An empirical analysis of the asset price monetary policy transmission channel in South Africa.

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DECLARATION

I Wilhelmus Petrus du Preez do declare that except for references specifically indicated in the text and such help as has been provided to me by my supervisor and co-supervisor, that this thesis is my own work and has not been submitted at any other University or Technikon for any degree purposes.

Signed by **Wilhelmus du Preez** on this 11th day of March 2021

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ABSTRACT

The asset pricing channel of monetary policy transmission breeds an interesting study. There has been an ongoing debate to determine whether monetary policy committees should directly influence the asset pricing channel through changes in the central bank control interest rate or whether monetary policy committees should refrain from targeting the asset pricing channel to meet their policy objectives.

The study aims to critically analysis the asset pricing channel, firstly on a global context to set the scene and then to critically focus on the study performed by Muroyiwa et al. (2017) who conducted a study on the South African monetary policy and its interdependence on the stock market through utilisation of an SVAR model. It was concluded that monetary policy does significantly influence stock prices. The purpose of this study is to build on the results which have been formed by Muroyiwa et al. (2017) and to expand on the period under analysis which encapsulates 1999:01 to 2007:12 in order to conclude whether there are conflicting conclusions or conclusions which build on what has already been done.

The results from the research shows that when the monetary policy committee decides to influence changes in the repo rate, the repo rate will have a direct effect on the asset markets, the indexes that were used to represent the asset market are the all share index, industrial 15 index and the financial 15 index. Furthermore. The study which has expanded the period under analysis has supplemented and built on the results provided by Muroyiwa et al. (2017).

Table of Contents

List of tables

List of figures

List of Acronyms

BG	Breusch–Godfrey
GDP	Gross Domestic Product
LM	Lagrange Multiplier
MPC	Monetary Policy Committee
SARB	South African Reserve Bank
SFM	Structural Factor Model
SVAR	Structural Vector Autoregressive Model
US	United States
VAR	Vector Autoregressive Model

CHAPTER 1

INTRODUCTION

1.1 Background of the Research

The monetary policy transmission mechanism is the mechanism responsible for all monetary policy related decision making in which the mechanism consists of five distinct channels. monetary policy decision making is delivered into the economy and effects different components with distinctive speeds and intensities (Loayza and Schmidt-Hebbel, 2002). The characteristics of each of the transmission channels are solely determined by the structure that governs each economy, so the exact way in which each of these channels operate may differ from one case to another. The five channels that the monetary policy transmission mechanism operates through consists of the interest rate channel, the exchange rate channel, the credit channel, the expectations channel, and the asset price channel (Loayza and Schmidt-Hebbel, 2002).

Monetary Policy can further be described as the actions and rules that are adopted by the South African Reserve Bank (SARB) to achieve its overarching objectives. Fundamental changes in monetary policy can be triggered by both external and domestic shocks which can imperil the attainment of policy objectives (Loayza and Shmidt-Hebbel, 2002). What the SARB aims to do is to implement policy changes through resetting of the policy instrument, usually through short-term interest rate changes or through monetary or bank credit aggregates. These underlying instruments have an effect on the economy through several mechanisms of transmission to the ultimate policy goals. The SARB's policy rule in this regard embodies its response to deviations in macroeconomic variables to ultimately achieve policy objectives and affect the economy in a positive manner (Loayza and Shmidt-Hebbel, 2002). Beyond simple policy rules however it is vitally important to assess their efficiency, this efficiency refers to their sense of achieving their goals subject to the overall structure of the economy, their prevailing economic conditions, and their optimality (Loayza and Shmidt-Hebbel, 2002).

It is critical to note the importance of channel selection and therefore its overall effect on the economy, which channels are of most importance and therefore the channels which the

central banks should target and ultimately which to refrain from and are self-organising. Identifying these channels are critical as they would determine the most effective policy instruments, the timing that these policy instruments should inhabit and the main restrictions that the SARB is facing in making their decisions (Loayza and Shmidt-Hebbel, 2002). Policy actions (both reflected as current and expected) taken based on central bank policy rules are directly transmitted to asset markets and money markets alike. Changes in these respective markets will have an overall effect on labour and goods markets and aggregate prices and output. Changes in current and projected inflation and output will feed back into monetary policy rules (Loayza and Shmidt-Hebbel, 2002).

It has been argued by many that central banks should place sole emphasis on price stability as the only objective of monetary policy and push aside considerations surrounding growth and employment. The desire in limiting this objective is surrounded on the sole consideration that policymakers and economists believe that monetary policy cannot affect the long-term growth of an economy (Kamin, 1998).

With a view such as this, efforts in stimulating growth above the potential rate merely leads to a higher rate of inflation. In developing countries such as South Africa there is an ongoing debate on arguments for and against restricting objectives of monetary policy to only one objective for price stability. On the other hand, however, monetary policy in developing countries is said to be less able than developed countries in the achievement of goals other than price stability. If however the ultimate objective of monetary policy implementation is that of price stability alone, it may not be possible then to ignore the implications that these do carry on output and employment (Kamin, 1998).

An important remark is that the channels which monetary policy operate through are extremely complex. They may change radically over time especially when new instruments emerge and financial markets are evolving, even on an international context, it is therefore increasingly important to test the asset pricing channel in order to better understand why the channel has not received more attention and if it could possibly be more significant (Kamin, 1998).

Further analysis on the asset pricing channel and how it operates in South Africa will be made in Chapter 3.

1.2 Problem Statement

From a multitude of studies on an international scale which will be emphasised in greater detail in chapter 4, the asset pricing channel has been concluded to be self-organising and therefore should be not be of consideration to monetary authorities. Although, according to Schwartz (2003) it is vitally important to consider whether asset price inflation has the ability to affect portfolios of various financial institutions in a way that may cause trouble for them should there exist any form of asset price inflation collapse.

Even if it be the case that monetary authorities are not tasked with dealing with asset prices and adjusting the repo rate to affect these changes, they should still be alerted to changes that they can stir in portfolios of financial institutions, whether in a direct or indirect manner. South Africa stirs an interesting study, as it is regarded as an emerging economy with an ever-changing financial landscape. For instance, in the assumption that monetary authorities have not caused a bubble, a response to worsening financial conditions may be through aiming to ensure a limit to a weakening of financial balance sheets rather than raising interest rates to puncture a bubble, it is therefore vitally important to understand what effects monetary policy changes have on asset prices. (Schwartz, 2003).

South Africa can be considered a middle-income economy that inhibits a sophisticated banking sector and financial market (Thlaku, 2011). In other economies, this attribute will serve to speed up the reaction of real and intermediate variables to changes in monetary policy. South Africa can also be considered a developing country which has many structural problems that a number of industrialised economies do not face. It needs to be factored in that monetary policy may be less effective and may experience significant lags which would otherwise not occur (Thlaku 2011).

Despite several international papers on the topic regarding the asset pricing channel, there have been very little empirical research on the asset pricing channel in South Africa and with a global pandemic, monetary authorities need to find the best way to utilise monetary policy decisions.

1.3 Goals of the Study

The goal of the study is to empirically investigate the asset price monetary policy transmission channel in South Africa. The sub-goals are to investigate the interdependence between monetary policy and the stock market; investigate the significance of monetary policy shocks on the stock market and economic activity in South Africa and determine whether or not the SARB should take more cognisance of the asset price transmission channel when implementing monetary policy.

1.4 Methods, Procedures and Techniques

The study will strictly follow a post-positivist paradigm. The study will also follow the methodology which has been adopted by Muroyiwa et al. (2017). The study will strictly focus on equity prices which come in the form of indexes in order to establish and bring forth a more focused study in order to establish whether the asset pricing channel can be regarded as a significant transmission mechanism in South Africa. A structural vector autoregressive model (SVAR) will be utilised and computed. An SVAR model is a useful tool that can be utilised in order to analyse the dynamics of a model which can be subjected to an unexpected shock, in this scenario the unexpected shock will be regarded as the repo rate changes which are instilled by the SARB (Gottschalk, 2001).

How this research looks to be set apart and ultimately build on what has been conducted by Muroyiwa et al. (2017). Is that there will be utilisation of quarterly data which will range from 1999:01 to 2019:12. quarterly data will be used strictly due to the fact that the data is easier to model and also that it is therefore easier to identify trends as well as noting that only quarterly data could be collected for GDP, thus all other variables need to match the type of data collected. One SVAR model will strictly be computed for the entire period under study,

therefore meeting the goal of broadening the period analysis and building a new conclusion as suggested by Muroyiwa et al. (2017).

Computation of the SVAR model mentioned will be utilised in order to find the relationship that exists between monetary policy shocks, stock prices in the form of distinct indexes and economic activity. The repo rate will be utilised as the monetary policy shock and proxy for monetary policy implementation. 3 distinct stock price indices will be utilised for this respective study, they will be the all share index, financial 25 index and the industrial 25 index. The Real Gross Domestic Product (GDP) will be used as the economic indicator for this respective study.

The stock market indices will be used strictly in order to evaluate how equities perform in aggregate settings. The reason for non-utilisation of individual stocks is simply due to the fact that they require fundamental aspects such as what a particular company's balance sheet will look like, how much debt this particular company has and how qualified their directors are etc. The goal then however is to rather assess how large portions of the market are affected by changes occurring due to monetary policy changes and to broaden the understanding of how significant the asset pricing channel could be and whether the monetary policy committee (MPC) should be more aware and take note of the asset pricing channel when instilling changes in monetary policy via the repo rate. Data will be collected from Bloomberg.

Other methods that will be utilised under study to support the argument will be various stationarity tests in order to ensure that the variables under study are suitable and correct for SVAR implementation. Then there will be utilisation of a standard VAR of which will be modified in order to ensure that the LAG Order Selection criteria is correct, and the correct lag length is stipulated. Usage of an AR roots table will also be used in order to assess whether any roots lay outside of the inner circle, this will confirm VAR satisfies the stability condition and therefore an SVAR can successfully be computed. The white test will be utilised in order to establish and confirm signs of heteroscedasticity.

Computation of the LM model will also be made in order to test for any serial correlation. Usage will then be made of Impulse responses in order to assess whether the same conclusions are drawn from the SVAR model and to finally confirm the entire investigation, there will be usage of granger causality in order to see if there are any contradictions drawn

to the results which have been gathered through the SVAR model and impulse responses to then build an overall conclusion as to whether there is a relationship that exists between monetary policy shocks, stock prices in the form of distinct indexes and economic activity and whether these relationships are direct and indirect. This will determine whether the MPC should be more vigilant of the asset pricing channel and should consider the channel for monetary policy changes.

1.5 Chapter Overview

The rest of this paper will be organised in the following manner: Chapter 2 will introduce the theory surrounding the monetary transmission mechanism. Chapter 3 will then focus on the Monetary Policy in South Africa. Chapter 4 will focus on the existing empirical findings and how these findings were utilised and used as motivation for this study. Chapter 5 will focus on the research methodology, design, and data. Chapter 6 will focus on the presentation and discussion of results and chapter 7 will focus on the conclusions and recommendations drawn from this paper.

CHAPTER 2

THEORY OF THE MONETARY TRANSMISSION MECHANISM

2.1 Introduction

Central banks of all countries have the responsibility to respond to anticipated, perceived or actual events, in the ultimate effort of achieving financial market and domestic price stability in what can seemingly be described as an ever-changing internationalised economy where countries such and their monetary authorities are becoming exposed to numerous and complex challenges (Mollentze, n.d.).

Put simply, a central bank will decide on a policy action where it will set in motion a number of economic events. The central banks influence starts with the initial influence of the financial markets which will have an effect on the current expenditure levels, when considering aspects such as private investment and consumption. Changes in the domestic demand that an economy can experience has an influence on components such as the current production levels, employment, and wages and in return will lead to a change in the rate of inflation. It is increasingly important to note and understand that the monetary policy transmission mechanism is an increasingly important component in the economy as it explains the process on which monetary policy changes and ultimately decisions are transmitted through inflation and GDP (Mollentze, n.d.).

What needs to be understood about monetary policy is that there exists a broad agreement about the overarching importance that monetary policy contributes throughout global

economies which as said, is geared towards ensuring that there exists a sense of price stability, which ultimately leads to an increase and improvement of economic prospects which will therefore raise the standard of living (Mollentze, n.d.). There is however no precise agreement on how monetary policy changes are exerted on the economy where consensus on the transmission mechanism seemingly does not always exists but as economists and researchers, we aim to clarify this (Mollentze, n.d.).

Monetary policy is a really powerful tool, a tool that can be used in order to transform and effect an economy in the most wonderous manner. To be completely successful in the conduction of monetary policy and understanding the effects that monetary policy changes will have on an economy it is important that monetary authorities have an accurate assessment on the effect and timing of policies and their changes on the economy. Below, there will be an overarching discussion on the role that monetary policy undertakes, the various unique channels that monetary policy authorities use as a reference when considering monetary policy changes and the relevance of the transmission channels for the conduct of monetary policy.

2.2 The role of Monetary Policy

There exists a general agreement about the major goals that are to be achieved by simple economic policy: these come in the forms of rapid growth, stable prices, and high employment amongst other important factors. There however is some room for discussion on whether monetary policy goals and objectives are well defined and whether there is a need to better define what monetary policy is out to achieve and in what respective channel it is to achieve its goals and objectives.

Monetary policy looks to contribute to nominal stability. What nominal stability aims to do is to create a more favourable operating environment for economic activity, and this also means that prices surrounding goods and services will ultimately become better conveyors of information (Gjedrem, 2001). What consequently happens is that changes in the distribution of wealth and income as a result of variable changes in price inflation are avoided. Nominal stability is a core factor in the assurance of developments that are to occur in the real

economy and can ultimately be seen as the most valuable contributing factor that monetary policy can make to economic growth (Gjedrem, 2001).

Ultimately however what monetary policy is, is the central bank of a country's communications and actions that will affect movements in the money supply (Amademo, 2020). The money supply is normally defined by using narrow and broad definitions. The narrow definition includes notes, coins, cheque, and transmission deposits where credit is not part of the money supply definition. Credit is instrumental in creating more money. Monetary policy works in increasing the rate of liquidity in an economy in order to instil economic growth and has the ability to reduce liquidity in order to prevent inflation.

Monetary policy in general has three distinct objectives that are monitored and executed on. The most important of these objectives is through the monitoring of inflation. The second objective is through the reduction of employment but ultimately only after the reduction of unemployment has occurred. Third objective is through the promotion of the moderate long-term interest rates. There are different monetary policies which the central bank can deploy (Amademo, 2020). The first is that of a contractionary monetary policy which is used to reduce inflation. What occurs here is the reduction of the money supply through the restriction on the volume of money that commercial banks are legally allowed to lend.

Commercial banks will ultimately charge a higher rate of interest, which will in change make loans more expensive and therefore fewer individuals and businesses will have the desire or ability to borrow which will therefore as a result, slow economic growth. On the other hand, there is the existence of expansionary monetary policy implementation which will lead to a lower unemployment rate and an avoidance of recession (Amademo, 2020).

Whether government spending can be regarded as either contractionary or expansionary will depend solely on the productivity of the given expenditure which has overarching implications for the efficiency of monetary policy (Makin, 2013)

Through expansionary monetary policy, monetary policy authorities will look to increase the level of liquidity through providing commercial banks with more money to lend. Commercial banks will lower interest rates which will therefore make loans far cheaper. Businesses will borrow more from commercial banks in order to hire more employees, buy needed

equipment and in general, expand their operations. Individuals on the other hand will borrow more from commercial banks in order to buy more real estate. This will in return increase demand and increase economic growth (Amademo, 2020).

Lastly, monetary policy holds three unique tools that are utilised for monetary policy implementation, these range from open market operations where ultimately central banks will buy and sell government bonds and a host of other securities from member banks. This exact action will change the reserve amounts that commercial banks will have on hand (SARB, 2016). The second tool of Monetary policy transmission is through the reserve requirement where the central bank will ultimately notify their members how much money the members have to keep on reserve each night and lastly, the third tool has to do with the discount rate which is ultimately where the central bank charges members to borrow funds from the central bank's discount window. The discount rate will determine either an increase or reduction in borrowing operations (Amademo, 2020).

In the following section, the different channels that occupy monetary policy will be discussed, the channels that will be discussed and their relative functions will range from the interest rate channel, exchange rate channel, credit channel, expectations channel and most importantly, the asset pricing channel. It is critically important to understand the other channels that encapsulate the monetary policy framework, how they differ and why it is important to direct attention to the asset pricing channel and how the asset pricing channel can be directed to monetary decisions for future considerations.

2.3 The channels that occupy the monetary transmission mechanism

There are a number of channels that encapsulate the monetary transmission mechanism, each with their own intensities and significance. Each channel is affected by changes in the central bank control interest rate whether they are affected directly or indirectly by the MPC, they are all significant, nonetheless. Before an assessment is made into the asset pricing channel, which is a core component of this study, it is important to understand the channels which encapsulate the monetary transmission mechanism. These are discussed in the subsections below:

2.3.1 Interest rate channel

This channel is often regarded as the traditional transmission mechanism which has often been referred to as the cost of capital channel. The interest rate channel often explains changes in the interest rate impact i.e., changes in the central bank control interest rate which influences the interest rate on retail financial products. As soon as the official rate is changed, domestic banks who borrow money from the central bank are inclined to adjust their rates, to the same extent of the policy change. How the interest rate channel would function is that firms and individuals will respond to a change in the interest rates by altering their spending and investment measures (Smal and de Jager 2001). As a result of this, real output, fixed capital formation and consumer spending will adjust. It is precisely through this channel where demand pressures feed through within the output gap present in inflation.

As an example, which has been outlined by Mishkin (1995), to put simply, as in a contractionary monetary policy, what would occur due to a contraction is that there will be a rise in the real interest rate in an economy, this will in turn have an effect on the cost of capital which would thereby effect any investment spending and lead to a reduction in output and aggregate demand.

All in all, the interest rate channel not only affects credit but cash flows to debtors and creditors as well. Changes in the interest rate will ultimately affect the marginal cost associated with borrowing, this will lead to change in savings and investment and thus aggregate demand. Changes in the interest rate will also have an overall effect on lenders and borrowers (Loayza and Schmidt-Hebbel, 2002). This channel has been explored significantly in various papers and is of utmost consideration to MPCs, the idea again is to try and ensure that the MPC steers their attention from one of the core channels into the asset pricing channels which does, more than often not receive direct attention.

2.3.2 The exchange rate channel

Open economies prevail in a globalised setting, so the exchange rate needs to be considered. The exchange rate channel functions as working through the aggregate supply an aggregate demand channel. On the demand side, monetary policy will lower domestic interest rates which will ultimately bring about a depreciation in value of a domestic currency – leading to more exports and a stronger aggregate demand. On the supply side, prices of imported goods rise and therefore raises inflation directly, a contraction of monetary supply (Loayza and Schmidt-Hebbel, 2002). Exchange rates can be described as one of the most important asset prices which monetary policy can influence. Under a floating exchange rate, a tightening of monetary policy has the ability to increase interest rates, raising demand for domestic assets and an appreciation of the exchange rate (Kamin, 1998). On the other hand, when the exchange rate is fixed or heavily managed for that matter, the effectiveness of the monetary policy which is induced will not be as effective.

An important consideration of this channel is that it also involves interest rate effects to a degree, this is simply due to the fact that when there exists a rise in the domestic real interest rate, domestic currency deposits can then become far more attractive relative to deposits that are denominated in that of a foreign currency (Mishkin, 1995). What this ultimately means is that there will be a higher value in domestic deposits relative to that of their foreign counterparts which would describe an appreciate of the domestic currency. The higher value that the domestic currency will hold will mean that domestic goods will seemingly be of a more expensive nature than their foreign counterparts, which will ultimately thereby cause a decrease in net exports and hence ultimately a decrease in aggregate output. This entire process shows how the exchange rate channel and interest rate effects work hand-in-hand (Mishkin, 1995).

2.3.3 The Credit Channel

Within the credit channel resides two unique streams in which the change in the central bank control interest rate has an effect, these come in the form of the bank lending channel and the balance sheet channel (Mishkin, 1995)

The bank lending channel is a part of the role that banks play, an integral role is performed in the financial system of an economy as they are seen as being well suited to deal with a

plethora of different borrowers, especially in small firms where there exist problems in asymmetric information that can be regarded as being especially pronounced (Mishkin, 1995). What needs to be understood is that large firms have direct access to the credit markets through that of bond and stock markets without the need to go through banks. Thus, ultimately as an example of the bank lending channel, contractionary monetary policy that reduces bank deposits and bank reserves will have an overall impact through the effect on these said borrowers (Mishkin, 1995).

On the other side of the credit channel debate exists the balance sheet channel which can simply be described as operating through the net worth of given business firms, there is no reason to project that this channel has become of less importance, especially over recent years (Mishkin, 1995). An example of how the balance sheet channel operates can be expressed through a simple example, in contractionary terms, when monetary authorities consider contractionary monetary policy, there will be the existence of an overall decline in equity prices, this will then ultimately lower the net worth of firms and will then lead to smaller investment spending measures and aggregate demand, this will be due to the increases that will exist in moral hazard and adverse selection (Mishkin, 1995).

Although there exists a plethora of literature on the credit channel which focuses on spending measures of business firms, the credit channel should apply equally well to aspects concerning consumer spending. As an example of this, a decline in bank lending abilities due to the induction of monetary policy contractions will cause an overall decline in housing and durables purchases by consumers who do not have access to any other forms of readily available credit. What can be described similarly is that increases in interest rates will cause a deterioration in the balance sheet of households due to their cash flows being adversely affected (Mishkin, 1995).

2.3.4 The Expectations Channel

The expectation channel deals with the considerations of future central bank announcements. Announcements of future policies may have a desired effect but only in the instance that the monetary authorities are committed to the policies that they are initiating. Changes in the monetary policy stance will affect the expectations of the public which

concerns future income, growth, employment, and inflation (Bank of Thailand, 2020). Such changes will in turn then effect private economic activities. The impact of this channel has been regarded as the most uncertain out of all the existing channels through monetary policy transmission. This is simply because it strongly depends on public interpretations of such changes in monetary policy (Bank of Thailand, 2020). As an example, the public may view that a decrease in the central bank control interest rate may be regarded as a strong signal that the economy is going to expand in a future sense, which from a consumer perspective, will be seen as a sign to either consume or an investor, to invest. They may alternatively believe that the economy is weaker than previously expected, lowering their confidence and investment and consumption measures (Bank of Thailand, 2020).

From the channels mentioned, the ones that have been said to receive a fair amount of attention from economic literature is that of the interest rate channel, the exchange rate channel, and the credit channel. The importance of the two remaining channels however should not be underestimated, these are the channels that strictly deal with expectations of both the markets and individual consumers and with the overall function that asset prices have on Monetary Policy decision making (Mishkin, 2001). Of these two channels however, there will be focus placed on the asset pricing channel. An extensive amount of research has been placed on the asset pricing channel globally however as compared to developing economies such as South Africa and therefore it presents an opportunity, an opportunity to delve deeper into the Asset Pricing Channel and its role in monetary policy transmission and its significant. When assessing monetary policy, it is vitally important to consider factors relating to the depth and structure of the financial system given an economy. Several characteristics need to be considered in a financial system such as whether it is run in a public or private manner and whether it offers a wide range of financial products affect the overall effectiveness of the monetary policy transmission.

2.3.5 The Asset Pricing Channel

The monetary policy transmission mechanism channel which affects the economy and households alike through the resultant effect of the interest rate policy on the valuation of assets such as equities. Higher interest rates hold the ability to bring down equity prices. Lower equity prices in that regard will therefore lead to a subsequent drop in financial wealth.

Less wealth therefore means less spending. Low value of equities relative to the replacement cost of capital will in turn lead to a reduced ability to invest (Cecchitti et al., 1999).

If asset prices do not respond in a meaningful manner to changes in the central bank control interest rate, monetary policy will have little to no real effect on the economy and would therefore be branded as meaningless, meaning that the channels are blocked or are branded as not being fully functional. Importantly, as the test of the viability of the asset pricing channel to monetary policy transmission decisions are explored, there tends to be long lags present in the transmission mechanism, branded between the changes residing in monetary policy and the rate of inflation and it can be noted here that these lags differ between countries and within the same country from time to time. The asymmetries, which will be explored are usually in part due to the different financial structures which exist between countries, another attributable factor could be due to the differences which exist between legal structures in countries (Cecchitti et al., 1999). In general, it is usually accepted that these lags vary between 12 and 24 months, however, due to rapid innovations pertaining to financial markets and globalisation measure, this lag may change significantly (Cecchitti et al., 1999).

The asset pricing channel therefore has the ability to affect the economy through a direct valuation of equity pricing. In an example, as monetary policy is relaxed, the general public will find that it has more money to spend, one place to spend their money in this regard would be the stock market. The higher demand pertaining to stocks will subsequently rise stock market prices. Combining higher investment measures with higher equity measures will lead to a unique monetary policy transmission scenario: When the central bank control interest rate is lowered, investment spending will lead to higher equity prices, as discussed, which will lead to higher investment capabilities which would therefore leader a larger output figure. When the monetary policy committees decide to decrease the policy rate, there is an overall adjustment placed on short-term money market rates (Mishkin, 2001). Individual investors will reallocate their savings towards more non-interest-bearing assets such as that of equity and real estate. A rise in demand for these assets will ultimately lead to an increase in the price of assets. As a result of all of this, wealth will increase, and a higher rate of consumption will follow. Higher equity prices will also increase the market value of firms which again, makes it more worthwhile to invest. An expansion in domestic demand will ultimately lead to

a higher level of economic growth. However, how quickly these changes respond to monetary policy implementations is an important component to justify the importance of the asset pricing channel and the amount of importance that is to be placed on this channel. (Bank of Thailand 2020).

For households, wealth is seen to be an important component of their lifetime resources. Their portfolios, which are said to consist of common stocks and property form a major part of individual wealth. Monetary policy can form a direct effect on the balance sheet of consumers, in other words, their wealth (Mishkin 2001). Relaxing monetary policy i.e., a reduction on the central bank control interest rate should if all assumptions hold, lead to an increase in equity and property prices, which thereby increases lifetime resources pertaining to consumers and the consequently increasing their consumption in the process. Therefore, if considered as a high-level process, a reduction in the central bank control interest rate will increase prices of equity, housing and land which will subsequently increase the capital of a consumer, therefore increasing their output capabilities (Mishkin, 2001).

The asset pricing channel operates through two distinct channels, that being Tobin's q and the wealth channel.

2.3.5.1 Tobin's q

Tobin's q, which is centred around a variable named q, which is the ratio between the market value a company currently inhabits and its replacement cost of capital. A q value of Tobin which is greater than one will signal the fact that the market under study is taking into consideration a series of assets (usually of an intangible nature) which are not reflected in a given company's financial statement and can be seen as a positive perception of the market in regard to the company's capacity in generating added value. On the other hand, a company that inhibits a q value that is lower than one will indicate that the market shows a lack of confidence in regard to a company's ability to generate added value and implicitly stated, a satisfactory amount of profit (Dan, 2013).

Ultimately, a high value pertaining to the q variable has a positive impact on investments, as there now exists a big market capitalization with respect to the replacement cost that exists which ultimately indicates that the company is in a position to not only issue equity at a higher

price but that this is high if related to the cost of acquiring new equipment, this thus will be advantageous which therefore has a direct impact on the general growth within an economy (Dan, 2013). On the other hand, however, there exists a smaller value of q which ultimately shows that rather than higher equity issues if related to replacement cost, companies would focus their attention a great deal into ensuring acquisitions with companies that inhibit similar assets which would work out to be far more profitable, in this case though the level of investment be effected in a negative manner, rather than the case of spending more money on investment into new equipment there is more focus placed on mergers and acquisitions measures (Dan, 2013).

Tobin's q plays a vital role in monetary policy. As an example, if money supply drops, this will lead to an increase in the interest rate (Dan, 2013). This will have a knock-on effect and effect spending in various spheres - this includes the level of spending in the financial markets, which influences stock prices as demand falls. In the same manner a higher interest rate will alter the profitability which exists between bonds and stock prices, putting a greater amount of pressure on stock prices.

All these effects will ultimately play a role in lowering the value of the q ratio which has been defined by Tobin, which will in turn, as has been discussed lead to a decrease in investments. Similarly, however, if there exists a rise in money supply and interest rates are effected negatively then there exists a positive effect on financial assets through the facilitation of capacity of companies to finance their investments from financial markets and on the other hand there exists increased difficulty to incorporate acquisitions and mergers due to the increased market value that firms now hold (Mishkin, 1995). In a cumulative manner, these factors play a role in determining the companies to finance themselves cheaply from the market and use the now gained attracted capital in order to buy into new plant and equipment, this thus has a positive overall effect on investment and consumption and in a desired non-inflationist (generally not the case) environment, an increase in the demand for goods due to the important effect on the production levels. Tobin's level may differ significantly from country to country due to their monetary zones (Dan, 2013).

2.3.5.2 The Wealth Channel

The wealth channel operates as follows, it is the channel where any monetary policy movements have an effect on interest rates, which will then lead to a change in the value of household assets such as real estate, bonds, and stocks. The link that exists between policy to consumption can be said to be complete when households respond to changes in the value of owned assets by changing their spending patterns (Lettau et al., 2002).

An important consideration of the wealth channel is that many when regarding the wealth channel only refer to households and separate an investment channel when there is reference to firms that invest more in asset prices, especially that of a firm's stock rises (Tobin's q). What needs to be understood then is that the wealth channel describes a positive linear relationship between aggregate demand and asset prices (Horlacher, 2010).

2.4 The relevance of the transmission channels for the conduct of monetary policy

2.4.1 The Channels as part of an integrated approach

In a given textbook example of a classical economy that is fully flexible, a monetary transmission shock translates into an instantaneous and equiproportionate increase in all nominal aggregates – this is the inclusion of credit, money, exchange rate, asset prices, goods prices, and credit (Loayza and Shmidt-Hebbel, 2002). In such a condition it is accepted that that it would not make sense to try and identify and separate existences of transmission mechanisms, much less their relative importance however this may be different. It may be important in monetary policy to try and distinguish between the differences between channels in which monetary policy transmission works – their dominance, speed of adjustment between announcement and response and intensities which will require an all-encompassing econometric model in order to distinguish between the intensities in response between the various channels while ensuring that method used is used between all channels,

all channels won't drive the same intensities with the all-encompassing idea of ensuring the correct channels are targeted (Loayza and Shmidt-Hebbel, 2002). There is an overall encompassing model where monetary policy changes have an overall effect as part of an integrated approach which can be represented by the following model as below.

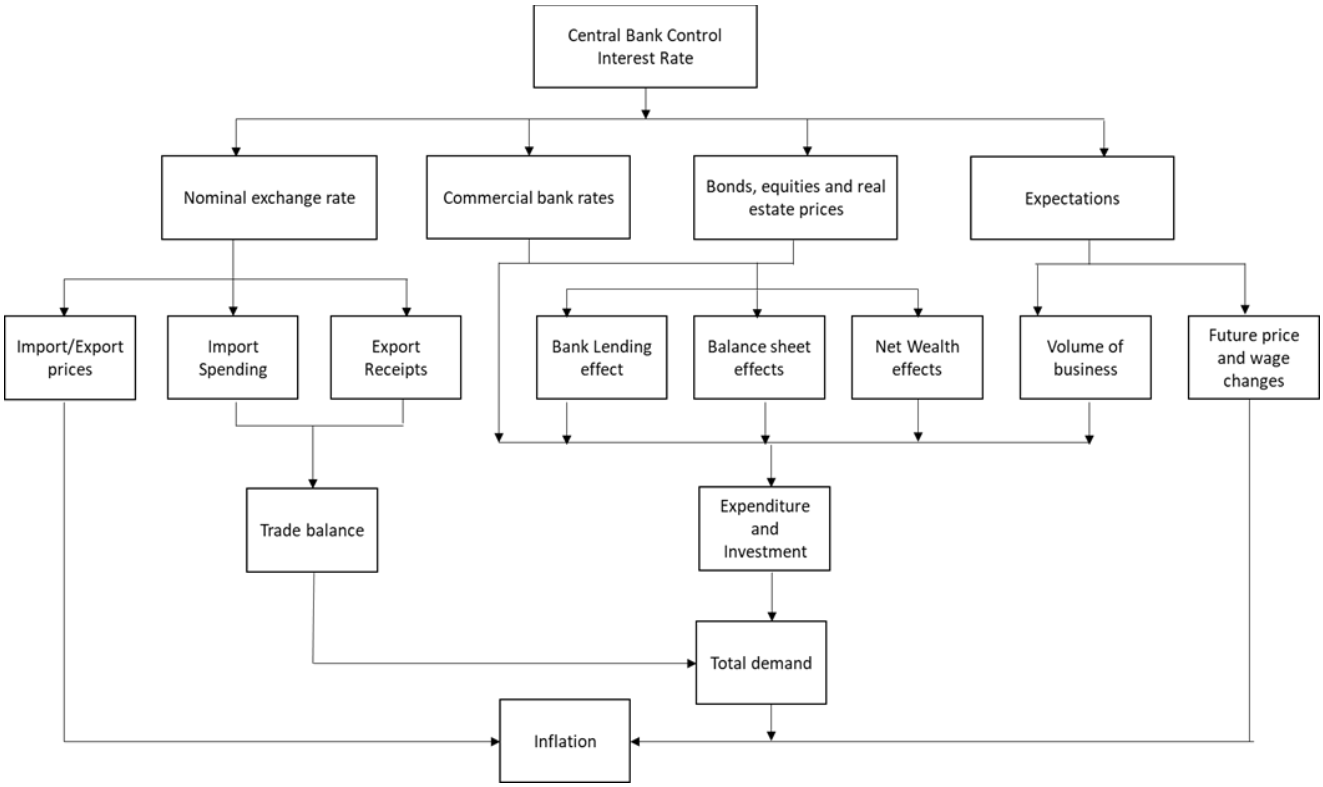


Figure 2.1: The monetary policy transmission mechanism

Source: Nel (2012), Monetary Economic Lecture Slides, derived from Mishkin (1995)

It is critically important to understand how the monetary policy transmission channel operates, not in isolation but as that of a broader approach and understanding. Monetary policy changes are made by the MPC through modification of the central bank control interest rate. Whether the rate targets expansionary monetary policy or contractionary monetary policy, changes in the interest rate will change the nominal interest rate, commercial bank rates, prices of bonds, equities and real estate and expectations of the wider population.

All these immediate effects will either have positive or negative connotations on various components. For instance, as referring to figure 2.1, nominal interest rate changes will effect import/export prices, import spending and export receipts, this will affect the trade balance which will effect total demand and then ultimately, inflation. Assessing Commercial bank

rates and bonds, equities and real estate prices, changes in these respective components will have bank lending effects, balance sheet effects and net wealth effects in accordance to figure All these changes will effect expenditure and investment, to then influence total demand and therefore inflation. Lastly, changes in expectations will have an effect on the volume of business, which effects expenditure and investment, to then effect total demand and therefore inflation. Furthermore, changes in expectations will have an effect on future price and wage changes which will effect inflation.

The crux of the entire argument is that any monetary policy changes that MPC makes will effect individual channels with their own intensities, however, as looking at an integrated approach, all effects on their own will ultimately effect inflation. One channel should therefore not be considered in isolation.

2.4.2 Structural features and transmission mechanisms

Not all economies react to monetary policy transmissions in the same manner. The choice of the particular transmission mechanism selected needs to depend on the specific features which an economy holds, as an example, if an economy had a poorly developed capital market and financial market (asset pricing channel) in general it may not be wise to include that as a major consideration for monetary policy transmission (Loayza and Shmidt-Hebbel, 2002). Monetary policy transmission can be divided into two distinct steps - the first is that the policy instrument selected will affect a variety of asset markets and prices and the second point being that these changes will ultimately affect the decisions which are carried out by households and firms. Each step is uniquely affected by the particular features that an economy inhibits and the financial development stage which the economy is in and importantly the openness to internal capital and trade. Changes in market prices can have an effect on the aggregate demand that is also determined by the liquidity and solvency of households (Loayza and Shmidt-Hebbel, 2002).

2.4.3 Depth and structure of the financial system

Several characteristics of the financial system need to be considered such as whether the financial system is solely comprised of banks or a variety of financial institutions, whether these are run in a private or public manner and whether those offer a large amount of

financial products or not. These all effect how the effectiveness of monetary policy which is instilled is (Loayza and Shmidt-Hebbel, 2002). For example, monetary policy would respond far faster and would be more closely related to changes in financial prices and interest rates if the financial system is far more diversified in terms of the products that financial institutions offer and the institutions that make up and provide these products. Importantly, investment and consumption decisions which are made by firms and households are far more responsive to prices and market rates if those firms and households are not financially constrained but are free to exercise their choices both across and intertemporally on services and goods.

The structure and depth of the financial system is also very important when considering the transmission system at play (Loayza and Shmidt-Hebbel, 2002). As an example, when the financial system is poor and shallow in diversification where there is only dependence on a few banks then the asset pricing channel will show little to no importance due to the low capitalisation of the stock market, as a start however South Africa's financial system is fairly well development showing a great deal of diversification in financial services. With a poorly developed financial system the interest rate channel will also be weak due to the monopoly power that banks carry, the credit channel in this scenario will instead dominate due to the adverse selection and moral hazard that characterize shallow and weak financial systems. The exchange rate channel also suffers in a very financially underdeveloped economy, due to the fact that such an economy usually imposes a wide range of controls on foreign exchange transactions whether this is related to capital flows or international trade (Loayza and Shmidt-Hebbel, 2002).

As a financial system becomes far deeper, developed, and diversified - the asset price, exchange rate and interest rate channels become far more significant. This is an important consideration for the study as we are reflecting on the significance of the asset pricing channel in a developing country as compared to the various other channels and with South Africa being in a unique situation as being a part of the BRICS countries which are developing countries at an advance stage of development which are on their way to becoming developed. Posing an interesting study for how the asset pricing channel significance and response to monetary policy decisions for a developing and complex financial system (Loayza and Shmidt-Hebbel, 2002).

2.4.4 Size and openness of the economy

The relative size that an economy exhibits and its openness to external transactions will determine just how important the exchange rate channel is and how monetary policy will determine its interest rates. A number of economies studied such as Israel, Chile, Canada, UK, and South Africa all exhibit similar features in that they are all open, all except for the UK are relatively small where all follow a monetary regime that is based around inflation targeting where there are exchange rates that are largely considered to be flexible (Loayza and Shmidt-Hebbel, 2002).

Importantly central banks can typically respond to gaps and deviations in inflation and output from a desired level. These gaps form the two standard arguments that surround monetary reaction functions. Some central banks would also consider reacting to a key open-economy variable, such as that of the exchange rate or the current account deficit when setting the monetary policy. Another argument to consider has to the with the inclusion in policy rules of the lagged value of the interest rate itself which reflects a certain degree of inertia in a central bank and its behaviour (Loayza and Shmidt-Hebbel, 2002).

2.5 Chapter Summary

The chapter explored the overall function and components that reside in the Monetary policy transmission mechanism. Exploring the role of monetary policy, to describing the channels that occupy the transmission mechanism which range from the interest rate channel, the exchange rate channel, the credit channel which leans into the bank lending channel and the balance sheet channel, the expectations channel, and the asset pricing channel. The asset pricing channel contains a critical discussion and comparison between Tobin's q and the wealth channel that occupies the asset pricing channel and its decisions.

Tobin's q is centred around a variable named q, which can simply be described as the ration between the market value a company inhabits and its replacement cost of capital, a q value that is greater than one will simply signal the fact that the market under study is taking into consideration a series of intangible assets which are not reflected in a given company's

financial statement and can be seen as a positive perception of the market in regard to the company's capacity in generating added value. A q value lower than one shows that the market shows a lack of confidence in a company's ability to generate added value and a satisfactory amount of profit. The wealth channel on the other hand is where any policy movements have an effect on interest rates, which lead to a change in the value of assets such as bonds and stocks. The link between policy and consumption is complete is complete when households respond to a change in the value of owned assets by the modification of spending patterns.

The chapter ends off with a discussion around the relevance of the transmission channels for the conduct of monetary policy. This component in the chapter looks to explore all aspects of the monetary policy transmission mechanism and ultimately how a monetary policy committee is to go about making monetary policy decisions that will affect the economy in a positive manner through consideration of factors such as the channels that form a part of an integrated approach, structural features and transmission mechanisms, depth of the financial system and size and openness of the economy to determine the best approach to monetary policy implementation.

The chapter lays the foundation for the discussion surrounding a deeper understanding on the developments that South Africa has undergone in regard to monetary policy and how this has effected the asset pricing channel as a whole.

CHAPTER 3

MONETARY POLICY IN SOUTH AFRICA

3.1 Introduction

In order to see the relevance of the asset price monetary transmission channel in proper perspective, it is necessary to view the way in which monetary policy operates in South Africa, how it evolved over the past decades in particular and the nature of the monetary control mechanism. When considering the South African constitution, the overall objective of monetary policy in South Africa can be found in the establishment of a stable financial environment which looks to support real economic growth over not only the medium term but also the long term. Although the case surrounding financial stability will not always guarantee that the real economy will perform at an overall maximum capacity, the SARB strongly believes that there lies importance in a precondition for the attainment of economic growth potential (Van der Merwe, 1999). All-in-all, there are many other economic and non-economic aspects that will determine actual economic growth performance. As said earlier, financial stability does not always guarantee that the real economy will perform at its maximum capacity, financial instability however will inevitably be extremely detrimental to South Africa's economic growth potential (Van der Merwe, 1999).

What this chapter aims to establish is how monetary policy has evolved in South Africa to what the SARB is currently utilising which is the repo system of control in an inflation targeting framework. The chapter then looks to explore how the current monetary policy framework works in South Africa, all its intricates and ultimately what it looks out to achieve. The chapter then ends off through a discussion on implications of the repo system in South Africa with core focus on the asset pricing channel.

3.2 The evolution of Monetary Policy Progression in South Africa

The foundation of the current monetary control system was laid in the 1980s with the De Kock Commission of Inquiry into the monetary system in South Africa where the report focused on ensuring a stable financial environment which was an action taken by most developing countries at this time. The problem with the monetary policy objectives initiated at the time was that they could only be achieved and sustained when financial conditions were in a stable state. The money supply was used as an underpin and guideline for monetary policy but as international capital developments and flows into domestic markets began to ultimately obscure the transmission mechanism prevalent in in South Africa, it became apparent that the change in the money supply became a far less reliable indicator in the underpinning of inflation and therefore ultimately a less reliable anchor for monetary policy (Smal and de Jager, 2001).

The SARB therefore moved away from targeting the money supply and began looking at a wide range of indicators for the determination of policy actions which was branded the eclectic approach to monetary policy decisions. According to Stals (1997) the wide range of indicators included are: The level pertaining to the yield curve, overall liquidity present in the banking system, actual and expected movements in the rate of inflation, changes in the extension of bank credit and lastly, the exchange rate of the rand and the changes in the official foreign reserves. At this time, many countries had shifted their monetary policy efforts towards inflation targeting as a means of ensuring financial market and domestic price stability. Stals at the time had commented that South Africa should also be moving towards this situation and that in the absence of predetermined inflation targeting, the bank should ultimately strive to bring down the inflation in South Africa to the average of its major trading-partner countries (Smal and de Jager 2001).

The repo rate however was introduced in 1998 in an effort to ensure that financial instruments become far more flexible in nature and that interest rates react faster to periodic changes in underlying market conditions. The repo rate was seen to be far more transparent and therefore replaced the previous bank rate system, what it does is that it continuously

signals what the SARBs intentions are. In other words, the regular disclose of the amount of liquidity that a bank is prepared to make available for daily tender basis to banking institutions, the most important signal therefore is the amount of liquidity that the bank is to make available (Smal and de Jager 2001).

As said monetary policy is forward looking in its nature because of the long lags between policy implementation and result, lags could range between 18 to 24 months. After adoption of this framework, although it does imply that the central bank needs to remain resolute in achieving its monetary policy targets, does not mean that the central bank is without any form of discretion. The SARB still needs to monitor its domestic economic developments closely in the determination of the origin and impact that any subversive shock can likely have on its ultimate goal in achieving its target (Smal and de Jager, 2001). The monetary policy stance is communicated to the public as frequently as possible where a monetary policy statement is to be released in every meeting from the MPC. A monetary policy forum is also held twice a year in the major centres in South Africa which is used for ongoing discussions surrounding monetary policy. A monetary policy review is also published twice a year, this all surrounds the whole notion of transparency that the SARB wants to establish with how monetary policy is transmitted (Smal and de Jager, 2001).

Currently under the inflation targeting system of monetary policy which has been adopted by the SARB, it is said that accountability and transparency has improved significantly and that further improvements are in prospect. There has been said to be an increase in credibility and anchoring of inflationary expectations under the current targeting (Smal and de Jager 2001). The suggested improvements which are prevalent such as transparency which has been mentioned leads to a greater sense of predictability in interest rates. The ability to then build models that better reflect more accurately the operation that monetary policy transmission mechanism goes through, with particular focus placed on asset prices, is considered to be an ongoing process (Smal and de Jager, 2001).

The new monetary policy procedures aimed to ensure that there is an overall quicker response shorter-term interest rates to any changes in the liquidity condition and therefore an overall improvement in the transmission process that monetary policy carries out (Van de Merwe, 1999). With the new monetary policy system there is greater flexibility within money

market interest rates with enough safety mechanisms for the prevention of unwanted and undue volatility in interest rates. The new monetary policy procedures that have been implemented ensures for a greater sense of transparency in monetary policy throughout the various forms of signalling that can be utilised, this leads to the overall improvement in credibility that monetary policy carries which is vitally important in the current volatile and integrated financial space. The current monetary policy procedures also lead to further development within the treasury bill and interbank market in South Africa. There is improved signalling from the market to the SARB regarding changes within the underlying overall liquidity position and lastly, more flexible options in regard to the management of the liquidity positions of banks (Van de Merwe, 1999).

While the development of monetary policy is vitally important to the health of financial institutions and the economy as a whole, it is critically important to understand how the current monetary policy in South Africa functions and how it is being utilised. With that said it is important then to understand how monetary policy and the repo rate, which will be discussed in far more detail in the section below can be utilised in the realisation of monetary policy objectives but then to ultimately try and understand how the repo rate has an overall effect on all the channels which reside in the monetary policy transmission mechanism, their intensities and importance and how going forward, considerations for the asset pricing channel could be a more forefront consideration in decision making procedures considering monetary policy changes.

For now, more on the current Monetary Control Mechanism in South Africa and its overall functions.

3.3 The Current Monetary Control Mechanism in South Africa

The SARB has of the year 2000 adopted an inflation targeting monetary policy framework which can be branded as forward looking in nature, where a specific target has to be met within a time that has been predetermined (Smal and de Jager, 2001). The forward-looking nature of the adopted framework ensures the acknowledgment of the time lags consistent in monetary policy in impacting the real economy and inflation. As known, central banks often play a crucial role in responding to anticipated, actual or perceived events. In an ever-

changing economy with an internationalised setting, the South African monetary authorities have become increasingly exposed to several challenges in their overarching efforts to achieve stability in both financial markets and domestic prices. In a global context, many economies are aiming at achieving and therefore maintaining price stability and in that context and the SARB it is of no exception. The bank's main objective is therefore to protect the value of the currency to achieve a sense of stability and balance in the economy over the long term (Smal and de Jager, 2001).

When the SARB decides to influence a change in the repo rate, what it does is it sets in motion several economic events. The pressure that demand has relative to its counter component, supply of the economy is a key factor which influences inflationary pressures. Inflation, amongst others is the result of pressure which simply originate in the labour market and/or the market for services and goods as the result of imported inflation (Smal and de Jager, 2001).

What is critical to understand is that the main component and reason for the existence of the SARB in money market terms is solely for the implementation of the interest rate policy, that being the repo rate which is determined by the MPC (SARB, 2016). This in turn ensures that the central bank achieves the most optimal economic conditions and also, achieves the Bank's overarching inflation targeting goals. In the Central bank's main monetary operations, the bank always aims to promote financial stability in the economy and managing any liquidity needs of the entire banking system. Importantly, the South African Reserve Bank aims for the overall efficiency and development of the domestic financial markets, which resides as part of the asset pricing channel, a core focus of this study. The financial markets department utilises various different instruments in order to conduct ant of the Bank's monetary operations (SARB, 2016).

An important consideration of the development around monetary policy considerations revolves around considering how the current monetary policy framework operates. The bank ultimately uses the refinancing system as the main instrument that the bank uses in order to implement any monetary policy changes. The bank ensures that it creates liquidity provisions for commercial banks which, ultimately enables these commercial banks to meet their daily liquidity requirements (SARB, 2016). Liquidity in this sense refers to balances that commercial

banks hold at the central bank that are essentially available in order to settle any transactions that they have with one another, this will be above the normal statutory amount that is required to be held . In regard to the monetary policy implantation framework, what the bank does is that it creates a form a liquidity shortage in the money market, which is where the bank then utilises refinances as the repo rate, which is the fixed interest rate that is determined by the MPC in order to meet its overall economic and policy objectives (SARB, 2016).

The repo rate that is determined by the central bank is a powerful tool that ultimately influences all participating commercial banks, the general level of interest rate that is found within an economy any other economic aggregates in an economy which come in the form of bank credit extension, money supply and credit extensions. The monetary policy implementation framework of the SARB can be simplified as below:

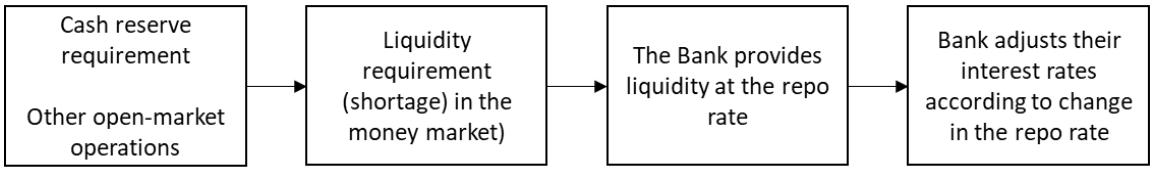


Figure 3.1: The monetary policy implementation framework of the SARB

SARB (2016)

Within the current refinancing system, the emphasis is solely placed on the size of the current money market shortage, this ultimately determines aspects such as the impact on the banks market operations on commercial banks' ability to grow their current balance sheet statuses, this is in order to manage any credit extensions. The impact is exerted in two unique ways (SARB, 2016). The first has to do with its determination of the availability and cost that commercial banks' requirements in terms of marginal funding, this is the funding that is required for excess asset growth on a daily basis. Secondly, it is vitally important that banks do hold securities that are of a relatively low-yielding nature, this is simply in order to ensure that they can be used as a form of collateral in a Bank's refinancing operations (SARB, 2016).

What is important to note is that the central bank plays an important role in ensuring that the monetary policy framework is assessed on a regular basis for not only its effectiveness in meeting economic and policy objectives but also to create any refinements if necessary.

Important criteria that fit the overall function of monetary policy implementation can be described below:

3.3.1 Creation of a liquidity shortage

For the assurance that the repo rate does remain effective, the bank needs to ensure that commercial banks remain dependant on the SARB. The SARB have to compel commercial banks to borrow amounts from the bank (liquidity requirement). What the SARB does is that they regularly transact within the money market in order to ensure that there is a shortage and that this is monitored regularly as it has to fulfil the function of draining excess liquidity from money markets. Apart from the cash reserve requirements that the SARB place on commercial banks, the SARB also makes use of additional open market-instruments such as reverse repos, SARB debentures and foreign-exchange swaps (SARB, 2016).

3.3.2 The cash reserve requirement

In regard to the Banks Act 94 of 1990 as well as the regulations that are in relation to banks, commercial banks are simply required to hold a percentage of the total liabilities held which is adjusted in cash on their cash-reserve accounts at the SARB (SARB, 2016).

The term that is used for the cash reserves that are held with the SARB is known as the structural liquidity requirement. What this means is that this is the amount that the liquidity requirement would have been of all the factors that influence liquidity in the money market had a total value of zero (SARB, 2016).

3.3.3 Open-Market Operations

In addition to what is required in terms of the cash reserve requirement, the SARB conducts what is known as Open-Market Operations, the SARB does this in order to drain any remaining excess liquidity from the market for the assurance that the appropriate liquidity requirement is maintained. This should in the best case be the exact same size as that of the commercial banks' cash reserve balance that is to be held with the SARB. One of the many instruments that the SARB utilises for the draining of the liquidity amount from the market is through the issuing of its own debentures (SARB, 2016).

3.3.4 The estimation of daily liquidity requirements

The SARB plays an integral role in ensuring that it estimates the overall liquidity requirements in the market on a daily, weekly, and also, a monthly basis. In the case of a refinancing operation that occurs on a weekly basis, the SARB calculates the average daily liquidity requirement of the given market and this amount is translated and offered to the commercial banks the auctions. In saying this, the SARB considers all transactions that not only expand but contract the balances that commercial banks hold with the SARB (SARB, 2016).

It is critically important to note that transfers and transactions that occur among commercial banks themselves does not affect the overall liquidity requirement on the money market. From a viewpoint of commercial banks strictly, any aspects that cause an overall net decrease in the cash balances held with the SARB increases the overall liquidity requirements and therefore the need for refinancing (SARB, 2016). A general rule that needs to be understood is that a rise in a liability item on a bank's balance sheet leads to an overall increase in the liquidity requirement, whereas the opposite occurs if there if there is an increase in an asset item, this leads to an overall decrease in the liquidity requirement with vice versa properties (SARB, 2016).

The SARB is in the most optimal position to estimate all the daily liquidity requirements mainly because they are the sole destroyers and creators of liquidity and overall, have the most optimal market information when it comes to the topic of liquidity (SARB, 2016).

3.3.5 Liquidity requirements refinancing operations

Liquidity requirements can be financed through distinct methods ranging from main refinancing auctions, supplementary auctions and standing facilities, access to statutory cash reserves and any special assistance if this is required. They are explained briefly below (SARB, 2016).

3.3.5.1 Main refinancing auctions

Main refinancing auctions occur when the bank has drained an amount of liquidity that is sufficient from the money market, what then occurs is the overall market position should then work to reveal a liquidity amount that is experiencing a significant shortage. The given

liquidity amount (requirement) is then funded at the main refinancing repo auction (SARB, 2016).

What further occurs at these operations is that the SARB makes provision for liquidity to the commercial banks through means of a repurchase agreement in exchange for other instruments such as SARB debentures and treasury bills. Commercial banks work to sell the securities to the SARB for a period of one week in return for a sum of money whilst also paying a repo rate on the sum of money received from the exchange. During the week throughout the exchange there are 5- and 2-day main repo auctions that are help, this is done in the accommodation of any rate changes that are made by the MPC. At maturity, the entire transaction is reversed, and the participating commercial banks returns the sum of money to the bank in exchange for the securities (SARB, 2016).

At 10:00 on Wednesdays on a weekly basis, the SARB posts the projected average daily liquidity requirement for the week and invite tenders for the refinancing auction. It is important to note that commercial banks only tenders for the amount of liquidity that is needed for refinancing measures as the main repurchase rate is of a fixed nature. It is further important to note that if the daily liquidity requirement that is posted is fairly different from the amount that is stipulated at the main repo auction, participating commercial banks have the ability to utilise supplementary auctions, that will be described next (SARB, 2016).

3.3.5.2 Supplementary auctions

As said before, the SARB is tasked to, at 10:00 on Wednesdays, post the liquidity requirements for the given week, there may however be a number of deviations that may occur which leads to the market being held in either a short or long liquidity position. These sudden fluctuations can occur due to factors such as changes that result in foreign exchange transactions and government spending. In the instances of a daily shortage occurring, what would happen is that a case of refinancing would be provided through that of a standing facility or a supplementary repo auction.

In contrast to that of the main auctions, the standing facilities and supplementary repo auctions mature the next day (SARB, 2016). In the case of the existence of surplus liquidity , the liquidity is absorbed through means of a standing facility reverse repo or a supplementary

reverse repo where the SARB pays interest on the cash that it absorbs on an overnight basis. The real difference that exists between the standing facilities and the supplementary auctions is that the supplementary facility is conducted through the discretion of the bank and the standing facility is conducted on that of an automated basis (SARB, 2016).

3.3.5.3 Access to statutory cash reserves

To add on to the standing facilities and the supplementary auctions which have been mentioned above, participating commercial banks has access to their own cash reserves at the SARB for the sole purpose of liquidity management purposes, this is only when the commercial banks adhere to the requirement on an average basis over that of a given full maintenance period. What this entails is that if a commercial bank decides to use some of the cash reserves that it has access to, which leads to the reserves falling below the required amount, the commercial bank is tasked to hold additional reserves for the remaining maintenance period to comply with all the statutory reserve requirements (SARB, 2016).

3.3.5.4 Special assistance

Commercial banks do often fall into distress and as the SARB acts as the lender of last resort, the SARB provides liquidity against a broader range of given collateral-like assets. Although special assistance does not fall into the overall Monetary policy implementation framework, it is related to the SARB's responsibility in the overall promotion of financial stability (SARB, 2016).

3.4 The implications of the Repo System for the transmission mechanism in South Africa

It is important to recognise and try and understand the overall effects that the repo system has on an economy in order to gain a greater understanding on channel selection that the MPC needs to utilise in order to instil better policy implementation. Again, the repo system currently utilised by the MPC is the sole driver in influencing all channels ranging from the interest rate channel, the expectations channel, the credit channel, the exchange rate channel, and our core focus the asset pricing channel. The repo rate has a direct effect on all the channels that have been mentioned but again, they vary significantly in their intensities

and lags. There exist long lags in the transmission mechanism between the overall change in the monetary policy stance and the effects on inflation (SARB, 2016).

Through the implementation of repo rate changes, these changes affect the various channels in several unique ways. Such as when there are repo rate adjustments, the interest rate channel is effected in the manner that the interest rates on various retail products are effected (Smal and de Jager, 2001). The effects on the interest rate channel are clear. Changes in the repo rate in regard to the credit channel has to do with asymmetric information in financial markets and has been discussed, operates through the bank lending channel and the balance sheet of firms (Smal and de Jager, 2001). In regard to the exchange rate channel, changes in the repo rate can cause domestic currency deposits to become far more attractive relative to the deposits that are denominated in the foreign currency (Smal and de Jager, 2001).

As has been said, in literature the interest rate channel, exchange rate channel and the credit channel have received a plethora of attention. The importance on the asset pricing channel and expectations channel are still not well understood. Although the expectations channel can be explained to a point where the channel deals with the considerations of future bank announcements and future announcements of policies may have a desired effect but only in instances where the MPC commit to the policies they are initiating. The asset pricing channel is an interesting channel to debate where there needs to be determination as to whether the MPC should be taking this channel into account when considering monetary policy changes in the form of repo rate changes in a direct fashion or whether the MPC should be leaving the channel to indirectly feed off of the effects of repo rate changes.

Several commentators have as of recently argued that there can not only exist an exclusive focus of monetary policy on achieving a stability in asset prices in a world where there is an existence of asset price misalignments and financial imbalances are said to be prevalent (Bordo and Jeanne, 2002). It has been stated that monetary policy should be reacting to asset price movements and prevalent financial imbalances over and above that which has been projected by the inflation outlook (Bordo and Jeanne, 2002). An important question to address is to know whether or not the conditions at present require the monetary policy

implementation to be proactive or not (Bordo and Jeanne, 2002). Similar studies will be elaborated on in more detail in chapter 4.

Historically, there have been many busts and booms in asset prices, importantly though is to note that they have different factors and features which are dependent on the country under study and whether the focus is on real estate or stock prices and lastly whether the study is dealing with small or large countries (Bordo and Jeanne, 2002). Two dramatic episodes have involved large countries and the stock market – these events include both the great depression, specifically its effects on the US and Japan in 1990s (Bordo and Jeanne, 2002).

The general view currently is that central banks should in fact not use the interest rate policy in order to control asset price trends through the seeking out of bubbles and busts in any form. The normal course of action would then therefore be to use a variety of instruments in order to restore stability in the economy on the few occasions where there are the existence asset market collapses (Bordo and Jeanne, 2002). Bernanke and Gertler (2001) however have argued that the central bank who are dedicated to price stability should not pay attention to asset prices per se, except in the way in which it signals changes in expected inflation, in such a scenario the central bank should intervene.

The case of whether the central bank should intervene or not within the asset pricing channel through changes in the repo rate is an interesting topic, especially when considering all the various papers which either argue for or against the considerations surrounding the asset pricing channel. For instance, do changes in the repo rate have a direct or indirect effect on changes within the financial markets and how do these changes affect our overall GDP in South Africa. These deserve clarification so that there can be suggestions made to the MPC to better utilise the repo rate and target the required channels such as the asset pricing channel especially considering that our economy is currently being effected by a global pandemic, it is vitally important to ensure that the MPC instils the correct monetary policy changes in order to ensure for a stable financial system and economy as a whole. The chapter that follows is to look at the different evidence that has been gathered in both developing and developed countries and comparing the different methods that have been used in order to test whether the asset pricing channel is a critical component in consideration for monetary policy changes. It is important to assess the current monetary policy framework that is

currently being utilised in a South African context and ensuring that monetary policy changes are best utilised, more in the chapter to follow which will discuss empirical findings surrounding the asset pricing channel.

3.5 Chapter Summary

Firstly, the evolution of the monetary policy system is discussed and how monetary policy has evolved from the 1980s. The problems around the then monetary policy objectives are discussed in detail ranging from the fact that the objectives at the time could only be sustained and achieved when the financial conditions were in a stable state. Many countries previously had shifted their monetary policy efforts towards more of an inflation targeting framework as a means in order to ensure that financial market and domestic price stabilises. In 1998, the repo rate was introduced in South Africa in an effort to ensure that financial instruments become far more flexible in nature and that interest rates respond faster to period changes in underlying market conditions. What the repo rate is in fundamental terms is the rate that is determined by the SARB and is a powerful tool that influences all the participating commercial banks in the South African economy, the general level of the interest rate within an economy and other economic aggregate in an economy which come in the form of bank credit extension, money supply and credit extensions.

Currently through the consideration of the inflation targeting framework that has been adopted by the SARB, it has greatly improved transparency and accountability completely and that there are further improvements on the horizon with an overall increase in credibility and the overall anchoring of inflationary expectations under the current targeting system. The current system being used has led to a greater sense of predictability. Hopefully, through the current system that has been adopted there is a greater focus placed on the asset pricing channel which this paper aims to clarify.

The forward-looking nature which is prevalent in the current inflation targeting regime ensures for the acknowledgement of lags that are consistent in monetary policy in impacting the real economy and inflation. It is important to reflect on the fact that the MPC have become exposed to a number of new challenges in their overarching effort to achieve complete stability in both financial markets and domestic prices. When the SARB decides that

it will influence a change in the existing repo rate, what it fundamentally does is set in motion several economic events, these economic events are transferred through the transmission mechanism of monetary policy. Changes in the repo rate has an effect on the demand and supply of services and goods in the South African economy.

The monetary policy implementation framework in South Africa works from creating an initial liquidity shortage in the economy where the SARB ensures that commercial banks hold the correct cash reserve requirement, to open market operations where the commercial banks drain any excess liquidity. The SARB also ensures that there is an estimation of all daily liquidity requirements which are factored in on a daily, weekly, and monthly basis. It also important to note that the liquidity requirements for refinancing operations can be funded through main refinancing auctions, main repurchase auctions, supplementary auctions, access to statutory cash reserves and special assistance.

Lastly, it is important to consider how the changes in the repo rate are transmitted throughout the monetary policy transmission mechanism, especially when considering the asset pricing channel in South Africa, which forms the basis of this study. There have been several commentators that have argued for and against the targeting of the asset pricing channel as a means of monetary policy transmission. Some have argued that central banks should in fact utilise the interest rate policy in order to control asset prices and their trends through the seeking out of bubbled and busts. The normal course of action from this statement would then be to utilise a variety of instruments in order to restore stability within the economy where there are market collapses. On the other hand, there are arguments that exist which state that a central bank that focuses on price stability should not pay attention to asset prices per se, except in the very occasion where it signals changes in expected inflation, in this sort of scenario the central bank should intervene. This paper however looks to again, clarify whether the MPC is to put more emphasis on the asset pricing channel when considering monetary policy changes in the form of the repo rate.

CHAPTER 4

EXISTING EMPIRICAL FINDINGS ON THE ASSET PRICING CHANNEL

4.1 Introduction

This chapter looks to explore how the asset pricing channel has been tested in a variety of different models and economic settings in order to build a strong argument for the study. The chapter looks to argue the different debates in order to support the need for a study on the monetary policy transmission channel through the asset pricing channel and how the MPC can best utilise the repo rate going forward in order to meet overall economic and policy objectives.

A assessment will be made on the asset pricing channel debate, further developments and progress within the asset pricing channel, global empirical findings on how monetary policy has been utilised and tested through the asset pricing channel which range from a plethora of different economies both developing and developed. The conclusions and shortcomings of the asset pricing channel will then be provided in much detail as argued by Mishkin where ultimately, the counter argument for the asset pricing channel will be explained and how this study aims to build on existing findings which have been found from a South African context.

4.2 The Asset Pricing Channel debate

The significance of the asset pricing channel and essentially the interdependence of the asset pricing channel (with core focus on the stock market) with monetary policy has long been an intriguing topic. Stoica et al. (2014) has long stated that the topic is well covered and well written about especially in consideration of developed countries. However, this should still remain an important topic of consideration especially when considering that the literature on the topic is long evolving and moulding especially when one considers times of economic crisis (Stoica et al, 2014).

Financial theory supports that the asset prices and monetary policy share a strong link. There are however strong contradicting schools of thought on how monetary policy authorities are to approach asset prices. On the one hand, the first school of thought which is presented by (Bernanke and Gertler 2001; Schwartz 2002; Greenspan 2004), have argued strongly that the central bank should not make use of interest rates to influence stock prices. The core focus on why they make these conclusions is that there is ongoing difficulty in the identification of bubbles ex ante and the ineffectiveness that comes with trying to utilise interest rates in the bursting of a bubble even though there may have been identification ex ante. This was further backed up by Bullard and Schaling (2002) who have stated that the inclusion of stock price information in monetary policy considerations will have dire consequences on the economic performance of a country.

There have contradicting schools of thought that were provided by Bullard and Schaling, (2002), the second school of thought which has been formulated by (Smets 1997; Cecchetti et al. 2000; Borio and White 2004; Bordo and Jeane 2002; Roubini 2006) holds the opposite view in which they have asserted that central banks need to hold some form of responsibility for the financial stability and that the central bank of a country should monitor the asset prices (stock prices) of financial markets in order to ensure that there is some sort of prevention of the emergence of bubbles that can inherently lead to crashes. Raghavan and Dungey (2015) on one hand have argued strongly that there is support for monetary policy in the way that it can pre-emptively lean against any stock price misalignments. This argument is further supported by the notion that monetary policy decisions will affect the stock market in the predicted and desired direction, on the opposite side, intervention by monetary policy authorities would be of a futile nature if monetary policy effects do not have any real influence on stock prices. Reinhart and Rogoff (2009) and Mishkin (2001) have been branded as the scholars who take centre stage in this argument.

It is crucially important to recognise the degree of predictability of stock market returns from monetary policy and whether the SARB be paying closer attention. Should the SARB be using stock-price information as a core indicator in monetary policy decision making, therefore determining the effectiveness and degree to which the asset pricing channel (stock market prices) have an effect on monetary policy decision making in South Africa. The general consensus and believe in this case are that there does exist a relationship between monetary

policy and stock prices which has been proven both empirically and theoretically and will be discussed in further detail in a later portion in this research topic.

There have been numerous studies from an emerging market perspective that have tried to directly link the relationships, in saying this it is important to recognise the rate at which emerging market economies and their financial markets are growing, which increases the need for central banks such as the SARB to understand the impact and the role at which stock markets have on their decision making. There is a good justification present for the research proposed and to pinpoint South Africa rather than any other African countries, the JSE (Johannesburg Stock Exchange) is the largest stock market present (and the fastest growing) in Africa which pinpoints it as the most attractive for investors all over Africa (Equity investors).

Apart from this a broad number of studies have focused on trying to discuss monetary policy and its link to financial schools of thought. Studies on this topic broadens when considering discussions focused on the announcement effects of monetary policy on stock returns (Bredin and O'Reilly, 2004; Duffy and Engle-Warnick, 2006). Also, empirical tests on the usage of stocks to hedge inflation (Sellin, 2001), to stock market volatility and effects of monetary policy on selected macroeconomic variables (Bernanke and Gertler 2001; Erdem et al. 2005). There have been numerous published papers, as said on emerging and developing countries on which a few will be explained in detail in this study and how they ultimately compare to more mature markets. Interesting studies done in Egypt, the middle east and northern African countries have attempted to explain the relationship that exists between monetary policy and equity markets. Naceur et al. (2009) study for the Middle Eastern and Northern African countries produced mixed results for the countries that were included in the sample attached. Stock prices for example in Saudi Arabia and Oman have been shown to react fairly significantly to real activity regarding inflation. A tightening of monetary policy in these countries have been shown to produce a reduction in stock price levels therefore showing that monetary policy does have an effect on the asset pricing channel.

Stock price shocks have shown to not result in much of a significant effect in both Jordan and Egypt. However, Jordanian monetary policy has been shown to have a large effect on impacting stock prices. Morocco and Tunisia's monetary policy have been shown to be

effective to some extent when considering stock prices (asset pricing channels) but have proven that their monetary authorities are not interested in following stock price movements when considering monetary policy as they believe that stock prices can be a misleading indicator to inflation, an assessment into Morocco and their testing will be done at a later stage to draw comparisons. Numerous studies have also been conducted into the US which has proven that there is strong correlations of monetary policy and stock returns and therefore that the asset pricing channel is significant (Bjornland and Leteimo 2009; Conover et al. 1999). Specific country studies will be discussed in far more detail in the following section.

Studies that are being conducted in more developed countries have shown a vast array of more varying results than to the few that have been conducted in more emerging/developing market economies. There exists a possible reason for this divergence and this could strongly be due to the methodology which has been used to carry out the study. The far more common model that has been used in conducting the interaction that exists between stock prices and monetary policy has been the ordinary VAR (vector autoregressive model).

There exists an insignificant degree of interdependence between the stock market and the money market ends of the financial system (Lee 1992; Thorbecke 1997; and Millard and Wells 2003). The problem which resides in these studies is that they form a bias, this is due to the researchers who are not allowing for simultaneous interdependence in which they also at its core failed to consider the presence of structural shocks in the utilisation of short-run restrictions on the interaction linking monetary policy and equity prices (Bjornland and Leteimo, 2009). This is where amongst other things there has been a growing amount of support which has existed for the use of SVAR (which may be suitable in a South African context).

It is important to note that South Africa has been operating under an inflation targeting regime as discussed earlier which has brought forward more credibility and transparency in the conduction of monetary policy as describe by Hewson and Bonga-Bonga (2005). Although inflation targeting is said to not directly target asset prices it has been said that nonetheless it will increase the confidence that investors have when they back their expectations on what future policy is likely to be. As said by Muroyiwa et al. (2017), it has been suggested that the

SARB needs to work strongly towards legislation that will increase the competitiveness of a country's financial sector which is currently described as being very closed and highly regulated. If this happens, there will be assurance that interest rate pass through will in turn ensure that monetary policy decisions are more effective and reach more areas.

Asset price inflation has a number of dimensions that are crucial considerations and should not be neglected. It is important to consider whether asset price inflation has the ability to affect portfolios of financial institutions in a way that may cause trouble for them should there be any form of asset price inflation collapse (Schwartz, 2002). A way to better understand then why it is important for monetary authorities to react to asset prices and be more aware of its effects is to understand that monitoring financial institutions may in fact be a core responsibility of regulatory authorities rather than the proposed monetary authorities, but it is important to understand that monetary policy decisions will inevitably be influenced if there so happens to be a worsening condition of financial institutions (Schwartz, 2002). Therefore, it is increasingly important that monetary authorities are well aware that the policies that they are to pursue has the potential to promote asset price inflation. To summarise, even if monetary authorities are not tasked with dealing with asset prices, they should be alerted to changes that they can stir in portfolios of financial institutions that asset price changes induce.

Rozeff (1974) has presented evidence that an increase in the growth rate of money can raise stock returns. As tested by Thorbecke (1997), a fundamental test was conducted on whether stock return data does in fact respond to monetary policy shocks, theory determines that stock price data equals the expected present value of future net cash flows. Thus, in this case, evidence that positive monetary policy shocks inhibit the ability to increase stock returns show an indication that expansionary monetary policy exerts real effects through increasing of cash flows and decreasing discount factors at which these cash flows are capitalised. Thornbecke, through the usage of various measurements of monetary policy and a variety of empirical techniques was able to evidence that monetary policy has the ability to exert large effects on post-ante (after the effect) and ex-ante (before the effect) on stock price returns. The findings by Thornbecke are consistent with the fact that monetary policy, at least in short run terms, has qualitatively important and real effects on real variables. Results extracted

from size portfolios have indicated that monetary policy shocks do indeed have larger effects on small firms than they do on larger firms.

4.3 History and Progress Surrounding the Asset Pricing Channel

Since the outset of the industrial revolution, the equity market has played a crucial role in the progression of economic production. With this role becoming far stronger with growing complexities surrounding economic structure, particularly since the vents unfolding surrounding the financial crisis (Borys, 2011; Chiarella et al., 2013; Dempsey, 2013). Thus, considering this, capital asset pricing and how equilibrium status is established in equity markets have become the core focus to asset pricing models. In the equity market in this instance because asset markets are said to be forward looking, asset pricing in equity markets are distinct from pricing mechanisms in other markets.

Given the role that asset prices play on the transmission mechanism, central banks have often wanted to use them as targets for monetary policy. When focusing our attention on stock market affects. Fluctuations as due to being influenced by monetary policy effects, have important impacts on the aggregate economy. Price dynamics and other financial assets (considering shares, stocks, real estate holdings etc) are usually ignored on a global context when making decisions surrounding monetary policy transmission (Mishkin, 2001). For an underdeveloped financial market, non-consideration over asset pricing would make sense, however, for a developing/developed financial market where there is a growing role pertaining to financial markets, transaction volumes on those financial market are importantly reflected (Mishkin, 2001).

This will lead to a review of current approach and considering a greater importance on pricing of financial assets when considering monetary policy decision making, however, a test should be conducted in order to clarify whether changes in monetary policy do have a significant effect on asset pricing and whether the central bank should consider closer evaluation on this channel in making decisions. Not only would this require a deeper assessment of South Africa's current asset channel pertaining to stock prices but also how drastically the channel is affected in terms of monetary policy decisions.

Bernanke and Mishkin alike have driven to the conclusion that central bank should not hold the sole responsibility for asset price changes. The opposite findings however have been found by Cecchitti, et al. (1999), who has proven on empirical and theoretical levels the viability of price consideration while monetary policy is realized.

Research on monetary impulses relating to research impact on market prices pertaining to stock assets in Russia was held by Ivanchenko (2010), who himself proved the existence of a statistically significant relationship between the dynamics that exist and the change of key parameters of monetary policy and stock market behaviour in Russia. He also proved that the Russian stock market without the underlying participation of the bank system as a medium has a direct impact on gross investments in the country and GDP level. Further and more in detail discussions on the effect of monetary policy on the asset pricing channel is evidenced below.

4.4 Global empirical Findings on the viability of the Asset Pricing Channel

4.4.1 The effects of Monetary Policy on the asset pricing channel in Morocco

Studies have been conducted on the effect asset prices have in monetary policy transmission and evidence suggests, through usage of the SVAR model that the channel is not important in transmitting a monetary policy shock, as throughout the study conducted it has been proven that the Moroccan capital market is narrow in its nature and not sufficiently developed and has concluded that the channel can play a more active role in the transmission process owing to the growing flexibility in the exchange rate and there are also substantial efforts being undertaken in order to render Casablanca as the first recognised financial city residing in North Africa (Ouchchikh, 2018)

4.4.2 The effects of Monetary Policy on the asset pricing channel in China

A further study has been conducted on the monetary policy transmission channels in China where the focus was placed on whether monetary policy influences household consumption via an impact on household wealth where links have been established both through the housing market and the stock prices and questions have been raised as to the role of loose monetary policy in causing a rise in asset prices in relation to China, results from the study

stated that a loosening monetary policy will indeed lead to higher asset prices in China and that urban households' consumption have reacted positively to a subsequent rise in residential or stock prices although the effects are seemingly weak and that the overall effect was that changes in asset prices due to changes in monetary policy did not affect household consumption in much of a robust manner (Koivu, 2010). The results can be interpreted in variety of ways showing that the possible side effects from a loose monetary policy to the household sector are small and not to be a cause of worry.

To conclude however, it has been stated that the possibilities of effecting households' decision-making via monetary policy is very limited from a Chinese standpoint, as the direct link between monetary policy and consumption is said to be weak. Although the outcome is said to not be surprising, considering that households have limited access to the financial sector, it may then raise concerns amongst policy makers where in order to make Chinese monetary policy more effective for the economy, there needs to be further liberalisation and reform that is needed in the financial sector (Koivu, 2010). Although Households are considered to be reluctant to react to changes in asset prices, it may be that asset prices play an integral role in other parts of the Chinese economy, an example can then be formed that implies that asset price developments cause fluctuations in the real economy. Price fluctuations in the real estate market were a key factor behind a slowdown in terms of investment growth in China in the first half of 2008, albeit this was indeed prior to the global economic downturn, data used in this study reflects data from 1998-2008. As when assessing how monetary policy affects the asset pricing channel and whether it is seen as viable for South Africa or not, it would then lead us to be able to build a conclusion as to how we can possibly make the asset price channel more viable (Koivu, 2010).

4.4.3 The effects of Monetary Policy on the asset pricing channel in Ukraine

From a Ukrainian perspective, there has been an attempt to prove the importance of the asset pricing channel. Asset price channels are said to impact the actions of central banks of the USA, EU, and many other listed countries. Due to findings by Roger and Sterne (1999), of the majority of 77 respondents have approved that the price volatility on assets have impacted their monetary policy decision making. While the calculation of monetary policy takes place, a central bank must calculate the possible impact that the monetary policy transmission will

have on the economy of a country. A good example of price bubbles in Japan in the 1980 have witnessed that the central bank itself may in fact sometimes become the generator of possible failures in an economy which may breed an economic crisis. Therefore, it is crucially important that whatever channel an economy looks to prioritise, that it does so knowing that it will lead to positive economic outcomes (Kozmenko and Plastun, 2016). A central bank's policy, which is directed on the enlarging of a monetary base and liquidity saturation of a given economy, may in fact lead to the appearance of price (In this scenario stock, speculative, financial market) bubbles. Their collapse will in fact be accompanied by significant losses of economic entities and again, may lead to an economic crisis (Kozmenko and Plastun, 2016).

Financial asset prices can show and generate price bubble formations, this thus provides the possibility for central banks to make a change as to how monetary policy will be transmitted. In the case of US monetary policy, when there existed a sharp rise in the US' stock market, in order to prevent a crisis instilled a heightening of interest rates (Kozmenko and Plastun, 2016). Incorporation of information regarding prices of financial markets is an important part of monetary policy for a central bank. In regard to the experience within developing countries such as South Africa and Ukraine. The central bank of England has an entirely different approach to Monetary transmission (Kozmenko and Plastun, 2016). It is predicted to them that changes in market value pertaining to key types of financial assets such as stock, shares and real estate prices which in turn have the ability to influence the economy either positively or negatively as a result of monetary policy decision making (Kozmenko and Plastun, 2016). The central bank thus is seen to have an important tool in regulation of prices in financial markets. What these decisions simply entail is that there may be an enlargement or in the opposite, less attractiveness of shares, stocks, and real estate holdings. What this would thus do is have a knock-on effect which will ultimately influence investment activity within the economy and all separate other sectors. For the central bank of England, it has been found that the asset price channel is an integral part of monetary policy decision making. This determines the impact of the real economic sector ultimately due to changes in relative prices of real assets and capital (Kozmenko and Plastun, 2016).

In Conclusion, the study that has been conducted on monetary policy transmission in the asset pricing channel and it has been found that the monitoring and quantitative asset valuation has been found to be an important element in terms of modern monetary policy

transmission. The speed that stock market prices react to changes in economic surroundings makes the asset pricing channel a unique form of information that the central bank can use for its monetary policy development and correction in that. Although the analysis conducted in the Ukrainian economy showed that the asset pricing channel has been deemed to not be viable and that it did not work, it has been concluded that it does play an important recommendations development need role and does play an important role in the transmission mechanism, it just does not reflect the importance of other related channels in the transmission mechanism. In evaluation of their importance and existence of the asset price channel, they made usage of the correlation analysis with and without the usage of lags. The need to use lags (As will also determine relevancy of channel) to determine potential delayed response time and Impulse transitions (From initial announcement to delivery) from bank systems to financial markets within Ukraine (Kozmenko and Plastun, 2016).

When assessing the empirical results in Ukraine, Stock Market analysts came forth to the conclusion that there is an underdevelopment of the Ukrainian stock market, low sales and liquidity levels pertaining to it, small quantity present of sellers give the condition of the ever-present lack of tight and operative connective actions between NBU and price movement of stock market (Asset price channel of monetary policy transmission mechanism). The problem lies simply in its almost stock market disconnects from economic realities (Kozmenko and Plastun, 2016). They even came forth to the conclusion that the stock market harboured in Ukraine does not have a direct impact on its GDP.

In regard to the stock market, the further conclusion was that that in terms of impulse transitions from NBU to stock markets, monthly data has been branded to be appropriate as daily data has been concluded to have mainly the features of accident values. The use of time lag transitions has found that the transition impulse from monetary policy changes to Asset channels range from a period for 2 years, in this scenario instrument parameters which had an effect on the stock market would be that of the NBU discount rate, repo transactions rate and weighted average rate of NBU instruments and capital base volume (Kozmenko and Plastun, 2016).

In regard to the real estate market analysis for Ukraine, same as the stock market analysis, there was strong evidence of some lag present, that is that the channel does overall react, it

does however react with some delay. It has been present that with the tightest relation is vivid between real estate prices and the changes present in instruments of parameters with time lags between 12 – 18 months of which the only exception was capital base with a stable and had present volatility between -0.5. Thus, all in all, the effects present due to actions from the NBU were that the resultant effects on the real estate market were shown from 1-1.5 years (Kozmenko and Plastun, 2016). When both put together, the viability of the asset channel and its significance into monetary policy transmission in Ukraine has been said to be worth defying the impulses from monetary transmission into stock market and real estate prices and they are transmitted with great delay.

All in all, the reason for such low dependency on the effects of the asset price channel is due to the low efficiency of the Ukrainian financial market. However, with time with the amount of evidence present in developed countries, with time, the asset price channel for monetary policy transmission will play a larger role than it did previously. Asset prices may not be a big factor for developing countries country as evidenced but asset prices do provide a unique source of information for any central bank concerning the economic state of the country (Kozmenko and Plastun, 2016).

While developing monetary policy, the central bank needs to not only consider key macroeconomic parameters but simultaneously do asset price monitoring on financial markets with the ultimate aim to quickly correct own actions depending on current state of economy present in country (Kozmenko and Plastun, 2016). In summary, financial market pricing monitoring is vitally important for the central bank in determination of monetary policy transmission. As an example, a collapse of price bubbles lead to great economic shock and economic crisis appearances and thus, temporary disbalances in the economy at present. In the development of monetary policy, the central bank has the vital task to ensure that it does account for price behaviour with the aim of not allowing the appearance of an accidental price bubble or collapse. It is important to note that this is only possible if there is proper asset price channel implementation in monetary policy transmission (Kozmenko and Plastun, 2016).

Classifying the research that has been conducted by numerous scientists on the viability of inclusion of the asset price channel in monetary policy considerations and mechanism of

decision making for central banks, in summation, these are some of the arguments that have been made for its inclusion:

- It is widely accepted that the central Bank action will lead to a correction which depends on asset price dynamics which lessens the possibility of the appearance of price bubbles that lessens the possibility of a probable crisis which breeds due to a price bubble collapse (Kozmenko and Plastun, 2016).
- While there is a measurement of the basis inflation, considering the real estate prices would be appropriate, at the same time it is seen that the prices for different financial assets may indeed be ignored (Kozmenko and Plastun, 2016).
- Asset price information contain information which pertains to possible future inflation, which therefore may be contained within future forecasts that are conducted in terms of monetary policy decision making. Thus, forecasted financial asset prices can be utilised in the forecasting of inflation (Kozmenko and Plastun, 2016).
- In terms of probable asset price Implementations into the transmission mechanism of Ukraine for example, the asset prices will ultimately influence investment expenditures, inflation process of country, manufacturing, and consumption alike. Asset price incorporation into any transmission mechanism of a country brings forth the ability to evaluate technology shocks within an economy, this relates to great scientific discoveries. An asset price rise is thus seen to make a firms' balance account better in a way and stimulate future investments. Investment enlarging will in that turn lead to numerous other asset prices rising and money flow increasing including a reversed effect from expenditure (Kozmenko and Plastun, 2016).

4.4.4 The effects of Monetary Policy on the asset pricing channel in Pakistan

An investigation has been done in Pakistan which covers their transmission mechanism of monetary policy throughout. The paper under consideration made use of vector autoregressions to examine the monetary policy in Pakistan. The results from the study have indicated that a monetary policy tightening will lead to first, a fall in domestic demand, investment demand which is primarily financed through bank lending, this will lead to gradual reductions in price pressures which that will then reduce the overall price level with a

significant lag (Mukhtar et al., 2019). An additional through studies of the interest rate channel, the results from monetary policy transmission pointed to a mechanism in which banks play an important role. Where the has been found to be an active asset price channel whereby comparison, the interest rate channel has been found to be far less important by comparison. Although they may not have an overly significant stock market, they have concluded that the asset prices in the transmission mechanism is to increase in the future as these capital markets develop which builds a good argument for asset price channel targeting and importance (Mukhtar et al., 2019).

4.4.5 The effects of Monetary Policy on the asset pricing channel in Egypt

A study in Egypt was attempting to identify any degree of predictability that may exist on stock market returns from monetary variables and whether when considering the transmission of monetary policy, can the stock market be regarded as an alternative channel rather than the usual, credit and money channels which monetary policy authorities usually consider when implementing monetary policy changes (Sourial, 2002). The empirical investigation was carried out through usage of Bayesian VAR models which had consisted of four endogenous various that had four lags and a constant. From the results provided through estimation, the evidence from the study is that monetary aggregates did not have any significant impact on the stock market performance prior to January 1998. However, when considering post December 1998 results, there rose new evidence between the interrelation of stock market returns and monetary policy in Egypt. The insignificance of some of the estimated parameters came to no surprise due to the same reoccurring issue in emerging financial markets where the price adjusts to monetary shocks, but this only occurs after a certain lag of time (Sourial, 2002).

It is fairly evident that through the estimation results that have been provided by this study that in accordance with the bank lending and balance sheet channel – which essentially composes the credit channel is and has been well established in Egypt in the successful transmission of Monetary Policy changes (Sourial, 2002). Nevertheless, what can be taken from the results of this study is that the magnitude of responses to stock market prices to monetary policy changes were significantly increased post December 1997. Consequently, what can be accepted is that in an environment that exhibits an efficient market and fair

equity culture, the asset pricing channel, in representation of the stock market could play a far more vital role for the transmission of monetary policy in future measures (Sourial, 2002).

4.4.6 The effects of Monetary Policy on the asset pricing channel in the USA

An important issue that does arise in the measurement of the effect that monetary policy has on equity markets is in fact the correct identification of monetary policy. Different papers in literature have focused on different angles in measurement. These range from using changes in official or market interest rates in the measurement of monetary policy (problem being that these can however coincide with changes present in business cycle conditions and any other economic variables that are relevant. Other papers have looked at monetary policy shocks through the usage of orthogonalized innovations from VAR models.

Interestingly, Conover et al., (1999) have looked at 16 industrialised countries and have found that equity markets in several of those markets react to both the U.S and local monetary environment. A shortcoming to this methodology however is that there is subject to endogeneity bias, in other words, monetary policy shocks that are extracted from a structural VAR model is unlikely to be purely exogenous. (Rigobon and Sack (2002, 2003) have convincingly shown that monetary policy reacts to stock market developments in a way that there is consistent take on the impact that stock market movements have on aggregate demand.

However, to account for monetary policy shocks in a more accurate manner several papers have now considered a more events studies-based approach which is based on a higher frequency observation which consists of daily data which analyses how equity markets ultimately react to changes in monetary policy. One shortcoming however of the events study approach the effects of monetary policy on equity markets is that monetary policy changes are in this case simply measured as changes in policy rates on days of FOMC meetings (Rigobon and Sack 2002, 2003). All methodologies of these approaches have some sort of shortcoming, but the idea then is to find the methodology that will be most suitable to testing the stock market (equities) as based in the South Africa.

It has been proven to be really difficult to properly identify monetary policy, this is due to the fact that monetary policy may be endogenous in that central banks may react to develops

within the stock markets. Considerable progress however has been made in the sense that Rigobon and Sack (2002, 2003) have formulated a methodology which exploits the heteroskedasticity which is present in financial markets in order to identify any monetary policy shocks while Kuttner (2001) and Bernanke and Kuttner (2003) have derived monetary policy shocks through the measures from market expectations which from an US standpoint have been obtained through federal funds futures contracts. In the study present by Ehrmann (2004), methodologies are employed that are of a similar status to that used in Bernanke and Kuttner (2003) which is by identifying monetary policy shocks through market expectations obtained from survey of market participants.

Delving deeper into whether the asset pricing channel is significant to monetary policy we can try to understand what aspects of the stock market are being affected and to what degree. The research compiled by Bernanke and Kuttner (2003) results show that little of the reaction of the market can be attributed to the effect of monetary policy and its effect on the real rate of interest but rather that the response that stock prices inhibit are in fact driven by future expected excess returns and to a small extent on what the expected future dividends are. The paper complied from Fratzscher and Ermhann (2004) however wanted to take this a step further through analysing which of these factors of these expectations are important in understanding the large heterogeneity in the reaction that individual stocks have to monetary policy. Evidence through research conducted on this paper has found that individual firms which are included in the S&P 500 index have reacted in a highly heterogenous manner to U.S monetary policy shocks.

There was then investigation as to whether there are industry specific effects to monetary policy. It was found that cyclical industries such as communications, technology and cyclical consumer goods react two to three times stronger to the effects of monetary policy in industries that are of a less cyclical nature (Fratzscher and Ermhann, 2004).

4.5 Conclusions and shortcomings provided by Mishkin

With the previous bursting of the real estate bubble and stock market bubble in Japan in the early 1990s and stock market boom in the USA, there has been an ongoing debate on how monetary authorities of countries may best react to market information pertaining to real estate and stock market fluctuations (Mishkin, 2001). An argument has been built up which argues that the reaction of asset prices raises similar issues to that of exchange rate fluctuations. Improved economic performance will only follow if the monetary policy response depends on various factors such as the nature of shocks, the central bank however is not to be perceived as having any sort of perceived target for asset prices whether this be real estate or stock market prices (Mishkin, 2001).

It has been accepted by Mishkin that stock price and real estate movements have an important impact on aggregate demand and is motivated to thus be followed closely by monetary authorities and their decision making in monetary policy transmission (Mishkin, 2001). However, there is still need for open discussion as to whether monetary authorities can improve on their performance through engaging and pricking of asset price bubbles. A subsequent collapse of these bubbles can be ever damaging to an economy such as in Japan 1990s. Cecchetti et al., (1999) have argued however that it is important to at times to target asset prices in order to ensure that the bubbles do not get out of hand.

Mishkin however fees that it is increasingly difficult to plan for these as monetary authorities may struggle to identify price bubbles and there also has to be the underlying assumption that monetary authorities have higher predictive ability and better information than the private sector (Mishkin, 2001).

If the central bank is said to then have no informational advantage and knows after speculation that a bubble has developed and will eventually crash, then the market too knows this information. If the central bank however does have some sort of informational advantage, then they may mis predict or predict right as often as the private sector and may thus frequently pursue the wrong monetary policy. Cecchetti et al., (1999) find favourable results in test where central banks conduct policy in order to prick asset price bubbles as they assume that the central bank knows that the bubble is in progress.

Again, Mishkin has advised that this would play on the assumption that the central bank has an informational advantage and this, however, has been proved wrong time and time again. Secondly, Mishkin has said that if the central bank is to target asset prices such as stock prices it makes the central bank look foolish (Mishkin, 2001). The linkage as discovered between stock prices and monetary policy determination is a good one but has been proven to be a weak one, nonetheless. Mishkin has stated that fluctuations in stock prices are usually due to unrelated reasons to monetary policy, either the changes are due to animal spirits or real fundamentals. The ability for the central bank to therefore have control (through monetary policy) over stock prices is really limited. Usually, if the central Bank likely wants stock prices to move into one direction, it usually moves in the complete opposite direction therefore making the central Bank look inept (Mishkin, 2001).

The most important element against asset price targeting from a monetary policy perspective is the case that it may in fact weaken support for the central bank as from the private sector perspective, it may seem that the central bank is trying to become too involved or try to control too many elements. By narrowing their focus more, central banks in recent years have due to their display of independence been able to garner a larger sense of support. In Mishkin's opinion, if a central bank is to extend their focus of monetary policy to asset prices then they may lose public support and may even, from the public perspective worry that the central bank brand themselves as too powerful and may have too much control over a large aspect over economic function.

4.6 The response of the asset pricing channel to monetary policy shocks is stronger than we thought

When assessing the aftermath of the global financial crisis and that of a current low interest rate scenario, it is of utmost importance to assess the relationship that exists between asset prices and monetary policy decisions. A paper was conducted on the usage of the SFM (Structural Factor Model) as compared to the standard VAR which is widely accepted to be the go-to model when testing for empirical evidence for the viability of the asset pricing channel, the SFM model considers a much wider data set. Instead of only giving consideration for a small range of variables such as that of VAR, SFM is said to incorporate more than over a hundred monthly variables covering variables which range from surveys, prices, real activity,

and financial markets as well as also taking into consideration the US economy (Alessi and Kerssenfischer 2016).

The advantages are in its results. Firstly, in a more smaller scale VAR model there are only a small number of variables (asset classes) that are being investigated at once (Alessi and Kerssenfischer 2016). This is said to be due to the curse of dimensionality which can be described as the number of parameters that an individual has to estimate when adding further variables. Given that samples are seen as being relatively small in a macroeconomic setting, a VAR that is far too large will yield inaccurate results. Using a factor model however such as the SFM however will allow for far more flexibility, it essentially allows an individual to investigate a wider range of asset prices in a given unified framework (Alessi and Kerssenfischer 2016). This ranges from aspects such as stock prices and housing prices for example. Secondly, in an environment that contains a larger more enriched pool of data there is the overcoming of the problem surrounding nonfundamentals which are essentially caused by a deficiency in an information set. If the empirical model used incorporates far less information than what is present in and used by economic agents, economic agents refer to households, firms, and central banks then the model will be branded as invalid (Alessi and Kerssenfischer 2016).

The issue is even more prevalent in smaller scale VARs, since they can only handle a small number of variables (macroeconomic) while economic agents are seen to arguably base their decisions on a much larger range of information. In term of the SFM and its ability to handle a larger information set, nonfundamentals no longer becomes an issue. SFM can identify shocks which small scale models are unable to identify (Alessi and Kerssenfischer 2016).

In the SFM what has been observed is that compared to what literature has said there is a far stronger effects of monetary policy shocks on asset prices as seen across the board (Alessi and Kerssenfischer 2016). The peak effects of asset prices in a euro setting have been said to be reached on impact or only shortly thereafter after a policy 'surprise'. In other words, asset prices are said to respond far quicker than has been commonly thought. As the study predicted, monetary policy has been shown to play a far more integral role to expanding asset price movements than to what was considered in the literature (Alessi and Kerssenfischer 2016). The SFM can account for the large swings of asset prices that have been observed and

standard VARs are unable to explain. Overall, it has been considered that there be increased vigilance on the possible repercussions that could be faced when a monetary policy tightening is to happen and that there is a rapid effect on financial market thus disproving a group of studies that have been conducted on the significance of the asset pricing channel (Alessi and Kerssenfischer 2016).

4.7 Building on strong evidence from a South African Context

With South Africa being a middle-income economy with an ever changing and sophisticated banking and financial sector, with developing properties which has many structural problems that industrialised economies do not face, it may be accepted that monetary policy may be less effective, especially considering the asset pricing channel. South Africa in general has seen a lack of empirical research on the topic considering the asset pricing channel in South Africa, research however was conducted by Muroyiwa et al. (2017) on which there was a conclusion that monetary policy does in fact influence stock prices and that there does exist a sense of interdependence between monetary policy and the stock market and that it was recommended that the SARB needs to work towards increasing the competitiveness of the financial sector which is currently considered to be highly regulated. The study concluded with a recommendation that a future study be done which would expand on the period analysis.

4.8 Chapter Summary

This chapter explored the asset pricing channel debate on different perspectives that have been presented for and against the utilisation of the asset pricing channel when considering monetary policy changes, which has led to no definitive answer but has led to the possibility of further development on the topic. The history and progress surrounding the asset pricing channel was also discussed which highlighted factors such as that central banks globally have wanted to use asset pricing channels as targets for monetary policy where ultimately for an underdeveloped financial market, strong non-consideration over the asset pricing channel would make sense but for a developed/developing financial market where there is a strong sense of growth in these financial markets, importance over the asset pricing channel is then

strongly considered thus supporting the need for a deeper study into the asset pricing channel and how monetary policy changes effect this channel from a South African context.

Global empirical findings are explored with different methods, economies, and financial market structures with arguments for and against utilisation of the asset pricing channel for monetary policy transmission. Conclusions and shortcomings are then provided by Mishkin who has stated that if central banks extend their focus of monetary policy on to asset prices, they may lose general support from the public where the central bank may brand themselves as too powerful and have too much control over a large portion of the economy. The response to the asset pricing channel to monetary policy shocks however has been argued to be stronger than we thought whilst building on a South African context from Muroyiwa et al. (2017) who has stated that monetary policy does in fact influence stock prices and that there is the existence of an interdependent relationship between monetary policy and the stock market and that the SARB should towards increasing competitiveness in the financial sector which is regarded as being highly regulated. This paper looks to extend the period under analysis in order to confirm whether a new recommendation can be drawn.

CHAPTER 5

RESEARCH METHODOLOGY, DESIGN AND DATA

5.1 Introduction

This chapter will outline and explain the analytical approach that is to be used in the study in order to address the main objective and goals that are to be met. This chapter of the study will start off by simply providing a discussion around the research paradigm, giving a deeper dive into why the post-positivist paradigm was accepted as the approach in conducting research. The research objective is then clarified with a further investigation into what has been researched before from a South African context and how this will ultimately be used a basis for research that will be performed in this paper. The research design will cover the research process on all variables that were of consideration and were selected as to form a part of the entire study, including the time period under study and on what time basis the study will be conducted.

As part of the research process, there have been many considerations around what technique to ultimately centre the entire study around, the SVAR model was chosen as to build on the findings from Muroyiwa et al. (2017), around this there are many diagnostic tests to supplement the usage of the SVAR model – this ranges from the unit root tests for the testing of stationarity, to the LM test in order to test for any serial correlation, there is further development through usage of the white test for any heteroscedasticity. A VAR is computed with its main purpose to ensure that the LAG length criteria is correct and to act as a pre-requisite for the construction of an SVAR. Once the SVAR is computed, the impulse responses will be run in order to illustrate and supplement findings on SVAR model and lastly, the granger causality test to either prove or disprove findings from the SVAR and impulse responses.

Ultimately, the chapter will focus on how all of the estimation technique work so that all results contained in chapter 6 are understood.

5.2 Research Paradigm

A research paradigm can be explained as simply an approach that is used in conducting research that has been approved by the research community or an approach that has been in practice for many years (Kivunja and Kayin, 2017). The research currently under study takes on a post-positivist approach, it addresses an expansion on the results that have been expressed by the study conducted by Muroyiwa et al. (2017) in which the study now looks at a similar research type but looks modify the approach by considering an expansion on the period under analysis to build on the results which have been provided by Muroyiwa et al. (2017). An expansion of the period under analysis will mean that there will be more data and therefore more information, this will inevitably lead to a higher sense of precision. The confidence in our projections increases, our uncertainty decreases. The focus is also placed on equity prices which will be used in order to establish a more focused study which can give an indication as to whether there is any form of significance found in the asset pricing channel with an expansion of the area under study.

5.3 Research Objective

The objective of the research is to investigate whether the asset pricing channel can be regarded as a vital consideration for monetary policy implementation through usage of the repo rate. Through this there is the requirement of identifying not only unique stock indexes to carry out the study that will be either directly or indirectly effected by the repo rate but to investigate how these indexes effect GDP.

The study looks to build on the results of Muroyiwa et al. (2017) who has concluded that a change in the interest rate will have a direct and significant effect on stock prices. What this means is that monetary policy changes have a significant impact on stock prices in the South African economy. Muroyiwa et al. (2017) further stated that that the MPC can to a large extent, through utilisation of the repo rate effect changes in stock price movements. There were further conclusions drawn and recommendations given that the SARB has to aim towards legislation for the increasing of competitiveness in the South African financial sector which can be regarded as regulated and very closed off. The idea then is to ultimately increase

interest rate intensities and pass through will ultimately ensure that monetary policy decisions be regarded as more effective.

The study utilised by Muroyiwa et al. (2017) utilised data between 1990:07 and 2010:02 in the estimation of an SVAR model while the objective of this study is to utilise data from 1999:01 to 2019:12 which not only further expands the period under analysis but also uses data that is current in order to either build on the conclusions that have been drawn by Muroyiwa et al. (2017) or to disprove and build different results entirely.

5.4 Research design

5.4.1 The Research Process

The first step in the research process will be in the identification of the proxy that will be used for monetary policy implementation, thereafter the identification of the indexes that will be used as stock market indicators that are to respond to the monetary policy shocks and then to the economic activity indicator. This data will then be collected and be expressed on a quarterly basis to then be used to compute the SVAR model and all the relevant econometric techniques ranging from simple stationarity tests, VAR model, a white test, LM test, impulse responses, and granger causality to supplement or deter the conclusion being built.

5.4.2 Data Source

The Repo rate, the All-share Index, the industrial 25 Index, the Financial 15 Index and the Gross Domestic Product (GDP) needed data was all collected through usage of Bloomberg (2020). The study examines quarterly data which is comprised of a proxy used for monetary policy shocks, 3 distinct indexes and 1 economic indicator. Data was extracted and is expressed on a quarterly basis and was done so in order to accommodate GDP, which is expressed on a quarterly basis.

It is important to note that there was consideration made for usage of the interbank rate as a proxy alongside the repo rate for determination of whether monetary policy changes have a direct effect on the financial market. However, the interbank rate data could only be

collected from 30/03/2007 Q1 – 31/12/2019 Q4 which means that there are insufficient entries required to fulfil the data requirements necessary for the period under analysis.

The stock price indexes selected in the form of the all share Index, the industrial 25 Index, the financial 15 Index were so selected as they are distinct and may offer different responses to changes in the repo rate.

5.4.3 Definition of variables

The following variables will be used in the study to determine whether monetary policy shocks have a direct effect on the stock market and ultimately, what effect this has on GDP.

- The repo rate: The repurchase rate (repo rate) is the interest rate that is set by the SARB's Monetary Policy Committee, it can simply be defined as the rate at which the SARB lends money to the commercial banks of South Africa. The SARB will adjust this rate in order to keep the inflation target between the range of 3% and 6%.
- The all share index: the JSE All-share index can be regarded as a market capitalization-weighted index. The companies which are included in this index make up the top 99% of the total given free-float market capitalisation of all the current listed companies which comprise the Johannesburg Stock Exchange (Bloomberg, 2021)
- The financial 15 Index: This index simply consists of the 15 largest financial based companies that currently trade on the JSE (SAshares, 2021)
- The industrial 25 index: Of all the shares that comprise the JSE, the industrial index is said to take up the majority of the biggest positions and take up the largest space on the JSE. The industrial 25 index includes some of the biggest companies that comprise the JSE and looks to give investors a breakdown of everything needed in order to make wise investment decisions (SAshares, 2021)
- Gross Domestic Product (GDP): GDP changes will reflect economic performance on a quarterly basis.

5.5 Estimation Techniques

5.5.1 Unit Root Tests

The unit root process can be defined as simple tests that will be used in order to test for stationarity in a time series. A time series can be said to be of a stationary nature if there exists a shift in time that does not cause any change in shape of a given distribution, the existence of unit roots will be the cause for non-stationarity. It is vital therefore to gain confirmation and ensure that all variables that are to be used in computation of the SVAR model do not contain a unit root, making them suitable for SVAR implementation (Glen, 2016).

A unit root in this regard can be defined as a 'random walk with drift', which means is that there is a time series that has a unit root, it would simply show the existence of a pattern that can be regarded as unpredictable. Unit roots can lead to many problems which range from:

- Errant behaviour: This occurs due to any assumptions on analysis not being valid such as when a t-ratio does not follow a t-distribution (Glen, 2016).
- Spurious regression: The existence of high r-squared values even if the data in use is uncorrelated(Glen, 2016).

The tests that are included as part of unit root computation is as follows:

- The Dickey Fuller Test: This is based on linear regression. In the instance where serial correlation can be a real issue, the Augmented Dickey-Filler test can be utilised. The Augmented Dickey Fuller Test can also be utilised in the handling of more complex data and models (Glen, 2016).
- The Philips-Perron Test: This test can be regarded as a modification of the Dickey Fuller Test which has the ability to correct for heteroscedasticity and autocorrelation (Glen, 2016).
- The Schmidt-Philips Test: Inclusion of coefficients of variables that are of a deterministic nature in both that of the null and alternate hypotheses (Glen, 2016).
- The Elliott-Rothenberg-Stock Test:

    - The DF-GLS test with application to detrended data with no intercept (Glen, 2016).
    - The P-test which will take an error term's serial correlation into account (Glen, 2016).
- The Zivot-Andrews test: This test will allow for a break at any unknown point in a linear trend or intercept (Glen, 2016).

For purposes of this study, it has been chosen to take on an Augmented Dickley Fuller approach for all variables, the approach has been chosen in order to keep a sense of consistently amongst the determination of whether there is the existence of a unit root or not.

The test will be conducted as follows for the determination of stationarity with constant intercept coefficients:

H0: Series will have a unit root which means that there is the existence of non-stationarity (Gujarati and Porter, 2009)

H1: Series does not have a unit root which means that there is the existence of stationarity (Gujarati and Porter, 2009)

If the variables under study which incorporates the repo rate, all-share index, industrial index, financial index, and GDP are not found to be stationary at level terms which is represented as I(0), the variables will be differenced in order to ensure that the variables match a level of stationarity. If the variables are then stationary at first difference terms they will be represented as I(1). It is important to note that the series may be I(0) or I(1) or a mixture for SVAR estimation.

if all variables are not statistically significant, the variables either have to be omitted or replaced in order to fulfil the objective of the study which is to carry out the SVAR model and compute the impulse responses and see whether computation of granger causality either agrees with the results obtained by the SVAR model or impulse responses or not.

5.5.2 BG serial correlation LM Test

What the LM test essentially does is that it will test for any serial correlation that can be found within the errors of a regression model. The LM test will essentially utilise the residuals that can be found in a model that is being considered in a regression analysis. From this a test statistic will be derived (eviews, 2020).

As said The LM test is to be used in order to check for any serial correlation between the variables because if there is the existence of such, then there may need to be removal of any variables from the SVAR model to be computed so as to remove any redundancy (eviews, 2020).

Through conduct of the LM test it will be assessed and represented as follows:

H0: In its null state, there is seen to be no serial correlation in the residuals up to that of a specified order (eviews, 2020).

H1: In its alternative state, there is seen to be serial correlation in the residuals up to that of a specified order (eviews, 2020).

5.5.3 The White Test

The White Test in its most basic form is used for the testing of any heteroscedasticity, which can be referred to as any differently dispersed errors within the regression analysis.

The white test can be evaluated as follows:

H0: Variances for the errors can be regarded as equal (Glen, 2016).

H1: Variances are not equal (Glen, 2016).

The test is conducted to ensure that the proxy for the asset markets at the given prices are not highly heteroscedastic, if confirmed to be highly heteroscedastic, this would mean that the entire system under study will be highly volatile (Glen, 2016). In order to correct this, the stock price indexes under study may need to be changed to their respective log variants in order to ensure that the data is normalised and therefore there exists the removal of

heteroscedasticity from the data. The execution of the study has to therefore ensures that log variant of the variables assist the entire model.

5.5.4 Vector Autoregressive Regression (VAR)

Vector Auto-Regressions (VARs) appear to be straightforward multivariate generalizations of univariate autoregressive models. However, they are in fact one of the key empirical tools in modern macroeconomics and financial economics (Gujarati and Porter, 2009).

Fundamentally simple models as they are multivariate linear time-series models, designed to capture the joint dynamics of multiple time series. VARs treat each endogenous variable in the system as a function of lagged values of all endogenous variables. They thus offer simple and flexible alternatives to the traditional multiple-equations models (Gujarati and Porter, 2009).

VARs are used for two purposes: forecasting and structural analysis. Reduced-Form VARs are sufficient for forecasting whilst Structural VARs are used for structural analysis. Structural VARs can be used to investigate the response to shocks (Gujarati and Porter, 2009).

The procedure for the estimation of a VAR model consists of firstly, the specification and estimation of a reduced-form VAR. Secondly, model checking, this has do with diagnostic analysis for the confirmation of the correct lag length. If this fails, there needs to be re-specification and estimation of a reduced form VAR, if passed however, the model can be utilised to produce forecasts and allow the user to estimate an SVAR model. The user will be able to analyse the impact of innovations through various short-run restrictions and run impulse response analysis and forecast-error variance decomposition.

5.4.4.1 VAR estimation

Let y_t be a vector containing the value of n variables at time t as described by equation 5.1:

$$y_t = [y_{1,t} \quad y_{2,t} \quad \cdots \quad y_{n,t}]' \qquad (5.1)$$

Where such variables could be output gap, interest rates, Inflation rates, stock price indices, etc.

A p-order vector autoregressive process is defined as a generalisation of a one variable $AR(p)$ process to n variables:

$$y_t = G_0 + G_1 y_{t-1} + G_2 y_{t-2} + \cdots + G_p y_{t-p} + e_t \quad (5.2)$$

This is a reduced form VAR since no economic restrictions have been imposed on the data and the residuals are not orthogonal and thus cannot be interpreted as fundamental or structural shocks (Gujarati and Porter, 2009).

The VAR model describes the evolution over time of the vector of variables y_t as a function of its past realisations $(y_{t-1}, y_{t-2}, \cdots, y_{t-p})$ and a vector of stochastic error terms (e_t). The matrices G represent:

G_0 which is a $(n \times 1)$ vector of constants

G_j for $j \in [1,p]$ which is a $(n \times n)$ matrix of coefficients

e_t is a $(n \times 1)$ vector of white noise innovations. White noise innovations means that they are serially uncorrelated with a mean of zero as can be seen in equation 5.3 and finite variance as can be seen in equation 5.4. This can be written as follows:

$$E[e_t] = 0 \quad (5.3)$$

$$E[e_t e_\tau'] = \begin{cases} \Omega, if\ t = \tau \\ 0\ otherwise \end{cases} \quad (5.4)$$

Where $e_t e_\tau'$ is a variance-covariance matrix and Ω is assumed to not be diagonal which means that the error terms of the individual equations can be contemporaneously correlated (values that do not lie on the principal diagonal are different from zero). Innovations must be uncorrelated with their own lagged values and uncorrelated with all the right-hand side variables (Gujarati and Porter, 2009).

A VAR(1) in 2 variables:

$$y_{1,t} = g_{11} y_{1,t-1} + g_{12} y_{2,t-1} + e_{1,t} \quad (5.5)$$

$$y_{2,t} = g_{21} y_{1,t-1} + g_{22} y_{2,t-1} + e_{2,t} \quad (5.6)$$

In matrix notation:

$$y_t = G_1 y_{t-1} + e_t \quad (5.7)$$

Where:

$$y_t = \begin{pmatrix} y_{1,t} \\ y_{2,t} \end{pmatrix} \quad (5.8)$$

$$G_1 = \begin{pmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{pmatrix} \quad (5.9)$$

$$e_t = \begin{pmatrix} e_{1,t} \\ e_{2,t} \end{pmatrix} \quad (5.10)$$

Assumptions about the error terms:

$$E[e_t e_t'] = \begin{pmatrix} \sigma_{e_1}^2 & \sigma_{e_1 e_2} \\ \sigma_{e_1 e_2} & \sigma_{e_2}^2 \end{pmatrix} = \Omega \quad \text{.....(5.11)}$$

Where:

$\sigma_{e_1}^2$ and $\sigma_{e_2}^2$ denotes the variance of the first variable and second variable respectively

$\sigma_{e_1 e_2}$ denotes the contemporaneous co-variance between the first and second variable. It is also different from zero.

Estimation of VARs are done via OLS estimations which is applied equation by equation.

Initially the impact of monetary policy on the economy is estimated with a VAR. VAR is an efficient tool for conducting multivariate analyses and forecasts for monetary policy shocks. For this reason, VAR is often used to perform an estimation of the Monetary Transmission Mechanism (MTM). The VAR equation will be constructed as follows:

$$\delta_t y_t = \varphi_t + \sum_{i=1}^{n} \delta_i y_{t-i} + \sum_{j=0}^{n} \beta_j x_{t-j} + \mu_t \ (eq\ 1) \quad \text{.....(5.12)}$$

Where y_t, φ_t, x_t and μ_t are vectors for the endogenous variables, constants, exogenous variables, and the white noise error term, respectively. δ_i specifies a polynomial matrix with the lag operator and β_j is a matrix of coefficients (Gujarati and Porter, 2009).

The construction of the VAR model will be denoted as

$$y_t = (RR_t, GDP_t, JALSH_t, INDI_t, FINI_t) \quad \text{.....(5.13)}$$

Where:

$RR_t =$ repo rate

$GDP_t =$ gross domestic product

$JALSH_t =$ All Share Index

$INDI_t =$ Industrial 25 Index

$FINI_t =$ Financial 15 Index

The VAR model to be run will then form the basis for determining what the LAG length criteria is. Once the VAR model is run, the LAG length criteria will be determined through the running

of a LAG order selection criteria via Eviews. The correct lag length will be determined through the sole comparison between Akaike information criterion (AIC) and Schwarz information criterion (SC). The criterion with the lowest value will be used to determine the correct lag length that will be used in order to build the SVAR model.

The lowest value of the 2 will strictly determine what the LAG length criteria is. From this the VAR will be reconstructed in order to ensure that the VAR represents the most optimal LAG length for the construction of the SVAR. Furthermore, there will be an assessment of the AR roots table/graph in order to ensure that the VAR with corrected LAG length satisfy the stability condition and is therefore fit for SVAR implementation.

As said, the VAR to be run will encapsulate the chosen variables to be incorporated into the SVAR model which are the repo rate, the stock price indexes of the all-share index, industrial 25 index and the financial 15 indexes with GDP. This is all done in order to further determine what the lag length criteria is and to further ensure that the stability conditions are met.

A VAR residuals covariance matrix will be computed as well, this is in order to ensure that the VAR is stable and well specified.

5.5.5 The SVAR

For SVAR identification, there needs to be an estimate matrix A, which will be expressed later. In order to achieve this, there needs to be restrictions imposed on matrix A since there are more unknowns than knowns. To determine the number of restrictions, there is usage of the following formula with $n = 5$ since have 5 variables.

$$\frac{n^2-n}{2} = \frac{5^2-5}{2} = 10 \quad \text{.....(5.14)}$$

Hence, the minimum number of restrictions imposed on matrix A needs to be 10. To do this, 10 values need to be set, off the principal diagonal, equal to zero according to economic rules.

The SVAR model is fairly compatible with economic theory as the SVAR approach functions quite well by introducing the desired restrictions to diagnose the effects of policy shocks. It

detects interactions and complicated relationships between policy and key macro indicators (Gottschalk, 2001).

To obtain the structural model's reduced form, multiply both sides of $eq\ 1$ by δ_0^{-1} to obtain:

$$y_t = \gamma + \theta_1 y_{t-i} + \rho x_t + \varepsilon_t \quad \text{.....(5.15)}$$

Where $\gamma = \delta_0^{-1}\varphi, \theta_1 = \delta_1\delta_0^{-1}, \rho = \beta\delta_0^{-1}$ and $\varepsilon_t = \delta_0\mu_t$. Structural disturbances are derived by imposing the required restrictions on δ_0 to determine the SVAR as follows:

$$\begin{bmatrix} \mu_{RR} \\ \mu_{GDP} \\ \mu_{JALSH} \\ \mu_{INDI} \\ \mu_{FINI} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ NA & 1 & 0 & 0 & 0 \\ NA & NA & 1 & 0 & 0 \\ NA & NA & NA & 1 & 0 \\ NA & NA & NA & NA & 1 \end{bmatrix} \times \begin{bmatrix} \varepsilon_{RR} \\ \varepsilon_{GDP} \\ \varepsilon_{JALSH} \\ \varepsilon_{INDI} \\ \varepsilon_{FINI} \end{bmatrix} \quad \text{.....(5.16)}$$

Row 1 represents the equilibrium in the money market, row 2 represents the equilibrium in the goods market and rows 3, 4 and 5 represent the equilibrium in the financial market.

The restrictions that are placed on the SVAR model can be describe as recursive factorisation (A root triangular and B diagonal)

5.5.6 Impulse Responses

Impulse response analysis is an important progression in econometric analysis. The main purpose of impulse responses is to describe any evolution that a model's variables might experience in a reaction to a shock to one or more variables. This feature alone allows econometricians to trace out any transmissions of a single shock within a system of equations (eviews, 2020).

It is an important tool that can be utilised in order to express the evolution of a given variable of interest along a given time horizon after a shock has occurred. It simply tracks the impact of variables on other variables and has the ability to trace effects on not only present but future values of all endogenous variable of one standard deviation shock to one of the given innovations.

5.5.7 Granger Causality

Granger causality can be determined as the test that is used in order to investigate whether there exists any form of causality between 2 chosen variables. The method found within granger causality can simply be described as a probabilistic account of causality in that it will use given empirical data sets for the sole purpose of findings any trends/patterns of correlation (Gujarati and Porter, 2009).

The basic steps to the determination and running of the granger causality test are as follows:

The stating of the null and alternative hypothesis for the test are as follows:

H0: Variable γ does not granger cause Variable χ (eviews, 2020)

H1: Variable γ does granger cause Variable χ (eviews, 2020)

And

H0: Variable χ does not granger cause Variable γ (eviews, 2020)

H1: Variable χ does granger cause Variable γ (eviews, 2020)

The lags have to also be determined which mostly depends on how much data has been collected and will form a part of the model.

It is important to note that with Granger causality tests in a Pairwise scenario the null hypothesis is that variable χ will not granger cause variable γ in the first regression and in the second regression variable γ will not granger cause χ (eviews, 2020).

If in both scenarios, there is rejection of the null hypothesis then there will be the existence of Bidirectionality. If in both scenarios there is no rejection of the null hypothesis in both scenarios, then there will be no sign of granger causality. If there exists, the rejection of only one scenario then granger causality will only run one way and not the other (eviews, 2020).

The testing of granger causality is done in order to either build on what has been found in the results obtained from the SVAR model and impulse responses or disprove the results in order to build a conclusion between the relationship of the repo rate, financial market, and GDP.

5.6 Chapter Summary

This chapter explains the methods and procedures which are utilised in order to carry out the study. The research paradigm that will be used will be that of a post-positivist approach, the reason for this is that the study looks to address a similar research type as that that has been conducted by Muroyiwa et al. (2017). In which the research that is being conducted looks to fundamentally build and expand on the research through utilisation of not only a longer period under analysis which runs from 1999:01 to 2019:12 but to also take on a quarterly approach as to accommodate GDP figures which were released on a quarterly basis.

The chapter identifies the exact variables that will be utilise, these variables can be identified as the repo rate which is the repurchase rate that is set by the SARB's Monetary Policy Committee which can simply be defined as rate at which the SARB lends money to the commercial banks of South Africa. The All share-index which regard all the companies which are included in this index make up the top 99% of the total given free-float market capitalisation of all the current listed companies which comprise the JSE. The financial 15 which consists of the 15 largest financial based companies on the JSE. The industrial 24 which includes some of the biggest companies that comprise the JSE and looks to give investors a breakdown of everything needed in order to make wise investment decisions and lastly GDP, which simply confirms how the South African economy is performing. All these variables and data will be collected through utilisation of Bloomberg and will be conducted on a quarterly basis.

Together these variables will be utilised in order to build on all the econometric techniques ranging from the standard VAR that will be utilised in conjunction with the LAG length criteria as will be determined by running the LAG order selection criteria via Eviews, comparisons will be drawn between the AIC and SC, the lowest value will determine whether the model Is fit for the SVAR, further clarification will determined through assessment of the AR toots table/graph in assurance that the LAG length satisfies the stability condition.

The SVAR model will be utilised, it is primarily chosen as it easily detects interactions and complications between policy, which is that of the repo rate and the financial market indexes utilised. This will be backed up by impulse response analysis to evaluate the transmissions of a single shock within a system of equations. Granger Causality will be utilised to supplement or deter results from the SVAR and impulse responses.

CHAPTER 6

PRESENTATION AND DISCUSSION OF RESULTS

6.1 Introduction

The presentation and discussion of results will first start with the stationarity tests in order to ensure that the repo rate, the all-share index, financial index, industrial index, and GDP are significant and suitable for usage in the SVAR model, this will come in the form of either being stationary at level terms or through first difference, if suitability is not achieved, different variables will have to be considered. A VAR will then be computed, which will then further be tested using the LAG length Criteria in order to ensure that the suitable LAG length is being utilised, to then utilise the AR roots table in order to assess whether any roots lie outside of the inner circle which will be presented, this is in order to ensure that the VAR meets the stability condition. The VAR residuals covariance matrix will then be computed in order to verify that the VAR is stable and well specified. A white test will be conducted in order to assess and check for any heteroscedasticity of the residuals, the idea is to ensure that the entire system under study is not highly volatile and unpredictable, log variants of the stock indexes will be tested to ensure that the data is normalised, and heteroscedasticity is removed.

An LM test will then be computed in order to check and assess for any serial correlation and to ensure that that the data is suitable for SVAR implementation. A full SVAR model will then be computed from the period between 1999:01 to 2019:12 in order to assess whether there are any significant relationships between the repo rate and the various indexes and between GDP and the various indexes, after this there will be the computation of impulse responses in order to supplement the result which has been obtained from the SVAR model and then to end off the study, all variables will be placed under granger causality which will either supplement or reject the conclusions drawn from the SVAR model and the impulse responses, the conclusions drawn from granger causality will ultimately determine whether there exists a direct or indirect relationship between monetary policy shocks and the stock market and how the stock market effects changes in GDP via the effects of monetary policy shocks.

6.2 Results

Before the various stationary tests are conducted, it is important to establish how the variables under study are trending overtime, the figure in discussion can be found in Appendix A as Figure A1. The repo rate can be shown to be generally decreasing over time. GDP has been shown to be very volatile with a major dip during the 2008 global financial crisis with a recovery from 2009. There exists a general upward trend of the all share index and the industrial 25 however and the financial 15 index has seen a slow increase, with a dip during the 2008 global financial crisis which then increases at an accelerated pace post 2008 global financial crisis

Various stationarity tests were computed in order to ensure that the variables used are suitable for SVAR implementation, it is important to ensure that all the variables do not contain a unit root and that there is no existence of a 'random walk with drift', this would lead to high unpredictability, as said the tests will be carried out through utilisation of the Augmented Dickey Fuller test, the tests will also be conducted with a constant intercept coefficient.

The results of the tests are as follows:

- The repo rate was tested on level terms and was found to be non-stationary on level terms, it was further tested at first difference and was found to be significant at I(1) at the 1% level, evidence of this can be found in appendix A in accordance with table A1.
- GDP was tested on level terms and has been found to be significant at I(0) at the 1% level, evidence of this can be found in appendix A in accordance with table A2.
- the financial 15 index was tested on level terms and was found to inhabit nonstationary at level terms but was further tested at first difference and was therefore found to be significant at I(1) at the 1% level. Evidence of this can be found in appendix A in accordance with table A3
- The industrial 25 index was tested on level terms and was found to inhabit nonstationary at level terms, it was further tested at first difference and was found to

be significant at I(1) at the 1% level, evidence of this can be found in appendix A in accordance with table A4.

- The all share index was tested on level terms and was found to inhabit non-stationarity at level terms, it was further tested at first difference and was found to be significant at I(1) at the 1% level, evidence of this can be found in appendix A in accordance with table A5.

It therefore confirms that the variables listed are suitable for model usage.

Table 6.1: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria		
Lag	AIC	SC
0	7.758343	7.911680
1	-2.485967	-1.565940*
2	-2.778932	-1.092217
3	-2.789950*	-0.336547
4	-2.524051	0.696042
5	-2.331205	1.655575
6	-2.288608	2.464862
7	-2.127692	3.392466
8	-2.754718	3.532129

* indicates lag order selected by the criterion
AIC: Akaike information criterion
SC: Schwarz information criterion

Source: Eviews 11 (2020)

After suitability for SVAR implementation, the next step was to formulate a standard VAR which can be found in appendix B as table B1, of which was modified to ensure that the LAG length criteria were accurate and correct. After further investigation and in accordance with the VAR LAG Order Selection Criteria, it was found that the leg length of 3 is the most suitable. The suitable LAG length Criteria was found through comparison of the AIC and the SC, with the AIC value lower than the SC at a LAG length of 3, the VAR was then modified to 3 lags, evidence of this can be found above in accordance with table 6.1.

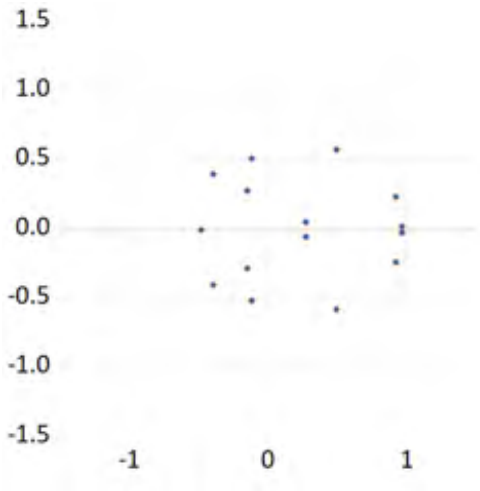


Figure 6.1: Inverse Roots of AR Characteristic Polynomial

Source: Eviews 11 (2020)

Table 6.2: Roots of AR Characteristic Polynomial

Roots of Characteristic Polynomial	
Lag specification: 1 3	
Root	Modulus
0.963483 - 0.023077i	0.963759
0.963483 + 0.023077i	0.963759
0.920173 - 0.234977i	0.949701
0.920173 + 0.234977i	0.949701
0.491932 - 0.575563i	0.757146
0.491932 + 0.575563i	0.757146
-0.394586 - 0.401918i	0.563237
-0.394586 + 0.401918i	0.563237
-0.121164 - 0.510765i	0.524939
-0.121164 + 0.510765i	0.524939
-0.481555	0.481555
-0.148082 - 0.282223i	0.318713
-0.148082 + 0.282223i	0.318713
0.272520 - 0.054757i	0.277967
0.272520 + 0.054757i	0.277967

No root lies outside the unit circle
VAR satisfies the stability condition

Source: Eviews 11 (2020)

After this, further investigation was placed on finding whether the AR roots table has any root that lies outside of the inner circle, after careful assessment it was found that no root lies outside of the inner circle and therefore that the VAR satisfies the stability condition, this is proven when assessing both the Figure 6.1 and table 6.2 above.

Table 6.3: VAR residuals covariance matrix

VAR residuals covariance matrix					
	Repo Rate	GDP	FINANCIAL 15 INDEX	INDUSTRIAL 25 INDEX	ALL SHARE INDEX
Repo Rate	0.20465	0.20418	-0.00434	0.00155	0.00559
GDP	0.20418	3.29206	-0.01176	0.01623	0.02255
FINANCIAL 15 INDEX	-0.00434	-0.01176	0.00648	0.00403	0.0027
INDUSTRIAL 25 INDEX	0.00155	0.01623	0.00403	0.00602	0.0037
ALL SHARE INDEX	0.00559	0.02255	0.0027	0.0037	0.00396

Source: Eviews 11 (2020)

Off diagonal elements are different from zero so therefore the residuals are correlated amongst themselves, this is in accordance with table 6.3 above. According to the correlograms as can be seen in Appendix B as figure B1, which shows the cross correlograms of the estimated VAR residuals for 12 lags, there is no indication of seasonality and the residuals are completely random.

Table 6.4: The White test

VAR Residual Heteroskedasticity Tests (Levels and Squares)

Joint test		
Chi-sq	df	Prob.
548.3918	450	0.001

Individual components					
Dependent	R-squared	F(30,50)	Prob	Chi-sq(30)	Prob.
res1*res1	0.570781	2.216353	0.0062	46.23324	0.0295
res2*res2	0.668945	3.367744	0.0001	54.18455	0.0044
res3*res3	0.426361	1.238759	0.247	34.5352	0.2599
res4*res4	0.392631	1.077411	0.3994	31.80314	0.3767
res5*res5	0.312779	0.75856	0.7889	25.33509	0.7086
res2*res1	0.473155	1.496818	0.1018	38.32554	0.1416
res3*res1	0.461615	1.429011	0.1299	37.39081	0.166
res3*res2	0.568544	2.196224	0.0068	46.05207	0.0307
res4*res1	0.242617	0.533893	0.9657	19.65197	0.9253
res4*res2	0.405706	1.137784	0.3365	32.86223	0.3286
res4*res3	0.311343	0.753503	0.7946	25.21879	0.7143
res5*res1	0.318174	0.777751	0.7669	25.77213	0.6867
res5*res2	0.306113	0.735261	0.8146	24.79514	0.7349
res5*res3	0.300375	0.715561	0.8352	24.33035	0.7569
res5*res4	0.368131	0.97101	0.5247	29.8186	0.475

Source: Eviews 11 (2020)

In computation of the White test as above in table 6.4, it has been confirmed that there is no sign of heteroscedasticity. The financial indexes were converted to their Log counterparts as it has been found that there was sign of heteroscedasticity without the conversion to Log format. With evidence from the above, there exists no violation of the assumptions for linear regression modelling, therefore there will be no impact in accordance with the validity of econometric analysis so the study can proceed.

Table 6.5: The LM Test

VAR Residual Serial Correlation LM Tests

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	31.44080	25	0.1748	1.281159	(25, 209.5)	0.1760
2	34.85352	25	0.0909	1.431504	(25, 209.5)	0.0917
3	24.98050	25	0.4635	1.002833	(25, 209.5)	0.4649
4	21.02188	25	0.6914	0.836263	(25, 209.5)	0.6925
5	20.91203	25	0.6975	0.831683	(25, 209.5)	0.6986
6	24.19184	25	0.5083	0.969410	(25, 209.5)	0.5097
7	45.83669	25	0.0067	1.931423	(25, 209.5)	0.0068
8	25.99906	25	0.4076	1.046177	(25, 209.5)	0.4091

Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	31.44080	25	0.1748	1.281159	(25, 209.5)	0.1760
2	59.76657	50	0.1623	1.219832	(50, 236.0)	0.1666
3	81.45006	75	0.2856	1.096306	(75, 224.5)	0.3009
4	96.98151	100	0.5668	0.953092	(100, 204.7)	0.6016
5	131.2674	125	0.3329	1.040242	(125, 182.1)	0.4012
6	186.1310	150	0.0240	1.296307	(150, 158.4)	0.0538
7	229.2321	175	0.0037	1.399839	(175, 134.2)	0.0206
8	268.8887	200	0.0008	1.440885	(200, 109.7)	0.0174

Source: Eviews 11 (2020)

Assessing table 6.5 above, at the 5% level of significance, there is no serial correlation at lag 1 to lag 6, but there is serial correlation at lag 7. From lag 1 to lag 6 there is no serial correlation at the 5% level of significance but for lag 1 to 7 and 8, there is serial correlation at the 5% level of significance. This confirms that the optimal choice of 3 lags is ideal.

The SVAR model was then computed for the full period from 1999:01 to 2019:12 in order to assess whether there are any significant relationships between the repo rate and the various indexes which will be measured against the repo rate which are the All-Share Index, Financial 15 Index and the Industrial 25 Index and these indexes will then be measured against GDP. Through computation of the SVAR as below, which has been converted from Eviews into an Excel Spreadsheet for easier interpretation.

Table 6.6: The SVAR for the Full Period

Matrix A					
	REPO RATE	GDP	JALSH	INDI25	FINI15
REPO RATE	1	0	0	0	0
GDP	-0.997682	1	0	0	0
JALSH	-0.021858	-0.00549	1	0	0
INDI25	0.018238	0.000547	-0.96476	1	0
FINI15	0.025813	0,006348	-0.25141	-0.53845	1

Matrix A p-value					
	REPO RATE	GDP	JALSH	INDI25	FINI15
REPO RATE	1	0	0	0	0
GDP	0.0208	1	0	0	0
JALSH	0,1572	0,1540	1	0	0
INDI25	0,1540	0,8639	0,0000	1	0
FINI15	0,0906	0,0912	0,1288	0,0000	1

Source: Eviews 11 (2020)

- In assessment of Matrix A, there exists a statistically significant relationship between the repo rate and GDP, this can be evidenced by assessing the Matrix A p-value of 0,0208 which is significant at the 1% level. This statistical relationship shows us that the relationship between the repo rate and GDP does not merely exist by chance.
- In assessment of the relationship between the repo rate and the All-share index, it is found that there exists no statistically significant relationship at the 1%, 5% and 10% level with a Matrix A p-value of 0.1572.
- In assessment of the relationship between the repo rate and the industrial 15 index, it is found that there exists no statistically significant relationship at either the 1%, 5% and 10% level with a Matrix A p-value of 0,1540.
- Furthermore, in assessment of Matrix A it can be found that there exists only one significant relationship between the repo rate and the various indexes chosen for this study. The only viable and significant relationship between the repo rate and the various indexes is found to be the financial 15 index which is significant at the 10% level with a Matrix a p-value of 0,0906. This statistical relationship shows us that the

relationship between the repo rate and the financial 15 index does not merely exist by chance.

In summary, there only exists relationships between the repo rate and GDP and the Repo rate and the financial 15 index. Further assessment would then be between GDP and the various indexes.

- In assessment of the relationship which can be found between GDP and the all-share index, there exists no statistically significant relationship at either the 1%, 5% and 10% level with a Matrix A p-value of 0,1540.
- In assessment of the relationship which can be found between GDP and the industrial 25 index, there exists no statistically significant relationship at the 1%, 5% and 10% level at a Matrix A p-value of 0,8639
- In assessment of the relationship that exists between GDP and the financial 15 index, there exists a statistically significant relationship at the 10% level with a Matrix A p-value of 0,0912. This statistical relationship shows us that the relationship between the GDP and the financial 15 index does not merely exist by chance.

To summarise the findings as stipulated by the SVAR model, there exists a direct relationship between the repo rate and GDP and an indirect relationship between the indexes and the repo rate due to the significance of the coefficients of the SVAR model. This will further be confirmed through the computation of the impulse responses and will either be supplemented or disproven by granger causality.

The impulse response functions indicate the dynamic reactions of the endogenous variables to a one-time shock in the Repo Rate. The X and Y axes refer to quarters and impulse responses of the variables, respectively. The dotted line in the graph shows ± 2 standard error confidence intervals in the response of the variables.

impulse response scenarios were run as follows:

- Impulses:
    - Repo Rate and GDP
- Responses:
    - GDP, all-share index, industrial 25 index and financial 15 index.

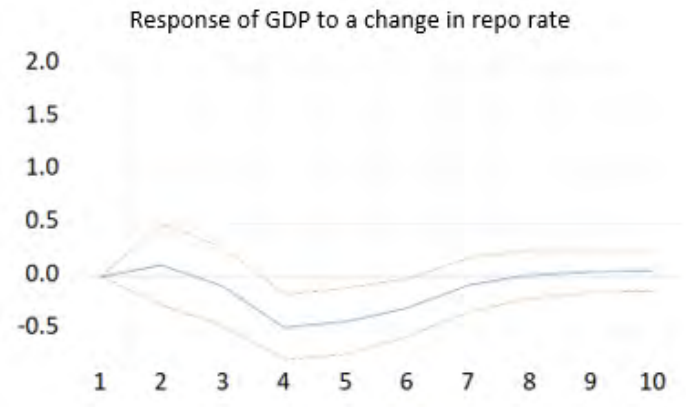
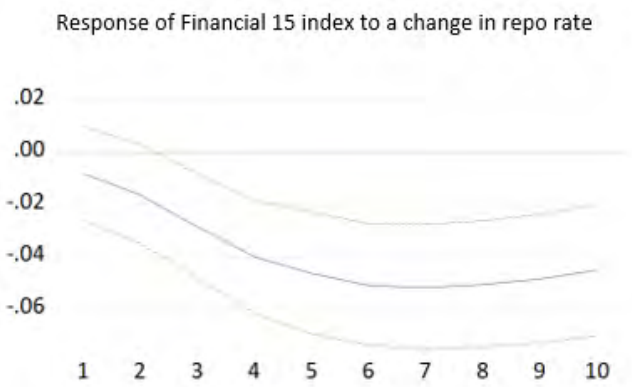


Figure 6.2: Impulse responses: Response of GDP to Repo Rate

Source: Eviews 11 (2020)

As can be seen in Figure 6.2, a rise in the Repo Rate leads to a decline in GDP which can be regarded as being economically significant. The increase in monetary policy tightening brings about a U-shaped trajectory in output, which bottoms out over the 4-th quarter.



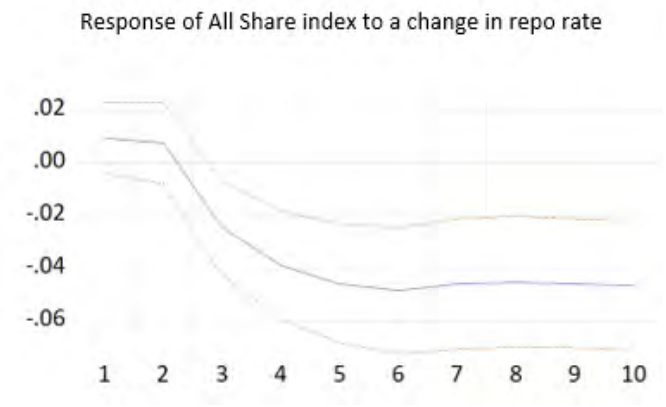
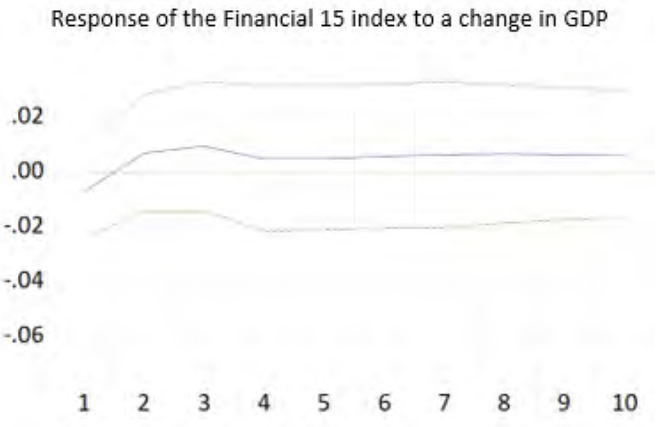


Figure 6.3: Impulse responses: Response of the stock indexes to a change in the repo rate

Source: Eviews 11 (2020)

As can be seen in figure 6.3, a rise in the Repo Rate leads to a decline in all 3 stock indexes present, as expected. It is important to note that the effects that the repo rate inhabit on the stock price indexes are consistent throughout. With regards to the indices, the monetary policy tightening has a sustained impact as the graphs never return to pre-shock levels over a 10-quarter period (2,5 years). The reason as to why the graphs never returned to pre-shock levels could be due to the fact that the indexes have not been performing well, thus the graphs do not return to their pre-shock state. It could also be due to the equity indexes and their performance overall being influenced by global risk sentiment rather than the reaction to monetary policy alone. Therefore, there are external factors which factor into the overall performance of the equity indexes.



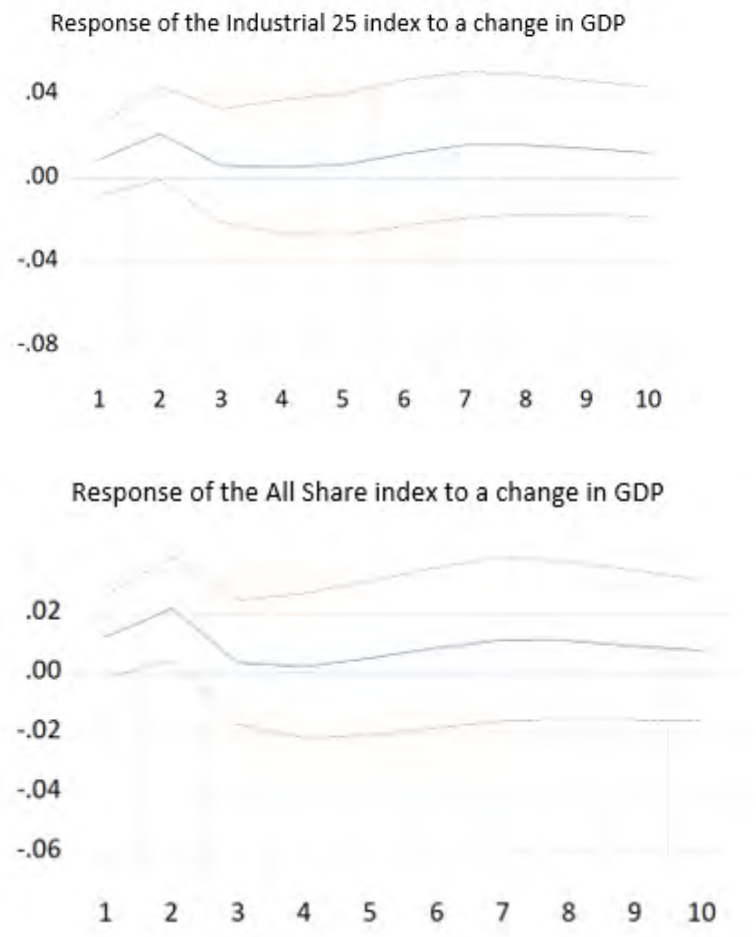


Figure 6.4: Impulse responses: Response of the stock indexes to a change in GDP

Source: Eviews 11 (2020)

As can be seen in figure 6.4, a rise in GDP leads to a rise in all the indices, any change in GDP has much of a consistent pattern on the All-Share index, industrial 25 index and the financial 15 index.

To confirm the entire investigation and ensure that it draws the same conclusion drawn from an SVAR model and the impulse responses, granger causality was used.

Table 6.7: Granger Causality

Pairwise Granger Causality Tests		
Null Hypothesis:	**F-Statistic**	**Prob**
GDP does not Granger Cause REPO RATE	1.56705	0.2045
REPO RATE does not Granger Cause GDP	1.70509	0.1733
ALL SHARE INDEX does not Granger Cause REPO RATE	4.28269	0.0076
REPO RATE does not Granger Cause ALL SHARE INDEX	11.9464	2.00E-06
INDUSTRIAL 25 INDEX does not Granger Cause REPO RATE	3.11552	0.0312
REPO RATE does not Granger Cause INDUSTRIAL 25 INDEX	12.5879	1.00E-06
FINANCIAL 15 INDEX does not Granger Cause REPO RATE	1.12564	0.3443
REPO RATE does not Granger Cause FINANCIAL 15 INDEX	9.57773	2.00E-05
ALL SHARE INDEX does not Granger Cause GDP	5.97972	0.001
GDP does not Granger Cause ALL SHARE INDEX	2.08297	0.1097
INDUSTRIAL 25 does not Granger Cause GDP	5.98542	0.001
GDP does not Granger Cause INDUSTRIAL 25 INDEX	1.82615	0.1498
FINANCIAL 15 INDEX does not Granger Cause GDP	7.40035	0.0002
GDP does not Granger Cause FINANCIAL 15 INDEX	1.69904	0.1746

Source: Eviews 11 (2020)

The Granger Causality test confirms a different conclusion to that which was found in both our SVAR and impulse response tests. The results are as follows:

- From the Granger Causality results of the first combination between GDP and the repo rate, it is confirmed that there exists no granger causality, the null hypothesis where GDP does not Granger Cause the repo rate cannot be rejected with a prob value of 0.2045. The second null hypothesis where the repo rate does not granger cause GDP can also not be rejected with a prob value of 0,1733.
- Assessing the second combination between the all share Index and the repo rate, there exists a bidirectional relationship. From the first null hypothesis where the all-share index does not granger cause the repo rate, there is acceptance the alternative hypothesis that the all share index does granger cause the repo rate at a prob value of 0,0076. In the 2nd null hypothesis where the repo rate does not granger cause the all share index, there is rejection of the null hypothesis and acceptance of the

alternative hypothesis that the repo rate does granger cause the all-share index at a prob value of 0,000006.

- When assessing the relationship between the industrial 25 index and the repo rate, there is also the existence of a bidirectional relationship. When assessing the null hypothesis that the industrial 25 index does not granger cause repo rate, there is rejection of the null hypothesis and acceptance of the alternative hypothesis that the industrial 25 index does granger cause the repo rate at a prob value of 0,0312. When assessing the second null hypothesis where the repo rate does not granger cause the industrial 25 index, there is rejection of the null hypothesis and acceptance of the alterative hypothesis that the repo rate does granger cause the industrial 25 index at a prob value of 0,000001.
- When assessing the relationship between the financial 15 Index and the repo rate, there exists only a one-way relationship. Firstly, there is assessment of the 1st null hypothesis that states that the financial 15 index does not granger cause the repo rate, failing to reject the null hypothesis at a prob value of 0,3443. When assessing the 2nd null hypothesis that states that the repo rate does not granger cause the financial 15 index, the null hypothesis is rejected and there is acceptance of the alternative hypothesis that the repo rate does granger cause the financial 15 index at a prob value of 0,00002.
- Looking at the next relationship between the all share index and GDP, there exists only a one-way relationship. When assessing the 1st null hypothesis where the all share index does not granger cause GDP, there is rejection of the null hypothesis and acceptance of the alterative hypothesis that the all share index does granger cause GDP at a prob value of 0,001. Assessing the 2nd null hypothesis that GDP does not granger cause the all-share index, there is a failure to reject the null hypothesis at a prob value of 0,1097.
- Looking at the next combination between the industrial 25 index and GDP, there exists a one-way relationship. Assessing the 1st null hypothesis where the industrial 25 index does not granger cause GDP, there is rejection of the null hypothesis and acceptance of the alterative hypothesis that the industrial 25 index does granger cause GDP at a prob value of 0,0010. Assessing the 2nd null hypothesis that states that GDP does not

granger cause the industrial 25 index, there is a failure to reject and accept the null hypothesis at prob value of 0,1496.

- Assessing the next combination, financial 15 and GDP there exists a one-way relationship. When assessing the 1st null hypothesis that the financial 15 index does not granger cause GDP, , there is rejection of the null hypothesis and acceptance of the alterative hypothesis that the financial 15 index does granger cause GDP with a prob value of 0,0002. Assessing the 2nd null hypothesis where GDP does not granger cause financial 15 index, there is a failure to reject the null hypothesis at a prob value of 0,1746.

6.3 Chapter summary

This chapter ran all the necessary tests that were required to fulfil the objectives of this research. Econometric techniques used ranged from simple unit root tests, LM test, white test, a VAR, SVAR, impulse responses and lastly, granger causality. To summarise the findings as stipulated by the SVAR model, there exists and direct relationship between the repo rate and GDP and an majority indirect relationship between the indexes and the repo rate due to the significance of the coefficients of the SVAR model. In assessment of the impulse responses a rise in the Repo Rate leads to a decline in GDP which can be regarded as being economically significant. Also, a rise in the Repo Rate leads to a decline in all 3 stock indexes present, as expected. Lastly, a rise in GDP leads to a rise in all the indices, any change in GDP has much of a consistent pattern on the All-Share index, industrial 25 index and the financial 15 index. Consistency is projected throughout for both how GDO effects the indexes and how the repo rate effects the indexes.

The conclusion drawn from the findings from running granger causality is that monetary policy changes does express a direct impact on the asset pricing channel and that the asset pricing channel is what is responsible for changes in GDP via monetary policy. Therefore, the causality is between the repo rate and the asset market and the asset market causes the changes in GDP.

CHAPTER 7

DISCUSSION OF RESULTS

7.1 Introduction

The assessment and research of the asset pricing channel of monetary policy transmission in South Africa breeds a plethora of suggestions that could be useful for the MPC. The crux of this research is to ensure that the MPC best utilise changes in the repo rate throughout the monetary policy transmission mechanism as to ensure that they meet overall policy objectives as optimally as possible.

7.2 Key findings

Through research conducted in this paper, the paper conducted by Muroyiwa et al. (2017) utilised to either build on the conclusion or to deter from it. As a reference of that particular study, it was concluded again that a change in in the interest rate will lead to a significant change in the stock prices. It was therefore concluded that monetary policy has an overall significant impact on stock prices in South Africa. It is therefore possible for the monetary authorities of South Africa to not only contain but influence stock market movements that a prevalent in the South African financial market.

Key components and findings from this research through careful assessment of an SVAR, impulse response reactions and granger causality can be summarised as follows. Careful assessment was made of the SVAR model which is a comparable approach employed by Muroyiwa et al. (2017), used to detect the interactions and complications of relationships between policy (repo rate) and key macro indicators which take the place of the chosen financial indexes. It was found that there exists a statistically significant relationship between repo rate changes and GDP and only one statistically significant relationship exists between that of the repo rate and the stock price indexes, which is the financial 15 index at the 10% level. Assessing the relationship between GDP and the financial indexes, there exists only a statistically significant relationship between GDP and the financial 15 index at the 10% level.

The findings from the SVAR model can be summarised as follows. As expected, a direct relationship exists between the repo rate changes and GDP and an indirect relationship exists between the indexes and the repo rate, this is primarily due to the overall significance that of the coefficients that make up the SVAR model. Further investigation however was required to supplement or deter the findings which have been collected by the SVAR model.

Impulse responses were formulated with the impulses taking the form of the Repo Rate and GDP and the responses taking the form of the repo rate, GDP, all-share index, industrial 25 index and the financial 15 index. Further investigation and usage of the impulse responses confirmed stipulated that a rise in the repo rate will consequentially lead to an overall decline in GDP which can therefore be regarded as being economically significant.

A rise in the repo rate however has led to an overall decline in the all-share index, the financial 15 index and the industrial 25 index which confirms that the repo rate has a similar effect on the financial market indexes across the board which therefore produced consistent results. Monetary policy tightening measures through the rise in the repo rate will bring about a U-shaped trajectory in output which has shown to bottom out over the 4th quarter over a 10-quarter period. With regards to monetary policy tightening through an increase in the repo rate, the tightening has a sustained impact as the graphs do not return to pre-shock levels over the 10-quarter period. The results which have been gathered by the impulse responses supplement the results which have been obtained by the SVAR model.

Computation was then made of Pairwise Granger Causality tests to either supplement or deter the results obtained by both the SVAR and the impulse responses. It was found that there exists bidirectionality between the combination of the all-share index and the repo rate, bidirectionality between the combination of the industrial 25 index with a one-way relationship between the combination of the financial 15 index and the repo rate where the repo rate does granger cause the financial 15 index but not the other way around. There then exists a one-way relationship between GDP and all the financial indexes present which are the all-share index, financial 15 index and the industrial 25 index. The relationship between these combination comes in the form of where the financial indexes granger cause GDP but not the other way around. In conclusion from assessing the pairwise granger causality tests, it is shown to deter the results which have been found by both the SVAR model and the

impulse responses. In conclusion from computing granger causality, it is shown that monetary policy changes in the form of the repo rate express a direct impact on the asset pricing channel and that the asset pricing channel will then be responsible for changes in GDP via the changes which have been bought about by monetary policy.

Therefore, in summation from the computation of granger causality is that there exists causality between the repo rate and the asset pricing channel and the asset pricing channel as shown through the stock market indexes will cause changes in GDP. When the MPC decides to inflict changes in the repo rate, this monetary policy change will have a direct impact on the financial market and changes that are made in the financial market will therefore have a direct impact on GDP.

7.3 Limitations

- Limitations of the study come in the form of only using the repo rate as a proxy for the study. It was initially decided to both use the repo rate and the interbank rate, however data for the interbank rate could only be collected for the period from 2007:01 – 2019:12 which would not be useful for the study as there needs to remain a sense of consistency throughout the period from 1999:01 to 2019:12.
- The data collected was also collected on a quarterly basis rather than on a monthly basis, this was done solely to accommodate GDP figures which could only be collected on a quarterly basis from Bloomberg.

7.4 Areas of future research

It is recommended that the MPC focus their attention on the asset pricing channel as a part of the broader monetary policy implementation considerations. It does form a part of the effected channels; however, it needs to be of higher consideration as has been concluded from this study and builds on the findings of Muroyiwa et al. (2017) that monetary policy considerations have an overall significant impact on stock prices in South Africa. South African monetary authorities have the power to influence and contain stock price movements prevalent in South Africa, they are to utilise this correctly, especially during a COVID-19 global pandemic. The South African monetary authorities need to as being built on the suggestions

made by Muroyiwa et al. (2017) build on the competitiveness of the South African financial market, the financial market in South Africa is currently highly closed off and regulated.

7.5 Conclusion

In this section of the thesis, there is a presentation of the main findings in regard to the asset pricing channel forming a part of the monetary policy transmission channel. It was found that monetary policy changes do lead to a direct impact on stock prices and stock prices directly impact GDP. It would therefore mean that the MPC need to be more vigilant when considering monetary policy decision making in respects to the repo rate and how this will be utilised in order to meet their overall policy objectives.

This would mean that, especially during a global pandemic and possible future financial collapses, the MPC needs to be far more careful with their repo rate changes and to further extenuate what Muroyiwa et al. (2017), the SARB needs to ultimately work towards a series of legislation that will ultimately increase competitiveness of the South African financial sector which is currently considered to be very regulated and closed. This will essentially then lead to an increase in interest rate pass through which will make any monetary policy considerations far more effective. Monetary policy changes can be used to boost economic growth more aggressively, especially when considering the asset pricing channel.

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APPENDIX A

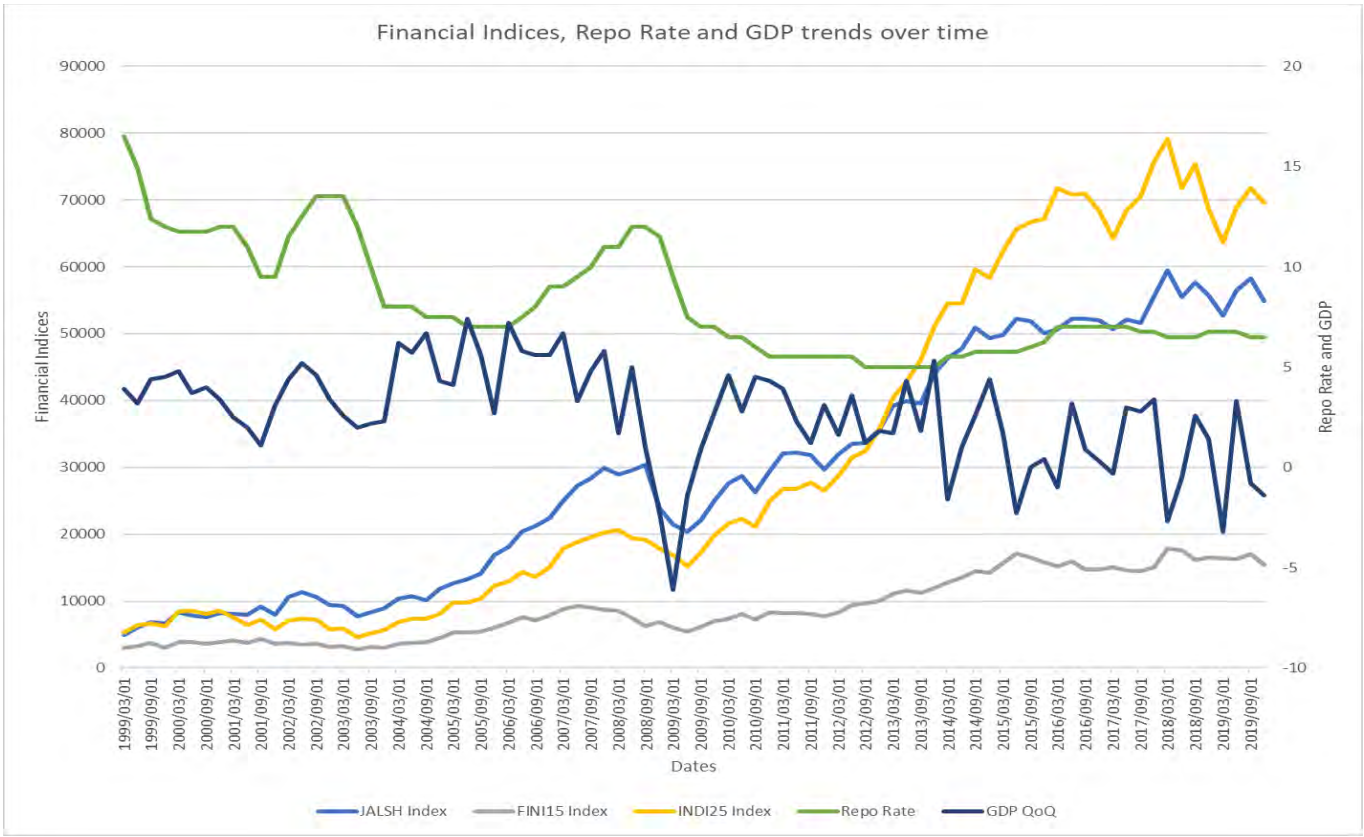

Figure A1: Financial Indices, Repo Rate and GDP trends over time

Table A1: Stationarity Test – REPO Rate

Null Hypothesis: D(REPO_RATE) has a unit root			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		-4.986831	0.0001
Test critical values:	1% level	-3.51229	
	5% level	-2.897223	
	10% level	-2.585861	

Source: Eviews 11 output (2020)

Table A2: Stationarity Test – GDP

Null Hypothesis: GDP has a unit root			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		-4.899676	0.0001
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

Source: Eviews 11 output (2020)

Table A3: Stationarity Test – Financial 15 Index

Null Hypothesis: D(FINANCIAL 15 INDEX) has a unit root			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		-10.57874	0.0001
Test critical values:	1% level	-3.51229	
	5% level	-2.897223	
	10% level	-2.585861	

Source: Eviews 11 output (2020)

Table A4: Stationarity Test – Industrial 25 Index

Null Hypothesis: D(INDUSTRIAL 25 INDEX) has a unit root			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		-9.401085	0
Test critical values:	1% level	-3.51229	
	5% level	-2.897223	
	10% level	-2.585861	

Source: Eviews 11 Output (2020)

Table A5: Stationarity Test – All-Share Index

Null Hypothesis: D(ALL SHARE INDEX) has a unit root			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		-8.792566	0
Test critical values:	1% level	-3.51229	
	5% level	-2.897223	
	10% level	-2.585861	

Source: Eviews 11 Output (2020)

APPENDIX B

Table B1: Vector Autoregressive Model

Vector Autoregression Estimates					
	REPO_RATE	GDP_QOQ	LOGFINI15_INDEX	LOGINDI25_INDEX	LOGJALSH_INDEX
REPO_RATE(-1)	1.292015	0.200867	-0.031132	-0.016621	-0.000796
	(0.10696)	(0.42899)	(0.01904)	(0.01835)	(0.01488)
	[12.0795]	[0.46824]	[-1.63550]	[-0.90598]	[-0.05351]
REPO_RATE(-2)	-0.42568	-0.286488	-0.001122	-0.059164	-0.064088
	(0.17161)	(0.68828)	(0.03054)	(0.02944)	(0.02387)
	[-2.48051]	[-0.41624]	[-0.03673]	[-2.00998]	[-2.68493]
REPO_RATE(-3)	0.023248	-0.278224	0.004319	0.048597	0.042463
	(0.10553)	(0.42327)	(0.01878)	(0.01810)	(0.01468)
	[0.22029]	[-0.65733]	[0.22996]	[2.68465]	[2.89280]
GDP_QOQ(-1)	-0.011975	0.073329	0.006740	0.007825	0.007053
	(0.03001)	(0.12038)	(0.00534)	(0.00515)	(0.00417)
	[-0.39897]	[0.60917]	[1.26194]	[1.52002]	[1.68955]
GDP_QOQ(-2)	-0.01674	-0.063737	0.006154	4.26E-05	-0.000613
	(0.02865)	(0.11491)	(0.00510)	(0.00491)	(0.00399)
	[-0.58428]	[-0.55468]	[1.20691]	[0.00867]	[-0.15391]
GDP_QOQ(-3)	-0.013522	-0.047936	0.002430	0.003886	0.001806
	(0.02770)	(0.11110)	(0.00493)	(0.00475)	(0.00385)
	[-0.48814]	[-0.43146]	[0.49300]	[0.81787]	[0.46865]
LOGFINI15_INDEX(-1)	-1.337778	-1.332749	0.415682	-0.334328	-0.077945
	(0.91747)	(3.67972)	(0.16328)	(0.15737)	(0.12761)

	[-1.45811]	[-0.36219]	[2.54586]	[-2.12449]	[-0.61080]
LOGFINI15_INDEX(-2)	1.140722	13.82481	0.355918	0.359981	0.369898
	(1.04581)	(4.19446)	(0.18612)	(0.17938)	(0.14546)
	[1.09075]	[3.29597]	[1.91233]	[2.00677]	[2.54290]
LOGFINI15_INDEX(-3)	3.140019	-8.294987	0.082111	0.143028	-0.007148
	(1.02766)	(4.12167)	(0.18289)	(0.17627)	(0.14294)
	[3.05550]	[-2.01253]	[0.44897]	[0.81142]	[-0.05001]
LOGINDI25_INDEX(-1)	-0.750409	5.500330	0.055475	0.925841	-0.110505
	(1.18895)	(4.76856)	(0.21159)	(0.20393)	(0.16537)
	[-0.63115]	[1.15346]	[0.26218]	[4.53988]	[-0.66821]
LOGINDI25_INDEX(-2)	2.939101	-14.10971	-0.075534	0.056978	0.099054
	(1.65456)	(6.63600)	(0.29445)	(0.28380)	(0.23014)
	[1.77636]	[-2.12624]	[-0.25652]	[0.20077]	[0.43042]
LOGINDI25_INDEX(-3)	-3.175232	4.964885	0.117296	-0.090063	-0.095231
	(1.21212)	(4.86147)	(0.21571)	(0.20791)	(0.16860)
	[-2.61957]	[1.02127]	[0.54376]	[-0.43319]	[-0.56485]
LOGJALSH_INDEX(-1)	1.762546	0.430834	0.081544	-0.097182	0.780132
	(1.30369)	(5.22875)	(0.23201)	(0.22362)	(0.18133)
	[1.35196]	[0.08240]	[0.35146]	[-0.43459]	[4.30222]
LOGJALSH_INDEX(-2)	-2.230779	3.780294	-0.076583	-0.000983	-0.145905
	(1.70733)	(6.84763)	(0.30384)	(0.29285)	(0.23747)
	[-1.30659]	[0.55206]	[-0.25205]	[-0.00336]	[-0.61440]
LOGJALSH_INDEX(-3)	-0.87918	-5.786849	-0.062501	0.052842	0.216223
	(1.21794)	(4.88484)	(0.21675)	(0.20891)	(0.16941)
	[-0.72186]	[-1.18465]	[-0.28836]	[0.25294]	[1.27636]

C	-2.003096	20.00888	1.128513	0.241805	0.217762
	(2.20931)	(8.86094)	(0.39318)	(0.37895)	(0.30730)
	[-0.90666]	[2.25810]	[2.87022]	[0.63809]	[0.70864]
R-squared	0.973288	0.602745	0.983876	0.994046	0.993412
Adj. R-squared	0.967124	0.511071	0.980155	0.992672	0.991892

Source: Eviews 11 output (2020)

Figure B1: Cross correlograms of the estimated VAR residual

Source: Eviews 11 Output (2020)