As a guide, E-views 5 recommends the use of Case 2 if none of the visual plots of the series and unit root tests

show the presence of a trend in the series, Case 3 if the series have stochastic trends, Case 4 if some of the series are trend stationary, while Cases 1 and 5 are rarely used in practice. Thus, the graphical analysis of the raw data and unit root tests, together with *a priori* knowledge from economic theory, should assist in selecting the deterministic trend assumption to be used in the Johansen test for cointegration (rank of Π). Wesso (2000:77) suggests that the final decision should be guided by both economic theory and statistical criteria.

5.4.4 COINTEGRATION AND VECTOR ERROR CORRECTION MODELING

In estimating the VAR, this study will take into account a combination of macroeconomic theory and statistical results. Macroeconomic variables are very often non-stationary in levels. Thus, we employ vector autoregressive (VAR) based co-integration tests using the methodology developed in Johansen (1991, 1995). The purpose of these cointegration tests is to determine whether the variables in balance sheet channel model are co[illegible]ed or not. Co-integration will be tested to determine the need of using a Vector Error Correction Model (hereafter VECM). A VECM is a restricted VAR designed for use with non-stationary series that are known to be co-integrated. The VECM has co-integration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics. The co-integration term is known as the correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments estimated. Thus, the presence of a cointegration relation(s) forms the basis of the vector error correction model (VECM) specification.

The Johansen methodology can be briefly described as follows:

Assume a vector:

$$Y_t = f[\ monetary\ policy\ , information\ assymetry, collateral, cashflow, GDP] \ldots . (1)$$

Where Y_t a vector of endogenous variables in the model.

and assume that the vector has a VAR representation of

the form:

$$X_t = z + \sum_{i=1}^{p} \Pi_i X_{t-i} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.13)$$

where z is a (n x 1) vector of deterministic variables, ε is a (n x 1) vector of white noise error terms and Π_i is a (n x n) matrix of coefficients. In order to use the Johansen test, the VAR (5.13) above needs to be turned into a VECM specification (Brooks, 2002: 403), which may be specified as:

$$\Delta X_t = z + \sum_{i=1}^{p-1} B_i \Delta X_{t-1} + \Pi X_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots (5.14)$$

Where X_t is a vector of $I(1)$ variables defined above, ΔX_t are all $I(0)$ variables, Δ indicates the first difference operator, B_i is a (n x n) coefficient matrix and Π is a (n x n) matrix whose rank determines the number of cointegrating relationships. The Johansen's cointegration test is to estimate the rank of the Π matrix (r) from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π (Brooks, 2002: 404). If Π is of full rank (r = n), it suggest that variables are level stationary and if it is of zero rank (r = 0), no cointegration exists among the variables. On the other hand, if Π is of reduced rank (r<n), then there exists (n x r) matrices α and β such that:

$$\Pi = \alpha\, \beta' \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.15)$$

where α represents the speed of adjustment matrix, indicating the speed with which the system responds to last period's deviations from the equilibrium relationship and β is a matrix of long run coefficients.

However, before one proceeds to test for the rank of Π, there are two issues that have to be attended to. The first is determining the appropriate order (k) of the VAR. Brooks (2002: 404) argues that the Johansen test can be affected by the lag length employed in the VECM, thus it is crucial to attempt to select the lag length optimally. The second issue is related to the choice of deterministic assumptions that the Johansen test requires in testing for cointegration. Once the appropriate VAR order (k) and the deterministic trend assumption have been identified, the rank of the Π matrix can then be tested.

There are two likelihood ratio (LR) test statistics for cointegration under the Johansen approach: the trace (trace λ) and the maximum Eigen value (max λ) statistics, which are specified as follows:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{N} \ln(1-\hat{\lambda}_i) \quad \text{(5.16)}$$

and

$$\lambda_{max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1}) \quad \text{(5.17)}$$

where r is the number of cointegrating vectors under the null hypothesis and i $\hat{\lambda}$ is the estimated value for the ith ordered Eigen value from the Π matrix (equation 5.17). The trace statistic sequentially tests the null hypothesis that the number of cointegrating relations is r against the alternative of k co integrating relations, where k is the number of endogenous variables. The maximum Eigen value conducts separate tests on each Eigen value and has as its null hypothesis that there are r cointegrating vectors against an alternative of r+1 (Brooks, 2002: 405). To determine the rank of the Π matrix the above trace and maximum Eigen value test statistics are compared to the (nonstandard) critical values from Osterwald-Lenun (1992), which differ slightly from those originally reported by Johansen and Juselius (1990). For both tests, if

the test statistic is greater than the critical values, the null hypothesis that there are r cointegrating vectors is rejected in favour of the corresponding alternative hypothesis.

However, the trace and maximum Eigen value statistics may yield conflicting results. To deal with this problem, Johansen and Juselius (1990) recommend the examination of the estimated cointegrating vector and basing one's choice on the interpretability of the cointegrating relations. Alternatively, Luintel and Khan (1999: 392) show that the trace is more robust than the maximum eigenvalue statistic in testing for cointegration. The two approaches will be considered in this study when faced with such a problem.

Once the number of cointegrating vectors in the model has been identified, a VECM (equation 5.14) can be estimated by specifying the number of cointegrating vectors, trend assumption used in the previous step and normalizing the model on the true cointegrating relation(s). Thus, a VECM is merely a restricted VAR designed for use with non stationary series that have been found to be cointegrated. The specified cointegrating relation in the VECM restricts the long run behaviour of the endogenous variables to converge to their cointegrating relationships, while allowing for short run adjustment dynamics. The coefficients of the VECM have already been explained and will not be repeated here. Once estimation is complete, the residuals from the VECM must be checked for normality, heteroskedacity and autocorrelation.

5.4.6 IMPULSE RESPONSE AND VARIANCE DECOMPOSITION

The above analysis identifies the balance sheet channel in a well-behaved model. Two interesting issues remain: how the balance sheet variables react to shocks in monetary policy and how the objective variables react to shocks in balance sheet variables. The other important questions that remain will be: which shock is relatively the most important and how long it will take for balance sheet variables to restore its equilibrium following such shock. The usual block F-tests and an examination of causality in a VAR will show which of the variables in the model have statistically significant influences on the future values of each of the variables in the system. However, these tests do not reveal two important issues. One: whether changes in a value of a

given variable have a negative or positive influence on the other variables in the system. Two: how long it would take for the effect to work through the system (Brooks, 2002: 341). To provide such information, Lütkepohl and Reimers (1992) and Mellander *et al.* (1992) developed impulse response and forecast error variance decomposition analyses for a VAR process with cointegrated variables. These are briefly discussed below.

IMPULSE RESPONSE ANALYSIS

Impulse response analysis traces out the responsiveness of the dependent variable in the VAR to shocks to each of the other variables. It shows the sign, magnitude and persistence of real and nominal shocks to the balance sheet channel. A shock to a variable in a VAR not only directly affects that variable, but is also transmitted to all other endogenous variables in the system through the dynamic structure of the VAR. For each variable from the equations separately, a unit or one-time shock is applied to the forecast error and the effects upon the VAR system over time are observed. The impulse response analysis is applied on the VECM and, provided that the system is stable, the shock should gradually die away (Brooks, 2002: 341). There are several ways of performing impulse response analysis, but the Cholesky orthogonalisation approach to impulse response analysis, which is a multivariate model extension of the Cholesky factorization technique, is preferred in this study. This approach is preferred because, unlike other approaches, it incorporates a small sample degrees of freedom adjustment when estimating the residual covariance matrix used to derive the Cholesky factor (Lütkepohl, 1991: 155-158).

VARIANCE DECOMPOSITION ANALYSIS

Further information on the linkages in the balance sheet channel can be obtained from variance decompositions analysis. It measures the proportion of forecast error variance in a variable that is explained by innovations in itself and the other variables. Variance decompositions performed on the VECM give the proportion of the movements in the dependent variables that are due to their 'own' shocks versus shocks to the other variables (Brooks, 2002: 342). Brooks also observed that own series shocks explain most of the forecast error variance of the series in a VAR. The same

factorization technique and information used in estimating impulse responses is applied in the variance decompositions.

5.4.7 DIAGNOSTIC CHECKS

This stage is crucial in the analysis of the balance sheet channel because it validates the parameter estimation outcomes achieved by the estimated model. Diagnostic checks test the stochastic properties of the model. These include residual autocorrelation, heteroskedasticity and normality. The multivariate extensions of the residual tests just mentioned will be applied in this study. Therefore they are briefly discussed here.

AUTOCORRELATION LM TEST

The Lagrange Multiplier (LM) test used in this study is a multivariate test statistic for residual serial correlation up to the specified lag order. The lag order for this test should be the same as that of the corresponding VAR (Harris, 1995: 82). The test statistic for the chosen lag order (m) is computed by running an auxiliary regression of the residuals (μ_t) on the original right-hand explanatory variables and the lagged residuals (μ_{t-m}). Johansen (1995: 22) presents the formula of the LM statistic and provides detail on this test. The LM statistic tests the null hypothesis of no serial correlation against an alternative of autocorrelated residuals.

WHITE HETEROSKEDACITY TEST

This test is an extension of White's (1980) test to systems of equations, as extended by Kelejian (1982). It tests the null hypothesis that the errors are both homoskedastic (no heteroskedacity problem) and independent of the regressors and that there is no problem of misspecification. The test regression is run by regressing each cross product of the residuals on the cross products of the regressors and testing the joint significance of the regression. The failure of any one or more of the conditions just mentioned above could lead to a significant test statistic. Thus, under the null of no heteroskedacity and no misspecification, the test statistic should not be significant.

RESIDUAL NORMALITY TEST

The residual normality test used in this study is the multivariate extension of the Jarque Bera normality test. It compares the third and fourth moments of the residuals to those from the normal distribution. The preferred residual factorization (orthogonalisation) method for the test is by Urzua (1997). This method makes a small sample correction to the transformed residuals before computing the Jarque-Bera statistic. The joint test is based on the null hypothesis that residuals are normally distributed. A significant Jarque-Bera statistic, therefore, points to non-normality in the residuals. However, the absence of normality in the residuals may not render cointegration tests invalid. A more important issue in carrying out the cointegration analysis is whether the residuals are uncorrelated and homoskedastic (Islam and Ahmed, 1999: 105).

5.5 CONCLUDING REMARKS

This chapter set an analytical framework in which the balance sheet channel of the monetary policy transmission mechanism is to be identified. Based on theory, a background on the South African monetary policy practice and the financial system an empirical model was specified. The VAR model contains following six variables which are divided into monetary policy variables (the repo rate and M3 growth), Balance sheet variables (the JSE All Share Index, stock market capitalization and inventories) and activity variables (inflation rate and gross domestic product).

The Johansen (1991, 1995) cointegration technique has been chosen as the preferred parameter estimation technique because of its several advantages over alternative techniques. If the estimated model passes several residual diagnostic checks, orthogonalised impulse response and variance decomposition analyses will be employed to investigate the impact and magnitude of shocks to each of the variables and the proportion of the variance that is accounted for by each variable over time. Having familiarized ourselves with the estimation techniques, we now apply these techniques to South African data in order to achieve the objectives of this study as set out in Chapter 1.

CHAPTER SIX

EMPIRICAL ANALYSIS AND FINDINGS

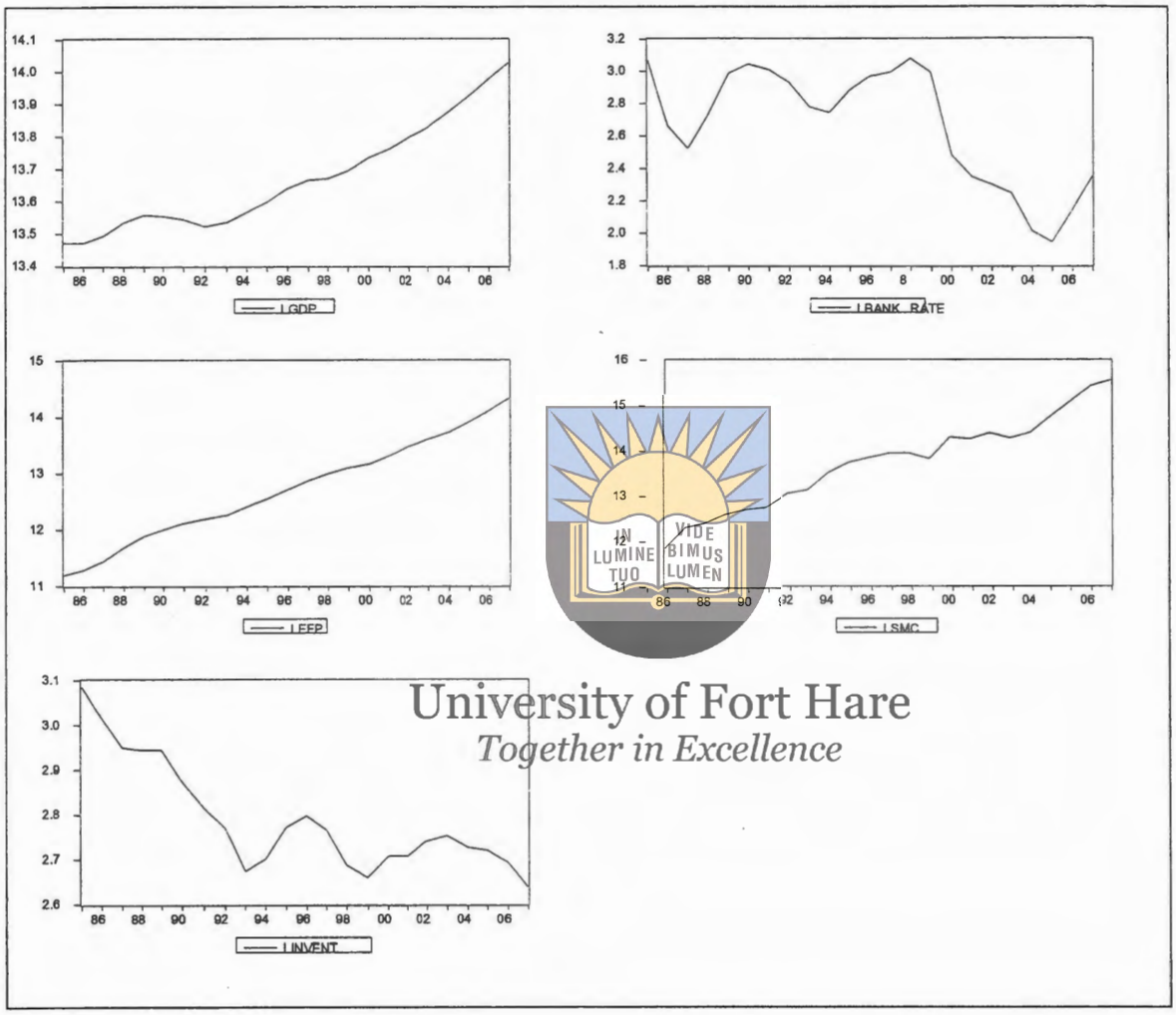
6.1 INTRODUCTION

The previous chapter set the analytical framework and reviewed the model estimation techniques to be used in this study. This chapter augments the previous chapter by applying that framework and the analytical techniques proposed to South African data covering the period 1985 to 2008. The results from this chapter provide answers to the questions which were raised in the first chapter of this study: Do firm balance sheets respond to monetary policy changes? Does the real economy respond to changes in firm balance sheets? What is the long and short run behavior of the balance sheet channel in South Africa? In pursuit of the answers to these questions, the VAR analysis combined with the Johansen (1991, 1995) approach is employed to provide an answer to the last question. The impulse response and variance decomposition analyses provide answers to the remaining questions. This section is divided into seven sub-sections. The first presents the results of stationary/unit root tests. Cointegration test and VECM results are discussed in the third and fourth section, respectively. Diagnostic checks results are provided in the fifth sub-section. Impulse response analysis and variance decomposition results are presented in the sixth and seventh sub-sections, respectively. The last section concludes this chapter.

6.1.1 STATIONARITY/UNIT ROOT TEST RESULTS

The first step of the Johansen (1991, 1995) methodology is to determine the order of integration of the series. This study employs one informal test and one formal test for stationarity. The informal test to be employed is the graphical analysis of the series. This preliminary examination is important. It gives an idea of structural breaks, trends and stationarity of the data set. Figure 5.1 plots the six variables in our model against time in levels.

Figure 6. 1: Graphical Representation of the Variables in Levels.



The first impression that we get from the plots in Figure 6.1 is that three of the variables (LGDP, LEFP and LSMC) seem to be trending upward and the other (LINVENT) trending downward, albeit with fluctuations. The other variable (LBANK) does not show any trend, but also show fluctuations over time. All the variables in Figure 6.1 have a time variant mean and variance suggesting that they are not stationary in their levels. However, LBANK could be stationary or closer to the stationary boundary. The variable seems to be hovering around its means, but their variances are clearly not constant over time. Thus, based on this analysis alone, the stationarity status of the variables is not clear. Therefore, what is required here is some kind of formal hypothesis testing procedure.

The formal test employed in this study is the ADF test discussed in Chapter 5. This test was applied to the data under different deterministic trend assumptions. Those that included a constant and no trend produced robust results. The option with no trend and no intercept produced 'explosive' results. The option with both a trend and intercept made test statistics less significant. Table 6.1, therefore, shows the stationarity/unit root test results for the option with a constant only.

Table 6. 1: Unit Root/ Stationarity Tests

VARIABLES	ADF TEST	
	LEVEL	1ST DIFFERENCE
LBANK	-1.803	-3.823*
LSMC	0.006	-3.200*
LINVENT	-1.847	-3.685*
LGDP	-3.311*	-1.105
LEFP	-1.943	-4.363*
LCREDIT	-2.976	-3.759

Notes: The MacKinnon (1996) critical values at 1%, 5% and 10% are -3.786, -3.0114 and -2.6457 respectively. Thus * denotes the rejection of the hypothesis of a unit root for both tests. The lag order for the series was determined by the Schwarz information criterion for ADF

It should be remembered that the ADF test tests the null hypothesis of a unit root. Therefore, a rejection of the null hypothesis means the series does not have a unit root. The results for the ADF tests in Table 6.1 show that LGDP is stationary in levels. Its test statistic (second column) is greater than the MacKinnon 5 per cent critical value of - 3.0114. The remaining variables were not stationary in levels. However, when the test is applied to first differences of the series, they all become stationary. This suggests that they are all I (1). Therefore, we conclude that five of the series (the repo rate, stock market capitalization, inventories, inflation rate) are first difference stationary I (1) while the other (LGDP) is level stationary, I (0). Thus the variables are not integrated of the same order. As mentioned in Chapter 5, I (0) and I (1) variables could be co-integrated, so we carry all the variables forward to co-integration tests.

6.1.2 COINTEGRATION ANALYSIS

Cointegration analysis is conducted using the Johansen procedure to determine whether the balance sheet channel exists in the short or long run. Testing for cointegration using the full model has always given researchers is a difficult task. In most cases, it has produced too many cointegrating relationships which are difficult if not impossible to interpret. Ericsson and Irons (1994) argues, "...the main difficulty is the interpretation of cointegrating vectors which include a large number of variables". We attempted the full model (equation 5.1) and apart from degrees of freedom problems, we experienced a similar problem to the one just mentioned. At least five co integrating relationships from several alternative specifications were found.

One option of dealing with the above problem is to estimate a simplified model with very few variables. However, there is risk of an omitted variables bias (misspecification). We use a pairwise correlation matrix to guide the variable selection exercise. Table 6.2 presents the pairwise correlations of the variables of our full balance sheet channel model.

Table 6. 2: Pairwise Correlation Matrix

	DLINF	DLINVENT	DLM3	DLREPO	DLSMC	LGDP	LCREDIT
DLINVENT	0.109401	1.000000	0.221672	0.039373	-0.282170	0.200898	0.221672
DLEFP	0.360655	0.221672	1.000000	0.715399	-0.122707	0.351945	0.2562
DLBANK	0.217227	0.039373	0.715399	1.000000	-0.197245	0.125218	0.415399
DLSMC	-0.180136	-0.282170	-0.122707	-0.197245	1.000000	0.016622	-0.122707
LGDP	0.176792	0.200898	0.351945	0.125218	0.016622	1.000000	0.051945
LCREDIT	0.060655	0.221672	0.346	0.115399	-0.122707	0.251945	1.000000

The following observations can be made from the pairwise correlations in Table 6.2:

- LREPO and LM3 are the only variables that are highly correlated. (column 4).
- The rest of the variables have very low correlations.

In order to minimize the risk of an omitted variables bias, the focus should first be on finding a model that simultaneously produces meaningful results and includes as many variables as suggested by theory. Following the observation that LM3 highly correlated with LREPO in the model, we initially exclude it from the model, since there is a likelihood of a multicollinearity problem. This could also be the reason why we found too many cointegrating relationships in the full model. Thus, we estimate a balance sheet channel model with the following explanatory variables: LREPO, LINVENT, LGDP, LINF, LCREDIT and LSMC.

As mentioned in Chapter 5, the Johansen cointegration technique requires us to specify the lag order and the deterministic trend assumption for the VAR. The test assumption uses Johansen's Assumption 5. Assumption 5 requires that data has quadratic trends and the cointegrating equations have linear trends. As for the choice of the lag order for the VAR, the information criteria approach, augmented by theoretical priors, is used as a guide in selecting the lag order. Table 6.3 shows the results of the co integration tests.

Table 6. 3: Johansen Co- integration tests.

Series: DLINF DLINVENT DLREPO DLSMC DLCREDIT LGDP

Eigenvalue	Likelihood Ratio	5 Percent Critcal Value	1 percent critical value	Hypothesized No. of CE(s)
0.979107	4.500378	12.25	16.26	None **
0.854412	75.75695	62.99	70.05	At most 1 **
0.676592	37.21747	42.44	48.45	At most 2
0.397708	14.64064	25.32	30.45	At most 3
0.201499	153.1242	87.31	96.58	At most 4

*(**) denotes rejection of the hypothesis at 5 %(1%) significance level.

L.R. test indicates 2 co integrating equation(s) at 5% significance level.

Table 6.3 presents the Johansen cointegration test on the maximum eigenvalue test. The maximum eigenvalue form of the Johansen test rejects the null hypothesis of no cointegration. It fails to reject the null hypothesis of the existence of at most 2 cointegrating vectors, since the test statistic of about 37.22 is now less than the 5 per cent critical value of about 48.45. Therefore, the maximum eigenvalue test suggests that there are 2 cointegrating relationships in the balance sheet channel model. Thus, we estimate VECMs restricted on 2 cointegrating vectors. What remains is to identify which 2 cointegrating vectors represent the true cointegrating relationships. Thus, the next section estimates the VECM.

6.1.3 VECTOR ERROR CORRECTION MODEL

The results from the cointegration test are going to be used to specify a VECM. This VECM allows us to distinguish between the long and short run variables for the balance sheet channel. However, before we can interpret the results from the VECM, we need to identify the true two cointegrating relationships that have been suggested in the last section. Table 6.4 presents the results from the estimated VECM without any restrictions (except for those automatically imposed by E-views).

We therefore normalize on LCREDIT and LGDP to obtain both the long and short run parameter estimates. The first vector gave evidence of the link between monetary policy and the balance sheet variables. The second vector gave evidence of the link between balance sheet variables and activity variables. Three alternative models are estimated following the same steps that we applied to this first model. The first model will explain the information asymmetry channel. The second one will explain the collateral channel. The third one will seek to explain the cashflow channel. We also test zero restrictions on the parameters of the cointegrating vectors in order to determine their significance in those vectors. The VECM results for our main model, together with the three alternative regressions are presented in Table 6.5.

Table 6.5: The balance sheet channels of Monetary policy transmission

	Information assymetry		Collateral		Cashflow	
Cointegrating Eq:	**Coint Eq 1**	**Coint Eq 2**	**Coint Eq 1**	**Coint Eq 2**	**Coint Eq 1**	**Coint Eq**
LCredit	1	0	1	0	1	0
LGDP	1.11	1	0.22	1	0.75	1
	[4.57]		[1.51]		[7.08]	
GDP	-3.19	-0.25	-1.87	0.45	-1.90	0.43
	[-13.36]	[-2.67]	[-9.42]	[2.76]	[-9.16]	[2.91]
EFP	-1.59	-0.96				
	[-4.57]	[-3.15]				
LINVENT					-0.75	1.72
					[-7.08]	[6.31]
LBank	0.68	-1.34	1.27		-0.75	-1.72
	[1.33]	[-4.87]	[4.76]	[-5.67]	[7.08]	[-6.31]
LSMC			-0.40			
			[-4.20]			
Trend	0.00	0.00	0.00	0.00	0.00	0.00
	[2.98]	[1.76]	[3.67]	[1.50]	[4.62]	[1.55]
C	30.16	3.33	17.43	-2.72	18.65	-2.60

Error Correction:	**Credit**	**LGDP**	**Credit**	**LGDP**	**Credit**	**LGDP**
EC 1	-0.11	0.06	-0.23	-0.14	-0.17	-0.16
	[-3.05]	[0.78]	[-3.85]	[-1.05]	[-3.38]	[-1.48]
EC 2	-0.10	-0.64	-0.13	-0.54	-0.05	-0.49
	[-1.26]	[-3.56]	[-1.97]	[-3.66]	[-0.74]	[-3.51]
Adj. R-squared	0.51	0.46	0.53	0.46	0.51	0.47
Weak exog: $?^2$ (prob)	0.00	0.00	0.00	0.00	0.03	0.01
Autocor LM(2) (prob)	0.70		0.44		0.52	
Autocor LM(4) (prob)	0.96		0.81		0.77	

Weakly exogenous $?^2$ (prob):

Model 1: GDP (0.00), EFP (0.37), TB rate (0.03), Bond rate (0.14)
Model 2: GDP (0.00), EFP (0.27), TB rate (0.01), Bond rate (0.25), Priv sector credit (0.77)
Model 3: GDP (0.00), EFP (0.37), TB rate (0.03), Bond rate (0.16), Priv sector credit (0.84)
Notes:
t-values in square brackets, statistically significant values (at a 5% level) in the cointegrating relationships are in italics

External Finance Premium has a positive long-run relationship with the monetary policy, as indicated by the significance of its coefficient in the information asymmetry channel model. This means that a tighter monetary policy in South Africa will increase the External finance premium by about 1.59%. This result corroborates the theoretical predictions. According to the theory on the balance-sheet channel one would expect that a tighter monetary policy would cause a deterioration in balance sheets, that, in turn, would cause EFP to increase.

Stock market capitalization has a negative sign in the collateral channel regression and is significant at the 1 per cent level. This means a tighter monetary policy by 1 per cent will decrease stock market capitalization by about 0.40 per cent. This result is in line with theoretical predictions. As emphasized in Kiyatoki and Moores' (1997) model of credit rationing. A reduction in interest rates will increases the value of long term assets such as stocks, bonds and real estate because of the documented relationship between interest rates and asset prices. These are the kind of assets that are likely to serve as collateral security.

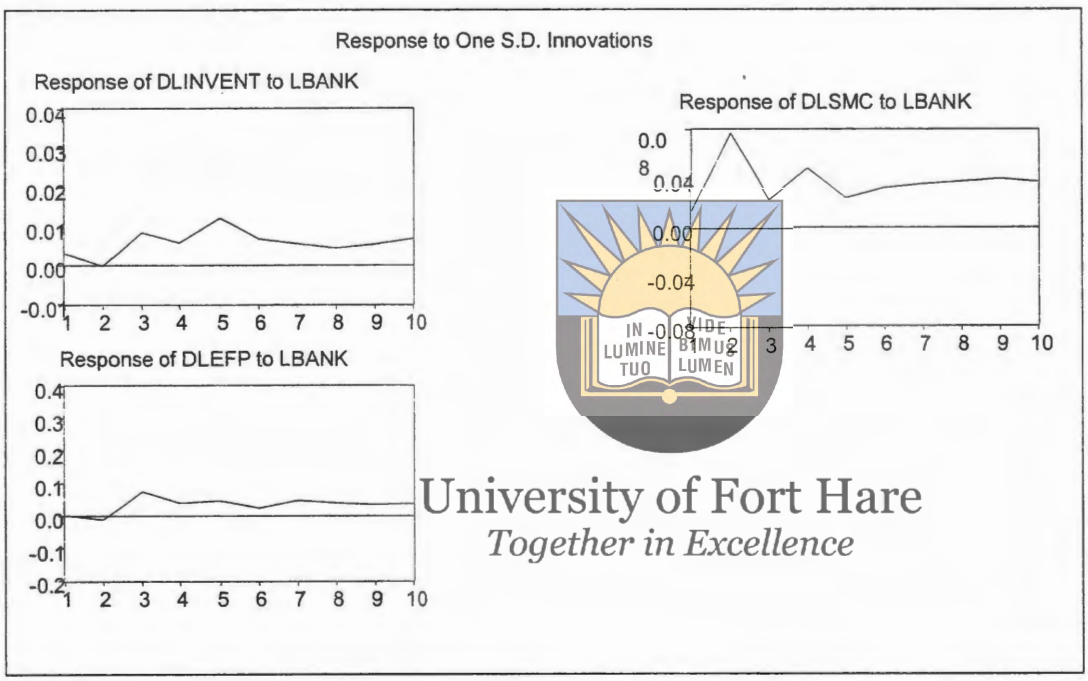
Inventory investment a measure of the credit channel is significant in the regression. The positive coefficient suggests that a tight monetary policy should increase inventory investments by 0.75%. The result corroborates with the cash flows sub channel of the balance sheet channel of monetary policy transmission. Expansionary monetary policy causes a rise in cash flows (decrease in inventories). The net worth of firms is improved. This relationship is in line with the works of Kashyap, Lamont and Stein (1994) and Carpenter, Fazzari and Petersen (1994) who concluded that financial variables do have an influence on inventory movements. (Smith 2004:137) also concludes that smaller increases in the levels of interest rates also contribute to decisions to increase the level of inventories.

6.1.6 IMPULSE RESPONSE ANALYSIS

Impulse response analysis reveals a wealth of information pertaining to the dynamic effects of a model. These impulse response functions show the dynamic response of each variable to a one-period standard deviation shock to the innovations of each paired variable. The responses of the links identified in the VECM are going to be analysed. That is: (1) the link between policy variables and balance sheet variables, (2) the link between balance sheet variables and activity

variables. The results from the impulse response analysis performed on the VECM regression a 10 year period are presented in figure 6.2 to figure 6.4.

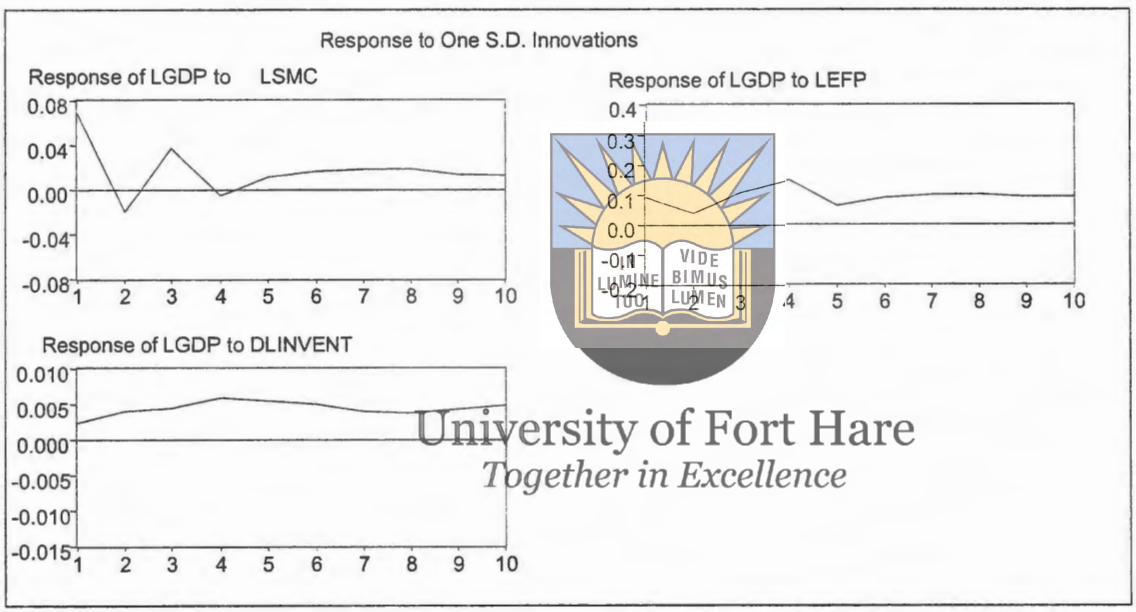
Figure 6. 2: Response to Monetary policy shock.



We examine the effect of a monetary policy shock reflecting a one percent shock to the Bank rate rate. Fig. 2 presents the impulse responses of Balance sheet elements. The effect of the innovation on the Bank rate is noticeable on stock market capitalization, inventory investment and external finance premium. However, the response is very weak on all the variables (less than 1%). The increase in the repo rate leads to an immediate increase in stock market capitalization. The increase remains persistently positive (average of 0.04%). A one standard error shock to Bank rate leads to an immediate decrease in external finance premium in the first two years. The response becomes positive after the second year. However, the response is weak in the short run (average of 0.1%). A shock to the bank rate has an enormous dampening impact on inventory investment as early as the second horizon. The effect seems to be reversed after the second year. A repo rate shock has a positive impact on inventory. However, the response of inventory investment is overall weak (an average 0.01%). Therefore, the impulse response analysis gives evidence of a balance sheet channel. The information asymmetry channel (proxied by external

finance premium) was found to be more responsive than the other two channels (cash flow and collateral channels)

Figure 6. 3: Response to Balance sheet Shocks.



Real GDP seams to respond to unanticipated shocks from inventory investment, stock market capitalization and external finance premium. A shock to inventories has a positive impact on real GDP. The positive impact of inventories seems to be persistent both in the short run and long run. Overall, the response of the inflation rate to inventory investment is very weak (an average of 0.005%). A one standard error shock to stock market capitalization leads to an immediate decrease in GDP. The positive response persists after the second year but with lesser response from GDP. GDP shows a tendency of returning to its initial value. However, the response is weak (an average of 0.04%). The impulse response of real GDP to unanticipated shocks to external finance premium is persistently positive. Overall, the response is weak in the short run (a peak of about 0.19 %).

6.1.7 VARIANCE DECOMPOSITION ANALYSIS

As mentioned in Chapter 5, variance decomposition analysis provides a means of determining the relative importance of shocks in explaining variations in the variable of interest. In the context of this study, it therefore provides a way of determining the relative importance of shocks to each of the variables in the balance sheet channel. The main question we are posing here is: What proportion of the variance in a series is due to its own shock or due to other shocks? Our analysis will look at the variance decomposition of the following variables: stock market capitalization, inventory investment, inflation rate, and output. All the results are presented in Tables 6.7 to 6.10 below.

Table 6. 4: Variance Decompositions of Inventory Investment.

Period	S.E.	LBANK	DLINVENT	LCREDIT	LGDP
1	0.032823	0.855754	99.14425	0.000000	0.000000
2	0.052205	2.597576	89.19650	7.866973	7.23E-05
3	0.060437	2.160925	88.42152	6.041624	1.425582
4	0.071327	2.204389	88.97432	6.973098	2.091764
5	0.079420	4.087737	88.95868	4.168438	2.907014
6	0.086385	5.067008	85.87921	4.539493	2.813614
7	0.091345	3.997297	83.13785	3.182532	2.655314
8	0.096235	3.805986	84.26479	3.029382	2.497300
9	0.101603	3.689750	85.19989	3.928894	3.425642
10	0.106871	3.736314	87.66476	2.737764	3.488352

For most of the period, inventory investment seemed to explain much of its variation. Inventory investment shocks accounted for 99 per cent of the variation in its own shock. The credit

extended to the private sector shock accounted for a larger portion of the variation in the inventory investment. However, For the rest of the period real GDP and the bank rate accounted for 4% and 3% respectively. The results, therefore shows that the repo rate has an influence on inventory investment. However, the influence is weak as shown by the low contribution of the variables (Below 5%).

Table 6. 5: Variance Decomposition of External Finance Premium.

Period	S.E.	LBANK	LEFP	LCREDIT	LGDP
1	0.128025	1.331896	28.68533	33.66556	36.31721
2	0.158920	24.43650	20.11044	26.57078	25.68817
3	0.166989	24.10523	23.21789	24.33408	25.42077
4	0.174969	29.61855	21.23323	23.19298	23.16774
5	0.182598	28.93633	[illegible]	[illegible]	22.82013
6	0.197245	27.51959	17.76909	31.06232	21.42525
7	0.208917	27.46038	16.61150	33.55355	20.32147
8	0.217696	28.28775	16.05760	34.03360	19.59536
9	0.224578	29.75949	15.46367	33.89169	18.84195
10	0.230641	30.86459	14.97234	33.87950	18.28644

The influence of the external finance premium decreased substantially from 28% to about 14 per cent over the ten year period. Real GDP and the bank rate explained the largest component of the 26 and 24 per cent variation in the external finance premium respectively. Their impacts increased over time. Credit extended to the private sector also explained a significant component of the variation in external finance premium. Overall, the results reflect that monetary policy and real output plays an important role in explaining variations in external finance premium.

Table 6. 6: Variance Decomposition of Stock Market Capitalization.

Period	S.E.	LBANK	LCREDIT	LSMC	LGDP
1	0.339963	0.001852	7.543274	92.45487	0.000000
2	0.380324	0.111858	7.124041	86.51102	6.204494
3	0.441976	2.980717	11.36331	80.60913	4.670137
4	0.470793	3.348339	20.09711	71.12813	5.033170
5	0.479364	4.165672	21.09917	69.29410	4.924236
6	0.491643	4.179744	23.31692	66.61938	5.367440
7	0.509400	4.769916	25.51657	63.82284	5.342262
8	0.522490	5.108319	27.94574	60.96418	5.418701
9	0.533583	5.323908	29.90018	58.85945	5.620093
10	0.545978	5.553215	31.38027	56.70096	5.765846

In the first period, 92 % of the variance in stock market capitalization is explained by its own innovations (shocks). From the periods ahead variance for stock market capitalization is largely explained by credit exended to the private sector (a peak of 31%). Real GDP and the bank rate seem to gain more momentum by explaining 6% each of the variation in stock market capitalization. However, the variation in stock market capitalization explained by monetary policy action and real output are weak (average of 5%).

Table 6. 7: Variance Decomposition of Real GDP.

Period	S.E.	LBANK	LSMC	LEFP	LGDP	LINVENT
1	0.009329	39.09321	6.274985	28.64552	12.07956	13.90673
2	0.018083	20.58794	6.600619	48.92475	14.20045	9.686247
3	0.024829	16.86229	6.695885	53.52392	15.30066	7.617242
4	0.030406	14.77175	8.247452	54.52419	16.51371	5.942889
5	0.033576	13.49303	9.410435	55.51580	16.48618	5.094559
6	0.035370	13.26034	10.47284	54.97893	16.49737	4.790514
7	0.036782	13.50699	10.86507	54.28867	16.53709	4.802176
8	0.038656	13.86247	10.79444	53.82618	16.56931	4.947593
9	0.041169	13.88383	10.60467	53.94611	16.59266	4.972743
10	0.043793	13.64708	10.59005	54.29213	16.63366	4.837080

The results also expose the effect of monetary policy explaining 39% of the variations. In the first horizon, output shock accounted for 12 per cent of the variation in its own shock. External finance premium and stock market capitalization are the major contributors in the variation of the output shock accounting for a larger part of the variation, respectively. All in all, the results reaveal that variations in External Finance Premium explain much of the variations in real output. Its contribution is significantly high.

6.7 CONCLUSIONS

This chapter analyzed the balance sheet channel model in South Africa. It started by analyzing the time series properties of the data by employing both informal and formal tests for stationarity. The variables were found not to be integrated of the same order. Six variables (the repo rate, stock market capitalization, inventories, inflation rate) were first difference stationary while the other one (GDP) was level stationary. Johansen cointegration and VECM tests provided evidence that there are both the long and short run relationships among the variables. This result was sufficient to achieve our first objective.

Impulse response and variance decomposition analyses were performed to determine the signs and strength of the effects between the classes of variables. In the short run the responses of stock market capitalization tight monetary policy was positive. The response of inventory investment to tight monetary policy was negati[illegible]short run. In the long run, the response of balance sheet variables to tight monetary policy was positive. Variance decomposition results revealed that the effect of monetary policy on balance sheet variables exists. However, the effect is very weak in both the short and long run. The response of activity variables to balance sheet variables was found to be positive in both the short and long run. However, conclusions from variance decomposition revealed that the effect of balance sheet variables is very weak in both the short and long run.

CHAPTER SEVEN

CONCLUSIONS, POLICY RECOMMENDATIONS AND LIMITATIONS

7.1 SUMMARY OF THE STUDY AND CONCLUSIONS

This study analyzed the balance sheet channel of monetary policy transmission in South Africa. That is the link from monetary policy, through firms' balance sheets, to the real economy. The major questions of the study were: Does South Africa has a balance sheet channel? Which sub channel(s) does it operate through? What is the strength of the various sub-channels in propagating monetary shocks? A significant amount of research has been conducted in developed countries to prove and establish this hypothesis. However, little has been done to explore this hypothesis in developing countries such as South Africa.

The importance of the balance sheet channel was briefly reviewed in this study. An extensive review of the literature on the balance sheet channel for both industrialized and developing economies was performed. A background of the South African monetary policy system was done. Based on data availability, an empirical model of the balance sheet channel was specified. The study covered a period of years (1980 to 2008), which incorporates time periods prior to and after the introduction of various economic reform programmes in South Africa. The VAR model contained the following variables, Bank rate (monetary policy effect), External finance premium (information asymmetry channel), stock market capitalization (to cater for the collateral channel), Changes in industrial and commercial inventories (cashflows channel) and gross domestic product (to cater for the aggregate shock).

In order to determine the long and short run behavior of the balance sheet channel, the VAR analysis combined with the Johansen (1991, 1995) co integration and error correction methodology was preferred. This was because of its added advantages over alternative techniques. In the application of this methodology, we started by analyzing the time series properties of the data. Informal and formal tests for stationarity were performed on the data. The variables were not integrated of the same order. Five were first difference stationary while the other one was level stationary. Johansen cointegration tests and the VECM performed on the

VAR provided significant evidence that the balance sheet channel exists both in the short and the long run.

The dynamic interaction amongst the variables of the model was mainly drawn from the results of the Impulse Response Functions and the Variance Decomposition. Impulse response analysis was used to determine the signs of the effects between the variables. That is: the effect between monetary policy variables and balance sheet variables and the effect between balance sheet variables and activity variables. However, a better picture of the importance of each of the shocks identified in impulse response was performed through variance decomposition analysis. The impulse response analysis provided evidence that the balance sheet variables respond to monetary policy shocks. Evidence of activity variables responding to firm balance sheets was also found. However, the results from variance decomposition analysis provided significant evidence that the responses were weak in both the short and the long run.

Our model may not have predicted sharp move[illegible] the balance sheet channel. However, it delivered an important contribution to the understanding of the behaviour of balance sheet channel in South Africa. This knowledge of the character of the balance sheet channel should help to improve the analyses of short and long term changes in macroeconomic conditions and contribute to improving economic policy formulation. Of significant importance was the ability to identify whether a balance sheet channel of monetary policy transmission applies in the South African context.

7.2 POLICY IMPLICATIONS AND RECOMMENDATIONS

Overall, the results of this study seem to suggest the existence of the balance sheet channel of monetary policy transmission in South Africa. This result need to be treated with caution. The balance sheet channel exists but it is weak as proved by the results. Thus, the balance sheet channel should not be neglected from both the policy perspective and academic literature point of view in South Africa.

The results of this study have a number of policy implications. Our analysis has shown that the repo rate plays an important role in determining inflation and GDP in South Africa. Thus, from a

policy point of view, the Central Bank could pursue a dual monetary policy objective i.e. price stability coupled with economic growth.

The findings of this study reveal that the balance sheet channel effects play a continuous role in the economy, though it is weak in strength. This finding implies that the monetary authorities should not neglect the impact of business firms when formulating policy. Our analysis has also shown that there is a strong link between monetary policy and the stock market. In this respect, it seem clear that firm balance sheet variables should be included as one of key information variables that the central bank need to closely monitor when formulating policy.

7.3 LIMITATIONS OF THE STUDY AND AREAS FOR FURTHER RESEARCH

Altogether, this study has successfully achieved its objectives. However, the study has obviously left some important gaps. Previous researchers have been confronted by issues that concern the unavailability of data, particularly in developing countries. Data on the actual variables suggested by the theoretical models of the balance sheet channel is scarce. This means that some of the variables either have to be excluded in the empirical models or some variables proxies have to be found. However, the risk involved in finding proxies is that they may not correctly represent the impact of the actual variables. This is a serious challenge to most empirical studies on the balance sheet channel. However, this problem seems not to have significantly affected the findings presented in this study, since they corroborate both the theoretical and empirical knowledge. Lastly, the sample period is relatively short. Therefore, the findings may only pertain to idiosyncratic economic developments during the sample period, while not necessarily serving as a best guide as to how the South African economy would work in the future.

The areas for further research that emerge from this study include covering the gap that has been left by this study of estimating the parameters of the balance sheet channel in both the short run and the long run. The other issues concern the proxies of the balance sheet variables. Research into what proxies represent the actual balance sheet variables may improve the performance of the empirical balance sheet model. The other area that remains widely debated is the exogenous factors. These factors have not been incorporated in this study. Further research is needed on how the balance sheet channel responds to external shocks such as oil prices and foreign exchange rates.

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