THE EFFECT OF INTEREST RATES ON INVESTMENT SPENDING: AN EMPIRICAL ANALYSIS OF SOUTH AFRICA

by

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DECLARATION

This page declares that the work produced is my own and was conducted whilst completing the degree of Masters of Commerce in Financial Markets whilst at Rhodes University. This thesis has not been submitted to other Universities, Technikons or Colleges for degree purposes.

Nicholas John Dakin

Signed:.................................

Date: ....

ABSTRACT

This thesis investigates the nature and strength of the relationship between short-, medium-, and long-term real interest rates and capital investment spending at both the aggregate and disaggregate levels in South Africa in order to determine whether changes in the real interest rate affect the level of capital investment in the economy. This thesis used quarterly data for the period 1987 to 2013. VAR modelling, variance decompositions, impulse response functions and Granger causality tests are used to explore the nature and strength of the relationship between interest rates and investment spending. It is found that interest rates explain very little of the variation in investment spending and seem to have little impact on investment (of any type). Furthermore, short-, medium- and long-term interest rates have different effects on the level of investment spending. A rise in short-term interest rates appears to decrease the level of investment spending in the long-run, whereas a rise in long-term interest rates results in an increase in investment.

Keywords: Investment, Interest Rates, Interest Rate Channel, User Cost of Capital, Monetary Policy, South Africa

JEL classification: E00, E40, E52

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CHAPTER 1: INTRODUCTION

1.1 Context of the Research

According to economic theory (Jorgenson, 1963; Fielding, 1997; du Toit and Moolman, 2004), interest rates should significantly affect the level of investment spending in the economy, *ceteris paribus*. However, there is still much uncertainty regarding the nature and strength of this relationship in South Africa due to a lack of active research.

The predominant goal of the monetary authorities, generally, has been to achieve an economic environment of financial market and price stability. This has become particularly challenging in a dynamic internationalised economy as most economies are constantly affected by numerous external influences and disturbances (Smal *et al.*, 2001:8). The aim of monetary policy is therefore to maintain a state of equilibrium in the economy rather than to disrupt its appropriate functioning. The prevailing domestic and foreign economic conditions, which include factors such as current business and consumer confidence, the fiscal policy stance and the state of the global economy, will have a significant impact on the monetary policy stance (Smal *et al.*, 2001:9). Given the fact that the aim of monetary policy in South Africa is to maintain a state of equilibrium in the economy, it should therefore *not* be viewed as a means of spurring investment spending and growth but rather as a tool in the stabilization of investment when shocks to the South African economy occur.

To bring about the desired effects within the South African economy, the South African Reserve Bank's (SARBs) Monetary Policy Committee (MPC) sets the repo rate (also known as the repurchase rate or key policy rate) at the appropriate level which will depend on the current state of the economy as well as the future economic outlook. This is the primary instrument used by the SARB to conduct monetary policy. Decisions about the level of the repo rate affect economic activity and the level of inflation through several channels, collectively known as the transmission mechanism of monetary policy (George *et al.*, 1999:3).

Policymakers and academics have placed considerable attention on the transmission of monetary policy changes as it shows the process through which central bank actions affect the real economy and inflation (Gumata *et al.,* 2013:2). This study deals specifically with the interest rate channel of the monetary policy transmission mechanism (MPTM).

The adjustment of the repo rate directly affects other money-market interest rates. This is due to the fact that lending rates are adjusted as an indirect result by domestic banks *via* the interbank market shortly after the change in the repo rate (Smal *et al.*, 2001:1). Under South Africa's inflation-targeting framework, aggregate demand is affected by these short-term interest rate changes, which alter the real cost of capital, wealth, the exchange rate, availability of credit, and household and business balance sheets (Bhattacharya and Mukherjee, 2011:3). Mishkin (1995:3) states that the real long-term interest rate is likely to fall when there is a decline in the short-term interest rate as a result of the expectations hypothesis of the term structure of interest rates, and that it is this long-term interest rate that has the most significant impact on investment spending decisions.

Du Toit and Moolman (2004) estimate that investment in South Africa is consistent with the traditional neoclassical supply-side model that allows for "profit-maximising or cost-minimising decision-making processes by firms, where supply-side factors such as interest rates, taxes and funding in the broader sense, play a significant role" (du Toit and Moolman, 2004:1). According to Jorgenson (1963:249), the first researcher to actively investigate traditional cost-of-capital effects, the cost of capital can be defined as "the cost which the firm incurs as a consequence of owning an asset". The user cost elasticity of the capital stock (UCE) is of considerable importance when analysing the quantitative effects of monetary policy changes on investment spending. The UCE measures the sensitivity of business investment to changes in the user cost of capital which includes interest, tax and depreciation rates (Chirinko *et al.,* 1999:54). Thus, interest rate changes should, theoretically, alter the cost of capital and hence the level of investment spending in the economy.

There has been a long-standing debate as to the effect of monetary policy on real economic variables. The standard textbook theory of the transmission mechanism is that monetary policy will have a significant impact on real economic activity as policymakers use their power over short-term interest rates to manipulate the cost of capital (Chirinko *et al.*, 1999:54). Therefore, with a high UCE, investment spending will be highly responsive to changes in monetary policy (the interest rate most notably). On the contrary, a low UCE indicates that changes in monetary policy would have little or no effect on the level of investment spending. The interest rate affects the cost of capital as it represents the opportunity cost a firm faces from holding capital goods instead of investing in alternative financial assets such as bonds and stocks (Jorgenson, 1993:4). That is, the interest rate represents the future return foregone by investing in greater capital stock instead of alternative financial assets that yield a different return. Thus, with a low interest rate, the opportunity cost of investing in capital stock will be low and firms are likely to direct funds towards capital investment. If the interest rate is high, the opportunity cost of investing in capital stock is higher and firms are likely to direct funds away from capital investments towards other assets (Gilchrist and Zakrajsek, 2007:15).

It is evident from existing empirical findings that estimates of the relationship between interest rates and investment spending have varied widely across different regions and countries ranging from fairly weak in some instances (Bernanke and Gertler, 1995; Guiso *et al.,* 2002; Michaelides *et al.*, 2005) to fairly strong in other cases (Fielding, 1997; Bader and Malawi, 2010; Pattanaik *et al.,* 2013; Haque *et al.,* 1990).

As far as could be determined, there is no existing literature that has been conducted recently which investigates both the nature *and* strength of the relationship between investment spending and interest rates in South Africa. Fielding (1997) used a comprehensive dataset for the period 1946 to 1992, hence a significant amount of data from recent years is omitted from his study. Gumata *et al.* (2013) did examine the effect of the interest rate channel on the cost of capital but only considered gross fixed capital formation growth as a whole. By determining the relationship between interest rates and investment spending for each investment category separately (as will been done in this study), a more precise estimate of the nature and strength of the relationship between investment spending and interest rates can be obtained. This is due to the fact that the various investment categories are likely to respond differently to interest rate changes as a result of the varying investment horizons corresponding to each category.

1.2 Problem Statement

The abovementioned points indicated the need for further research in order to determine how responsive investment levels are to the interest rate and whether a decline (rise) in interest rates will in fact increase (decrease) capital investment in South Africa. This will assist in the formulation of monetary policy as policymakers can understand the extent to which their decisions will affect investment choices made by firms and the South African economy as a whole, and whether the interest rate channel of the MPTM is able to effectively assist the SARB in achieving its objective of price stability.

1.3 Goals of the Thesis

The primary goal of the thesis is:

- To determine the nature and strength of the relationship between short-, medium-, and long-term real interest rates and capital investment spending at the *aggregate level* (i.e. total investment) in South Africa.

The secondary goal of the thesis is:

- To determine the nature and strength of the relationship between short-, medium-, and long-term real interest rates and capital investment spending at the *disaggregate level* (i.e. investment by private business enterprises, public corporations and general government) in South Africa.

1.4 Methods, Procedures and Techniques

The principal method of research utilized is quantitative analysis and the paradigm employed is positivist. The data was obtained from the SARB, Thomson DataStream, the Organisation for Economic Co-operation and Development (OECD), Principal Global Indicators and the Federal Reserve Bank of St. Louis (FRED). Quarterly data for the period 1987Q1 to 2013Q4 was used and time series analysis employed. To determine the effect of short-term interest rates on investment spending, the prime lending rate as well as the 91-day Treasury bill discount rate were used. Medium-term interest rates were measured using the yield on government bonds from zero to three years and the yield on government bonds from three to five years, while the yield on government bonds from five to 10 years and government bonds 10 years and over were used as a measure of the long-term interest rate. All interest rates were adjusted for inflation according to the Fisher equation (i.e. by subtracting the inflation rate from the nominal interest rate).

Gross fixed capital formation at both the aggregate level (total investment) and disaggregate level (investment by private business enterprises, public corporations and general government) was used as a measure of the level of investment spending. Gross fixed capital formation includes: land improvements; plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings (Trading Economics, 2014). The control variables included in the analysis were South African GDP, United States (US) GDP, the Rand Merchant Bank/Bureau for Economic Research business confidence index as well as two dummy variables to account for the effect of apartheid and the Global Financial Crisis on investment spending respectively.

A vector autoregression (VAR) model was estimated to determine the relationship between interest rates and investment spending at various lags. Variance decompositions, impulse response functions and Granger Causality tests were also used to explore the relationship between investment and the real interest rate. These are well-accepted and reliable econometric methods for displaying co-movements amongst the variables included in an econometric model (Stock and Watson, 2001:110).

1.5 Organisation of the Study

The study is organised as follows: Chapter 2 discusses the theory of interest rates, investment and monetary policy in South Africa. Chapter 3 provides an overview of the existing literature and empirical findings. In Chapter 4, the data used in the empirical section of the study is explained in detail. Chapter 5 discusses the methods and procedures used while the empirical results and findings are presented in Chapter 6. Finally, Chapter 7 provides a conclusion to the study and recommendations for future research.

CHAPTER 2: THEORY OF INTEREST RATES, INVESTMENT SPENDING AND MONETARY POLICY IN SOUTH AFRICA

2.1 Introduction

This chapter provides a brief discussion of the theory applicable to interest rates and investment spending, as an understanding of this theory is crucial when trying to determine how monetary policy affects the level of interest rates and how these interest rate changes affect capital investment spending in the South African economy.

The chapter begins with an overview of monetary policy which briefly discusses the underlying theory and concepts related to the topic under analysis. Thereafter, the interest rate channel of the monetary policy transmission mechanism, an important theoretical component of capital investment spending, is discussed comprehensively by explaining how changes in the Reserve Bank's repo rate affect the prime lending rate of banks *via* the interbank market, how these changes in the prime lending rate affect other market interest rates, and finally, how investment spending responds to changes in these market interest rates.

2.2 An Overview of Monetary Policy and the Transmission Mechanism

The predominant goal of the monetary authorities, generally, has been to achieve an economic environment of financial market and price stability (SARB, 2014). According to Mishkin (1995:3), it has been advocated by economists and politicians alike, that monetary policy should be concerned primarily with stabilizing the level of output and inflation of the economy.

Bernanke and Gertler (1995) emphasize four basic facts regarding the effects of monetary policy changes on the economy. The first is that a monetary policy tightening will lead to continued declines in real GDP and the price level, yet it will only have transitory effects on interest rates (Bernanke and Gertler, 1995:29). The second fact states that the initial impact of a monetary tightening is absorbed by final demand which falls relatively quickly following a change in monetary policy (Bernanke and Gertler, 1995:29). It is implied that inventory stocks rise in the short-run as production follows the decline in final demand with a lag of one month. Inventories do decline eventually however, and a large portion of the fall in GDP is accounted for by this. Thirdly, residential investment exhibits the earliest and most considerable decline in final demand, followed by spending on durable and non-durable consumer goods (Bernanke and Gertler, 1995:29). Lastly, the decline in fixed business investment to a monetary policy shock lags behind the fall in production and interest rates (Bernanke and Gertler, 1995:30).

It is particularly challenging to conduct monetary policy in a dynamic internationalised environment as is the case in South Africa as the economy is constantly affected by numerous external influences and disturbances (Smal *et al*., 2001:8). The aim of monetary policy is therefore to maintain a state of equilibrium in the economy rather than to disrupt its appropriate functioning. The prevalent domestic and foreign economic conditions which include factors such as current business and consumer confidence, the fiscal policy stance and the state of the global economy, will have a significant impact on the monetary policy stance (Smal *et al*., 2001:9). In light of this, monetary policy should therefore not be viewed as a means of spurring investment spending and economic growth but rather as a tool to stabilise the economy (and thus investment) when shocks occur.

Once the country's central bank has decided on a route that needs to be undertaken in order to attain its desired objectives, a series of economic events are set into motion. This cycle of events starts with an initial impact which over time affects current expenditure levels, private consumption and investment most notably (Mishkin, 2007). Furthermore, the changes in domestic demand will have an impact on production levels, wages and employment, eventually resulting in a change in the rate of inflation (the domestic price level). This chain of events is referred to as the transmission mechanism of monetary policy or the monetary policy transmission mechanism (Smal *et al*., 2001:1). The repo rate is the primary instrument used for monetary policy in South Africa as it directly affects other variables including other interest rates, and decisions on spending and investment as well as the exchange rate, money and credit which in turn will alter the demand and supply levels of goods and services (Smal *et al*., 2001:5).

There are extensive time lags present in the transmission mechanism. This is due to the fact that there may be a delay before the final result originating from the initial influence is felt. Thus, it is of great importance that policymakers are aware of the lags present in the transmission mechanism when making certain policy decisions (Mishkin, 1995:4).

For nearly three decades, the main goal of the SARB has been to achieve low and stable inflation. The SARB was not very successful in achieving this up until the 1990s. However, it managed to reduce the inflation rate in the 1990s when it followed an implicit monetary targeting regime (Gupta *et al*., 2009). Under this regime, a pre-announced M3 monetary target was set and the bank rate was used to influence the market interest rate. From 1998, the SARB utilised daily tenders of liquidity through repurchase transactions instead of the discount rate. Increased financial liberalisation and openness of the capital account made it very difficult for the SARB to achieve its monetary target, reducing the effectiveness of the regime (Bhorat *et al*., 2014:7).

In February 2000, the then Minister of Finance, Trevor Manuel, announced that the SARB would follow an explicit inflation targeting regime with the primary objective of achieving and maintaining price stability. The SARB therefore adopted a regime with the aim of keeping the inflation rate of the consumer price index excluding mortgage costs (CPIX) in a target range of 3-6% through its main policy instrument - the repo rate (Gupta *et al.*, 2009). The target was changed from the CPIX to headline-inflation in January 2009. The SARB does not have goal independence as it is the government that sets and changes the inflation target. However, it does have instrumental independence as it is able to utilise whichever monetary policy instrument it believes is most appropriate to achieve the inflation target (Bhorat *et al*., 2014:8).

For central banks, the effectiveness and efficiency of the monetary policy transmission is dependent upon the ability of monetary policy actions - with respect to changes in the repo rate, amount of liquidity in the banking system and forward guidance - to influence both deposit and lending rates, which should lead to changes in the level of the country's savings, investment and growth (Pattanaik *et al*., 2013:14).

This chapter deals specifically with the interest rate channel of the transmission mechanism, which is the core focus of this study. The interest rate channel, also commonly referred to as the traditional or neoclassical cost-of-capital channel, has been a key feature of the basic Keynesian textbook model for over 50 years. The channel applies to both consumers' and businesses' decisions about investment spending (Mishkin, 1995:4).

Empirical research has confirmed that monetary policy can have a significant influence on the real economy. Most economists therefore agree that monetary policy does play a role in affecting real output. However, agreement has not been reached regarding exactly how this influence is exerted by monetary policy. This has led to the development of a number of channels that attempt to explain how monetary policy may affect the real economy (Gumede and Stuart, 2013:2). Early Keynesians believed that monetary policy was of little importance as they were unable to find any strong links between the level of interest rates and investment during the Great Depression. This Keynesian interpretation was later contested by the Monetarist school of thought which believed that the link between interest rates and investment was not identified as attention was focused on nominal interest rates rather than real interest rates (Gumede and Stuart, 2013:2).

2.3 The Interest Rate Channel of the MPTM

2.3.1 From the Repo Rate to Banks' Prime Lending Rates

Interest rates are the compensation paid by a borrower to a lender for the use of money for a certain period and are therefore referred to as the rates payable on debt and deposit obligations (instruments and securities) by the debtors to the creditors (Gitman *et al.*, 2010:260). Short-term interest rates are controlled by the SARB *via* the repo rate and all other interest rates are determined by the current short-term interest rates as well as future expectations regarding the movement of interest rates (Faure, 2014:3).

Key factors determining the interest rate on a particular debt security include, *inter alia*, the following (Malede, 2014; Faure, 2014):

- The time to maturity
- The size of the loan
- The borrower's credit risk
- The borrower's income
- The quality of the borrower's collateral
- The marketability of the security

While these factors do play a highly important role in the determination of the interest rate on a debt security, it is the SARBs repo rate which directly affects other market interest rates *via* the interbank market (discussed in section 2.3.1.1), thereby providing the origin of all other market interest rates. This makes it the most important factor in the determination of market interest rates (Faure, 2014:7).

2.3.1.1 The Interbank Market

Interest rates apply to debt and deposit instruments, and instruments of various terms to maturity have their own interest rate levels. All interest rates are related nonetheless *via* the interbank market. The first step to understanding why this is the case is to understand the relationship between the SARBs repo rate and the prime lending rate of banks (De Angelis *et al*., 2005:656). Prior to an in-depth discussion of the interest rate channel of the MPTM and its effect on capital investment, it is important to understand how the repo rate is made effective, and how it plays a role in determining other market interest rates (how changes in the repo rate result in changes to the prime lending rate (PR) of banks). The interbank market serves as the foundation of monetary policy and the transmission of monetary policy changes to the rest of the economy (De Angelis *et al.*, 2005:658).

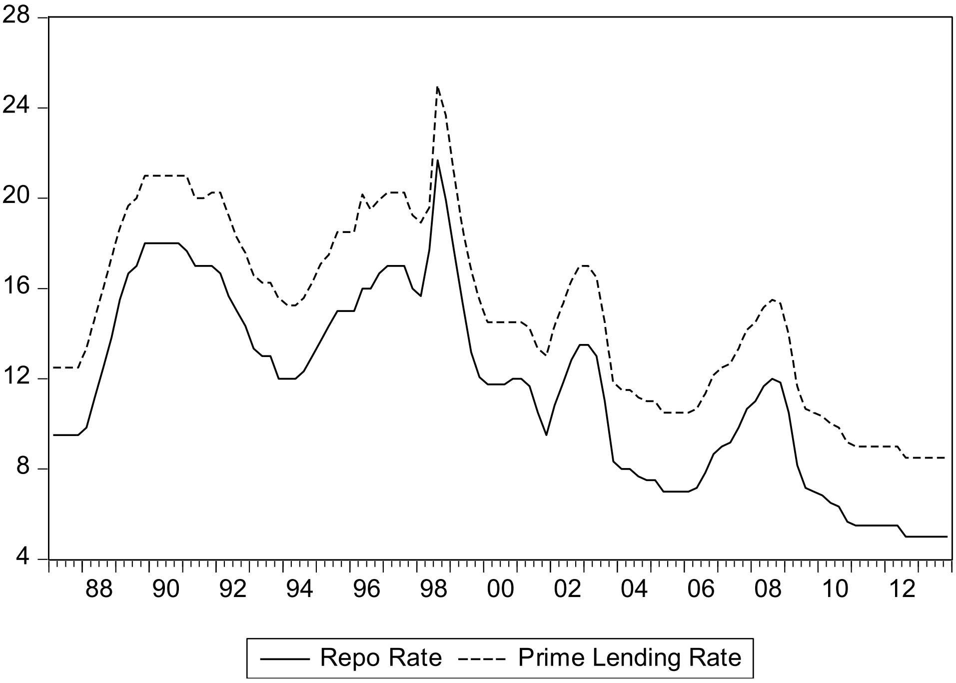
The interbank market provides the genesis of all market interest rates and therefore plays an especially crucial role in the determination of short-term interest rates. In short, the PR of banks is controlled *via* the central bank's repo rate on borrowed reserves (Faure, 2014:3). The repo rate is the rate at which the SARB lends money to the commercial banks in South Africa as per their daily liquidity requirements. Assets are sold to the SARB at the repo rate under a repurchase agreement in exchange for reserves that the banks require to meet the shortfall in their liquidity (De Angelis *et al.*, 2005:657). A repurchase agreement is a contract which involves the sale of an asset coupled with an agreement to repurchase the same asset sometime in the future (Acharya *et al*., 2010:319).

Thus, other market rates such as the PR are highly correlated with the SARBs repo rate *via* the interbank market which is the starting point of the MPTM. According to the SARB, "effective monetary policy implementation implies [...] that the central bank should manage liquidity in such a manner that the interbank overnight rate stays near (or generally slightly below) the level of the repo rate" (Smal *et al*., 2001:5).

In summary, the SARB ensures that the banks are indebted to it at all times and are in a permanent liquidity shortage situation (or money market shortage). The repo rate is therefore made effective as the SARB supplies the needed liquidity (BR) at this rate. The goal of this is to affect bank lending rates through the bank margin which is influenced by the changing cost of the bank's liabilities. This entire process can be viewed schematically as follows (Faure, 2014:20):
Repo rate → interbank market rates → bank call money rates → other bank deposit rates → PR

Figure 1 shows the relationship between the SARBs repo rate and the PR of banks in South Africa for the period 1987 to 2013. The figure shows a highly significant and positive relationship between the two rates (correlation coefficient of 0.99):

Figure 1: Repo rate and prime lending rate in South Africa, 1987-2013



Source: SARB (2015)

2.3.2 From the Prime Lending Rate to Other Market Interest Rates

2.3.2.1 The Term Structure of Interest Rates

The term structure of interest rates refers to the changes in market interest rates which occur as a result of changes in monetary policy. It measures the relationship between the yields on securities that are default-free and differ only with respect to their term to maturity (Orphanides and Wei, 2012:245).

The plot of the yields on bonds (usually government bonds) with the same liquidity, risk and tax considerations but with different terms to maturity is referred to as the yield curve. Also worth noting is that the long-term rates for any maturity are correlated and it is the maturity of long-term rates that determines the magnitude of the effect of repo rate changes. Long-term interest rates generally exhibit less variability when compared to short-term interest rates and the extent to which bond yields change will be different according to the maturity of the bond itself (Taylor, 1995).

Three important observations regarding the term structure of interest rates have been identified by examining the yield curve (Ireland, 2004:5):

- Fact one: Interest rates on bonds with different terms to maturity tend to move together over time.
- Fact two: The yield curve can either be upward-sloping or downward-sloping. It usually slopes upwards (downwards) if short-term interest rates are low (high).
- Fact three: The yield curve slopes upwards the majority of the time.

Long-term interest rates are affected differently by changes in short-term interest rates. The complexity in determining the impact of monetary policy on long-term interest rates is confirmed when studying the mixed empirical results which have been reported thus far (Bonga-Bonga, 2009:2). The three main theories which have arisen to explain the resultant changes in longer-term interest rates that occur when short-term interest rates change are as follows:

- The expectations theory (Bonga-Bonga, 2009; Holmes *et al.*, 2010)
- The market segmentation theory (Holmes *et al.*, 2010)
- The preferred habitat or liquidity premium theory (Baye and Jansen, 1995)

2.3.2.2 Interest Rate Pass-Through

Interest rate pass-through denotes the nature and strength of the relationship between repo rate changes and changes in longer-term market interest rates (Holmes *et al.*, 2015). In order for monetary policy action to have a significant effect on real output, repo rate changes should pass-through to other market and retail rates over a reasonably short time horizon (Hoffman and Mizen, 2001:99).

For monetary policy to achieve the desired results, it is crucial that effective interest rate pass-through occurs so that the corresponding changes in other market interest rates can take place, and hence put the interest rate channel of the MPTM into effect (Aziakpono and Wilson, 2013:1). A delayed interest rate pass-through will have little or no effect on the targeted economic variables (such as investment spending).

Gumata *et al.* (2013) studied the response of various market interest rates to changes in the repo rate and concluded that real interest rates and long-term interest rates are affected by contractionary monetary policy, and that interest rate pass-through is particularly strong in South Africa. The results of their impulse response functions indicated that there is a contemporaneous rise in the three-month Treasury Bill rate and the prime overdraft rate to a one percentage point increase in the repo rate. Long-term interest rates closely followed the changes in the repo rate, depicting the same patterns as the three-month TB rate and prime overdraft rate (Gumata *et al*., 2013:20).

Bonga-Bonga (2009) also examined the response of short-term and long-term interest rates to shocks in monetary policy in South Africa. There was a positive and highly significant correlation of both short- and long-term interest rates to a monetary policy shock providing further evidence that interest rates pass-through takes place effectively in South Africa.

The results of Gumata *et al.* (2013) and Bonga-Bonga (2009) provide strong evidence of interest rate pass-through in South Africa and it can therefore be inferred that repo rate changes will have an effect on other market interest rates, effectively putting the interest rate channel of the MPTM into action.

When looking only at the interest rate channel, if the MPTM is able to affect a broad spectrum of interest rate levels, then monetary policy can be considered to be effective. Bonga-Bonga (2009) acknowledges the fact that it is difficult to establish whether it is short-term or long-term interest rates that have the most significant impact on the economy, but believes that the long-term interest rate is more important based on the fact that investment in plant and capital equipment is a decision taken with a long-term view.

Figures A1 to A5 graph the relationships between the repo rate and the 91-day Treasury Bill discount rate as well as the yields on government bonds of various terms to maturity for the period 1987 to 2013. The graphs clearly show the considerable influence exerted by the SARBs repo rate on all of the rates investigated. The corresponding correlation coefficients for each of the rates with the repo rate are shown in Table 1.

TABLE 1: CORRELATION COEFFICIENTS BETWEEN VARIOUS INTEREST RATES AND REPO RATE

Interest Rate	Correlation Coefficient with Repo Rate
91-day Treasury Bill discount rate	0.99
Government bond yield (0-3 years)	0.96
Government bond yield (3-5 years)	0.93
Government bond yield (5-10 years)	0.91
Government bond yield (10 years and over)	0.88

Source: Author's own estimates using EViews 7

2.3.3 From Interest Rates to Real Output (Capital Investment)

Since monetary policy changes feed through effectively to market interest rates in South Africa, the next point which will be addressed is concerning the effect of changes in the level of interest rates on the cost-of-capital and hence capital investment spending in the economy.

Theoretically, the response by firms and individuals to the adjustment in real interest rates is to alter their investment and spending decisions in the short run. When faced with changes in the level of interest rates, it is believed that businesses in South Africa tend to focus on long-term interest rates as they take a long-term approach when making investment decisions. The elasticities of investment spending with respect to the short-term interest rates are therefore quite small (Gumata *et al.*, 2013:10).

Consumer spending (C), investment (I) and real output (Y) begin to respond and as a result lead to a change in demand pressures (Smal *et al.*, 2001:9). The traditional Keynesian view of the IS-LM model of the effect of a monetary expansion can be viewed schematically as:

$$\uparrow M \rightarrow \downarrow i_r \rightarrow \uparrow I \rightarrow \uparrow Y \quad \text{...(1)}$$

where the implementation of expansionary monetary policy (a drop in the repo rate), represented by $\uparrow M$, brings about a decline in real interest rates ($\downarrow i_r$). This causes the cost of capital to fall (the fall in the real interest rate lowers the opportunity cost of consumption and investment), resulting in an increase in investment spending ($\uparrow I$), and hence aggregate demand, which results in greater output ($\uparrow Y$) and inflationary pressures (Mishkin, 1995). In summary, the cost of capital is influenced by policymakers who use their leverage over short-term interest rates (the cost-of-capital variable) to bring about the desired changes in spending on durable goods (Bernanke and Gertler, 1995:27).

2.3.3.1 Interest as the User Cost of Capital

According to Jorgenson (1963:249), the first researcher to actively investigate traditional cost-of-capital effects, the cost of capital can be defined as "the cost which the firm incurs as a consequence of owning an asset". The price of capital relative to the price of output, the expected gains associated with capital purchases, the real rate of return on financial assets, the rate of capital depreciation and the tax treatment of both capital purchases and income are all key elements of the user cost of capital (Gilchrist and Zakrajsek, 2007:10). The user cost of capital (*r*) can be expressed in nominal terms as:

$$r = price\ of\ capital\left(\frac{interest\ rate + rate\ of\ depreciation}{1 - tax\ rate}\right) \text{..............(2)}$$

Fielding (1997:350) defines the real user cost of capital (the user cost of capital adjusted for inflation) as:

$$r_a = price\ of\ capital(i - \pi + \delta) \text{....................................(3)}$$

where i is the nominal interest rate, π is the rate of inflation and δ is the rate of depreciation. The user cost elasticity of the capital stock (UCE) is of considerable importance when analysing the quantitative effects of monetary policy changes on investment spending. The UCE measures the sensitivity of business investment to changes in the user cost of capital which includes interest, tax and depreciation rates (Chirinko *et al.,* 1999:54). This is shown by the following equation:

$$UCE = \frac{\Delta I}{I_1} \div \frac{\Delta UC}{UC_1} \text{...(4)}$$

where ΔI is the change in investment spending between two time periods and ΔUC is the change in the user cost of capital between two time periods. Therefore, with a high UCE, investment spending will be highly responsive to changes in monetary policy such as changes in the interest rate. In contrast, a low UCE indicates that changes in monetary policy will have little or no effect on the level of investment spending in the economy (Chirinko *et al.*, 1999:54).

There has been a long-standing debate as to the effect of monetary policy on real economic variables. The standard textbook theory of the transmission mechanism is that monetary policy has a significant impact on real economic activity as the manipulation of short-term interest rates by policymakers will alter the cost of capital and hence capital investment (Chirinko *et al.*, 1999:54).

The interest rate affects the cost of capital as it represents the opportunity cost a firm faces from holding capital goods instead of investing in alternative financial assets such as bonds and stocks (Jorgenson, 1993:4). That is, the interest rate represents the future return foregone by investing in greater capital stock instead of alternative financial assets which yield a different return. Thus, with a low interest rate, the opportunity cost of investing in capital stock will be low and firms are likely to direct funds towards capital investment. If the interest rate is high, the opportunity cost of investing in capital stock is substantially higher and firms are likely to direct funds away from capital investment towards other assets (Gilchrist and Zakrajsek, 2007:15).

Traditionally, theory has concluded that the cost of capital is equivalent to the rate of interest on bonds and any rational, profit maximizing firm will increase investment levels to the point where the marginal yield on physical assets or capital stock is equivalent to the market interest rate (Modigliani and Miller, 1958). A firm will therefore acquire a greater holding of physical assets if it increases the owner's net profit (the expected rate of return of the asset exceeds the interest rate) or if the value of the owner's equity rises as a result of the asset. The capitalised value, which is given by capitalising the stream of revenue that the asset generates, will be greater than its cost if and only if the asset's yield is greater than the interest rate (Modigliani and Miller, 1958:262).

Du Toit and Moolman (2004:1) estimate that investment in South Africa is consistent with the traditional neoclassical supply-side model which allows for "profit-maximising or cost-minimising decision-making processes by firms, where supply-side factors such as taxes, interest rates and funding in the broader sense, play a significant role". Thus, interest rate changes should, theoretically, alter the cost of capital and hence the level of investment spending in South Africa. Their work bears considerable resemblance to an earlier study by Fielding (1997), who also utilizes a neoclassical framework for analysing aggregate investment in South Africa.

According to the neoclassical model, K_t is the net capital stock at the end of time t or the aggregate level of capital stock (K), assuming a constant exponential rate of depreciation (δ), and is defined as:

$$K_t = (1 - \delta)K_{t-1} + I_t \quad \text{...(5)}$$

From equation (5), replacement investment equals δK_{t-1} and the net increment in the capital stock or net investment equals the total level of investment (I_t) minus replacement investment:

$$I_t - \delta K_{t-1} \quad \text{..(6)}$$

The neoclassical model was developed by Jorgenson (1963) to provide a framework that assists in the analysis of investment behaviour. The model is based on optimisation behaviour which is what distinguishes it from other models. The desired level of capital stock is related to the interest rate level, tax policies, capital prices and output. According to Jorgenson (1963), if a firm uses two inputs in production, namely capital (K) and labour (L), to produce one unit of output (Y), then the ultimate objective of the firm is to maximise its net worth, which is the sum of the net present value of the stream of future profits from t_0. This optimisation problem can be represented as follows:

$$max_{K,I,L}V = \int_0^\infty \exp\left(-\int_0^t I_s ds\right)\left[p_t f\left(K_{t,}L_t\right) - w_t L_t - q_t I_t\right]dt \text{.......(7)}$$

It is assumed that the firm is a price taker and therefore maximises the firm's net present value in a perfectly competitive market by choosing the appropriate level of L_t, K_t and I_t that achieves this. The rate of interest at time s and gross investment (net purchase) of capital stock at time t are represented by I_s and I_t respectively. The prices of the inputs are w_t and q_t to produce the output that is sold at p_t (du Toit and Moolman, 2004:5). The model can be reduced to its static equivalent if certainty with regard to the exogenous variables is assumed (Nickell, 1978:26). The model then becomes a one-period optimisation problem defined as:

$$\begin{aligned} max_{K,L}\pi_t &= \pi_t(Y_t, K_t, L_t;\, p_t, r_t, w_t) = p_t Y_t - (w_t L_t + r_t K_t) \\ &= p_t f(K_t, L_t) - (w_t L_t + r_t K_t) \text{...(8)} \end{aligned}$$

It is at this point that the model becomes more relevant as it now includes the user cost of capital in period t (r_t). Using the Lagrange multiplier procedure, the conditions for the optimal level of capital (equation 9) and labour (equation 10) can be obtained:

$$p_t \frac{\partial Y_t}{\partial K_t} = r_t \Rightarrow MPK_t = \frac{r_t}{p_t} \text{ ....(9)}$$

and

$$p_t \frac{\partial Y_t}{\partial L_t} = w_t \Rightarrow MPL_t = \frac{w_t}{p_t} \text{ ....(10)}$$

where MPK_t and MPL_t are the marginal products of capital and labour respectively (du Toit and Moolman, 2004:6). Thus, solving for the optimal level of capital (K^*) by taking the partial derivative with respect to K (equation 11), the marginal product of capital can be obtained where it equals the real user cost of capital:

$$UCC = \frac{\alpha Y}{K} \text{ ....(11)}$$

where the elasticity of capital is shown by α.

The fact that investment in South Africa can be approximated by the neoclassical investment model suggests accordingly that the interest rate level will alter the cost of capital in South Africa and hence lead to a change in the level of investment spending.

2.4 Conclusion

This chapter provided a brief overview of the theory applicable to interest rates and investment spending by focusing on the operation of the interest rate channel of the MPTM. In summary, repo rate changes are made effective and hence affect bank lending rates as there is a permanent liquidity shortage in the banking system. Thereafter, other market interest rates start to respond. According to user-cost-of-capital theory, as well as the fact that investment spending in South Africa is believed to follow neoclassical investment theory, these interest rate changes will alter the cost of capital and therefore the level of capital investment expenditure in the South African economy. Chapter 3 will discuss the existing empirical research which has examined the relationship between capital investment and interest rates both in South Africa and abroad.

CHAPTER 3: LITERATURE REVIEW AND EXISTING EMPIRICAL FINDINGS

3.1 Introduction

Numerous results and findings relating to the relationship between investment spending and interest rates have been reported. This chapter will provide a concise review of existing research and empirical findings, both internationally and locally, to gain a greater understanding of the theories, methodologies and procedures underlying existing research into this topic.

Results of existing studies have varied considerably and there is still much uncertainty regarding the nature and strength of the relationship between interest rates and investment. For example, Taylor (1995) believes that the interest rate channel of monetary transmission is strong and hence that there are significant interest rate effects on consumer and investment spending. However, Bernanke and Gertler (1995) argue that the interest rate channel is not significant as they were unable to identify "quantitatively important effects of interest rates through the cost of capital" (Bernanke and Gertler, 1995:27).

Section 3.2 presents the international findings, while section 3.3 discusses the existing empirical findings which have been obtained in South Africa specifically. Section 3.4 concludes the chapter.

3.2 International Findings

Existing research - for the most part - has had difficulty in identifying a significant relationship between the level of interest rates and investment as well as quantifying the strength of this relationship. Bader and Malawi (2010), Pattanaik *et al.* (2013) and Haque *et al.* (1990) are three international papers which have identified a significant relationship between these two variables.

Bader and Malawi (2010) investigated the relationship between the real interest rate and investment levels in Jordan over the period 1990-2005. Cointegration analysis was used to perform the study. The model included the following three variables: the level of investment, the real interest rate, and the level of income (GDP). The results were consistent with economic theory due to the fact that there was a negative relationship between the real interest rate and investment spending - investment fell by 0.44 percentage points for each percentage point increase in the real interest rate.

Pattanaik *et al.* (2013) used both firm-level and macroeconomic data, and various methodologies including panel regression, VAR, quantile regression and simple ordinary least squares to determine the effect of changes in the real interest rate on the investment rate in India using monthly data for the period 2000 to 2010. They found that for a 100 basis point increase in the real interest rate, investment fell by approximately 50 basis points which suggests that the Reserve Bank of India can stimulate economic growth by lowering real lending rates as there is a strong relationship between the real interest rate and investment spending.

An estimated elasticity of -0.113 between investment and the real interest rate was obtained by Haque *et al.* (1990) by pooling consistent time-series data of 31 small and open developing countries. Investment therefore declines by 0.11% for each percentage point increase in the interest rate. The result was significant at the five percent level of significance and hence it was concluded that the interest rate does affect the level of investment spending in developing countries.

It is therefore evident that interest rates do have the ability to exert a significant influence on the level of investment spending in certain cases and that an inverse relationship, corresponding with traditional cost-of-capital theory, exists in the cases considered. However, this is a rarity as most studies have been unable to identify a significant and strong relationship between interest rates and investment spending. Studies where this has been the case are expanded upon below.

Using a VAR model, Bernanke and Gertler (1995) determined the effect of an unanticipated monetary policy tightening on various economic aggregates in the US. The sample was comprised of monthly data from January 1965 to December 1993, with the monetary policy stance indicated by the federal funds rate. It was found that following a monetary contraction, a large portion of the fall in final demand was accounted for by a drop in residential investment. Consumer durables and nondurables showed the next largest response. Business fixed investment also fell but with a greater time lag than the other types of spending. Furthermore, the fall in fixed investment was primarily as a result of the decrease in equipment investment. There was only a small response in structures investment by businesses to the policy shock. It was also noted that business fixed investment only began to respond between six and 24 months following the shock. It was concluded, based on their results, that monetary policy actions do not have much effect on the level of fixed investment which lead to greater attention being focused on the other channels of monetary policy transmission such as the bank lending and balance sheet channels.

In order to determine the sensitivity of investment to the interest rate in the US, Sharpe and Suarez (2013) used the responses that were obtained by the Duke/CFO Global Business Outlook survey which asked respondents a number of questions regarding the sensitivity of their investment plans to potential changes in the interest rate. It was also found that most firms are fairly insensitive to a fall in interest rates but are slightly more responsive to increases in interest rates (no reason is given for this asymmetry). However, the change in the interest rate required for firms to alter their investment decisions is “quite large” in both cases.

The European Central Bank (ECB) performed extensive research into the elasticity of investment demand with respect to its user cost by estimating the relationship between firm-specific estimates of the user cost of capital and the investment decisions made by European firms. They provide a summary of empirical evidence and state that published estimates of the elasticity of investment demand with respect to its user cost range from zero to -2. Furthermore, it is found that the interest rate plays a minor role as a determinant of investment spending while accelerator variables such as output and cash flow have a much larger impact on the level of capital investment expenditure in comparison to interest rates (Gilchrist and Zakrajsek, 2007:18).

The result attained by the ECB was confirmed by Guiso *et al.* (2002) who used a dataset consisting of over 30 000 Italian firms over a ten-year period to determine the sensitivity of investment to changes in the interest rate. It was found that the effect of interest rate increases on investment decisions was negative but small and the elasticity of capital to changes in its user cost was about -1. Their findings also suggested that the reason for the apparent insensitivity between investment and interest rates can be attributed to a combination of simultaneity bias and measurement error.

Michaelides *et al.* (2005) conducted research into the determinants of investment in Greece using annual data for the period 1960 to 1999. As part of their research, the responsiveness of investment to changes in the interest rate was investigated. An estimated elasticity of -0.028 was obtained leading to the conclusion that interest rate adjustments would be almost completely ineffective when trying to create investment incentives.

Ahmed and Islam (2004) investigated the responsiveness of investment spending to the interest rate level in Bangladesh at both the aggregate and disaggregate levels. They used a quarterly dataset from the fourth quarter of 1979 to the second quarter of 2005 and an unrestricted VAR approach. An exact estimate of the elasticity of investment with respect to the interest rate was not obtained. However, several important conclusions were made regarding the strength of the relationship, the most important of which was that interest rates do not affect investment spending at the aggregate level. There was a moderate decline in private sector investment in response to an increase in interest rates.

Greene and Villanueva (1991) found that private investment was negatively related to the real deposit interest rate when exploring the determinants of the level of private investment in 23 developing countries (not including South Africa) over the period of 1975 to 1987. A pooled time-series, cross-section approach was used to estimate an equation for the private investment rate in the countries considered. The coefficient of the real interest rate indicated that for each percentage point increase in the real interest rate, private investment would fall by 0.083 percentage points. This lead to the conclusion that while the relationship between interest rates and investment spending is significant, it is not particularly strong as it has much less of an impact on the level of private investment than other factors in these developing countries such as GDP growth and the level of public investment.

3.3 South Africa

This section discusses the existing empirical findings which have been obtained in South Africa specifically to determine the historical relationship between investment and the level of interest rates, and to determine how the results obtained in South Africa compare with those that have been obtained internationally.

Fielding (1997) used annual data for 1946 to 1992 to estimate a regression model for modelling the level of aggregate investment in South Africa in order to establish which factors affect investment and hence determine the effect of the liberalisation of South African economy on investment and growth. The nominal loan rate and consumer price index were used to construct the real interest rate series. There was a negative and significant relationship between the level of investment demand and the real interest rate; short-run and long-run interest elasticities were -1.365 and -0.748 respectively (Fielding, 1997:363). Increases in interest rates will therefore reduce investment demand in both the short-run and long-run, and that the response by investment to interest rate changes is more sensitive in the short-run than in the long-run. It was also concluded that the sensitivity of investment to market interest rate changes is moderate when compared to the impact of other variables on investment demand in South Africa, such as public investment (elasticities of 0.44 and 0.24 in the short- and long-run respectively), the real exchange rate (short-run elasticity of 2.68 and long-run elasticity of -0.331) and wage prices (elasticity of 2.503 in the short-run and 1.371 in the long-run).

Gumata *et al.* (2013) investigated the different channels of monetary policy transmission in South Africa to determine the effectiveness of a monetary policy shock on the economy. A Large Bayesian Vector Autoregressive (LBVAR) model and a sample of 165 quarterly variables for the period 2001Q1 to 2012Q2 were used. An unexpected increase in the repo rate of 100 basis points was used as a measure of the effectiveness of a monetary policy shock on the economy *via* the various transmission channels. The results of their variance decomposition indicated that the interest rate channel is the most important channel of monetary policy transmission, and that repo rate changes (which lead to interest rate changes) have a significant effect on variables such as growth in gross fixed capital formation. There was a direct increase in short-term interest rates following an increase in the repo rate. This affected the cost of capital, which causes a fall in corporate and household investment spending.

Kabundi and Ngwenya (2011) conducted a study into the efficiency of South African monetary policy for the period 1985 to 2007 using monthly data and a Factor-Augmented Vector Autoregressive (FAVAR) approach. It was confirmed that price stability can be obtained in South Africa by using monetary policy (i.e. repo rate changes) based on the fact that monetary policy was able to affect macroeconomic variables (including investment). According to their empirical findings, a 100 basis point increase in the interest rate resulted in a decline in private fixed investment (refer to Figure A50). The impulse response function of private fixed investment to a shock in the repo rate exhibited a sharp increase before declining gradually. Investment started to rise again after approximately 11 months until it stabilised at its initial level in the long-run.

Gupta *et al.* (2009) used a FAVAR model and monthly data to determine the effect of a monetary policy shock on a number of macroeconomic variables in South Africa. They divide their sample into two equal sub-samples for the periods 1989 to 1997 and 2000 to 2008 corresponding with the pre- and post-inflation targeting periods in South Africa. This was done to assess whether the SARB has become more successful in achieving the desired changes in the economy under the inflation targeting regime. It was evident that the ability of monetary policy in affecting the macroeconomy, such as the level of investment spending, has risen in the post-inflation targeting period when compared to the pre-inflation targeting period. Variance decomposition results indicated that approximately 4.15% of the variation in gross fixed capital formation in manufacturing (the only investment category considered in the study) was accounted for by the monetary policy shock in the pre-inflation targeting period, while 22.19% of the variation in this variable was attributed to the monetary policy shock in the post-inflation targeting era. Investment has therefore become more responsive in the post-inflation targeting period. More importantly, it was found that the effect of monetary policy on gross fixed capital formation in manufacturing was not significant. This was attributed to the short lengths of the sub-samples in relation to the number of variables that were included in the study.

3.4 Conclusion

It is evident from the existing empirical findings that estimates of the relationship between interest rates and investment spending have varied widely across different regions and countries ranging from fairly weak and insignificant in some instances (Bernanke and Gertler, 1995; Guiso *et al.,* 2002; Michaelides *et al.*, 2005) to fairly strong and significant in other cases (Fielding, 1997).

As far as could be determined, there is no existing literature that has been conducted recently which investigates both the nature *and* strength of the relationship between short-, medium- and long-term interest rates and investment spending at both the aggregate and disaggregate level (focusing separately on each investment category as recorded by the SARB) in South Africa. Fielding (1997) was the last researcher to comprehensively investigate interest rate effects on the cost-of-capital and investment spending in South Africa. He used a dataset up to 1992 and hence a significant amount of data from recent years is omitted from the study.

Gumata *et al.* (2013) did examine the effect of the interest rate channel on the cost of capital but only considered gross fixed capital formation growth as a whole and only looked at the effect of the repo rate on investment spending. By determining the relationship between interest rates and investment spending for each investment category separately and short-, medium- and long-term interest rates, a more precise estimate of the relationship between investment and the interest rate can be obtained. This is due to the fact that the various investment categories are likely to respond differently to interest rate changes as a result of the varying investment horizons corresponding to each category. Chapter 4, which follows, will discuss the data used in this study.

CHAPTER 4: DATA

4.1 Introduction

This chapter provides a description of the data used in the analysis as well as justifications for using the selected variables to achieve the relevant results. The sample period is discussed in section 4.2. Sections 4.3 and 4.4 explain the interest rates and investment categories used to perform the analysis respectively. In section 4.5, the control variables included in the model are discussed. Section 4.6 concludes the chapter.

Table A1 provides a list of all data used in the analysis as well as the variable names used for each time series. It also shows the expected relationship between the various variables and investment spending - according to theory - as well as the data source for each series. Summary statistics for each time series are presented in Table A3.

4.2 Sample Period

The data set used in this study contains quarterly time series data from 1987Q1 to 2013Q4, obtained from the SARB, Thomson DataStream, OECD, Principal Global Indicators and FRED. This sample period was chosen as it encompasses a large sample of monetary policy and economic activity in South Africa and due to the limited availability of certain data. The sample period also adequately covers a sufficient portion of recent economic developments in order to yield results that are relevant and applicable to the current economic climate.

4.3 Interest Rates

Bonga-Bonga (2009) acknowledged the fact that it is difficult to establish whether it is short-term or long-term interest rates that have the most significant impact on capital investment. However, he believes that the long-term interest rate is more important and can be used as an indicator of the cost-of-capital based on the fact that investment in plant and capital equipment is a decision taken with a long-term view. According to

Nel (1996), the 10-year government bond and the 91-day Treasury Bill yields can be used to represent the long-term and short-term interest rates in South Africa.

Taking the above into consideration, it was decided that a variety of market interest rates of varying time horizons would be used in this study to determine whether it is short-, medium-, or long-term interest rates that have the most significant impact on capital investment spending in South Africa. The interest rates used as proxies for the cost of borrowing for each time horizon are shown in Table 2:

TABLE 2: INTEREST RATES USED IN ANALYSIS

Short-term interest rates
Prime lending rate (*PR*)
91-day Treasury Bill discount rate (*TB*)
Medium-term interest rates
Government bond yield 0-3 years (*GBY03*)
Government bond yield 3-5 years (*GBY35*)
Long-term interest rates
Government bond yield 5-10 years (*GBY510*)
Government bond yield (*GBY10*)

All interest rates excluding the 91-day Treasury Bill discount rate were obtained from the SARB. The latter was obtained from the Principal Global Indicators website. All interest rates were adjusted for inflation according to the Fisher equation (by subtracting the inflation rate from the nominal interest rate) as consumer and business decisions are altered by the real interest rate and not the nominal interest rate according to economic theory. The consumer price index (CPI) year-on-year inflation rate for all items was obtained from the OECD and used to deflate the nominal interest rates. Figures A6 to A11 graph the various interest rates used in the analysis for the sample period.

4.4 Investment Spending

The International Monetary Fund (IMF) defines gross fixed capital formation as follows: "Gross fixed capital formation is measured by the total value of a producer's acquisitions, less disposals of fixed assets during the accounting period plus certain specified expenditure on services that adds to the value of non-produced assets" (IMF, 2009:198).

Gross fixed capital formation (GFCF) is used by the SARB as an indicator of the overall level of capital investment expenditure in the South African economy (SARB, 2014) and the IMF definition provided above is used by the SARB to determine what does and does not constitute GFCF. Table A2 shows the various components that make up GFCF according to type of economic activity, organisation and asset class (the form of classification used by the SARB).

Total GFCF (*TOT*), GFCF by private business enterprises (*PVT*), public corporations (*PUB*) and general government (*GOV*) at constant 2010 prices (seasonally adjusted) were obtained from the SARB and converted into one-period percentage changes (i.e. growth rates). This study therefore examines the interest rate responsiveness of investment spending at both the aggregate level (*TOT*) and at the disaggregate level (*PVT*, *PUB* and *GOV*). The 'type of organization' classification was chosen as quarterly data was only available for this classification. Moreover, the other two classifications used by the SARB (refer to Table A2) have considerably more subcategories in comparison, which would require estimation of a vast number of models and result in a rather cumbersome analysis.

Figures A12 to A19 graph the various investment categories used in this study. The contribution of investment to GDP averaged 25% between the 1970s and early 1980s, peaking at 30% in 1976. Political uncertainty and high inflation lead to a considerable decline in investment from the mid-1980s to 1993, causing a fall in the contribution of investment to GDP to below 15% (Faulkner and Loewald, 2008: 8). Public sector investment played a significant role over this period, dropping from a share of total investment of 53% in 1976 to 27% in 1994, as it withdrew from all infrastructure investment in order to cover the increase in its current expenditure obligations (Bhorat *et al*., 2014: 11).

The transition to democracy, which subsequently lead to the removal of international sanctions, improved political stability and hence investor sentiment within the economy between 1995 and 2000. This resulted in a substantial recovery in investment.

Thereafter, investment was further assisted by greater stability in the fiscal policy stance. Investment in South Africa is now primarily conducted by the private sector which contributed 63% to total GFCF in 2014Q4, making it the driving force behind GFCF when compared to public investment and investment by general government, which contributed 20% and 17% to total GFCF, respectively.

TOT experienced an average growth rate of 1.11% over the sample period, a maximum of 11.21% in 1996Q1 and a minimum of -7.06% in 1999Q1. *PVT* attained a mean of 1.28%, reaching a high of 8.82% in 1988Q1 and a low of -11.51% in 2009Q1. *PUB* obtained an average of 1.55% over the period under analysis, maximum of 24.92% in 1989Q1 and minimum of -26.87% in 1999Q1. *GOV* achieved an average growth rate of 0.74%, maximum growth rate of 36.06% in 1996Q1 and minimum growth rate of -18.98% in 1987Q2.

4.5 Control Variables

Other variables included in the analysis include South African GDP (*GDPG*), US GDP (*USGDPG*), the Rand Merchant Bank/BER business confidence index (*BCI*) as well as two dummy variables, *DUMAPARTHEID* and *DUMCRISIS*. These variables were included to ensure that the model could successfully account for a significant portion of the variation in investment spending in South Africa.

4.5.1 South African GDP

The data for South Africa's GDP at constant 2010 prices (seasonally adjusted) were obtained from the SARB and converted into a one-period percentage change (*GDPG*). The level of national income can be approximated by GDP. Theoretically, higher levels of national income should lead to higher levels of investment as businesses and individuals direct their increased availability of funds towards capital investment (Adams, 2009; Ndikumana, 2000; Kwenda and Holden, 2014). A positive relationship between investment spending and real GDP growth is therefore expected.

A graph of South African GDP is shown in Figure A20, while Figure A21 shows the growth rate of South African GDP (*GDPG*). South African GDP displayed a gradual increase from 1987Q1 to 2008Q3, whereafter it declined considerably due to the international financial crisis. *GDPG* exhibited considerable volatility over the period. It reached a maximum of 1.87% in 1996Q2, a minimum of -1.56% in 2009Q1, and averaged 0.64% over the period.

4.5.2 US GDP

US GDP was used as a proxy for world GDP as quarterly data for world GDP was not available. US GDP seasonally adjusted and in absolute terms was obtained from the FRED and then converted into a one-period percentage change (*USGDPG*). US GDP accounts for a significant portion of world GDP (22% in 2014) and is therefore regarded as an appropriate proxy (World Bank, 2015).

Figures A22 and A23 graph US GDP in absolute and growth terms respectively. *USGDPG* attained an average growth rate of 4.95% and remained fairly constant over the sample period. It reached a maximum of 10.40% in 1987Q4 and a minimum of -7.70% in 2008Q4 as a result of the financial crisis.

As is the case with South African GDP, and for the same reasons as described in section 4.5.1, a significant and positive relationship is expected between US GDP and the level of investment spending in South Africa.

4.5.3 Business Confidence Index

The business confidence index used in this study was obtained from the Bureau for Economic Research (BER). In summary, the index reflects the market-related business climate, and takes into account developments in the economy that have an effect on business sentiment in South Africa. The business confidence is derived from the results of questionnaires that have been completed by executives from the trade, manufacturing and building sectors. Questions included in the questionnaire relate to current and expected developments regarding sales, orders, employment, inventories, selling prices and constraints. The results provide information on current business confidence, the ratings of conditions within business and the expectations with respect to developments in the business cycle for the following quarter (Kershoff, 2000:4).

The index can therefore be used as a proxy for the level of investor confidence in the economy. According to economic theory, business confidence is considered to be an important determinant of investment spending (Gelb, 2001; Gordon, 1987). Uncertainty regarding the future and what may or may not occur can lead to a fall in business confidence. Firms may decide to postpone their investment decisions and planned capital expenditure as a result of this. Increased investor confidence will have the opposite effect – firms may decide to bring their planned capital expenditure forward which will have a positive effect on investment spending (IDC, 2013). It was therefore seen as a necessary component of the analysis to account for the variation in the level of investment spending.

The index can vary between 0 and 100 where 0 indicates an extreme lack of confidence, an index of 50 indicates neutrality and an index of 100 indicates extreme confidence. The *BCI* is plotted in Figure A24. The index reached a maximum of 87 in 2004Q4, minimum of 12 in 1998Q4 and averaged 47.12 over the period under analysis. A number of peaks and troughs are present over the period with the index falling sharply from 1988Q2 to 1992Q3, increasing rapidly from 1992Q4 to 1994Q4, falling between 1995Q4 and 1998Q4, rising from 1999Q1 to 2004Q4, and then dropping once again from 2006Q3 to 2009Q3.

4.5.4 Apartheid Dummy Variable

The apartheid era had a considerable influence on the level of investment spending in South Africa. By the end of the era, spending on capital investment had dropped to "astonishingly low levels" (Bhorat, 2014:11). This was largely as a result of the economic sanctions that were applied against South Africa in the mid-1980s in order to pressure the South African government to abolish apartheid (Levy, 1999:2).

The apartheid dummy variable (*DUMAPARTHEID*) was assigned a value of one from 1994Q2 to 2013Q4, indicating the end of apartheid in South Africa (i.e. democratic South Africa). The period 1994Q2 was chosen as it coincides with the country's first democratic election and hence the abolishment of apartheid. Furthermore, it was during this period that all economic sanctions that were imposed against South Africa were lifted (SA History, 2015).

4.5.5 Global Financial Crisis Dummy Variable

The Global Financial Crisis had a considerable impact on the level of investment spending in South Africa as well as worldwide (Ksantini and Boujelbene, 2014). As can be seen from Figures A12 and A13, investment spending exhibited a sharp decline between 2008 and 2010 as a result of the crisis.

In order to account for the effect of the Global Financial Crisis on the level of investment spending in South Africa, a dummy variable is included. It is highly common for empirical studies to differ in their choice of dates (starting and ending time periods) pertaining to the crisis. For the purposes of this study, the Global Financial Crisis dummy variable (*DUMCRISIS*) was set equal to one (indicating the presence of the crisis) from 2008Q3 to 2012Q4, representing the 'start' and 'end' of the crisis respectively, and set equal to zero for all other periods. The 'start' date for the crisis was chosen based on the sudden fall in the yield on long-term government bonds in the US and European Union and the 'end' of the financial crisis was noted by the reversal of long-term government bond yields.

4.6 Conclusion

This chapter discussed the data and variables used in the analysis. Section 4.2 discussed the sample period and data frequency used to perform the analysis. Section 4.3 provided an explanation of the various short-, medium-, and long-term interest rates that were used. Section 4.4 described the different measures of investment spending. Finally, section 4.5 provided an overview of the control variables that were included in the model to ensure that it could successfully account for a significant portion of the variation in investment spending. Chapter 5 explains the methods and procedures used to conduct the analysis using the data and variables discussed in this chapter.

CHAPTER 5: METHODOLOGY

5.1 Introduction

This chapter explains the methods and procedures that were used to obtain the findings of the study. The principal method of research utilized was quantitative analysis and a positivist paradigm was employed. The chapter is structured as follows: Section 5.2 describes the tests for stationarity that were used to determine the order of integration of the variables used in the analysis. Section 5.3 details the VAR models that were estimated to determine the relationship between investment spending and the real interest rates. Section 5.4 discusses the variance decomposition and impulse response functions that were used to explain the dynamic short-term relationships amongst the variables. Section 5.5 explains the Granger causality tests used to determine whether interest rate changes are useful in forecasting changes in investment spending. Section 5.6 concludes the chapter.

5.2 Tests for Stationarity

The first step in the analysis was to test whether each individual time series was stationary or non-stationary. If a time series is non-stationary, it is necessary to perform the appropriate transformation on the series. This is done to certify that the mean, variance and covariance of the series remain constant, independent of the point in time at which they are measured and hence to ensure accurate estimation of the model (Gujarati, 1995).

In determining whether the time series used in this analysis were stationary, a preliminary graphical assessment of the series was conducted, as well as the Augmented Dickey-Fuller (ADF) unit root test and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test.

The popular ADF test generally involves the estimation of the following regression equation (Enders, 2010:207):

$$\Delta Y_t = \beta_0 + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{n} \Delta Y_{t-i} + \varepsilon_t$$

where ε_t is a pure white noise error term. The ADF tests for the presence of a unit root in the time series ($\delta = 0$) against the alternative that the series is stationary ($\delta < 0$).

Unlike the ADF, which tests for the presence of a unit root in series, the KPSS tests the null hypothesis of stationarity of the time series versus the alternative hypothesis of non-stationarity (Kwiatkowski *et al.*, 1992). The KPSS test statistic is given by:

$$KPSS = \frac{1}{T^2} \frac{\sum_{t=1}^{T} S_t^2}{\hat{\sigma}_\infty^2}$$

where T is the sample size, $S_t = \sum_{s=1}^{t} \hat{e}_s$ is a partial sum, and $\hat{\sigma}_\infty^2 = \frac{1}{T} var(S_t)$ is a HAC estimator of the variance (Kwiatkowski *et al.*, 1992:163). For a series to be stationary, the null hypothesis should be rejected in the ADF test and not rejected in the KPSS test.

5.3 VAR Models

VAR modelling was utilised to investigate the relationship between the real interest rate and investment spending. According to Bernanke and Gertler (1995), VARs are a convenient method to summarise the dynamic relationships among the variables included in a model as they are able to "stimulate the response over time of any variable in the set to either an 'own' disturbance or a disturbance to any other variable in the system" (Bernanke and Gertler, 1995:30). Stock and Watson (2001:113) recommend the use of VAR models in studies such as this one as they are powerful tools that are capable of generating reliable results that describe the data. Due to the fact that VAR models include both current and past values of multiple time series, they have the ability to model co-movements between the variables that cannot be detected using univariate or bivariate models.

A VAR model is defined as a systems regression (multi-equation) model whereby an endogenous variable (investment spending) is explained by its own lagged values as well as lagged values of the other endogenous variables in the model (short-, medium- and long-term interest rates as well as the control variables included in the model). If a significant relationship exists between the lagged values of investment spending or the lagged values of any of the other variables in the model, then it can be concluded that past values of that particular variable will have an effect on the current level of investment spending (Gujarati, 1995).

When constructing a VAR model, it is important to determine the appropriate number of lags to include in the model to ensure accurate estimation (Stock and Watson, 2001). In order to achieve this, the following selection criteria were used to determine the appropriate number of lags to include in each of the VAR models: log-likelihood, sequential modified LR test statistic, final prediction error, Akaike information criterion, Schwarz information criterion, and Hannan-Quinn information criterion. The VAR residual serial correlation LM test was used to ascertain whether any autocorrelation was present in the residuals of the various VAR models. If it was found that autocorrelation was present in the VAR model, the lag length was adjusted slightly in order to correct for the autocorrelation.

In order to obtain a more precise estimate of the relationship between investment and the interest rate, the relationship between the various interest rates (short-, medium-, and long-term) and investment spending for each of the four investment categories was estimated separately. This was done as one would expect, *a priori*, for each investment category to respond differently to short-, medium- and long-term interest rates depending on the investment horizon of the particular investment category under investigation. Table A4 shows the different VAR model specifications used for the various investment categories and interest rates.

5.4 Variance Decompositions and Impulse Response Functions

In order to explain the dynamic short-term relationships amongst the variables, this study also makes use of variance decompositions and impulse response functions.

Using a general two-variable model, for illustrative purposes, the VAR can be written as follows:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}$$

which can be written as:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} e_{1t-i} \\ e_{2t-i} \end{bmatrix}$$

through algebraic and matrix manipulation, one can get the following moving-average representation:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{z} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \emptyset_{11}(i) & \emptyset_{12}(i) \\ \emptyset_{21}(i) & \emptyset_{22}(i) \end{bmatrix} \begin{bmatrix} \varepsilon_{yt-i} \\ \varepsilon_{zt-i} \end{bmatrix}$$

This representation allows one to investigate the interaction between the $\{y_t\}$ and $\{z_t\}$ sequences in the system. The four components, ϕ_{jk} (0), are called impact multipliers. For example, the coefficient $\phi_{12}(0)$ is the instantaneous effect of a one-unit change in ε_{zt} on y_t. $\phi_{12}(1)$ therefore shows the effect of a unit change in ε_{zt} on y_{t+1}. The four elements $\phi_{12}(1)$, $\phi_{12}(1)$, $\phi_{12}(1)$ and $\phi_{12}(1)$ are referred to as the impulse response functions (Enders, 2010:308). Thus, the impulse response functions trace out the responses of the various investment categories to changes in the interest rates and provide a practical way of seeing the response of the various investment categories to shocks in the interest rates.

Variance decompositions show the portion of the variance in the forecast error for each variable which occurs as a result of an innovation to all the variables included in the system (Enders, 2010:313). If ε_{zt} shocks do not assist in explaining the variance in the forecast error of $\{y_t\}$ at all of the forecast horizons considered, then one can say that $\{y_t\}$ is exogenous and that it moves independently of the ε_{zt} shocks as well as the $\{z_t\}$ sequence. If the shocks explained all of the forecast error variance in the $\{y_t\}$ sequence, then $\{y_t\}$ would be referred to as being endogenous (Enders, 2010:314). It is common for a variable to explain a large majority of its forecast error variance at short horizons and smaller proportions at longer horizons.

5.5 Granger Causality Tests

The Granger causality test, developed by Clive Granger in 1969, was used to determine whether interest rate changes are useful in forecasting changes in investment spending and *vice versa*. This was done as regressions are only able to reflect correlations between variables, and correlation does not imply causality (Lin, 2008:1). Furthermore, it is difficult to distinguish correlation from causality in VAR models (Stock and Watson, 2001:113).

According to Granger (1969), prior values of one time series can be used to measure the ability to predict future values of another time series and hence test for causality amongst the variables. Interest rates would therefore Granger cause investment spending if it can be shown that interest rates provide statistically significant information regarding the future value of investment spending. The test is based on two principles (Granger, 1969):

i. The cause takes place before its effect
ii. The cause has information that is unique regarding the future values of the effect

X_t has a causal effect on Y_t if:

$$P(Y(t+1) \in A \mid \Omega(t)) = P(Y(t+1) \in A \mid \Omega_{-X}(t))$$

where A is an arbitrary non-empty set, $\Omega(t)$ is the information available in the entire universe as of time t, and Ω_{-X} is the information available in the entire universe excluding that of X_t (Granger, 1969:428).

5.6 Conclusion

This chapter detailed the various methods and procedures that were used to obtain the results presented in the next chapter. After reviewing the existing literature discussed in Chapter 3, the methods and procedures outlined in this chapter were believed to be the most appropriate to achieve the objective of the study. Section 5.2 explained the ADF and KPSS tests for stationary that were used to determine the order of integration of the variables included in the model. Section 5.3 explained the VAR models that were run to determine the nature and strength of the relationship between investment spending and the real interest rates. Section 5.4 detailed the variance decompositions and impulse response functions used to explain the dynamic short-term relationships amongst the variables. Section 5.5 explained the Granger causality tests used to determine whether interest rate changes are useful in forecasting changes in investment spending and *vice versa*. Chapter 6 which follows presents the empirical findings that were obtained using the abovementioned methods and procedures.

CHAPTER 6: EMPIRICAL RESULTS

6.1 Introduction

This chapter presents and discusses the empirical results obtained using the methods and procedures discussed in the previous chapter. Section 6.2 shows the results of the ADF and KPSS tests that were performed to determine the order of integration of the time series used in the model. Sections 6.3 to 6.6 present the results of the VAR models, variance decompositions, impulse response functions and Granger causality tests for *TOT*, *PVT*, *PUB* and *GOV* respectively. Section 6.7 provides an interpretation of the results and section 6.8 concludes the chapter.

6.2 Tests for Stationarity

Table 3 shows the ADF test results. The ADF test indicated that all variables were stationary (integrated of order zero) as the null hypothesis of a unit root can be rejected in each case.

TABLE 3: ADF TESTS FOR STATIONARITY

Variable	Test Statistic (Level Terms)	P-value*	Order of Integration
PR	-3.3237	0.0162	I(0)
TB	-3.6138	0.0070	I(0)
GBY03	-3.5894	0.0075	I(0)
GBY35	-3.7457	0.0047	I(0)
GBY510	-3.7996	0.0039	I(0)
GBY10	-3.9346	0.0026	I(0)
TOT	-6.1793	0.0000	I(0)
PUB	-8.7144	0.0000	I(0)
PVT	-6.8493	0.0000	I(0)
GOV	-9.8358	0.0000	I(0)
GDPG	-4.6393	0.0002	I(0)
USGDPG	-3.8010	0.0039	I(0)
BCI	-2.6198	0.0922	I(0)

Notes:
Null hypothesis: Series is non-stationary
Lag length: Automatic selection (Schwarz Info Criterion)
* MacKinnon (1996) one-sided p-values
Source: Author's own estimates using EViews 7

The results obtained from the KPSS tests for stationarity are shown in Table 4. The KPSS test indicated that all variables excluding *USGDPG* were stationary.

TABLE 4: KPSS TESTS FOR STATIONARITY

Variable	Test Statistic (Level Terms)	Test Statistic (First Differences)	Order of Integration
PR	0.2825	-	I(0)
TB	0.2671	-	I(0)
GBY03	0.2775	-	I(0)
GBY35	0.2620	-	I(0)
GBY510	0.2491	-	I(0)
GBY10	0.2255	-	I(0)
TOT	0.1394	-	I(0)
PUB	0.2113	-	I(0)
PVT	0.0589	-	I(0)
GOV	0.2181	-	I(0)
GDPG	0.2565	-	I(0)
USGDPG	0.5187**	0.0461	I(1)
BCI	0.1602	-	I(0)

Notes:
Null hypothesis: Series is stationary
Automatic bandwidth selection: Newey-West Bandwidth
Source: Author's own estimates using EViews 7

The results of both tests therefore only differed with respect to *USGDPG*. It was decided to perform two further tests (Dickey-Fuller GLS and Phillips-Perron) to determine the order of integration of *USGDPG*. Based on the results of both the Dickey-Fuller GLS and Phillips-Perron tests (not shown) it was concluded that *USGDPG* was also stationary as was the case with the other time series included in the model. All variables are therefore appropriate to include in the VAR estimations.

6.3 Results for *TOT*

The VAR results for *TOT* using model specifications 1 to 6 (Table A4) are presented in Table A5. On the basis of these results, aggregate investment did not exhibit any significant response to changes in any of the interest rates at the first lag but showed a significant and negative response to an increase in short-term interest rates (*PR* and *TB*) at the second lag. A significant inverse relationship between *TOT* and *GBY03* at the third lag was also evident. No significant relationship was present between *TOT* and the other three interest rates (*GBY35*, *GBY510*, *GBY10*). This contradicts economic theory (Bonga-Bonga, 2009; Mishkin, 1995; Gumata *et al.*, 2013), which states that it is longer-term interest rates that will have the most significant effect on capital investment due to the fact that it is spending taken with a long-term view, generally speaking.

All control variables included in the model had a significant effect on *TOT* at various lags and using the different model specifications. *TOT* responded significantly and positively to an increase in both *GDPG* and *USGDPG* at the second lag for all model specifications. The level of business confidence also had a significant impact on *TOT* at the first lag using model specifications 4 to 6. Both dummy variables that were included in the model exhibited relationships as per *a priori* expectations. *TOT* responded positively and significantly post-apartheid, and exhibited a significant and negative response to the Global Financial Crisis of 2008.

In order to further examine the results and findings of the VAR model, variance decompositions and impulse response functions were used. For simplicity's sake, and for ease of presentation, only the variance decompositions and impulse response functions of the different investment categories with respect to the various interest rates are shown and explained in this chapter.

Table A6 and Figures A25 to A30 provide the results of the variance decompositions and impulse response functions for *TOT* respectively. Shorter-term interest rates accounted for a greater proportion of the variation in *TOT* when compared to longer-term interest rates. More importantly, the results of the variance decompositions show that all interest rates explain very little of the variation in aggregate investment in South Africa, and at no stage does any interest rate explain more than seven percent of the variation in the total level of investment. This suggests that interest rates are not that important in determining aggregate investment, and that there are other factors that are potentially stronger drivers of investment and investment decisions in South Africa – the level of GDP for example which explains approximately 18 percent of the variation in investment.

The impulse response functions for *PR*, *TB* and *GBY03* displayed similar patterns to one another. *TOT* exhibited a sharp increase initially (up to period two approximately), in response to a one standard deviation innovation in these three interest rates. Thereafter, *TOT* began to drop significantly until period three whereafter it remained relatively constant. *TOT* started to increase gradually once again after period four but remained negative and did not return to its initial level in the long-run. *TOT* also responded positively to *GBY35*, *GBY510* and *GBY10* at first before steadily dropping. However, the results for these three interest rates differed from *PR*, *TB* and *GBY03* as *TOT* remained positive and did not become negative, even in the long-run.

The impulse responses show that short-term interest rates and long-term interest rates do not have the same effect on aggregate investment. A rise in short-term interest rates appears to decrease the level of investment spending in the long-run, whereas a rise in long-term interest rates results in an increase in investment. This could be due to the fact that if long-term interest rates rise, investors expect borrowing costs to rise in the future and would therefore borrow more for capital investment purposes now before interest rates rise, as this will increase the cost of borrowing and hence make capital investment relatively more expensive in later periods.

Furthermore, investment exhibited a strong positive response initially to an increase in interest rates. One possible reason for the apparent positive response by aggregate investment to an increase in a number of the interest rates initially (predominantly the longer-term interest rates) and the noticeable fall in investment spending thereafter (once some time has passed) is the presence of a threshold interest rate or non-linear relationship between these interest rates and investment spending. This issue is addressed by McKinnon (1973) who argues that an increase in the real interest rate will promote savings and the substitution from physical assets to bank deposits in countries (developing countries specifically) where self-finance is of considerable importance and interest rates are low or even negative – although this is fairly unlikely in South Africa where the level of savings is very poor in comparison to other developing economies. According to McKinnon (1973), an increase in the interest rate will have a positive effect on the level of investment spending due to the increased availability of funds which can be used to finance profitable investment opportunities. However, when interest rates are extremely high, it would be expected that physical capital investment will yield a low or negative return and an inverse relationship will therefore exist between the real interest rate and investment spending once more.

Table A7 shows the results of the pairwise Granger causality tests for *TOT* and the various interest rates. None of the tests yielded a significant result and it was therefore concluded that, in the Granger sense, past interest rates do not provide a statistically significant forecast of future investment spending. This provides further support to the findings reported above as they suggest, once again, that interest rates may not be that important in determining the level of aggregate investment due to the fact that they do not provide statistically significant information regarding the future value of investment spending.

Overall, the results indicate that interest rates have little effect on the aggregate level of investment and that interest rate changes are not capable of achieving substantial changes in aggregate investment in the long-run.

6.4 Results for *PVT*

Table A8 shows the VAR results for *PVT* using model specifications 7 to 12 (Table A4). The VAR results differed slightly when compared to aggregate investment. It was found that short-term interest rates exerted a significant and inverse effect on *PVT* at the first lag. *GBY03* did not exert any significant effect on *PVT* as was the case with *TOT*. However, as was evident with the VAR results for *TOT*, *PVT* was not significantly affected by changes in *GBY35*, *GBY510* and *GBY10*. Looking at the other variables included in the model, both *GDPG* and *USGDPG* had a highly significant and positive effect on *PVT* at the first lag in all model specifications. The magnitude of the effect of changes in the level of business confidence was found to be negligible. *DUMAPARTHEID* and *DUMCRISIS* both exerted a highly significant influence on *PVT*, which responded positively once apartheid had ended, and negatively to the Global Financial Crisis.

The results of the variance decompositions for *PVT* are presented in Table A9. Short-term interest rates accounted for the largest proportion of the variation in private investment – six percent at most when looking at the effect of *PR* on *PVT*. Once again, the variance decompositions suggest that interest rates do not explain a large proportion of the variation in investment by private business enterprises as was discovered with aggregate investment, and that interest rates do not have much impact on this investment category either when compared to other factors such as *GDPG* and *USGDPG* which accounted for as much as 20 percent and 12 percent of the variation in *PVT* respectively.

The impulse response functions for *PVT* to shocks in the various interest rates showed that private investment, like total investment, also responds differently to shocks in short-, medium-, and long-term interest rates. The impulse response functions for *PVT* displayed a rapid decline from period one in response to a positive shock in short-term interest rates (*PR* and *TB*) – Figures A31 and A32. *PVT* began to rise slowly from period four onwards but remained negative for all periods. *PVT* did not show any response to changes in *GBY03* (Figure A33) at first but started falling gradually from period two onwards. It began to increase slowly around period six before stabilising at its initial level after 11 quarters had passed. Similar to total investment, *PVT* exhibited a sharp positive response to shocks in *GBY35*, *GBY510* and *GBY10* initially (Figures A34 to A36), and fell thereafter but remained positive, even in the long-run.

These results therefore indicate that an unexpected increase in short-term interest rates does lead to a fall in investment by private business enterprises and that the effect is persistent even in the long-run. However, medium- and long-term interest rate shocks have a different effect on private investment as investment showed a positive response to an unexpected increase in these interest rates. As explained in section 6.3, this might be as a result of private business enterprises increasing investment spending today in anticipation of higher borrowing costs in the future.

The pairwise Granger causality test results for *PVT* are shown in Table A10. As with *TOT*, the Granger causality tests did not show any significant relationship between *PVT* and the interest rates considered. Hence, past values of the interest rate do not provide any significant information regarding future movements in the level of private investment.

6.5 Results for *PUB*

VAR model specifications 13 to 18 (Table A4) were used to obtain the results for *PUB* which are shown in Table A11. The results indicated that investment by public corporations behaves differently in response to interest rate changes when compared to aggregate and private investment. A strong positive relationship exists between short- and medium-term interest rates (*PR*, *TB*, *GBY03*, *GBY35*) and *PUB* at the first lag. However, the opposite was true at the second lag with *PUB* responding significantly and negatively to an increase in short- and medium-term interest rates. The fall in *PUB* in response to an increase in these interest rates at the second lag was smaller in magnitude than the increase in *PUB* at the first lag in all instances. Once again, as with the investment categories discussed above, no significant relationship – positive or negative - was found to exist between *PUB* and the long-term interest rates (*GBY510* and *GBY10*) at all lags considered.

In contrast to the results obtained for *TOT* and *PVT*, *GDPG* was not found to have a significant effect on *PUB* in all model specifications. Furthermore, the relationship between *USGDPG* and *PUB* does not conform to *a priori* expectations according to the results of the VAR model as *USGDPG* at the second lag had a significant and negative effect on *PUB* in all model specifications. *BCI* at the second lag significantly and positively affected *PUB* using all model specifications. Neither *DUMAPARTHEID* nor *DUMCRISIS* had a significant effect on the level of investment by public corporations in all of the model specifications.

The variance decompositions for *PUB* presented in Table A12 indicate once again that it is shorter-term interest rates which account for the greatest proportion of the variation in investment spending - approximately seven percent for *PR* and *TB*. As with the results in sections 6.3 and 6.4, the results suggest that interest rates do not explain much of the variation in public investment and that factors other than interest rates may therefore be more important in determining the level of investment by public corporations. Furthermore, it was found that the other variables included in the model also explained very little of the variation in public investment, such as *GDPG* which explained approximately four percent of the variation in this investment category at most.

The impulse response functions for *PUB* in response to a one standard deviation innovation in the various interest rates can be seen in Figures A37 to A42. All impulse response functions exhibit very similar patterns to one another. *PUB* therefore has a similar response to shocks in short-, medium- and long-term interest rates. This differs from the results obtained for *TOT* and *PVT* which showed that short- and long-term interest rate shocks have different effects on both aggregate and private investment in the long-run. The sharp initial increase in investment (i.e. *PUB*) in period one in response to an increase in interest rates can be seen once again for all interest rates analysed. *PUB* drops rapidly immediately thereafter and stabilises marginally below its initial level for *PR*, *TB* and *GBY03*, and slightly above its initial level once stabilised for *GBY35*, *GBY510* and *GBY10* in the long-run. In Figures A37, A38, and A39, the confidence bands fall entirely above the zero line at certain periods, implying that the effect is statistically significant at those specific lags. These are the only three impulse response functions in the study that display such significant effects. So although interest rates do not play much of a role in determining investment, interest rates (especially short-term ones) may have a small and significant effect on investment by public corporations.

Table A13 shows the pairwise Granger causality test results for *PUB*. According to the results, the null hypothesis that *TB* does not Granger cause *PUB* was rejected at the 10 percent significance level. This was also nearly true for *PR* (p-value = 0.11). All the other null hypotheses were not significant and could therefore not be rejected. The results suggest that past values of short-term interest rates are useful in forecasting investment spending by public corporations. Short-term interest rates therefore do assist in determining the level of public investment in future periods in South Africa on the basis of these results.

6.6 Results for *GOV*

The VAR results for *GOV* using model specifications 19 to 24 (Table A4) are presented in Table A14. Unlike the other investment categories, *GOV* did not show any significant response - positive or negative - to interest rate changes at all lags included in the various VAR models. Furthermore, the results indicated that *GOV* does not exhibit a significant relationship with any of the control variables included in the VAR model.

Table A15 shows the results of the variance decompositions of *GOV* for the various interest rates. The interest rates as a whole accounted for a very small proportion of the variation in *GOV*, and therefore support the findings of the VAR models as it suggests that interest rates are not an important determinant of investment by general government in South Africa.

The response of *GOV* to an unexpected increase in *PR* (Figure A43) increased sharply at first, dropped sharply thereafter and remained relatively constant below its initial level in the long-run. *GOV* showed little response to a *TB* innovation for the first four periods (Figure A44) but declined gradually thereafter and stayed marginally below its initial level in the long-run. *GOV* responded positively to an increase in *GBY03*, *GBY35*, *GBY510* and *GBY10* (Figures A45 to A48) in a similar manner to the impulse response functions looked at previously. *GOV* increased gradually for approximately four periods. After declining steadily for a number of periods thereafter, *GOV* stabilised at its initial level for these medium- and long-term interest rates in the long-run. As a whole, the impulse response functions do not indicate that interest rates are capable of affecting the level of investment by government enterprises in the long-run.

Table A16 shows the results of the Granger causality tests for *GOV*. None of the p-values were significant and all null hypotheses could therefore not be rejected. Short-, medium- and long-term interest rates do not provide any meaningful information regarding the future movement of investment by general government based on these results. This lead to the conclusion that current interest rates are not an important determinant of investment by general government in the future.

The results above suggest, as a whole, that this investment subcategory is unaffected by interest rate changes, as well as changes in other factors. This indicates that investment by general government may be exogenously determined in South Africa.

6.7 Interpretation of findings

Overall, the results indicate that while interest rates do have some effect on the level of investment spending in South Africa, and do result in changes in the level of investment, the magnitude of the impact of interest rate changes on investment spending is not particularly large. When comparing the results of this paper to studies of a similar nature that have also had difficulty in identifying substantial interest rate effects on investment, one can draw a number of inferences and possible explanations for the relatively small impact of interest rate changes on investment spending in South Africa.

According to Bernanke and Gertler (1995), the interest rate channel of MPTM is not as strong as it was in the past due to the increased importance of other channels of MPTM, specifically the bank lending and balance sheet channels - collectively known as the credit channels of MPTM. The bank lending channel focuses on changes in the supply of loans by depository institutions resulting from changes in monetary policy. A monetary expansion, which is associated with an increase in reserves and hence deposits, will mean that more loans can be funded and thus the supply of loans will increase resulting in higher levels of investment and aggregate output (Mishkin, 1995:8). With respect to the balance sheet channel, expansionary monetary policy results in an increase in equity prices. As a result, the net worth of firms is higher than it was previously resulting in a fall in the adverse selection and moral hazard problems (lenders have more collateral for their loans and owners have a higher equity stake in their firms, giving them less incentive to engage in risky investment contracts). This results in increased levels of lending to finance investment spending (Mishkin, 1995:8).

This may also hold in South Africa as well as research suggests that it is a high-borrowing economy. According to a report published by the World Bank in 2015, South Africans exhibited the highest level of borrowing in the world in 2014 with 86% of South Africans taking out loans (either from financial institutions, family and friends, or private informal lenders) during the year (Demirguc-Kunt *et al*., 2015). Thus, the question to answer is whether South Africans, in planning their capital expenditure, are more concerned with and influenced by the availability and ease of obtaining credit from financial institutions in order to fund their capital expenditure, as opposed to the borrowing costs associated with the loan, and hence whether South Africa is becoming a credit-driven economy whereby access to funding is the driver of investment spending.

Sharpe and Suarez (2014) attribute the apparent insensitivity of investment spending to the relatively high average hurdle rates which are present in the U.S. While interest rates have declined steeply, average hurdle rates have remained high and fairly unchanged over the past few decades. The hurdle rate is the minimum, or required rate of return on an investment, necessary to cover all of the costs relating to the project (Brunzell *et al.*, 2013). Firms will only invest in projects (undertake capital expenditure) if they yield a return which exceeds the minimum acceptable hurdle rate. Thus, with the high hurdle rates present in the U.S., interest rate changes have had less of an effect on the level of capital investment, as the return from investing in new capital stock will still not exceed this rate. In a South African context, this may also be the case. The cost of debt in South Africa (as well as other emerging market economies) is relatively high compared to more developed nations (Power, 2004). This means that even if interest rates fall in South Africa, firms are still faced with high borrowing costs (hurdle rates), and the decline in interest rates may therefore fail to induce firms to undertake higher levels of capital investment due to the risk that the expected return from their investments will still not prove to be profitable given the high level of interest rates.

As discussed in section 3.2, the ECB found that accelerator variables such as output and cash flow have a much larger impact on the level of capital investment expenditure in comparison to interest rates (Gilchrist and Zakrajsek, 2007:18). Therefore, in an environment characterised by low economic growth, aggregate demand, and cash flows, as is being experienced in South Africa currently, firms are faced with exceptionally tough trading conditions and may be less concerned by the current level of interest rates when making capital investment decisions as there are more pertinent issues which are currently having a greater effect on their future prospects.

In this regard, the current economic environment in South Africa is not conducive to high levels of capital investment due to low economic growth. The VAR results in this study, as well as the results obtained in numerous other studies, have shown the significant and relatively large influence that GDP growth has on the level of capital investment. Real GDP growth in South Africa has been declining steadily over the past decade and was recorded at -1.3% in the second quarter of 2015 (World Bank, 2015) as a result of the fact that government has failed to address structural problems within the economy such as the low-skilled labour force, high (and ever-increasing) wage levels, unemployment, poor infrastructure and development, as well as corruption and crime. This has resulted in sluggish economic growth which is below the GDP growth rate in Sub-Saharan Africa (last recorded at 4.3% in 2014 by the World Bank), and will continue to have a negative impact on capital investment. We may fail to see any improvement in the level of capital investment in future periods should these issues not be addressed and dealt with efficiently and effectively.

The results of this study both support and contradict existing research which has been conducted into this topic in South Africa. Gupta *et al.* (2009) examined the effect of a monetary policy shock on the manufacturing sub-sector of gross fixed capital formation by the private sector. While this study does not examine the effect of interest rates on this sector specifically, it is still beneficial to compare the results obtained by Gupta *et al.* (2009) to those obtained in this study as the impulse response function for the period 1989 to 1997 presented in Gupta *et al.* (2009) bears considerable resemblance to those obtained in this study. Noteworthy similarities include the following (refer to Figure A51):

- An initial sharp increase in the level of investment once the positive monetary policy shock takes place, and the severe decline in investment immediately thereafter. No reasons are provided for the initial positive response by investment.
- The inability of the monetary policy shock to achieve large long-run changes in the level of investment.

The impulse response functions in this study therefore support the findings of Gupta *et al*. (2009) for the period up to 1997.

Referring to the results of Gumata *et al.* (2013), an unexpected increase in the repo rate of 100 basis points resulted in a direct increase in short-term interest rates which affected the cost of capital and hence investment. Yet again, GFCF growth exhibited a strong positive response initially before declining rapidly (Figure A49). GFCF growth stabilised at its initial level in the long-run (after approximately 24 quarters) as was found to be the case in this study.

The results of this study also support the findings obtained by Kabundi and Ngwenya (2011) who confirmed that price stability can be obtained in South Africa by using monetary policy (i.e. repo rate changes) based on the fact that monetary policy was able to affect macroeconomic variables (including investment). The impulse response function of private fixed investment to a shock in the repo rate (Figure A50) exhibited an initial sharp increase, once again, before declining gradually. Investment started to rise again after approximately 11 months until it stabilised at its initial level – indicating that interest rate changes are unable to lead to persistent long-run changes in the level of investment as was found in this study.

Finally, the findings of this study contradict those obtained by Fielding (1997) who found that interest rate changes were able to achieve fairly large changes in the level of investment in both the short-run *and* long-run (short-run and long-run interest elasticities of -1.365 and -0.748 respectively). This may be as a result of the fact that his sample ends in 1992, and hence a large portion of data from recent years is excluded from his study, resulting in a finding that does not correspond with developments (such as the end of apartheid, increased capital flows due to greater trade liberalisation, the Global Financial Crisis) which have taken place in the South African economy after this period. Furthermore, the results of this study, which does include more recent data, may indicate that interest rates are not able to influence the level of investment spending as much as they did in the past when looking at the results obtained by Fielding (1997).

In summary, existing South African research has therefore also found that interest rate changes have a relatively small impact on the level of investment spending in the long-run. The reason for the sharp increase in investment spending in response to an increase in interest rates is not clear and therefore warrants further research.

It is also clear from existing international research that there are a number of other factors which can be considered to be more effective drivers of capital investment in South Africa compared to interest rates.

6.8 Conclusion

This chapter presented and discussed the empirical results obtained using the methods and procedures discussed in the previous chapter. Section 6.2 showed the results of the ADF and KPSS tests that were performed to determine the order of integration of the time series used in the model. All time series were stationary, and therefore did not require any differencing.

Sections 6.3 to 6.6 present the results obtained for the various investment categories. Overall, the results of the VAR models, variance decompositions and impulse response functions reported above provide considerable insight into the nature and strength of the relationship between short-, medium- and long-term interest rates and investment spending at both the aggregate and disaggregate levels in South Africa.

Each of the various investment subcategories examined in this study responded differently to changes in interest rates. However, common to investment at both the aggregate level and disaggregate level, was an initial sharp increase in investment spending in response to an increase in interest rates. This has also been reported in other South African studies. Investment spending therefore increases initially in response to rising interest rates before declining thereafter. Investment spending also appears to respond differently to shorter- and longer-term interest rate changes based on the variance decompositions. Shorter-term interest rates have a larger long-term impact on the level of investment spending in South Africa when compared to medium- and long-term interest rates changes. Moreover, investment spending appears to respond positively to an increase in longer-term interest rates.

More importantly, while the results indicate that, as a whole, interest rate changes do have some effect on the level of investment spending, and do result in changes in the level of investment in the long-run, the magnitude of the impact of interest rate changes on investment spending is not particularly large. Interest rates appear to explain a small amount of the variation in investment spending and seem to have little impact on investment (of any type). The results of the Granger causality tests also support this finding. There is some evidence that short-term interest rates have an impact on public investment, but there does not seem to be any relationship. In general, therefore, interest rates are not a strong predictor of investment in SA. The relatively small impact of interest rate changes on investment spending may also be as a result of a number of other possible factors discussed in section 6.7 (such as GDP growth, credit extension levels, hurdle rates and cash flow).

Chapter 7, which follows, concludes the study by providing a summary of the main results and findings as well as recommendations for future research.

CHAPTER 7: CONCLUSION

7.1 Introduction

According to economic theory (Jorgenson, 1963; Fielding, 1997; du Toit and Moolman, 2004), interest rates should significantly affect the level of investment spending in the economy, *ceteris paribus*. However, there is still much uncertainty regarding the nature and strength of this relationship in South Africa due to a lack of active research. The goal of this study was therefore to determine the nature and strength of the relationship between real interest rates and capital investment at the aggregate level (i.e. total investment) and disaggregate level (i.e. investment by private business enterprises, public corporations and general government) in South Africa.

Chapter 2 discussed the theory of interest rates, investment and monetary policy in South Africa as an understanding of this theory is necessary when trying to determine how monetary policy affects the level of interest rates and how these interest rate changes affect capital investment spending. Chapter 3 gave an overview of the existing literature and empirical findings which have been reported both internationally and locally. Chapter 4 provided a description of the data used in the analysis as well as justifications for using the selected variables in the model. Chapter 5 discussed the methods and procedures used to achieve the empirical results. VAR models were estimated to determine the relationship between interest rates and investment spending at various lags. Variance decompositions, impulse response functions and Granger causality tests were also used to explore the relationship between investment and the real interest rate. The empirical results were presented in Chapter 6.

7.2 Summary of Findings

The main conclusions which can be drawn from this study are:

- Interest rates do have some effect on the level of capital investment in South Africa. Thus, monetary policy is capable of achieving changes in the level of capital investment. Investment spending in South Africa is therefore consistent with economic theory in this regard.

- Investment spending responds differently to shorter- and longer-term interest rate changes. Shorter-term interest rates have a stronger impact on the level of investment spending in South Africa in the long-run when compared to medium- and long-term interest rates. This contradicts economic theory, which suggests that longer-term interest rates will have a greater impact on investment spending compared to shorter-term interest rates. Furthermore, investment spending appears to respond positively to an increase in longer-term interest rates in the long-run, a further contradiction to economic theory which suggests that interest rate increases will have a negative impact on the level of investment spending.
- While the results indicate that interest rates do affect investment spending in South Africa, the magnitude of this effect is not particularly large. Interest rates explain very little variation in investment spending and seem to have little impact on investment (of any type). There is some evidence that short-term interest rates have an impact on public investment, but there does not seem to be any relationship. In general, therefore, interest rates are not a strong predictor of investment in SA.

According to du Toit and Moolman (2004:13), results such as those obtained in this study are of great importance to policymakers in achieving their goals of increased productive capacity and growth in South Africa as they address whether or not the user cost of capital (i.e. interest rates) must be addressed (amongst other things) in order to enhance (and alter) capital investment in the South African economy. The results therefore will assist monetary policy formulation as policymakers can better understand the extent to which their decisions will affect investment choices at both the aggregate and disaggregate level as well as the effect of these decisions on the South African economy as a whole.

Existing empirical research (Bonga-Bonga, 2009) has ascertained that changes in the repo rate are effectively passed-through to other market interest rates. This study adds on to this existing research by establishing that these interest rate changes do affect the level of investment spending at both the aggregate and disaggregate level but that the magnitude of these changes is not particularly large in the long-run. The results therefore do indicate that monetary policy in South Africa (i.e. the interest rate channel of the MPTM) can be used as a 'tool' to affect the level of investment spending, and hence aggregate demand, thereby assisting the SARB in achieving its primary goal of price stability, and hence maintaining a state of equilibrium in the economy as a result. However, in order to spur capital investment spending within the South African economy in the long-run, other issues will need to be addressed.

It is crucial that the factors (such as those discussed briefly in section 6.7) capable of driving gross fixed capital formation to higher levels are identified and addressed in order to stimulate economic growth in South Africa, which is at depressed levels currently.

7.3 Future Research Areas

Future research could potentially aim at determining the reason for the initial positive relationship between investment spending and interest rates, as was seen from the results of the impulse response functions in particular, as well as the presence of a possible threshold interest rate in South Africa (i.e. a non-linear relationship between investment and interest rates) as was undertaken by McKinnon (1973).

Furthermore, it could be beneficial to analyse why investment spending responds more strongly to shorter-term interest rates when theory predicts that it is longer-term interest rates which have the greatest effect on the level of investment spending.

It may also be insightful to determine the responsiveness of the various subcategories of investment as listed in Table A2 (e.g. residential investment, non-residential investment, investment in construction works, machinery investment, investment in transport equipment) in order to understand which asset classes/economic activities are most affected by interest rate changes as well as differences in the strength of the relationships between interest rates and these investment categories.

As this study only touches on one channel of the MPTM, further empirical research could be conducted into determining the nature and strength of the other channels of transmission (especially the credit channels of MPTM) to allow for comparison of results and hence the effectiveness of the various channels in bringing about the desired changes in the South African economy.

Finally, considerable research should be conducted into identifying which factors must be addressed to increase and accelerate capital investment in South Africa in order to drive economic growth, as interest rates are not capable of achieving the necessary long-run changes in investment spending.

APPENDIX

TABLE A1: TIME SERIES, VARIABLE NAMES AND EXPECTED RELATIONSHIPS WITH INVESTMENT

Time Series	Variable Name	Expected Relationship with Investment	Data Source
Real prime lending rate	*PR*	Negative	SARB
Real 91-day Treasury Bill rate	*TB*	Negative	PGI
Real government bond yield (0-3 years)	*GBY03*	Negative	SARB
Real government bond yield (3-5 years)	*GBY35*	Negative	SARB
Real government bond yield (5-10 years)	*GBY510*	Negative	SARB
Real government bond yield (10 years and over)	*GBY10*	Negative	SARB
Total gross fixed capital formation at constant 2010 prices and seasonally adjusted (1-period % change/growth rate)	*TOT*	Not applicable	SARB
Gross fixed capital formation by public corporations at constant 2010 prices and seasonally adjusted (1-period % change/growth rate)	*PUB*	Not applicable	SARB
Gross fixed capital formation by private business enterprises at constant 2010 prices and seasonally adjusted (1-period % change/growth rate)	*PVT*	Not applicable	SARB
Gross fixed capital formation by general government at constant 2010 prices and seasonally adjusted (1-period % change/growth rate)	*GOV*	Not applicable	SARB
South African GDP at constant 2010 prices and seasonally adjusted (1-period % change/growth rate)	*GDPG*	Positive	SARB
United States GDP seasonally adjusted (1-period % change/growth rate)	*USGDPG*	Positive	FRED
Business confidence index	*BCI*	Positive	BER
Apartheid dummy variable	*DUMAPARTHEID*	Positive	Not applicable
Global Financial Crisis dummy variable	*DUMCRISIS*	Negative	Not applicable

TABLE A2: GROSS FIXED CAPITAL FORMATION CLASSIFICATIONS

Gross Fixed Capital Formation (GFCF)		
By economic activity	**By type of organisation**	**By type of asset**
Agriculture, forestry and fishing	General government	Residential buildings
Mining and quarrying	Public corporations	Non-residential buildings
Manufacturing	Private business enterprises	Construction works
Electricity, gas and water		Transport equipment
Construction (contractors)		Information, computer and telecommunications equipment
Wholesale and retail trade, catering and accommodation		Machinery and other equipment
Transport, storage and communication		Research and development
Financial intermediation, insurance, real-estate and business services		Computer software
Community, social and personal services		Mineral exploration and evaluation
		Cultivated biological resources
		Transfer costs

Source: SARB

TABLE A3: SUMMARY STATISTICS

	TOT	*PVT*	*PUB*	*GOV*	*PR*	*TB*	*GBY03*	*GBY35*	*GBY510*	*GBY10*	*GDPG*	*USGDPG*	*BCI*
Mean	1.1099	1.2824	1.5477	0.7363	6.9288	2.8471	3.2115	3.7171	4.0912	4.2320	0.6393	4.9528	47.1204
Median	1.4081	1.4299	1.0441	1.2284	6.7231	2.7855	2.8666	3.5441	3.7262	4.0196	0.6898	5.0500	45.0000
Max	11.2053	8.8216	24.9190	36.0557	17.2626	12.3793	11.2667	11.8834	12.3701	12.4634	1.8730	10.4000	87.0000
Min	-7.0633	-11.5075	-26.8684	-18.9817	-4.6508	-8.4841	-6.3275	-4.2175	-2.3527	-2.7127	-1.5555	-7.7000	12.0000
Std Deviation	2.6038	2.5484	7.8169	6.3470	3.9777	3.6933	3.6105	3.4834	3.3222	3.3739	0.6648	2.7569	20.4910
Skewness	-0.0766	-1.1255	0.1120	1.0435	-0.1529	-0.3124	0.0634	0.2651	0.3757	0.2963	-0.6687	-1.2941	0.2260
Kurtosis	5.7571	8.3331	5.3485	11.3211	3.6460	3.9112	2.8543	2.5793	2.5290	2.5710	3.4614	7.0736	2.1399

Source: Author's own estimates using EViews 7

TABLE A4: VAR MODEL SPECIFICATIONS

No.	VAR Model Specification
TOT	
No.	**VAR Model Specification**
1	*TOT = f {TOT(-1), TOT(-2), RPR(-1), RPR(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
2	*TOT = f {TOT(-1), TOT(-2), RTB(-1), RTB(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
3	*TOT = f {TOT(-1), TOT(-2), TOT(-3), RGBY03(-1), RGBY03(-2), RGDY03(-3), GDPG(-1), GDPG(-2), GDPG(-3), USGDPG(-1), USGDPG(-2), USGDPG(-3), BCI(-1), BCI(-2), BCI(-3), DUMAPARTHEID, DUMCRISIS}*
4	*TOT = f {TOT(-1), TOT(-2), RGBY35(-1), RGBY35(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
5	*TOT = f {TOT(-1), TOT(-2), RGBY510(-1), RGBY510(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
6	*TOT = f {TOT(-1), TOT(-2), RGBY10(-1), RGBY10(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
PVT	
No.	**VAR Model Specification**
7	*PVT = f {PVT(-1), RPR(-1), GDPG(-1), USGDPG(-1), BCI(-1), DUMAPARTHEID, DUMCRISIS}*
8	*PVT = f {PVT(-1), RTB(-1), GDPG(-1), USGDPG(-1), BCI(-1), DUMAPARTHEID, DUMCRISIS}*
9	*PVT = f {PVT(-1), PVT(-2), RGBY03(-1), RGBY03(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
10	*PVT = f {PVT(-1), PVT(-2), RGBY35(-1), RGBY35(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
11	*PVT = f {PVT(-1), PVT(-2), RGBY510(-1), RGBY510(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
12	*PVT = f {PVT(-1), PVT(-2), RGBY10(-1), RGBY10(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
PUB	
No.	**VAR Model Specification**
13	*PUB = f {PUB(-1), PUB(-2), RPR(-1), RPR(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
14	*PUB = f {PUB(-1), PUB(-2), RTB(-1), RTB(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
15	*PUB = f {PUB(-1), PUB(-2), RGBY03(-1), RGBY03(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
16	*PUB = f {PUB(-1), PUB(-2), RGBY35(-1), RGBY35(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
17	*PUB = f {PUB(-1), PUB(-2), RGBY510(-1), RGBY510(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*

18	*PUB = f {PUB(-1), PUB(-2), RGBY10(-1), RGBY10(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
GOV	
No.	**VAR Model Specification**
19	*GOV = f {GOV(-1), GOV(-2), RPR(-1), RPR(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
20	*GOV = f {GOV(-1), GOV(-2), RTB(-1), RTB(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
21	*GOV = f {GOV(-1), GOV(-2), RGBY03(-1), RGBY03(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
22	*GOV = f {GOV(-1), GOV(-2), RGBY35(-1), RGBY35(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
23	*GOV = f {GOV(-1), GOV(-2), RGBY510(-1), RGBY510(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*
24	*GOV = f {GOV(-1), GOV(-2), RGBY10(-1), RGBY10(-2), GDPG(-1), GDPG(-2), USGDPG(-1), USGDPG(-2), BCI(-1), BCI(-2), DUMAPARTHEID, DUMCRISIS}*

TABLE A5: VAR RESULTS FOR *TOT*

Variable \ Specification	1	2	3	4	5	6
TOT(-1)	0.1763 (0.0965) [1.8268]	0.1700 (0.0965) [1.7619]	0.1675 (0.1074) [1.5590]	0.1899 (0.0976) [1.9458]	0.1941 (0.0978) [1.9849]	0.1975 (0.0979) [2.0179]
TOT(-2)	-0.2112 (0.0941) [-2.2452]	-0.2073 (0.0933) [-2.2210]	-0.2100 (0.1035) [-2.0287]	-0.2015 (0.0948) [-2.1247]	-0.2110 (0.0953) [-2.2146]	-0.2090 (0.0954) [-2.1897]
TOT(-3)	-	-	-0.04680 (0.1034) [-0.4524]	-	-	-
PR(-1)	0.1800 (0.1640) [1.0975]	-	-	-	-	-
PR(-2)	-0.3146 (0.1621) [-1.9406]	-	-	-	-	-
TB(-1)	-	0.1330 (0.1588) [0.8373]	-	-	-	-
TB(-2)	-	-0.2894 (0.1557) [-1.8584]	-	-	-	-
GBY03(-1)	-	-	-0.0817 (0.1760) [-0.4645]	-	-	-
GBY03(-2)	-	-	0.2000 (0.2435) [0.8214]	-	-	-
GBY03(-3)			-0.3082 (0.1667) [-1.8480]	-	-	-
GBY35(-1)	-	-	-	0.0835 (0.1555) [0.5369]	-	-
GBY35(-2)	-	-	-	-0.2103 (0.1517) [-1.3862]	-	-
GBY510(-1)	-	-	-	-	0.0685 (0.1618) [0.4232]	-
GBY510(-2)	-	-	-	-	-0.1813 (0.1587) [-1.1428]	-
GBY10(-1)	-	-	-	-	-	0.0731 (0.1548) [0.4720]
GBY10(-2)	-	-	-	-	-	-0.1692 (0.1511) [-1.1198]
GDPG(-1)	0.6021 (0.4403) [1.3677]	0.5691 (0.4371) [1.3021]	0.5463 (0.4647) [1.1756]	0.5580 (0.4562) [1.2230]	0.5720 (0.4583) [1.2481]	0.5563 (0.4583) [1.2139]
GDPG(-2)	0.8206 (0.4502) [1.8226]	0.8189 (0.4495) [1.8221]	0.8582 (0.5074) [1.6913]	0.9180 (0.4722) [1.9441]	0.8838 (0.4783) [1.8479]	0.8673 (0.4740) [1.8298]

GDPG(-3)	-	-	0.1790 (0.5167) [0.3462]	-	-	-
USGDPG(-1)	0.1779 (0.0865) [2.0571]	0.1842 (0.0860) [2.1410]	0.2018 (0.0926) [2.1794]	0.1937 (0.0887) [2.1840]	0.1936 (0.0904) [2.1422]	0.1921 (0.0905) [2.1229]
USGDPG(-2)	-0.0823 (0.0893) [-0.9221]	-0.0784 (0.0890) [-0.8808]	-0.0724 (0.0963) [-0.7516]	-0.0811 (0.0912) [-0.8899]	-0.0817 (0.0927) [-0.8819]	-0.0856 (0.0929) [-0.9219]
USGDPG(-3)	-	-	-0.0315 (0.0967) [-0.3262]	-	-	
BCI(-1)	0.0373 (0.0271) [1.3743]	0.0362 (0.0270) [1.3415]	0.0368 (0.0292 [1.2600]	0.0481 (0.0267) [1.8006]	0.0519 (0.0267) [1.9403]	0.0522 (0.0269) [1.9511]
BCI(-2)	-0.0071 (0.0256) [-0.2769]	-0.0037 (0.0256) [-0.1428]	-0.0193 (0.0369) [-0.5234]	-0.0131 (0.0262) [-0.4995]	-0.0155 (0.0265) [-0.5858]	-0.0152 (0.0266) [-0.5714]
BCI(-3)	-	-	0.0185 (0.0270) [0.6860]	-	-	-
Intercept	-1.3767 (0.9553) [-1.4412]	-2.0090 (0.8836) [-2.2738]	-2.1223 (1.0432) [-2.0344]	-2.0137 (0.8995) [-2.2386]	-1.9540 (0.9079) [-2.1521]	-1.9895 (0.9080) [-2.1910]
DUMAPARTHEID	1.1963 (0.6935) [1.7249]	1.2077 (0.6603) [1.8289]	1.3738 (0.7785) [1.7646]	0.8816 (0.6636) [1.3286]	0.7266 (0.6467) [1.1236]	0.6879 (0.6538) [1.0519]
DUMCRISIS	-1.0455 (0.6773) [-1.5437]	-1.0191 (0.6485) [-1.5715]	-1.2137 (0.7064) [-1.7182]	-0.8115 (0.6568) [-1.2356]	-0.7652 (0.6585) [-1.1621]	-0.6723 (0.6416) [-1.0478]
R-squared	0.4955	0.4993	0.5025	0.4814	0.4758	0.4739
Adjusted R-squared	0.4303	0.4347	0.4053	0.4144	0.4082	0.4060
F-statistic	7.6102	7.7288	5.1700	7.1927	7.0355	6.9809
AIC	4.2675	4.2598	4.3602	4.2951	4.3056	4.3093
SIC	4.5942	4.5865	4.8152	4.6217	4.6323	4.6360

Notes:
Dependent variable: *TOT*
AIC: Akaike Information Criterion
SIC: Schwarz Information Criterion
Numbers in ( ) denote the standard errors of the estimated coefficients
Numbers in [ ] denote the associated t-Statistic for the variable
Source: Author's own estimates using EViews 7

TABLE A6: VARIANCE DECOMPOSITIONS FOR *TOT*

Period	*PR*	*TB*	*GBY03*	*GBY35*	*GBY510*	*GBY10*
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	1.4097	1.2758	0.0996	1.6250	1.4026	1.5371
3	1.3011	1.1981	2.3829	2.1944	2.3237	2.4788
4	2.4396	2.2115	2.1879	2.1840	2.6811	2.9387
5	3.8414	3.4303	2.1955	2.1140	2.7955	3.1356
6	4.7733	4.2412	2.5836	2.0777	2.8522	3.2482
7	5.3624	4.7464	3.0865	2.0525	2.8932	3.3239
8	5.7595	5.0733	3.4866	2.0314	2.9316	3.3862
9	6.0476	5.2997	3.7502	2.0190	2.9675	3.4396
10	6.2627	5.4626	3.8993	2.0145	2.9999	3.4858
11	6.4236	5.5807	3.9721	2.0137	3.0279	3.5247
12	6.5428	5.6659	4.0098	2.0139	3.0514	3.5568
13	6.6306	5.7268	4.0326	2.0137	3.0707	3.5828
14	6.6954	5.7704	4.0501	2.0133	3.0864	3.6036
15	6.7435	5.8016	4.0641	2.0127	3.0989	3.6201

Source: Author's own estimates using EViews 7

TABLE A7: PAIRWISE GRANGER CAUSALITY TESTS FOR *TOT*

Null Hypothesis	F-statistic	Prob (F-statistic)
PR does not Granger Cause *TOT*	0.7058	0.4961
TB does not Granger Cause *TOT*	0.8091	0.4481
GBY03 does not Granger Cause *TOT*	0.8348	0.4779
GBY35 does not Granger Cause *TOT*	0.5273	0.5918
GBY510 does not Granger Cause *TOT*	0.5488	0.5794
GBY10 does not Granger Cause *TOT*	0.6150	0.5426

Source: Author's own estimates using EViews 7

TABLE A8: VAR RESULTS FOR *PVT*

Specification / Variable	7	8	9	10	11	12
PVT(-1)	0.0621 (0.0959) [0.6471]	0.0559 (0.0958) [0.5835]	0.0808 (0.1030) [0.7839]	0.0811 (0.1027) [0.7899]	0.0975 (0.1035) [0.9423]	0.1076 (0.1033) [1.0418]
PVT(-2)	-	-	0.0230 (0.0950) [0.2424]	0.0208 (0.0965) [0.2152]	0.0324 (0.0980) [0.3305]	0.0317 (0.0985) [0.3215]
PR(-1)	-0.2084 (0.0721) [-2.8890]	-	-	-	-	-
TB(-1)	-	-0.2209 (0.0726) [-3.0411]	-	-	-	-
GBY03(-1)	-	-	-0.2070 (0.1582) [-1.3087]	-	-	-
GBY03(-2)	-	-	-0.0978 (0.1564) [-0.6255]	-	-	-
GBY35(-1)	-	-	-	-0.0814 (0.1581) [-0.5148]	-	-
GBY35(-2)	-	-	--	-0.1964 (0.1577) [-1.2458]	-	-
GBY510(-1)	-	-	-	-	-0.0977 (0.1671) [-0.5847]	-
GBY510(-2)	-	-	-	-	-0.1549 (0.1671) [-0.9266]	-
GBY10(-1)	-	-	-	-	-	-0.0719 (0.1601) [-0.4493]
GBY10(-2)	-	-	-	-	-	-0.1508 (0.1588) [-0.9500]
GDPG(-1)	1.0075 (0.4191) [2.4038]	1.0170 (0.4175) [2.4361]	1.0764 (0.4536) [2.3731]	1.0634 (0.4643) [2.2903]	1.0549 (0.4699) [2.2451]	1.0147 (0.4722) [2.1490]
GDPG(-2)	-	-	0.3290 (0.4794) [0.6862]	0.4220 (0.4933) [0.8554]	0.3194 (0.5031) [0.6347]	0.3192 (0.4999) [0.6384]
USGDPG(-1)	0.2956 (0.0858) [3.4455]	0.2965 (0.0853) [3.4745]	0.2547 (0.0883) [2.8834]	0.2586 (0.0901) [2.8705]	0.2598 (0.0923) [2.8158]	0.2553 (0.0929) [2.7493]
USGDPG(-2)	-	-	0.1103 (0.0932) [1.1840]	0.1065 (0.0947) [1.1241]	0.1073 (0.0969) [1.1079]	0.0996 (0.0974) [1.0224]
BCI(-1)	0.0054 (0.0126) [0.4323]	0.0092 (0.0121) [0.7582]	0.0431 (0.0273) [1.5774]	0.0480 (0.0275) [1.7433]	0.0539 (0.0278) [1.9414]	0.0542 (0.0280) [1.9386]
BCI(-2)	-	-	-0.0478 (0.0252) [-1.8982]	-0.0516 (0.0257) [-2.0087]	-0.0567 (0.0263) [-2.1573]	-0.0557 (0.0265) [-2.1022]

Intercept	-0.6782 (0.8222) [-0.8249]	-1.6288 (0.7415) [-2.1966]	-1.3735 (0.8655) [-1.5870]	-1.2391 (0.8774) [-1.4123]	-1.0696 (0.8916) [-1.1996]	-1.1317 (0.8964) [-1.2626]
DUMAPARTHEID	1.5834 (0.6799) [2.3290]	1.4952 (0.6463) [2.3135]	1.7307 (0.6868) [2.5199]	1.4187 (0.6716) [2.1125]	1.1367 (0.6555) [1.7341]	1.0707 (0.6658) [1.6080]
DUMCRISIS	-1.4430 (0.6974) [-2.0691]	-1.3180 (0.6659) [-1.9793]	-1.4822 (0.6786) [-2.1843]	-1.2412 (0.6703) [-1.8517]	-1.1117 (0.6760) [-1.6446]	-0.9136 (0.6607) [-1.3829]
R-squared	0.4052	0.4101	0.4636	0.4485	0.4343	0.4266
Adjusted R-squared	0.3631	0.3684	0.3944	0.3773	0.3614	0.3526
F-statistic	9.6332	9.8330	6.6973	6.3016	5.9508	5.7679
AIC	4.3012	4.2929	4.2902	4.3180	4.3433	4.3568
SIC	4.5011	4.4927	4.6169	4.6446	4.6699	4.6835

Notes:
Dependent variable: *PVT*
AIC: Akaike Information Criterion
SIC: Schwarz Information Criterion
Numbers in ( ) denote the standard errors of the estimated coefficients
Numbers in [ ] denote the associated t-Statistic for the variable
Source: Author's own estimates using EViews 7

TABLE A9: VARIANCE DECOMPOSITIONS FOR *PVT*

Period	*PR*	*TB*	*GBY03*	*GBY35*	*GBY510*	*GBY10*
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.4940	0.4062	0.0024	0.5430	0.4293	0.5715
3	1.1486	1.0179	0.0861	0.5673	0.6921	0.9140
4	1.8577	1.7016	0.4601	0.5379	0.7364	1.0284
5	2.5429	2.3659	0.9215	0.5976	0.7451	1.0835
6	3.1665	2.9670	1.3186	0.6932	0.7439	1.1061
7	3.7159	3.4902	1.5565	0.7496	0.7449	1.1238
8	4.1909	3.9354	1.6699	0.7646	0.7497	1.1407
9	4.5972	4.3093	1.7136	0.7634	0.7604	1.1591
10	4.9422	4.6206	1.7278	0.7633	0.7757	1.1772
11	5.2341	4.8783	1.7315	0.7671	0.7923	1.1935
12	5.4802	5.0907	1.7321	0.7721	0.8072	1.2068
13	5.6872	5.2652	1.7319	0.7760	0.8191	1.2171
14	5.8611	5.4082	1.7317	0.7783	0.8280	1.2249
15	6.0070	5.5250	1.7317	0.7795	0.8344	1.2308

Source: Author's own estimates using EViews 7

TABLE A10: PAIRWISE GRANGER CAUSALITY TESTS FOR *PVT*

Null Hypothesis	F-statistic	Prob (F-statistic)
PR does not Granger Cause PVT	0.0682	0.7945
TB does not Granger Cause PVT	0.0829	0.7740
GBY03 does not Granger Cause PVT	0.0492	0.9520
GBY35 does not Granger Cause PVT	0.1727	0.8416
GBY510 does not Granger Cause PVT	0.2198	0.8031
GBY10 does not Granger Cause PVT	0.2938	0.7461

Source: Author's own estimates using EViews 7

TABLE A11: VAR RESULTS FOR *PUB*

Specification / Variable	13	14	15	16	17	18
PUB(-1)	0.0118 (0.0965) [0.1218]	0.0153 (0.0956) [0.1599]	0.0442 (0.0967) [0.4577]	0.0470 (0.0975) [0.4828]	0.0552 (0.0984) [0.5609]	0.0568 (0.0985) [0.5765]
PUB(-2)	0.1485 (0.0967) [1.5359]	0.1572 (0.0960) [1.6381]	0.1478 (0.0964) [1.5339]	0.1618 (0.0975) [1.6604]	0.1663 (0.0984) [1.6905]	0.1675 (0.0985) [1.7010]
PR(-1)	1.5582 (0.5822) [2.6764]	-	-	-	-	-
PR(-2)	-1.3707 (0.5748) [-2.3845]	-	-	-	-	-
TB(-1)	-	1.6354 (0.5632) [2.9037]	-	-	-	-
TB(-2)	-	-1.4671 (0.5510) [-2.6627]	-	-	-	-
GBY03(-1)	-	-	1.3267 (0.5552) [2.3896]	-	-	-
GBY03(-2)	-	-	-1.0580 (0.5342) [-1.9805]	-	-	-
GBY35(-1)	-	-	-	1.0893 (0.5586) [1.9501]	-	-
GBY35(-2)	-	-	-	-0.8920 (0.5455) [-1.6354]	-	-
GBY510(-1)	-	-	-	-	0.9424 (0.5900) [1.5974]	-
GBY510(-2)	-	-	-	-	-0.7771 (0.5748) [-1.3520]	-
GBY10(-1)	-	-	-	-	-	0.9011 (0.5649) [1.5952]
GBY10(-2)	-	-	-	-	-	-0.7172 (0.5479) [-1.3090]
GDPG(-1)	-0.4309 (1.5591) [-0.2764]	-0.6141 (1.5444) [-0.3977]	-1.2822 (1.5994) [-0.8017]	-1.1286 (1.6219) [-0.6959]	-0.8454 (1.6207) [-0.5216]	-0.8415 (1.6192) [-0.5197]
GDPG(-2)	2.1054 (1.5502) [1.3581]	2.2715 (1.5469) [1.4685]	2.2774 (1.6143) [1.4108]	2.2907 (1.6552) [1.3840]	2.2069 (1.6720) [1.3199]	2.1139 (1.6572) [1.2757]
USGDPG(-1)	0.0008 (0.3093) [0.0027]	0.0102 (0.3065) [0.0333]	0.0025 (0.3123) [0.0082]	0.0370 (0.3169) [0.1167]	0.0269 (0.3233) [0.0831]	0.0305 (0.3229) [0.0946]
USGDPG(-2)	-0.6237 (0.3168) [-1.9689]	-0.6279 (0.3148) [-1.9947]	-0.6515 (0.3211) [-2.0290]	-0.6224 (0.3250) [-1.9152]	-0.6332 (0.3312) [-1.9118]	-0.6416 (0.3317) [-1.9346]

BCI(-1)	-0.0821 (0.0973) [-0.8434]	-0.0919 (0.0964) [-0.9528]	-0.0840 (0.0963) [-0.8725]	-0.0852 (0.0967) [-0.8814]	-0.0830 (0.0969) [-0.8565]	-0.0826 (0.0968) [-0.8532]
BCI(-2)	0.1965 (0.0939) [2.0934]	0.1990 (0.0934) [2.1317]	0.2120 (0.0951) [2.2306]	0.2088 (0.0963) [2.1673]	0.2039 (0.0973) [2.0949]	0.2054 (0.0975) [2.1078]
Intercept	-2.9795 (3.3870) [-0.87969]	-1.9516 (3.0555) [-0.6387]	-2.3239 (3.0863) [-0.7530]	-2.6002 (3.1165) [-0.8343]	-2.4352 (3.1589) [-0.7709]	-2.4882 (3.1477) [-0.7905]
DUMAPARTHEID	-0.5447 (2.4692) [-0.2206]	-0.3467 (2.3432) [-0.1480]	-1.0236 (2.4363) [-0.4202]	-0.6917 (2.3960) [-0.2887]	-0.6385 (2.3658) [-0.2699]	-0.7144 (2.3903) [-0.2989]
DUMCRISIS	0.0962 (2.4314) [0.0396]	-0.2199 (2.3174) [-0.0949]	0.2412 (2.3908) [0.1009]	-0.0565 (2.3558) [-0.0240]	-0.3041 (2.3629) [-0.1287]	-0.3696 (2.2990) [-0.1608]
R-squared	0.2864	0.2956	0.2760	0.2617	0.2520	0.2519
Adjusted R-squared	0.1943	0.2047	0.1826	0.1664	0.1555	0.1554
F-statistic	3.1108	3.2518	2.9543	2.7464	2.6106	2.6102
AIC	6.8163	6.8034	6.8308	6.8504	6.8635	6.8635
SIC	7.1430	7.1301	7.1575	7.1771	7.1901	7.1901

Notes:
Dependent variable: *PUB*
AIC: Akaike Information Criterion
SIC: Schwarz Information Criterion
Numbers in ( ) denote the standard errors of the estimated coefficients
Numbers in [ ] denote the associated t-Statistic for the variable
Source: Author's own estimates using EViews 7

TABLE A12: VARIANCE DECOMPOSITIONS FOR *PUB*

Period	*PR*	*TB*	*GBY03*	*GBY35*	*GBY510*	*GBY10*
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	6.2203	6.9870	4.0648	2.6390	1.8112	1.8303
3	5.9938	6.7257	3.9151	2.5553	1.7127	1.7318
4	5.9851	6.7039	4.0793	2.6973	1.8090	1.8499
5	5.9221	6.6539	3.9990	2.6424	1.7715	1.8114
6	5.9903	6.7444	3.9458	2.6065	1.7428	1.7820
7	6.0851	6.8381	3.9009	2.5725	1.7127	1.7520
8	6.2389	6.9745	3.8801	2.5441	1.6853	1.7241
9	6.4025	7.1093	3.8722	2.5159	1.6613	1.7006
10	6.5720	7.2449	3.8797	2.4915	1.6427	1.6840
11	6.7313	7.3689	3.8941	2.4708	1.6301	1.6748
12	6.8732	7.4766	3.9119	2.4541	1.6219	1.6705
13	6.9943	7.5663	3.9297	2.4409	1.6167	1.6691
14	7.0936	7.6383	3.9458	2.4306	1.6134	1.6692
15	7.1727	7.6945	3.9597	2.4228	1.6112	1.6698

Source: Author's own estimates using EViews 7

TABLE A13: PAIRWISE GRANGER CAUSALITY TESTS FOR *PUB*

Null Hypothesis	F-statistic	Prob (F-statistic)
PR does not Granger Cause PUB	2.2385	0.1119
TB does not Granger Cause PUB	2.8803	0.0607
GBY03 does not Granger Cause PUB	1.1768	0.3125
GBY35 does not Granger Cause PUB	0.5970	0.5524
GBY510 does not Granger Cause PUB	0.2156	0.8064
GBY10 does not Granger Cause PUB	0.2263	0.7979

Source: Author's own estimates using EViews 7

TABLE A14: VAR RESULTS FOR *GOV*

Variable \ Specification	19	20	21	22	23	24
GOV(-1)	-0.1109 (0.1006) [-1.1028]	-0.1118 (0.1004) [-1.1138]	-0.1209 (0.1011) [-1.1962]	-0.1186 (0.1014) [-1.1698]	-0.1228 (0.1010) [-1.2153]	-0.1194 (0.1009) [-1.1840]
GOV(-2)	-0.1126 (0.0997) [-1.1290]	-0.1119 (0.0998) [-1.1217]	-0.1143 (0.1002) [-1.1407]	-0.1120 (0.1006) [-1.1132]	-0.1110 (0.1000) [-1.1101]	-0.1113 (0.1002) [-1.1111]
PR(-1)	0.1856 (0.4890) [0.3795]	-	-	-	-	-
PR(-2)	-0.1613 (0.4842) [-0.3332]	-	-	-	-	-
TB(-1)	-	-0.0471 (0.4768) [-0.0989]	-	-	-	-
TB(-2)	-	0.0346 (0.4664) [0.0743]	-	-	-	-
GBY03(-1)	-	-	-0.1626 (0.4699) [-0.3461]	-	-	-
GBY03(-2)	-	-	0.2308 (0.4519) [0.5106]	-	-	-
GBY35(-1)	-	-	-	-0.0694 (0.4688) [-0.1479]	-	-
GBY35(-2)	-	-	-	0.1551 (0.4572) [0.3393]	-	-
GBY510(-1)	-	-	-	-	-0.1724 (0.4838) [-0.3562]	-
GBY510(-2)	-	-	-	-	0.2983 (0.4746) [0.6286]	-
GBY10(-1)	-	-	-	-	-	-0.1009 (0.4619) [-0.2185]
GBY10(-2)	-	-	-	-	-	0.2101 (0.4512) [0.4657]
GDPG(-1)	2.0963 (1.3091) [1.6014]	2.0812 (1.3077) [1.5915]	2.1307 (1.3377) [1.5929]	2.0553 (1.3472) [1.5256]	2.0287 (1.3382) [1.5160]	2.0149 (1.3373) [1.5067]
GDPG(-2)	2.1243 (1.3556) [1.5671]	2.0145 (1.3584) [1.4831]	1.8435 (1.3833) [1.3326]	1.8833 (1.3979) [1.3472]	1.7528 (1.4044) [1.2480]	1.8393 (1.3939) [1.3195]
USGDPG(-1)	-0.0948 (0.2613) [-0.3629]	-0.0726 (0.2611) [-0.2780	-0.0703 (0.2623) [-0.2678]	-0.0890 (0.2644) [-0.3289]	-0.0838 (0.2676) [-0.3133]	-0.0897 (0.2677) [-0.3351]
USGDPG(-2)	-0.1423 (0.2689) [-0.5292]	-0.1335 (0.2688) [-0.4965]	-0.1472 (0.2696) [-0.5460	-0.1542 (0.2702) [-0.5706]	-0.1644 (0.2724) [-0.6037]	-0.1617 (0.2729) [-0.5924]

BCI(-1)	0.0387 (0.0824) [0.4698]	0.0397 (0.0822) [0.4825]	0.0472 (0.0806) [0.5862]	0.0446 (0.0801) [0.5571]	0.0452 (0.0796) [0.5680]	0.0434 (0.0796) [0.5451]
BCI(-2)	0.0003 (0.0761) [0.0040]	-0.0002 (0.0765) [-0.0023]	-0.0029 (0.0763) [-0.0379]	0.0003 (0.0767) [0.0038]	0.0020 (0.07729) [0.0258]	0.0027 (0.0776) [0.0347]
Intercept	-2.3256 (2.7728) [-0.8387]	-2.3258 (2.5491) [-0.9124]	-2.4232 (2.5383) [-0.9547]	-2.3937 (2.5376) [-0.9433]	-2.5624 (2.5520) [-1.0041]	-2.4745 (2.5455) [-0.9721]
DUMAPARTHEID	-0.1731 (2.0913) [-0.0828]	0.0229 (1.9950) [0.0115]	-0.3752 (2.0392) [-0.1840]	-0.4091 (1.9749) [-0.2071]	-0.4401 (1.9044) [-0.2311]	-0.4335 (1.9249) [-0.2252]
DUMCRISIS	-0.4269 (2.0450) [-0.2088]	-0.5619 (1.9657) [-0.2858]	-0.2636 (2.0026) [-0.1316]	-0.2573 (1.9575) [-0.1314]	-0.1215 (1.9470) [-0.0624]	-0.2319 (1.8956) [-0.1223]
R-squared	0.1853	0.1841	0.1866	0.1856	0.1884	0.1868
Adjusted R-squared	0.0802	0.0789	0.0816	0.0806	0.0837	0.0819
F-statistic	1.7626	1.7490	1.7776	1.7667	1.7993	1.7801
AIC	6.4771	6.4785	6.4755	6.4767	6.4732	6.4753
SIC	6.8037	6.8052	6.8022	6.8033	6.7999	6.8019

Notes:
Dependent variable: *GOV*
AIC: Akaike Information Criterion
SIC: Schwarz Information Criterion
Numbers in ( ) denote the standard errors of the estimated coefficients
Numbers in [ ] denote the associated t-Statistic for the variable
Source: Author's own estimates using EViews 7

TABLE A15: VARIANCE DECOMPOSITIONS FOR *GOV*

Period	*PR*	*TB*	*GBY03*	*GBY35*	*GBY510*	*GBY10*
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0823	0.0037	0.0056	0.0579	0.0094	0.0065
3	0.0876	0.0035	0.6238	0.8604	0.6856	0.6812
4	0.1144	0.0036	1.0766	1.6329	1.7690	1.7409
5	0.1371	0.0132	1.1703	1.9270	2.4891	2.4149
6	0.1757	0.0473	1.1719	1.9940	2.8506	2.7377
7	0.2340	0.1014	1.1699	1.9968	2.9812	2.8527
8	0.3032	0.1644	1.1774	1.9917	3.0098	2.8812
9	0.3741	0.2270	1.1889	1.9886	3.0098	2.8845
10	0.4402	0.2841	1.1999	1.9864	3.0061	2.8829
11	0.4978	0.3332	1.2089	1.9842	3.0031	2.8812
12	0.5460	0.3739	1.2157	1.9821	3.0007	2.8802
13	0.5850	0.4066	1.2208	1.9803	2.9990	2.8804
14	0.6158	0.4322	1.2246	1.9789	2.9981	2.8815
15	0.6398	0.4520	1.2274	1.9778	2.9982	2.8832

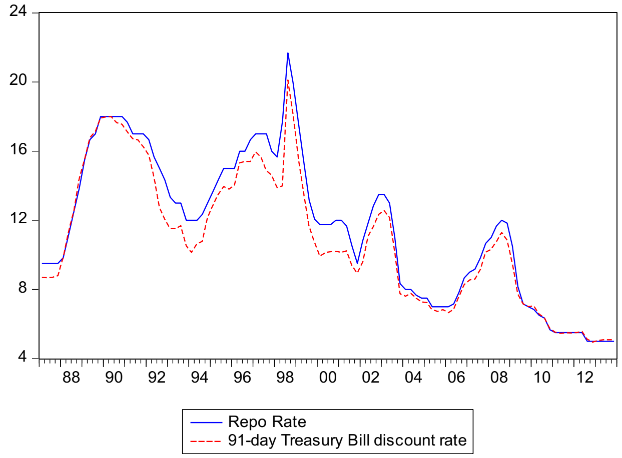
Source: Author's own estimates using EViews 7

TABLE A16: PAIRWISE GRANGER CAUSALITY TESTS FOR *GOV*

Null Hypothesis	F-statistic	Prob (F-statistic)
PR does not Granger Cause GOV	0.0547	0.9468
TB does not Granger Cause GOV	0.0887	0.9152
GBY03 does not Granger Cause GOV	1.0181	0.3650
GBY35 does not Granger Cause GOV	1.3208	0.2715
GBY510 does not Granger Cause GOV	1.8710	0.1593
GBY10 does not Granger Cause GOV	1.7024	0.1874

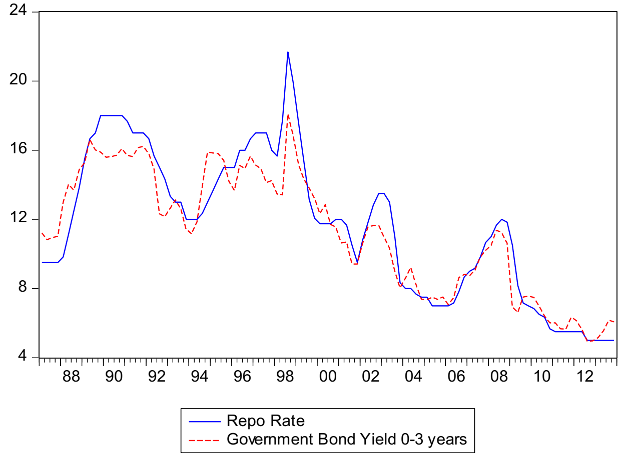
Source: Author's own estimates using EViews 7

Figure A1: Repo rate and 91-day Treasury Bill discount rate



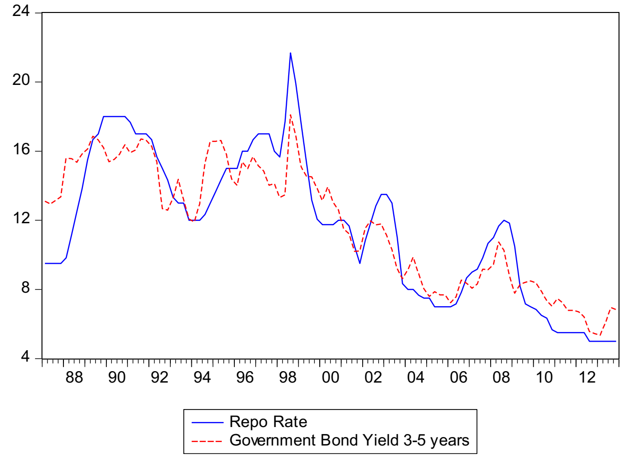
Source: SARB

Figure A2: Repo rate and government bond yield 0-3 years



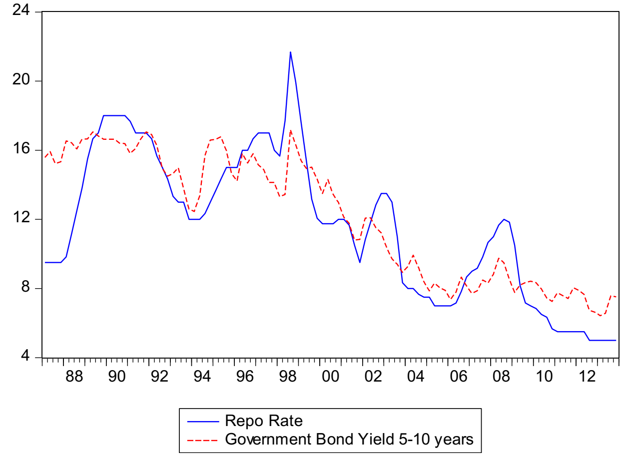
Source: SARB

Figure A3: Repo rate and government bond yield 3-5 years



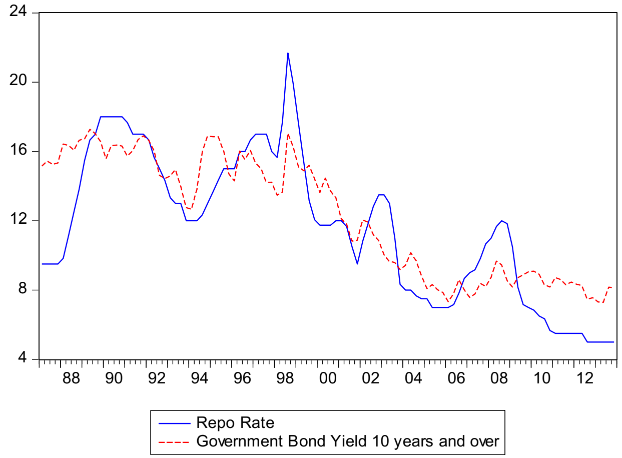
Source: SARB

Figure A4: Repo rate and government bond yield 5-10 years



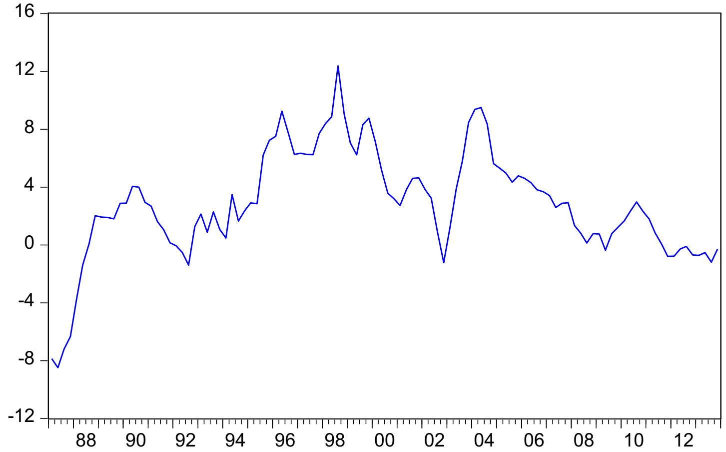
Source: SARB

Figure A5: Repo rate and government bond yield 10 years and over



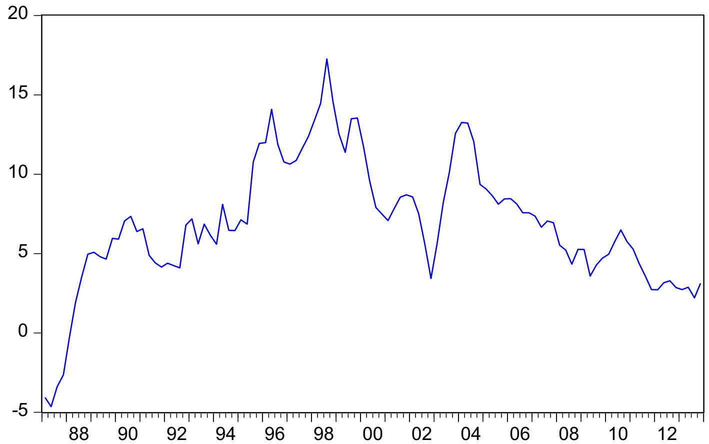
Source: SARB

Figure A7: Real 91-day Treasury Bill discount rate



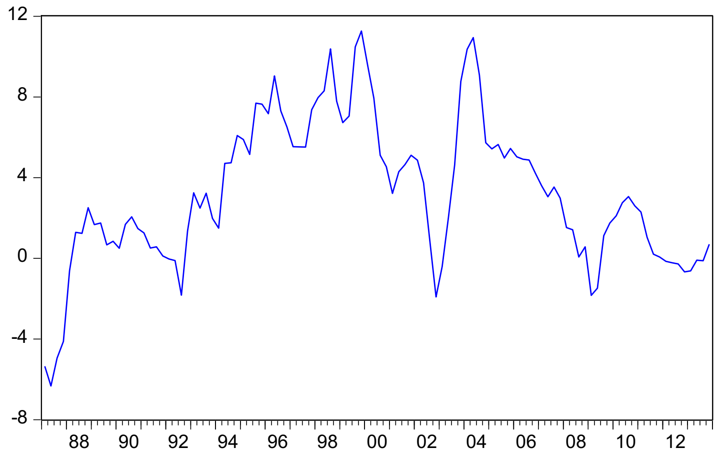
Source: SARB

Figure A6: Real prime lending rate



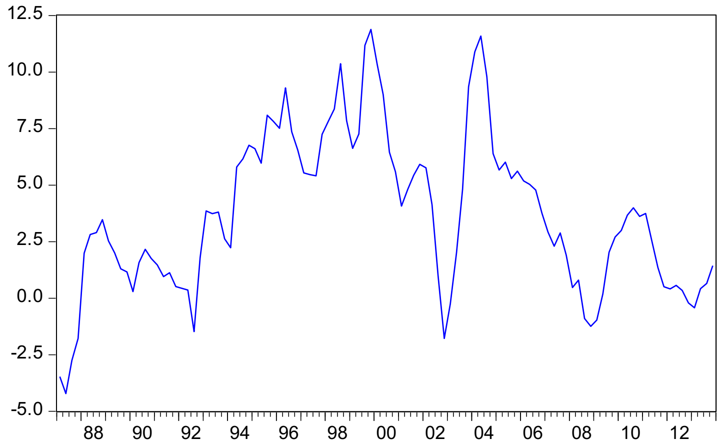
Source: SARB

Figure A8: Real government bond yield 0-3 years



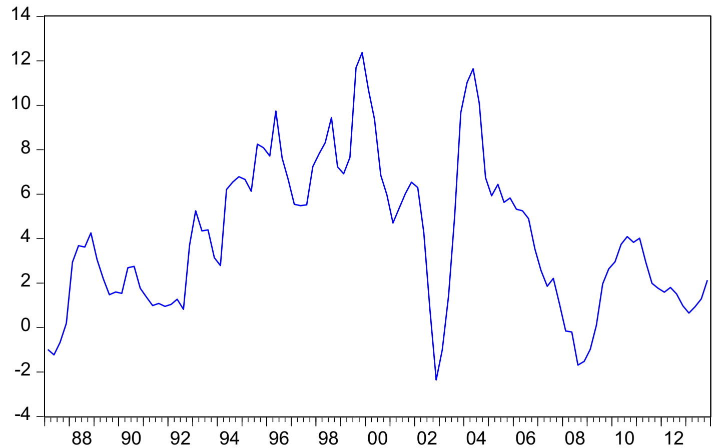
Source: SARB

Figure A9: Real government bond yield 3-5years



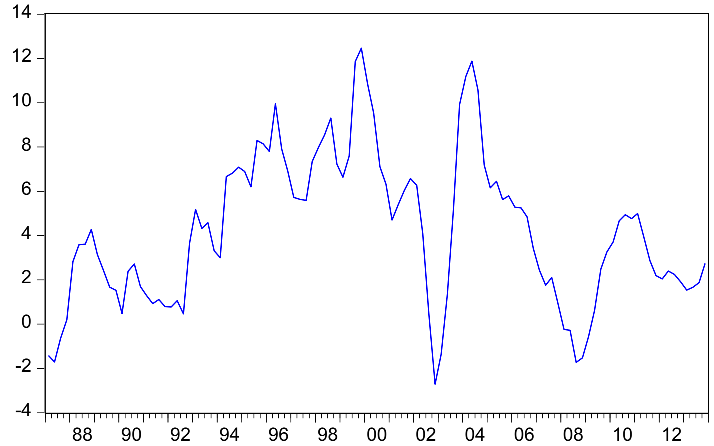
Source: SARB

Figure A10: Real government bond yield 5-10 years



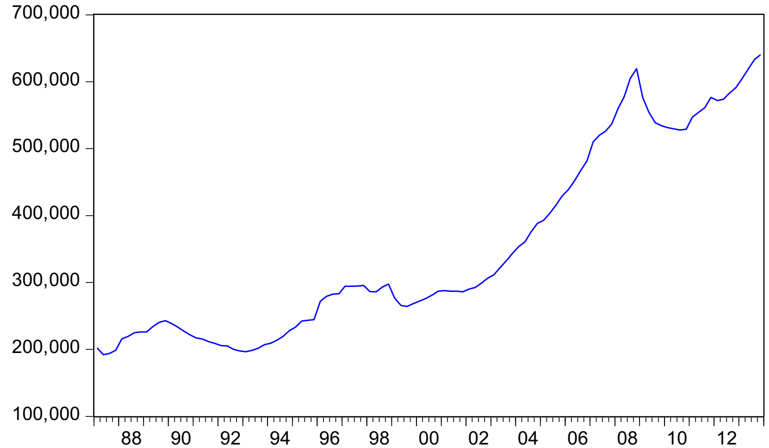
Source: SARB

Figure A11: Real government bond yield 10 years and over



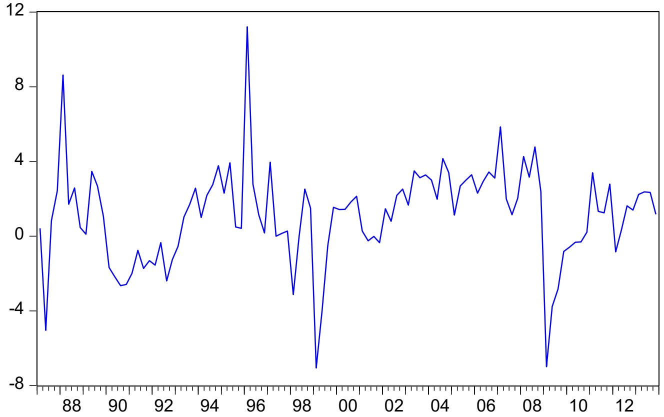
Source: SARB

Figure A12: Total gross fixed capital formation in R millions



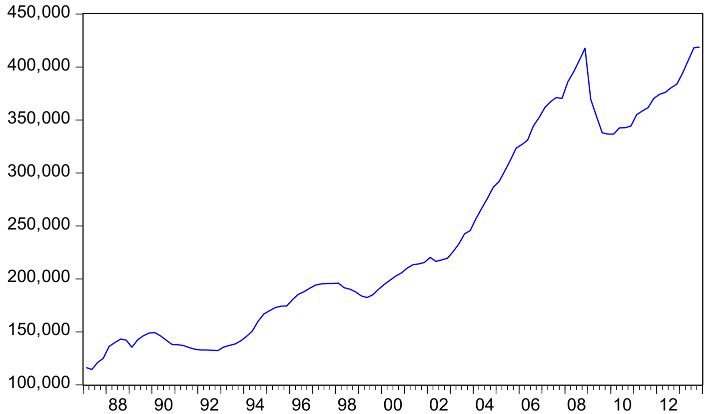
Source: SARB

Figure A13: Total gross fixed capital formation (1-period % change)



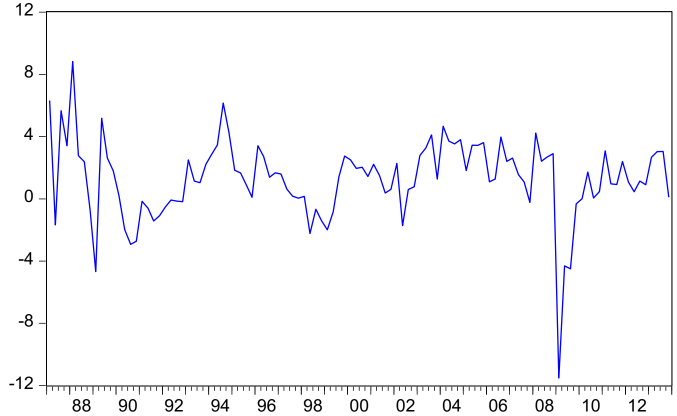
Source: SARB

Figure A14: Gross fixed capital formation by private business enterprises in R millions



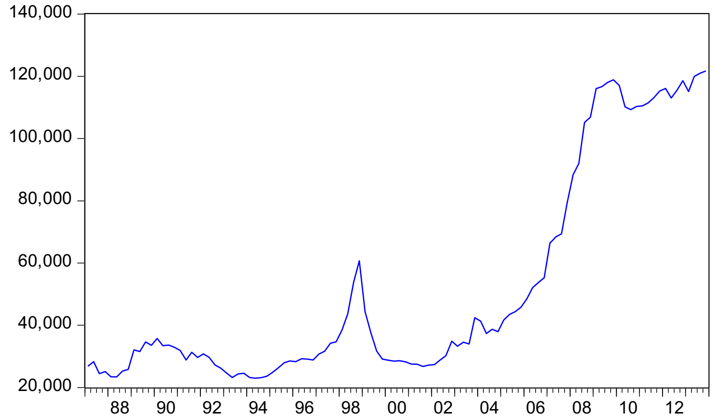
Source: SARB

Figure A15: Gross fixed capital formation by private business enterprises (1-period % change)



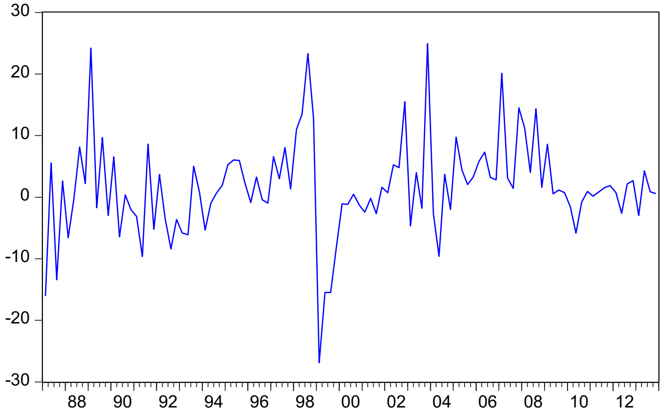
Source: SARB

Figure A16: Gross fixed capital formation by public corporations in R millions



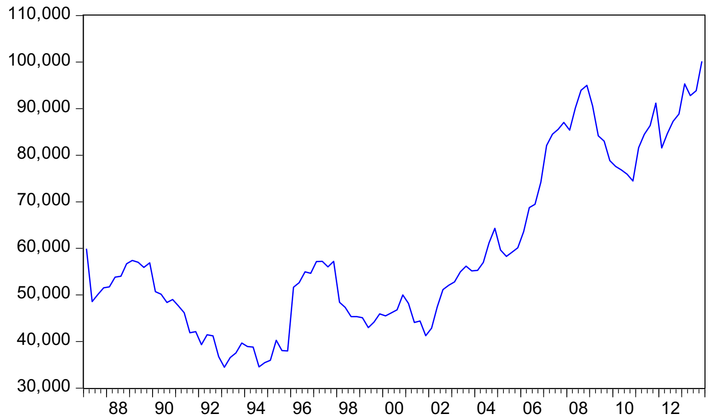
Source: SARB

Figure A17: Gross fixed capital formation by public corporations (1-period % change)



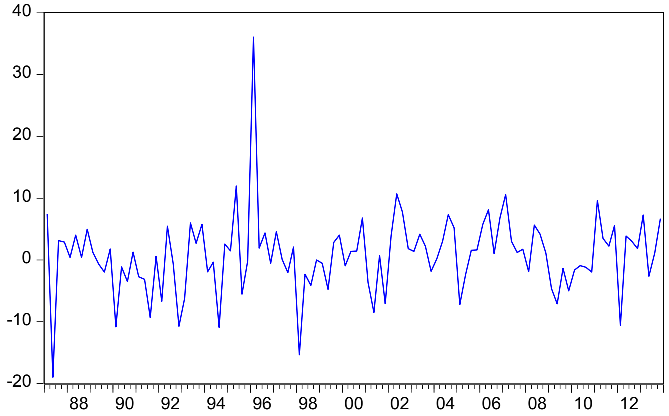
Source: SARB

Figure A18: Gross fixed capital formation by general government in R millions



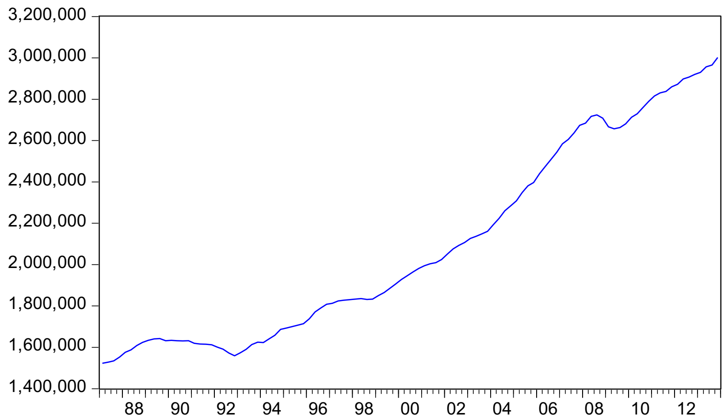
Source: SARB

Figure A19: Gross fixed capital formation by general government (1-period % change)



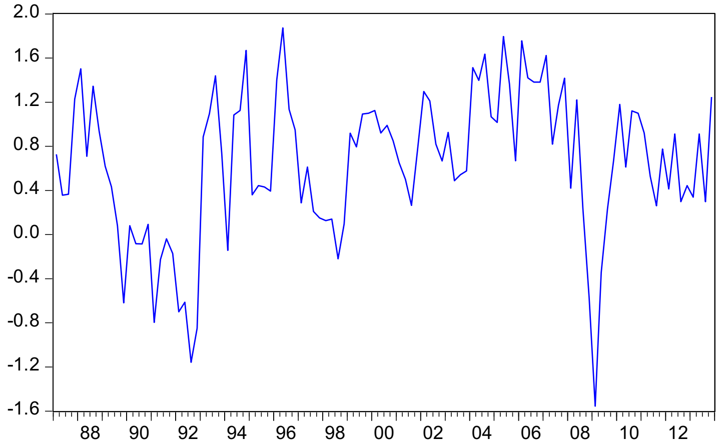
Source: SARB

Figure A20: South African GDP in R millions



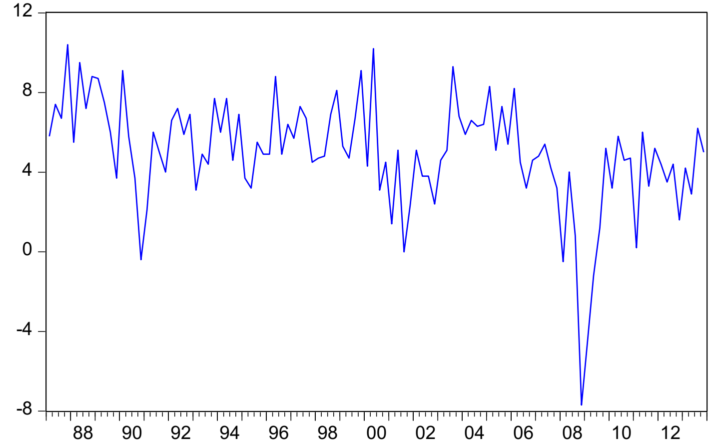
Source: SARB

Figure A21: South African GDP (1-period % change)



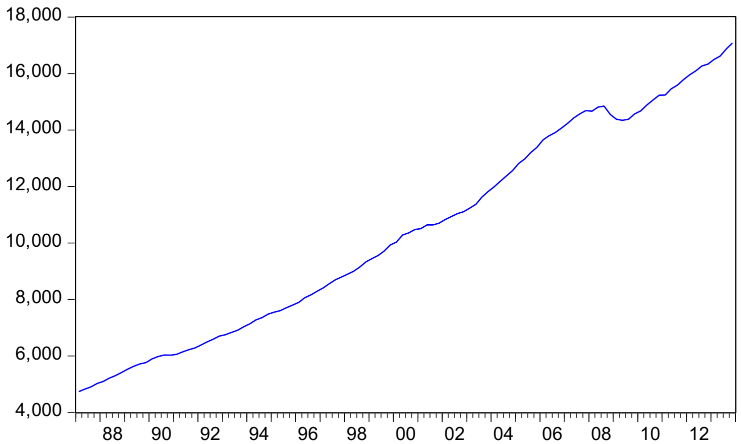
Source: SARB

Figure A23: United States GDP (1-period % change)



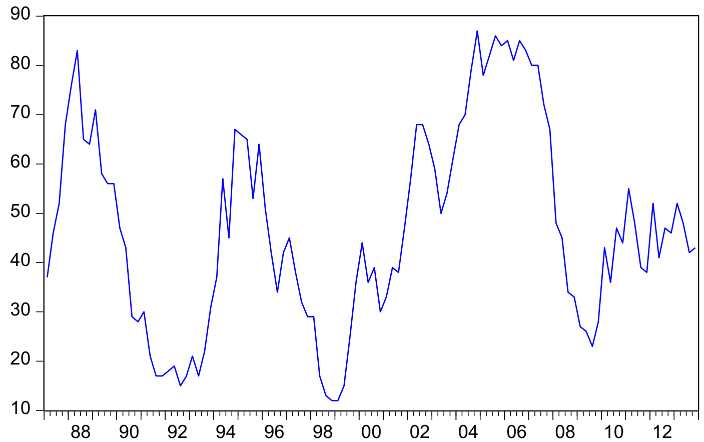
Source: FRED

Figure A22: United States GDP in USD billions



Source: FRED

Figure A24: Business Confidence Index



Source: Bureau for Economic Research

Figure A25: Response of *TOT* to *PR* Innovation

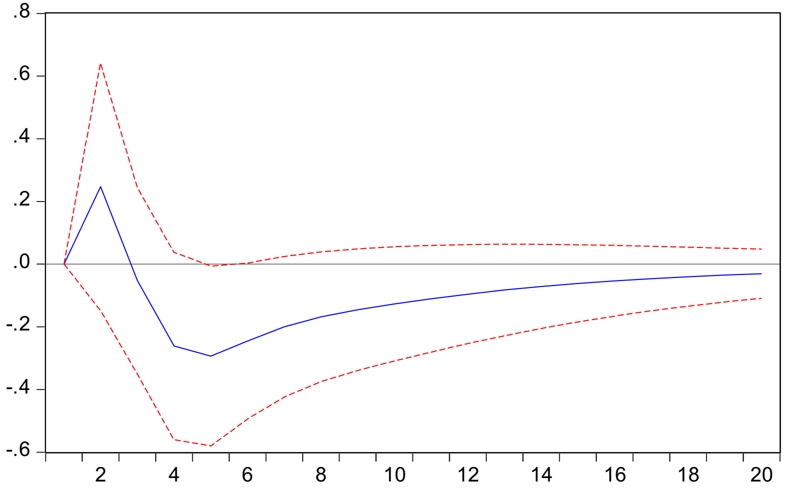


Figure A27: Response of *TOT* to *GBY03* Innovation

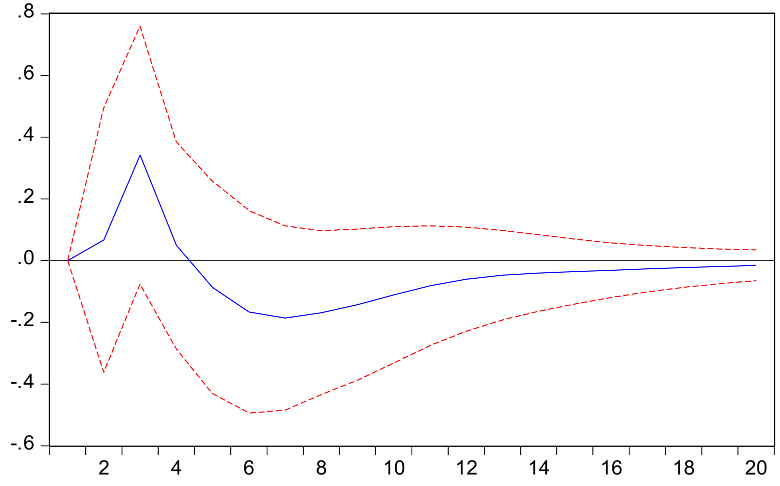


Figure A26: Response of *TOT* to *TB* Innovation

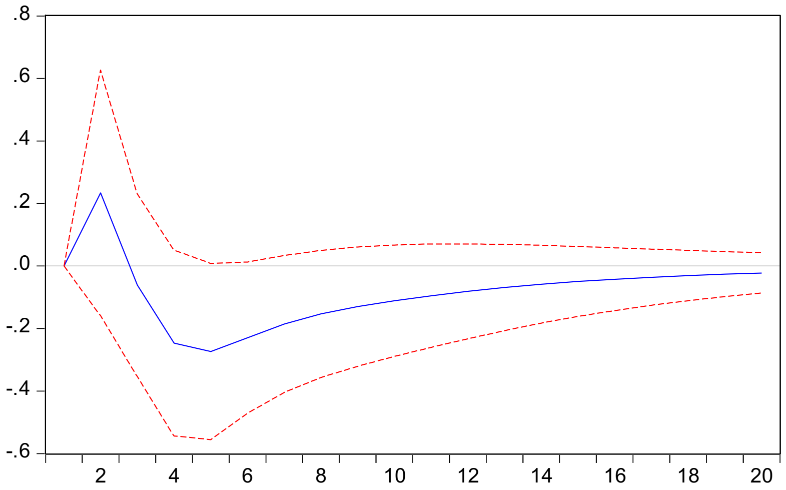


Figure A28: Response of *TOT* to *GBY35* Innovation

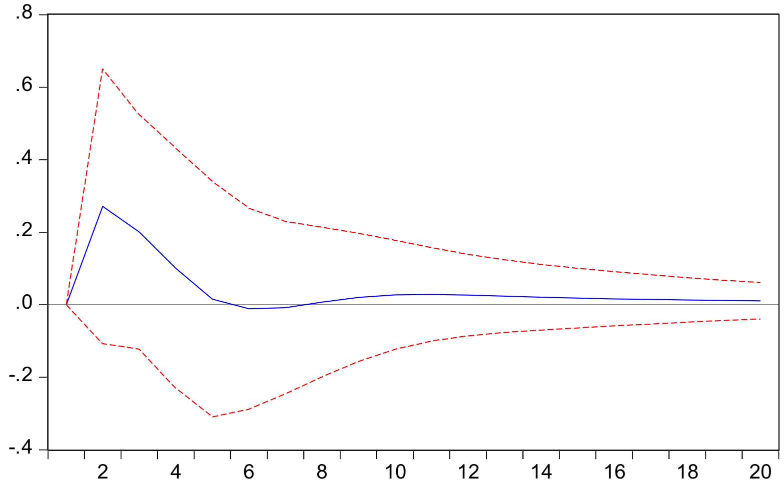


Figure A29: Response of *TOT* to *GBY510* Innovation

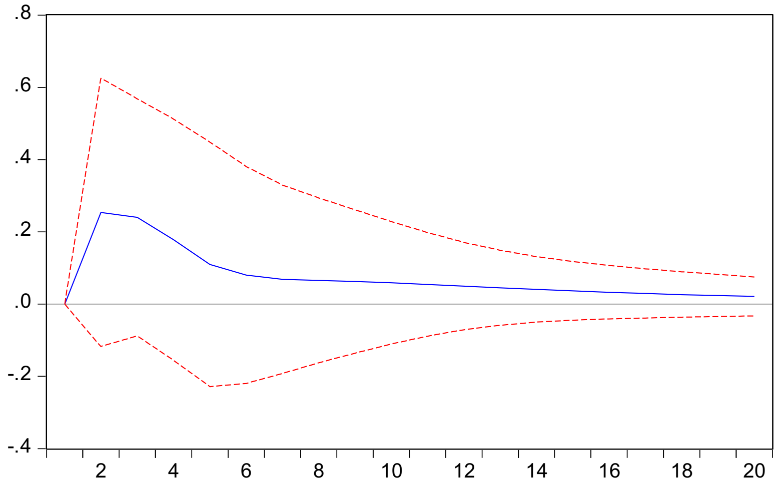


Figure A31: Response of *PVT* to *PR* Innovation

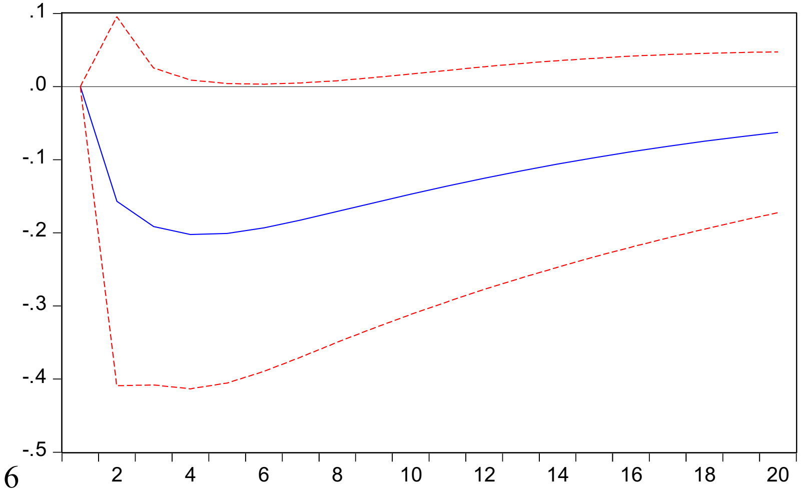


Figure A30: Response of *TOT* to *GBY10* Innovation

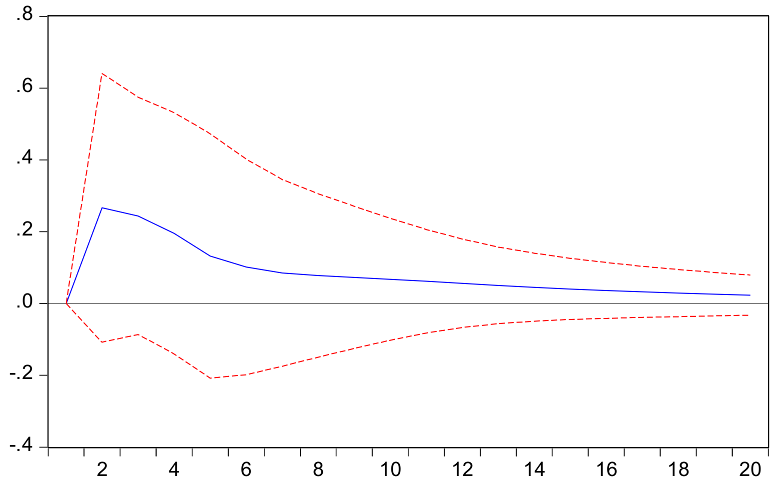


Figure A32: Response of *PVT* to *TB* Innovation

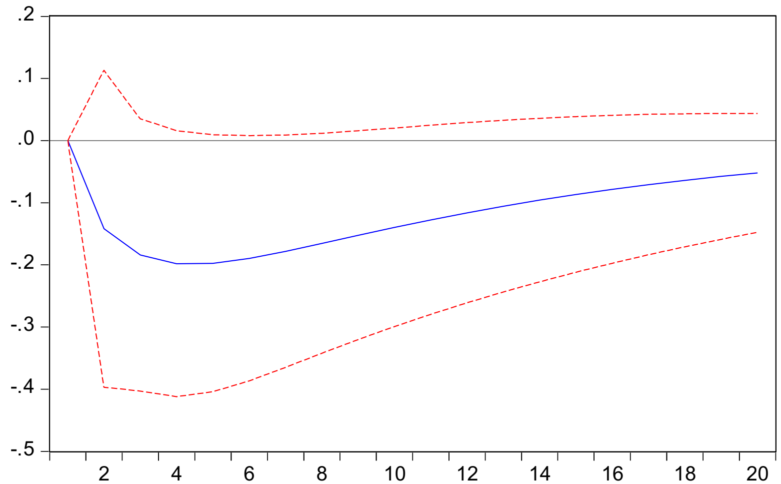


Figure A33: Response of *PVT* to *GBY03* Innovation

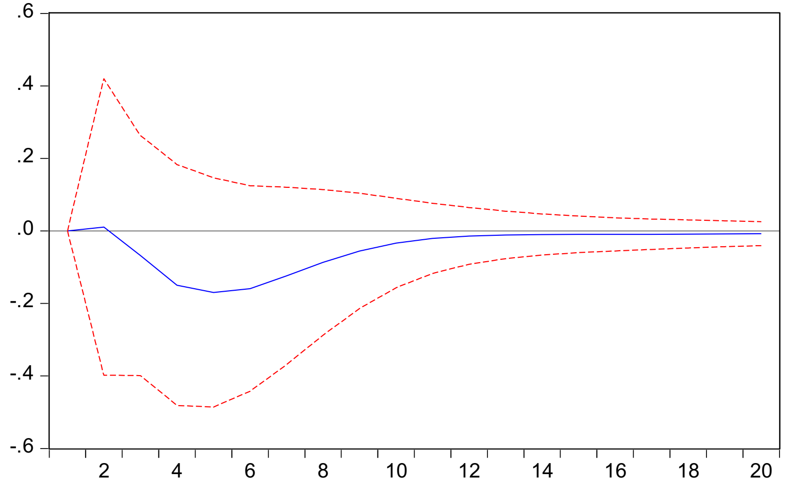


Figure A35: Response of *PVT* to *GBY510* Innovation

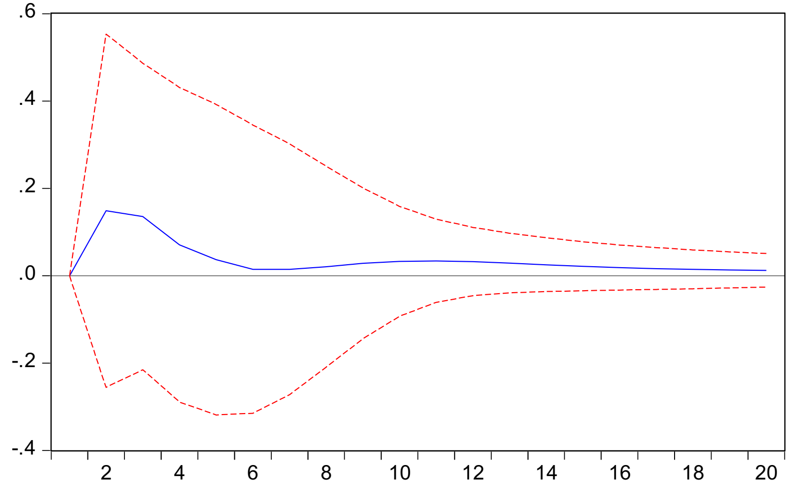


Figure A34: Response of *PVT* to *GBY35* Innovation

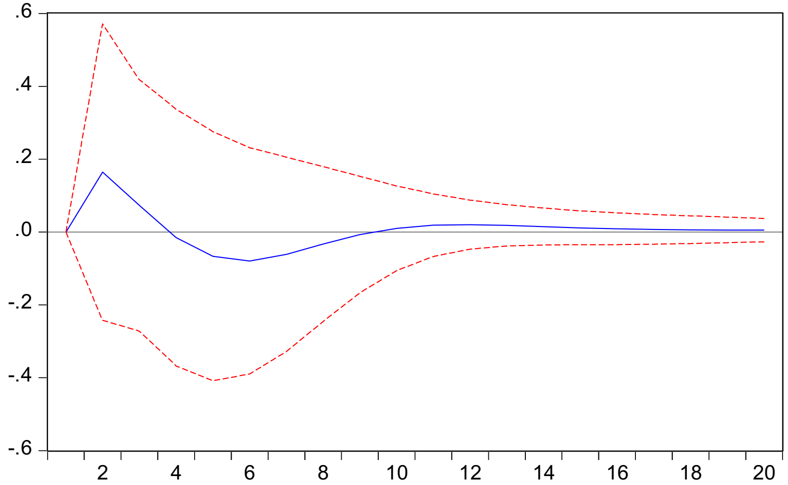


Figure A36: Response of *PVT* to *GBY10* Innovation

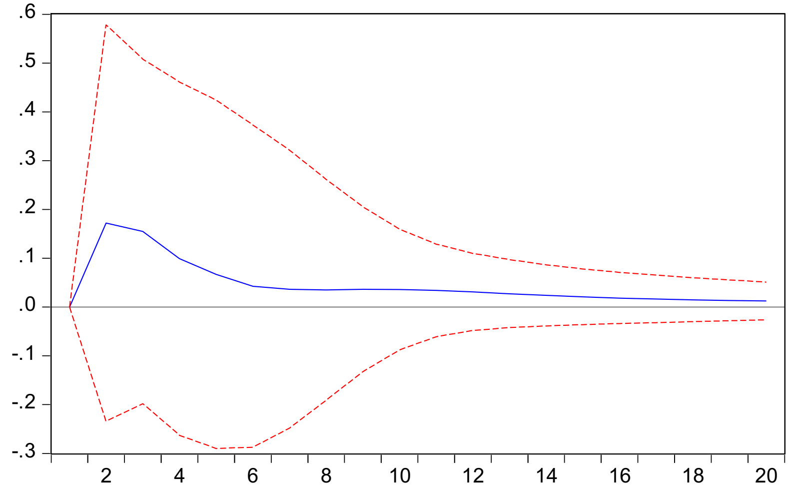


Figure A37: Response of *PUB* to *PR* Innovation

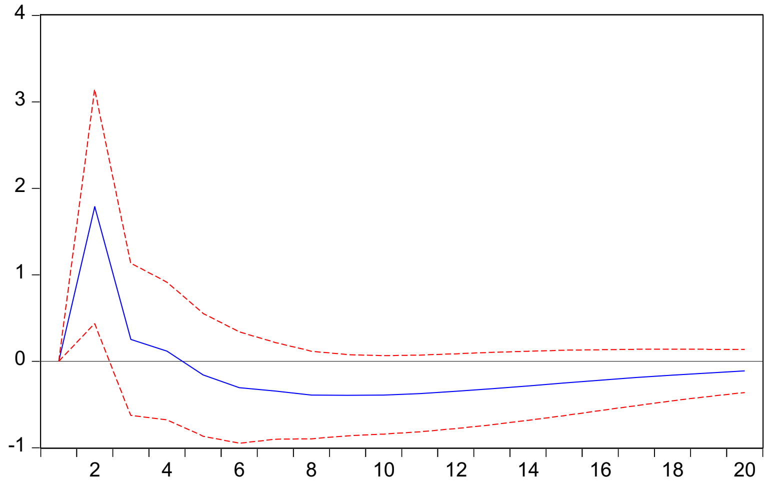


Figure A38: Response of *PUB* to *TB* Innovation

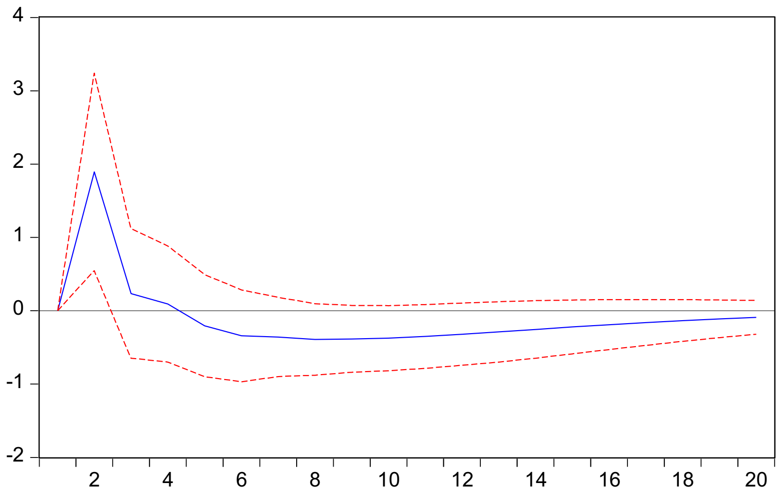


Figure A39: Response of *PUB* to *GBY03* Innovation

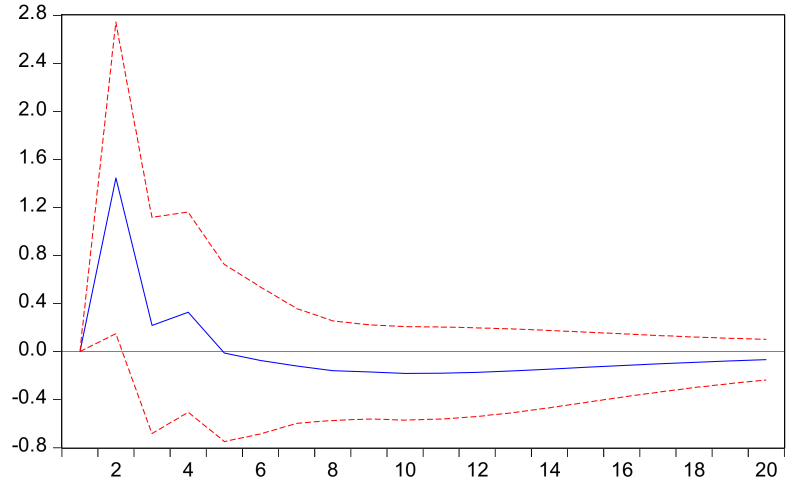


Figure A40: Response of *PUB* to *GBY35* Innovation

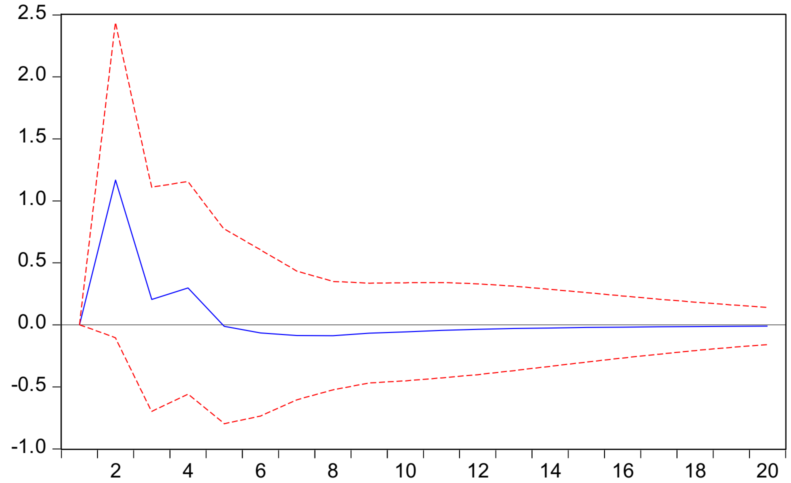


Figure A41: Response of *PUB* to *GBY510* Innovation

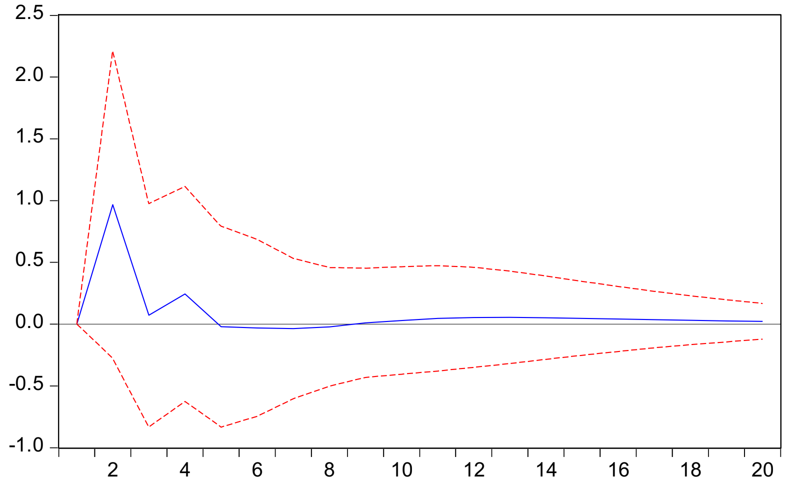


Figure A43: Response of *GOV* to *PR* Innovation

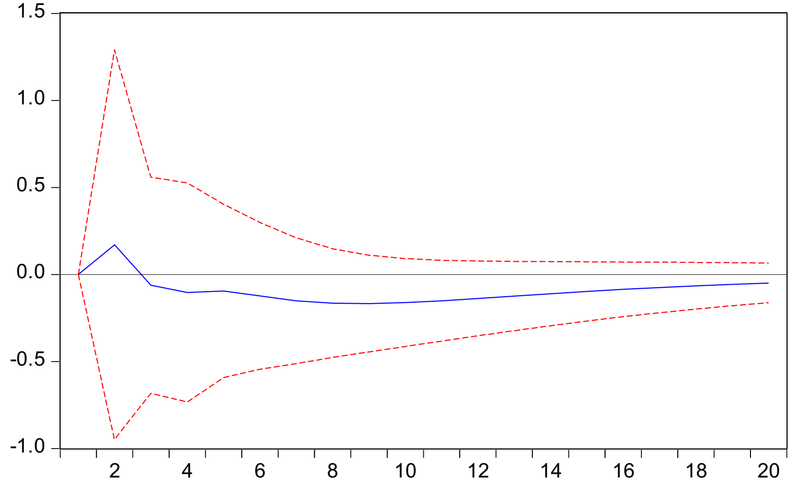


Figure A42: Response of *PUB* to *GBY10* Innovation

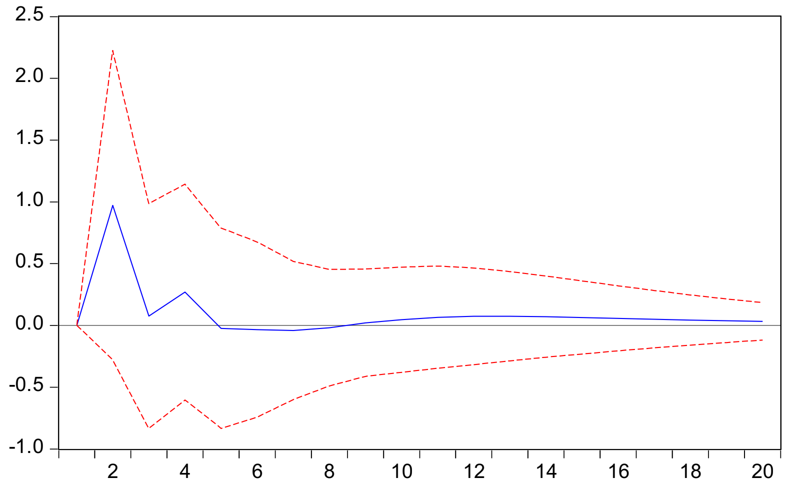


Figure A44: Response of *GOV* to *TB* Innovation

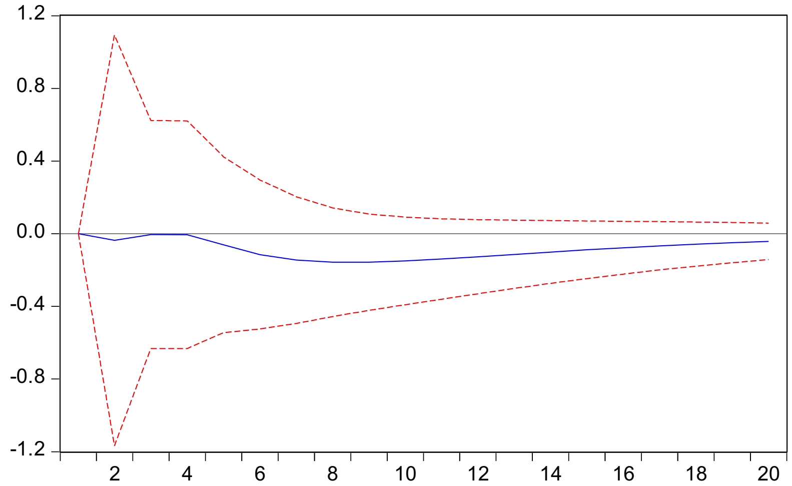


Figure A45: Response of *GOV* to *GBY03* Innovation

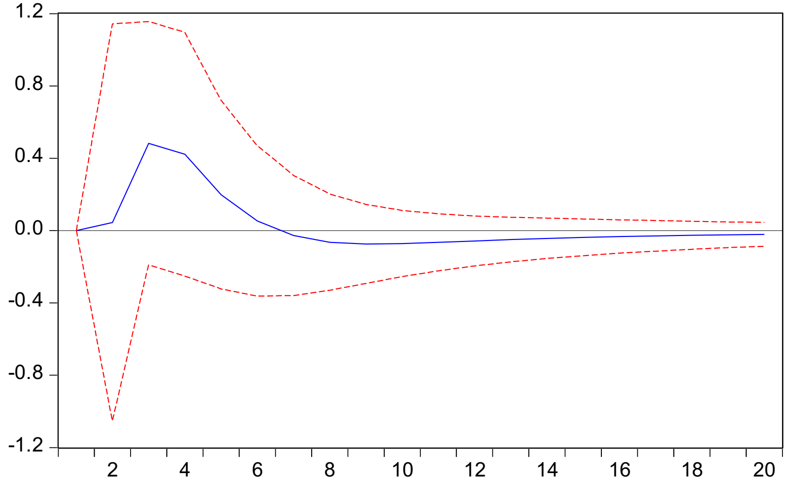


Figure A46: Response of *GOV* to *GBY35* Innovation

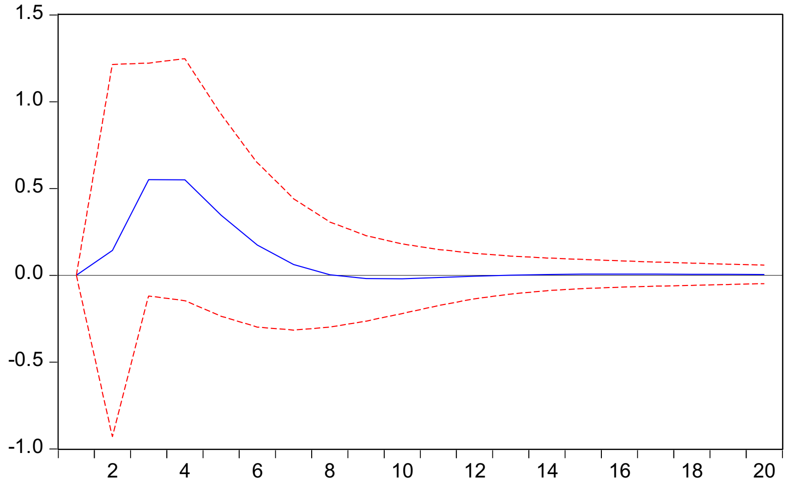


Figure A47: Response of *GOV* to *GBY510* Innovation

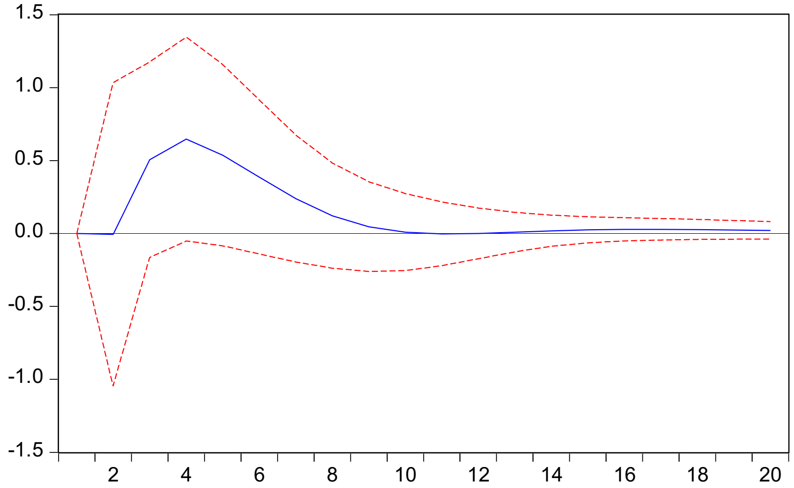


Figure A48: Response of *GOV* to *GBY10* Innovation

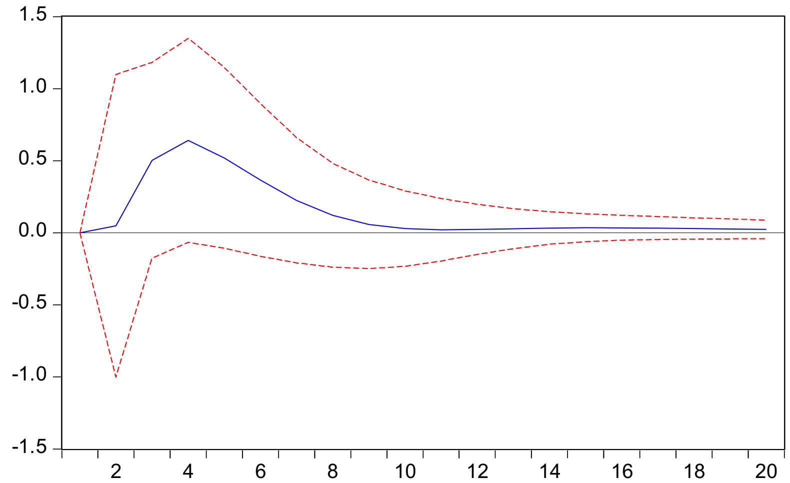
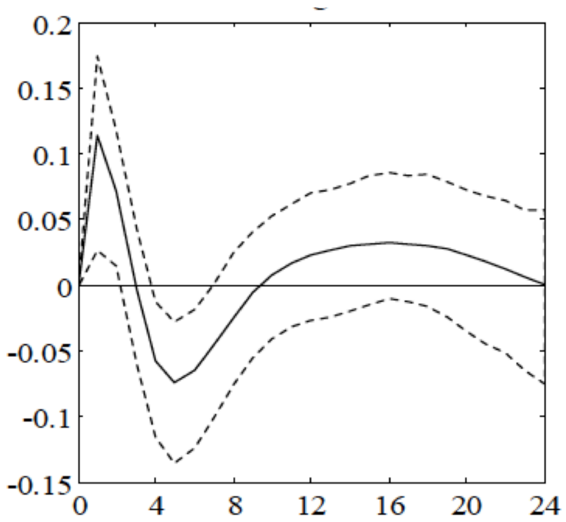
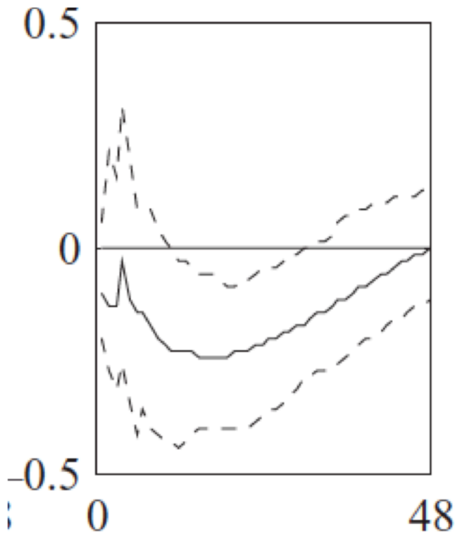


Figure A49: Response of GFCF growth to a monetary policy shock



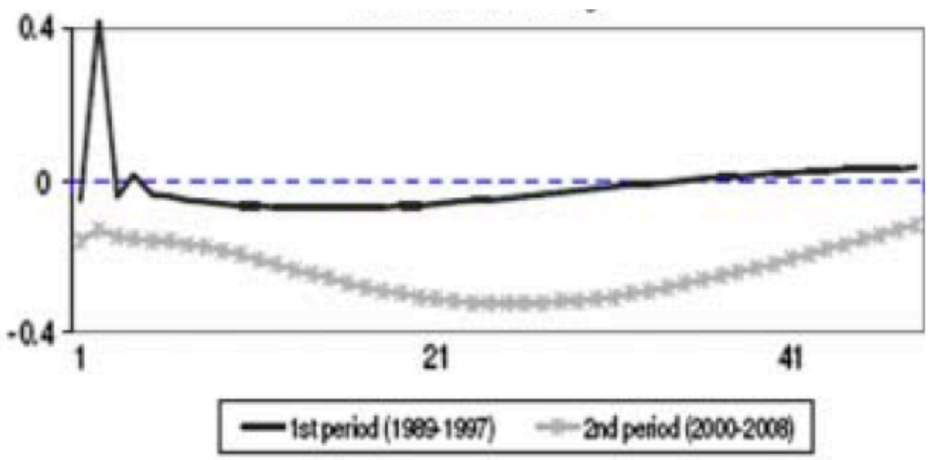
Source: Gumata et al. (2013)

Figure A50: Response of GFCF by private sector to a monetary policy shock



Source: Kabundi and Ngwenya (2011)

Figure A51: Response of GFCF by private manufacturing sector to a monetary policy shock



Source: Gupta et al. (2009)

REFERENCES

ACHARYA, V.V. and ONCU, T.S. (2010). *The Repurchase Agreement (Repo) Market*. New York: New York University School of Business.

ADAMS, S. (2009). Foreign direct investment, domestic investment, and economic growth in Sub-Saharan Africa. *Journal of Policy Modelling*. 31(6): 939-949.

AHMED, S. and ISLAM, E. (2004). Interest Rate Responsiveness of Investment Spending in Bangladesh: A VAR Approach. *Bangladesh Development Studies.* 30(1): 1-48.

AZIAKPONO, M.M. and WILSON, M.K. (2013). Interest Rate Pass-Through and Monetary Policy Regimes in South Africa. *AERC Research Paper 259. African Economic Research Consortium, Nairobi*.

BADER, M. and MALAWI, A.I. (2010). The Impact of Interest Rates on Investment in Jordan: A Cointegration Analysis. *Economics and Administration*. 24(1): 199-209.

BAYE, M.R. and JANSEN, D.W. (1995). *Money, Banking, and Financial Markets: An Economics Approach.* Kentucky: Houghton Mifflin College Division.

BERNANKE, B. and GERTLER, M. (1995). Inside the Black Box: The Credit Channel of Monetary Policy Transmission. *Journal of Economic Perspectives*. 9(4): 27-48.

BHATTACHARYA, R. and MUKHERJEE, S. (2011). Inflation Targeting and Monetary Policy Transmission Mechanisms in Emerging Market Economies. *IMF Working Paper*. 11(229):1-27.

BHORAT, H., HIRSCH, A., KANBUR, R. and NCUBE, M. (2014). Economic Policy in South Africa: Past, Present and Future. *Development Policy Research Unit Working Paper 2014-01*. DPRU, University of Cape Town.

BONGA-BONGA, L. (2009). Monetary Policy and Long-Term Interest Rates in South Africa. *University of Johannesburg Working Paper Number 125*.

BRUNZELL, T., LILJEBLOM, E. and VAIHEKOSKI, M. (2013). Determinants of capital budgeting methods and hurdle rates in Nordic firms. *Accounting and Finance*. 53(1): 85-110.

CHIRINKO, R.S., FAZZARI, S.M. and MEYER, A.P. (1999). How Responsive is Business Capital Formation to its User Cost: An Exploration with Micro Data. *Journal of Public Economics*. 74(1): 53-80.

DE ANGELIS, C., AZIAKPONO, M.J. and FAURE, A.P. (2005). The Transmission of Monetary Policy Under the Repo System in South Africa. *South African Journal of Economics*. 73(4): 657-673.

DEMIRGUC-KUNT, A., KLAPPER, L., SINGER, D. and VAN OUDHEUSDEN, P. (2015). Measuring financial inclusion around the world. *World Bank Policy Research Working Paper No. 7255*.

DU TOIT, C. and MOOLMAN, E. (2004). A Neoclassical Investment Function of the South African Economy. *Economic Modelling*. 21(4): 647-660.

ENDERS, W. (2010). *Applied Econometric Time Series* (3e). New York: John Wiley & Sons, Inc.

FAULKNER, D. and LOEWELD, C. (2008). Policy Change and Economic Growth: A Case Study of South Africa. *National Treasury of the Republic of South Africa Policy Paper No. 14*.

FAURE, A.P. (2014). *Interest Rates: An Introduction*. South Africa: Quoin Institute.

FIELDING, D. (1997). Aggregate Investment in South Africa: A Model with Implications for Political Reform. *Oxford Bulletin of Economics and Statistics*. 59(3): 349-369.

GELB, S. (2001). Socio-political risk, confidence and firm investment in South Africa. *Paper for the CSAE/UNIDO Workshop on "New Industrial Realities and Firm Behaviour in Africa, Oxford, September 2001*.

GEORGE, E., KING, N., CLEMENTI, D., BUDD, A., BUITER, W., GOODHART, C. and VICKERS, J. (1999). *The Transmission Mechanism of Monetary Policy*. Bank of England.

GILCHRIST, S. and ZAKRAJSEK, E. (2007). Investment and the Cost of Capital: New Evidence from the Corporate Bond Market*. NBER Working Paper Series 27-2007*.

GITMAN, L.J., JUCHAU, R. and FLANAGAN, J. (2010). *Principles of Managerial Finance*. Pearson Education: Melbourne.

GORDON, R.J. (1987). *The American Business Cycle: Continuity and Change*. University of Chicago Press: Chicago.

GRANGER, C.W.J. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. *Econometrica*. 37(3): 424-438.

GREENE, J. and VILLANUEVA, D.S. (1991). Private Investment in Developing Countries: An Empirical Analysis. *IMF Staff Papers*. 38(1): 33-58.

GUISO, L., KASHYAP, A., PANETTA, F. and TERLIZZESE, D. (2002). How Interest Sensitive is Investment? *In Paper presented at the NBER Summer Institute, Capital Markets in the Economy Workshop*.

GUJARATI, D. (1995). *Basic Econometrics*. McGraw Hill Inc: New York.

GUMATA, N., KABUNDI, A. and NDOU, E. (2013). Important channels of transmission of monetary policy shock in South Africa. *South African Reserve Bank Working Paper Series*. No. 06/2013.

GUMEDE, N. and STUART, R. (2013). The Credit Channel of Monetary Policy and Monetary Endogeneity. Unpublished paper. Grahamstown: Department of Economics and Economic History, Rhodes University.

GUPTA, R., KABUNDI, A. and MODISE, M.P. (2009). Has the SARB Become More Effective Post Inflation Targeting? *Economic Change and Restructuring*. 43(3): 187-204.

HAQUE, N.U., LAHIRI, K. and MONTIEL, P.J. (1990). A Macroeconometric Model for Developing Countries. *IMF Staff Papers*. 37(3): 537-559.

HOFFMAN, B. and MIZEN, P. (2001). Interest Rate Pass-Through and Monetary Transmission: Evidence from Individual Financial Institutions' Retail Rates. *Economica*. 2004(71): 99-123.

HOLMES, M.J., IREGUI, A.M. and OTERO, J. (2015). Interest rate pass through and asymmetries in retail deposit and lending rates: An analysis using data from Colombian banks. *Econometric Modelling*. 49(2015): 270-277.

IDC (2013). *Economic Overview: Recent developments in the global and South African economies*. Department of Research and Information, Industrial Development Corporation.

IMF (2009). *System of National Accounts 2008*. New York: International Monetary Fund.

IRELAND, P.N. (2004). Money, Banking and Financial Markets. Lecture notes. Boston: Department of Economics, Boston College.

JORGENSON, D.W. (1963). Capital Theory and Investment Behavior. *American Economic Review*. 53(2): 247-259.

JORGENSON, D.W. and LANDAU, R. (1993). *Tax Reform and the Cost of Capital: An International Comparison*. Washington: The Brookings Institution.

KABUNDI, A. and NGWENYA, N. (2011). Assessing Monetary Policy in South Africa in a Data-Rich Environment. *South African Journal of Economics*. 79(1): 91-107.

KERSHOFF, G. (2000). *Measuring Business and Consumer Confidence in South Africa*. Stellenbosch: Bureau for Economic Research.

KSANTINI, M. and BOUJELBENE, Y. (2014). Impact of Financial Crisis on Growth and Investment: An Analysis of Panel Data. *Journal of International and Global Economic Studies*. 7(1): 32-57.

KWENDA, F. and HOLDEN, M. (2014). Determinants of working capital investment in South Africa: Evidence from Selected JSE-Listed firms. *Journal of Economics and Behavioural Studies*. 6(7): 569-580.

KWIATKOWSKI, D., PHILLIPS, P.C.B., SCHMIDT, P. and SHIN, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of Econometrics*. 54(1): 159-178.

LEVY, P.I. (1999). *Sanctions on South Africa: What Did They Do?* Yale University: Economic Growth Center.

LIN, J.L. (2008). Notes on Testing Causality. Taipei: Department of Economics, National Chengchi University.

MALEDE, M. (2014). Determinants of Commercial Banks Lending: Evidence from Ethiopian Commercial Banks. *European Journal of Business and Management*. 6(20): 109-117.

MCKINNON, R.I. (1973). *Money and Capital in Economic Development*. Washington: The Brookings Institute.

MICHAELIDES, P.G., ROBOLI, A., ECONOMAKIS, G. and MILIOS, J. (2005). The Determinants of Investment Activity in Greece. *Journal of Transport and Shipping*. 3(1): 23-45.

MISHKIN, F.S. (1995). Symposium on the Monetary Transmission Mechanism. *Journal of Economic Perspectives*. 9(4): 3-10.

MISHKIN, F.S. (2007). *The Economics of Money, Banking and Financial Markets*. Boston: Pearson Addison-Wesley.

MODIGLIANI, F. and MILLER, M.H. (1958). The Cost of Capital, Corporation Finance and the Theory of Investment. *American Economic Review*. 48(3): 261-297.

NDIKUMANA, L. (2000). Financial Determinants of Domestic Investment in Sub-Saharan Africa: Evidence from Panel Data. *World Development*. 28(2): 381-400.

NEL, H. (1996). The Term Structure of Interest Rate and Economic Activity in South Africa. *South African Journal of Economics*. 64(3): 161-174.

NICKELL, S. (1978). *The Investment Decisions of Firms*. Nisbet: Cambridge University Press.

ORPHANIDES, A. and WEI, M. (2012). Evolving macroeconomic perceptions and the term structure of interest rates. *Journal of Economic Dynamics and Control*. 36(2): 239-254.

PATTANAIK, S.S., BEHERA, H., KAVEDIYA, S.R., DAS, A., SHRIVASTAVA, A.K. and JOSHI, H. (2013). *Real Interest Rate Impact on Investment and Growth - What the Empirical Evidence for India Suggests*. Reserve Bank of India. [Online]. Available: http://www.rbi.org.in/scripts/PublicationsView.aspx?id=15113. [Accessed 01 April 2015].

POWER, M. (2004). How has South Africa Inc sought to reduce its high cost of capital? *OECD Development Centre Seminar: Cheaper Money for Southern Africa – Unlocking Growth, 07 October 2004.*

SARB (2014). *The South African Reserve Bank's System of Accommodation*. SARB. [Online]. Available: https://www.resbank.co.za/Lists/Attachments/5001.pdf. [Accessed 01 April 2015].

SHARPE, S.A. and SUAREZ, G.A. (2013). *The Insensitivity of Investment to Interest Rates: Evidence from a Survey of CFOs*. Finance and Economics Discussion Series Division of Research & Statistics and Monetary Affairs, Federal Reserve Board. Washington D.C.

SMAL, M. and DE JAGER, S. (2001). The Monetary Transmission Mechanism in South Africa. Occasional Paper No. 16, September, South African Reserve Bank.

SA HISTORY ONLINE (2015). *European Community lifts sanctions against SA*. SA History. [Online]. Available: http://www.sahistory.org.za/dated-event/european-community-lifts-sanctions-against-sa. [Accessed 23 April 2015].

STOCK, J.H. and WATSON, M.W. (2001). Vector Autoregressions. *Journal of Economic Perspectives*. 15(4): 101-115.

TAYLOR, J.B. (1995). The Monetary Transmission Mechanism: An Empirical Framework. *Journal of Economic Perspectives*. 9(4): 11-26.

TRADING ECONOMICS (2014). *Gross Fixed Capital Formation in South Africa*. Trading Economics. [Online]. Available: http://www.tradingeconomics.com/south-africa/gross-fixed-capital-formation-annual-percent-growth-wb-data.html. [Accessed 19 June 2014].

WORLD BANK (2015). *United States Gross Domestic Product.* World Bank. [Online]. Available: http://data.worldbank.org/indicator/NY.GDP.MKTP.CD. [Accessed 25 September 2015].