

https://dspace.org/

Credit procyclicality and financial regulation in South Africa.

Raputsoane, Leroi J

2014-08-01
http://hdl.handle.net/10539/15100

Downloaded from a DSpace repository. https://dspace.org/

Credit procyclicality and financial regulation in South Africa

Leroi Raputsoane

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2014

ABSTRACT

This study examines the behaviour of credit extension over the economic cycle in South Africa to assess its usefulness as a common reference guide for implementing the countercyclical capital buffers for financial institutions in South Africa, paying special attention to the recent proposals of the Basel Committee on Banking Supervision. The Basel Committee on Banking Supervision at the Bank for International Settlements has identified credit extension as one of the major causes of the financial crises. It therefore came up with several proposals in the form of Basel III to strengthen the financial system to make it more resilient to future financial crises. One of the key proposals of Basel III is to implement the countercyclical capital buffers for financial institutions using credit extension as a common reference guide to limit credit procyclicality and its associated systemic and economic risks. This study seeks to establish how the proposed reference guide for setting countercyclical buffers that is based on the gap between the ratio of aggregate private sector credit to gross domestic product gap and its long term trend behaves during periods of expansions and contractions in the economic cycle. The study also seeks to establish how this common reference guide for setting countercyclical capital buffers behaves during periods of upturns and downturns in the economic cycle. The empirical results reveal a statistically significant positive relationship of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend relative to its recent past during the normal fluctuations in the economic cycle, while such a relationship cannot be established during the periods of economic cycle booms. The empirical results further reveal a statistically significant positive relationship of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend relative to its recent past during the upturns in the economic cycle, while such relationship turns negative during the economic cycle downturns. The conclusion is that the use of the proposed common reference guide to determine the level of the countercyclical capital buffers for financial institutions may not be appropriate in South Africa given that it would tend to increase capital requirements during the economic downturns, exacerbating the procyclicality of credit extension with dire consequences for the economy.

DECLARATION

I, _____, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Signed at ……

On the …….. day of ……. 2014

DEDICATION

Dedicated to my Mother and the entire Family.

ACKNOWLEDGEMENTS

I would like to thank my Supervisor, Mr James Bernstein, for his assistance, advice and support while preparing this research report.

I would like to thank my Co-Supervisor, Prof Eric Schaling, for making time to review this research report and for his useful comments.

I would like to thank my fellow students for the positive interaction during the course of my MBA studies.

TABLE OF CONTENTS

ABSTRACT II

DECLARATION III

DEDICATION IV

ACKNOWLEDGEMENTS V

LIST OF TABLES VIII

1. CHAPTER 1: INTRODUCTION 1

1.1 PURPOSE OF THE STUDY 1

1.2 CONTEXT OF THE STUDY 2

1.2.1 CREDIT PROCYCLICALITY 3

1.2.2 COUNTERCYCLICAL FINANCIAL REGULATION 3

1.3 PROBLEM STATEMENT 4

1.3.1 MAIN PROBLEM 4

1.3.2 SUB PROBLEMS 4

1.4 SIGNIFICANCE OF THE STUDY 5

1.5 DELIMITATIONS OF THE STUDY 6

1.6 DEFINITION OF TERMS 7

1.7 ASSUMPTIONS 7

2. CHAPTER 2: LITERATURE REVIEW 9

2.1. INTRODUCTION 9

2.2. COUNTERCYCLICAL FINANCIAL REGULATION 9

2.3. CREDIT PROCYCLICALITY AND FINANCIAL CRISES 12

2.3.1 CREDIT EXTENSION AND ECONOMIC CYCLES 12

2.3.2 CREDIT EXTENSION AND FINANCIAL CRISES 13

2.4. CREDIT EXTENSION AND FINANCIAL REGULATION 14

2.4.1 COUNTERCYCLICAL CAPITAL BUFFERS 14

2.4.2 CREDIT EXTENSION MEASUREMENT 16

2.5 CONCLUSION OF THE LITERATURE REVIEW 18

2.5.1 HYPOTHESIS 1: 18

2.5.2 HYPOTHESIS 2: 18

3. CHAPTER 3: RESEARCH METHODOLOGY 20

3.1 INTRODUCTION 20

3.2 RESEARCH PARADIGM 20

3.3 METHODOLOGICAL APPROACH 21
3.3.1 LOGISTIC SMOOTH TRANSITION AUTOREGRESSIVE MODEL 21
3.3.1 HODRICK PRESCOTT FILTER 22
3.4 DATA DESCRIPTION 24
3.5 DATA ANALYSIS AND INTERPRETATION 25
3.6 LIMITATIONS OF THE STUDY 26
3.7 VALIDITY AND RELIABILITY 27

4. CHAPTER 4: PRESENTATION OF RESULTS 30

4.1 INTRODUCTION 30
4.2 DESCRIPTIVE STATISTICS 30
4.3 MEASURES OF MODEL ADEQUACY 30
4.4 RESULTS PERTAINING TO HYPOTHESIS 1 32
4.5 RESULTS PERTAINING TO HYPOTHESIS 2 33
4.6 SUMMARY OF THE RESULTS 34

5. CHAPTER 5: DISCUSSION OF THE RESULTS 35

5.1 INTRODUCTION 35
5.2 DESCRIPTIVE STATISTICS AND MODEL DIAGNOSTICS 35
5.3 DISCUSSION PERTAINING TO HYPOTHESIS 1 35
5.4 DISCUSSION PERTAINING TO HYPOTHESIS 2 36
5.5 SIMILARITIES WITH RELATED LITERATURE 38
5.6 IMPLICATIONS FOR COUNTERCYCLICAL CAPITAL BUFFERS 39
5.7 CONCLUSION 41

6. CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS 42

6.1 INTRODUCTION 42
6.2 CONCLUSIONS OF THE STUDY 42
6.3 RECOMMENDATIONS 43
6.4 SUGGESTIONS FOR FURTHER RESEARCH 43

REFERENCES 45

APPENDIX A 52

APPENDIX B 54

CONSISTENCY MATRIX 55

LIST OF TABLES

Table 1: Descriptive Statistics 52

Table 2: Logistic Smooth Transition Autoregressive models results 52

Table 3: Consistency matrix 55

LIST OF FIGURES

Figure 1: Evolution of the main Variables 54

1. CHAPTER 1: INTRODUCTION

1.1 Purpose of the study

The purpose of this study is to examine the behaviour of credit extension over the economic cycle to assess its usefulness as a reference guide for implementing countercyclical capital buffers for financial institutions in South Africa. The study is motivated by the fact that, during the recent global financial crisis in 2008 and 2009, the overextended financial institutions in most countries, particularly in developed economies, experienced unprecedented problems resulting in either defaults or massive bailouts. As a result of the financial system problems, most world economies went into recession requiring massive stimulus packages to resuscitate them from the recessionary economic conditions.

The Basel Committee on Banking Supervision at the Bank for International Settlements has identified credit extension as one of the major causes of the financial crises. In the quest to strengthen the financial system to make it more resilient to future financial crises, it came up with several proposals in the form of Basel III in 2010. One of the proposals is to implement countercyclical capital buffers to be introduced in 2013 and fully implemented by 2015 for financial institutions using credit extension as a common reference guide to limit credit procyclicality and its associated systemic and economic risks. Credit procyclicality defines the tendency of credit extension by financial institutions to rise during periods of booming economic conditions and to fall in periods of weakening economic conditions. Systemic risks may come in the form of financial system wide liquidity problems, defaults and bankruptcy, while economic risks may come in the form of productivity disruptions and prolonged recessions.

1.2 Context of the study

The recent financial crisis, experienced in 2008 and 2009, resulted in the worst economic recession the world has experienced since the great depression of the 1930s. The European Central Bank (2012) points out that the widespread distress in financial markets following the recent financial crisis resulted in financial system difficulties with some large financial institutions in advanced countries collapsing, and eventually, ceasing to exist. For instance, in the years leading up to the recent financial crisis, large financial institutions, such as Lehman Brothers, accumulated significant subprime mortgage related assets making them vulnerable to a downturn in that market. Lehman Brothers filed for bankruptcy in September 2008, causing ripple effects across global financial markets. Notable financial institutions that experienced problems due to the subprime mortgage crisis include Northern Rock, Bear Sterns, Fannie Mae and Freddie Mac, as well as American International Group. Shortly thereafter, three of the largest UK banks, Royal Bank of Scotland, HBOS and Lloyds Bank were put under administration.

Consequently, the problems experienced by the large financial institutions created liquidity problems in a considerable number of countries around the world. Liquidity problems arise when a party interested in trading an asset cannot do so quickly enough to prevent or minimise a loss because of lack of demand to trade for that asset. According to Brei et al. (2011), bank recapitalisations totalled $1,380 billion by the end of 2010, primarily within G10 economies. Ren (2011) contends that the consequence of the financial crisis was the deterioration of borrowers' creditworthiness, weakening collateral values, higher perceived risks, and the tightening of lending standards. These resulted in a severe shortage of liquidity and significantly constrained credit extension. According to Schularick and Taylor (2009), the recent financial crisis highlighted vulnerability of the financial system, its ability to generate economic instability through endogenous credit booms, or credit booms that originate within the financial system, and has refocused attention on money and credit fluctuations, as well as policy responses to avert future financial crises.

1.2.1 Credit procyclicality

The willingness of financial institutions to lend tends to rise during periods of booming economic conditions, or periods when real GDP grows faster than its trend, and to fall in periods of weakening economic conditions. This procyclical behaviour of credit extension by financial institutions can have adverse implications for economic activity by amplifying the fluctuations in the economic cycle and considerably prolonging and deepening the recessions, as suggested by Borgy et al. (2009) and Jeong (2009). Booming economic conditions that are amplified by the procyclical behaviour of credit extension is associated with the build-up of systemic financial distress and vulnerability, hence Schularick and Taylor (2009) and Taylor (2012), among others, argue that excessive credit extension is the foremost predictor of financial crises. According to Guo and Stepanyan (2011), as a consequence of uncontrolled and rapid liberalisation and deregulation of the financial sector leading up to the financial crisis, imprudent and relaxed lending standards by financial institutions arose, necessitating a range of initiatives on regulatory, macroprudential and accounting principles to mitigate systemic risk in the financial system. Thus, since the recent financial crisis, the emerging consensus is that a failure to establish appropriate regulatory and monitoring frameworks is one of the main causes of credit bubbles and financial crises.

1.2.2 Countercyclical financial regulation

In an effort to further strengthen the financial system following the recent financial crisis, the Basel III policy framework, which is a regulatory and monitoring framework aimed at mitigating systemic risk in the financial system, was introduced. This framework is sought to improve the quality and quantity of capital, enhance liquidity and leverage ratios, widen risk coverage, and supplement financial systems' stress testing approaches. The countercyclical capital buffers are among the key macroprudential policy proposals, which are policy proposals aimed at ensuring the health of financial institutions to help determine the financial system's sensitivity to economic shocks, detailed in the guide by Basel Committee on Banking Supervision (2010b). The aim is to

protect the financial system from procyclicality of credit extension and hence protect financial institutions during periods of excessive credit growth. According to the Basel Committee on Banking Supervision (2010a, 2011a), countercyclical capital buffers will ensure that financial institutions have adequate capital to maintain the flow of credit in the economy in periods of broader financial system distress. This will prevent the build-up of systemic risk that is associated with excessive credit growth extended by financial institutions. Systemic risk defines the interlinkages and interdependencies of financial institutions in the financial system where failure of a single institution, or a group of financial institutions, can cause failure of the entire financial system. Consequently, the Basel Committee on Banking Supervision has identified the gap between the ratio of aggregate private sector credit to gross domestic product from its long term trend as a common reference guide for the implementation of the countercyclical capital buffers for financial institutions.

1.3 Problem statement

1.3.1 Main problem

The main problem investigated in this study is to establish the behaviour of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend over the economic cycle in South Africa, following the recent proposals by the Basel Committee on Banking Supervision to use credit extension as a common reference guide to determine the level of the countercyclical capital buffers for financial institutions.

1.3.2 Sub problems

The first sub problem is to establish how the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend behaves during periods of expansions and contractions in the economic cycle or, in other words, when the economic cycle is positive and when it is negative.

The second sub problem is to establish how the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend behaves during periods of upturns and downturns in the economic cycle or, in other words, when the economic cycle is increasing and when it is decreasing.

1.4 Significance of the study

Since the start of the recent financial crisis, efforts to understand the causes and consequences of systemic financial risk have intensified. According to Hollo et al. (2012), the recent financial crises have uncovered substantial gaps in theoretical and empirical frameworks for analysing, monitoring and regulating systemic risk in the financial system. Thus, identifying and appreciating the causes and consequences of the recent global financial crisis is a high priority for researchers and policymakers. The appreciation and identification of the causes and consequences of financial crises will inform the design of policy frameworks for financial regulation that will help diagnose and mitigate the risk of future crises. Tan (2012) contends that one of the important gaps in a prudential approach to financial regulation policy analysis is in understanding the nature and the behaviour of credit over the economic cycle.

Akinboade and Makina (2009, 2010) and Fourie et al. (2011) have provided evidence of procyclical credit extension in South Africa. However, these studies analyse the behaviour of credit extension over the economic cycle, whereas the gap between the ratio of credit as a percentage of gross domestic product and its long term trend is a more appropriate variable proposed by the Basel Committee on Banking Supervision (2010b). Van Vuuren (2012) uses the deviation of the gap between the ratio of credit as a percentage of gross national product as proposed by the Basel Committee on Banking Supervision. However, this study is concerned with the weaknesses of the prescribed method to construct the gap between credit as a percentage of gross domestic product and its long term trend and hence it does not seek to uncover the behaviour of credit extension over the economic cycle. Moreover, the ratio of credit to gross domestic product used in this study is different from official data

such that its signals for the implementation of countercyclical capital buffers are inconsistent with those in the South African Reserve Bank's (2011) Financial Stability Report.

The contribution of this study to the existing literature on prudential regulation of the financial system in South Africa is to analyse the behaviour of the common reference guide for countercyclical capital buffers that is based on the gap between credit as a percentage of gross domestic product and its long term trend over the economic cycle paying special attention to the proposals of the Basel Committee on Banking Supervision (2010b, 2011a). The study provides evidence of whether or not the deviation of the ratio of credit to gross domestic product from its long term trend is indeed procyclical with reference to the economic cycle. This evidence provides important policy implications for the implementation of countercyclical capital buffers for financial institutions in South Africa. The deviation of the ratio of credit to gross domestic product from its long term trend has been identified by the Basel Committee on Banking Supervision as one of the key indicators of systemic distress in the financial system. Consequently, the study provides evidence of whether or not this common reference guide for setting countercyclical capital buffers should be an important theme in the rapidly growing literature on prudential regulation of the financial system in South Africa.

1.5 Delimitations of the study

Credit extension can be broken down by the sources of credit and by the uses of credit. Since this study follows the prescriptions set out by the Basel Committee on Banking Supervision (2010b, 2011a), it only considers aggregate credit extension. However, studying disaggregated credit extension by type of lenders and by type of borrowers is more desirable because it provides a more comprehensive analysis of credit extension. Thus, future research should study the behaviour of credit extension at the disaggregated level over the economic cycle.

1.6 Definition of terms

Credit Procyclicality is the magnification and contraction of fluctuations in the economic cycle on account of endogenous booms and bursts in credit extension, among other factors. According to Athanasoglou and Daniilidis (2011), the endogenous booms and bursts in credit extension result in high credit extension during the booming phase of the economic cycle. In contrast, economic cycle downturns are characterised by strong risk aversion where financial institutions constrain credit extension because they are concerned about the quality of the loans and the heightened probability of default.

Macroprudential policy is a regulatory and monitoring framework aimed to mitigate systemic risk in the financial system as a whole to reduce the spillover effects of financial instability to the economy. According to Clement (2010), macroprudential analysis identifies and addresses the sources of contagion and spillover risks that threaten the normal functioning of the financial system as a whole. These risks comprise exposures, risk concentrations, as well as the linkages and interdependencies between financial institutions.

Countercyclical capital buffers are guidelines to determine the prudent amount of risk weighted assets that financial institutions are required to hold in periods of heightened financial distress applied at the aggregate level of the financial system. They are an important element of the Basel III macroprudential policy framework and one of the key proposals by the Basel Committee on Banking Supervision (2010a, b, 2011a). The countercyclical capital buffers aim is to accomplish the broader macroprudential goal of protecting the economy in periods of excessive aggregate credit growth that is associated with the build-up of systemic risk in the financial system.

1.7 Assumptions

The main assumption is that the study adequately addresses the potential procyclicality of the credit extension in South Africa, given that the country has not experienced a fully-fledged financial crisis originating from excessive credit

extension similar to the crises that have occurred in other countries in recent history.

2. CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The literature review commences by discussing countercyclical financial regulation. This is followed by the discussion of the literature on credit procyclicality and financial crises and credit extension and countercyclical financial regulation. Last is the conclusion and hypotheses.

2.2. Countercyclical financial regulation

The emerging consensus since the recent financial crisis is that a failure to establish appropriate regulatory and monitoring frameworks is one of the major contributing factors to credit bubbles and financial crises. Thus understanding the relationship between credit extension and economic activity necessitates understanding regulation of the financial system to limit economic losses due to financial crises.

The consequence of uncontrolled, rapid liberalisation and deregulation of the financial sector was imprudent and relaxed lending standards, according to Guo and Stepanyan (2011). Consequently, comprehensive financial system regulation and supervision measures have been proposed by the Bank for International Settlements, through the Basel Committee on Banking Supervision, with the objective of averting future financial crises. Important among these proposals are the macroprudential and microprudential policy frameworks. Macroprudential policy is a financial system-wide policy framework, while microprudential policy framework is aimed at individual financial institutions. The macroprodential policy framework seeks to strengthen the financial institutions' capital requirements by enhancing their quality and quantity of capital, to supplement their liquidity and leverage ratios, to curtail excessive credit extension, to improve and widen risk coverage and to enhance the financial system stress testing approaches.

The Basel Committee on Banking Supervision (2010b) has proposed various tools to address procyclicality of the financial system. Basel III is the latest instalment of the three accords by the Basel Committee on Banking Supervision to be introduced from 2013 until 2018. According to the Basel Committee on Banking Supervision (2011b), Basel III is the international framework for liquidity risk measurement, standards and monitoring to strengthen the capital and liquidity rules of financial institutions to promote a resilient financial sector. The countercyclical capital buffers for financial institutions are among the key tools to address procyclicality in the financial system and they are to be fully implemented by 2015. The International Monetary Fund (2011) and the European Banking Federation (2011) argue that the objective of the countercyclical capital buffers is to limit disruptions in the provision of financial services and to avoid adverse consequences for the economy by ensuring that financial institutions are able to extend credit during periods of heightened financial distress, whilst limiting excessive credit extension during the economic booms.

The countercyclical capital buffers are macroprudential tools whose primary objective is to achieve the broader macroprudential goal of protecting the financial institutions during periods of excessive growth in aggregate credit relative to its long term trend. This is because excessive growth in aggregate credit is associated with system wide financial risk. As such, the aim is to ensure that the aggregate financial system has adequate capital to continue credit extension with no solvency and distress challenges, averting adverse consequences on the performance of the economy. The countercyclical capital buffers are expressed as a ratio of financial institutions' risk weighted assets, where different classes of financial institution's assets have different risk weights associated with them. For instance, Basel III standardized risk weights for credit risk assigns a risk weight of 0 percent to cash and guaranteed deposits, 100 percent for unsecured residential mortgage exposures, while high volatility commercial real estate loans are assigned a risk weight of 150 percent of financial institutions assets. Basel III standardized risk weights for credit risk are detailed in the Basel Committee on Banking Supervision (2011a).

The countercyclical capital buffers include Tier I and Tier II capital with proposed limits and minimum amounts that financial institutions should hold at any particular point in time. Tier I capital constitutes common shares and retained earnings, while Tier II capital includes gone concern capital, which is contingent capital that acts as a buffer for depositors when financial institutions experience bankruptcy or liquidation. The Basel Committee on Banking Supervision (2010b) has outlined the general guidelines on the use of countercyclical capital buffers. The countercyclical capital buffers are to be set within the range of 0 and 2.5 percent in addition to the mandatory capital conservation buffers of 2.5 percent. The proposal is to use the deviation of credit as a percentage of gross domestic product from its long term trend as a guide for setting the counter cyclical buffers. The long term trend of credit as a percentage of gross domestic product is to be extracted using the Hodrick Prescott (1997) filter with the recommended smoothing parameter of 400 000.

The countercyclical capital buffers are to be implemented incrementally when the gap between credit as a percentage of gross domestic product and its long term trend is between 2.5 percent and 10 percent. This implies that the countercyclical buffer of 0 percent will apply when the gap between credit as a percentage of gross domestic product from its long term trend is less than 2.5 percent, whereas the countercyclical buffer of more than 0 to 2.5 percent applies when the gap between credit as a percentage of gross domestic product from its long term trend is between 2.5 and 10.0 percent. The operation of the countercyclical capital buffers is to be left to the judgement and discretion of relevant national authorities depending on whether they see systemic financial risks increasing or decreasing because of the differences in institutional arrangements across the world. The relevant authorities will be required to monitor credit growth and make an assessment regarding whether credit growth is excessive. They are also expected to use judgement and discretion to remove the countercyclical capital buffers requirement timeously when they deem systemic risk to financial institutions to be low.

2.3. Credit procyclicality and financial crises

The recent global financial crisis has focused much attention on credit procyclicality and its consequences for economic stability. As such, there has been an explosion of empirical work to understand the sources and consequences of financial crises and the remedial measures to avert future crises and the associated costs to the economy.

2.3.1 Credit extension and economic cycles

Credit extension is said to be procyclical when the upturns in the economic cycle are characterised by strong credit extension, whereas the downturns in the economic cycle are characterised by restrained credit extension. According to Athanasoglou and Daniilidis (2011), procyclicality represents the under and overestimation of the exposure of the financial sector to risks resulting in high credit extension during the booming phase of the business cycle, while credit extension decreases during the downward phase of the economic cycle.

Empirical evidence on credit procyclicality is mixed, with the majority of studies finding evidence of credit procyclicality across a number of developed and emerging economies and across different financial crises. Jeong (2009) examines whether the extent of procyclicality of bank lending in Korea changed after the 1998 Asian financial crisis and finds that bank lending increased substantially after that financial crisis. Angelini and Penetta (2009) analyse the main forces affecting financial system procyclicality by reviewing the major structural developments in financial markets that may influence procyclicality and that have been overlooked in earlier analyses in developed economies and conclude that excessive credit extension is among the key factors affecting financial system procyclicality. In South Africa, Fourie et al. (2011) investigate the relationship between the business cycle and credit and find a positive relationship, while Akinboade and Makina (2009,2010) provide evidence that bank lending has moved together with the business cycle.

Cross country empirical evidence on credit procyclicality includes Jorda et al (2010), Huidrom et al. (2010) and Bouvatiery et al. (2011), among others. Jorda

et al (2010) study the role of credit in the business cycle for 14 advanced countries and find that financial crises are costly compared to other crises in terms of lost output. They also find that credit led economic expansions are followed by deeper recessions and slower recoveries. The findings by Huidrom et al. (2010) suggest that credit market shocks are important in driving global economic activity during the latest global economic recession after estimating the common components in various macroeconomic and financial variables of the G7 countries. Bouvatiery et al. (2011) investigate credit procyclicality using a nonlinear framework for a sample of 17 OECD countries. They provide evidence of nonlinear credit procyclicality depending on economic conditions as well as evidence that financial factors are important in explaining the short run behaviour of bank credit. Xu (2012) examines the role of bank credit in 33 advanced and emerging market economies, and finds evidence that credit improves modelling and forecasting of output growth, while Guo and Stepanyan (2011) find that increasing credit extension is detrimental to economic growth in emerging market economies. On the contrary, Bebczuk et al (2011) fail to find evidence of credit procyclicality using correlation and Granger causality tests on a sample of 144 countries, while Bertay et al. (2012) find that lending by state banks is less procyclical than lending by private banks and that it is actually countercyclical in high income countries.

2.3.2 Credit extension and financial crises

Financial crises manifest in panic runs on financial institutions, contagion due to counterparty risks, uncertainty and information asymmetry as well as systemic failure of financial institutions due to exposure to common shocks. According to Davis (2009), although the episodes of financial instability are diverse in definite details, the broad generic types can be distinguished as credit risk, market risk and liquidity risk. Credit risk is associated with the failure of financial institutions due to loans and trading losses as a result of default on debt by borrowers, which may result in lost principal and interest, disruption to cash flows, and increased collection costs. Market risk is the systemic risk due to financial loss as a result of movements in market prices such as interest rates, foreign exchanges rates, commodity prices and equity prices, etc. Liquidity risk is the

risk that arises from the incapacity to honour obligations without incurring unacceptable losses due to unavailability of funds at appropriate times and the lack of timely marketability of assets holdings.

Empirical evidence supporting the view that credit extension increases during the booming economic periods, followed by financial crises can be found in Taylor (2012). This study takes an historical perspective on macroeconomic and financial history to provide answers to the causes of financial crises. It concludes that credit booms stand out as the most plausible predictors of financial crises since the beginning of modern finance capitalism in the late nineteenth century. Other empirical studies that link credit extension with financial crises include Goodhart and Hofmann (2008), who assess the linkages between money, credit, house prices and economic activity in industrialised countries and find that the effect of the shocks to money and credit are stronger when house prices are booming. Schularick and Taylor (2009) study the behaviour of money, credit, and macroeconomic indicators for 14 countries and demonstrate that credit growth is an important predictor of financial crises. Jorda et al. (2011) study the macroeconomic dynamics before financial crises and show that credit growth tends to be elevated and natural rate of interest is low in the build up to global financial crises.

2.4. Credit extension and financial regulation

Given the central role played by the financial sector in the economy, the disruptions in the financial system have necessitated various regulatory measures to mitigate procyclicality of the financial system. The emerging consensus since the recent financial crisis is that a failure to establish appropriate regulatory and monitoring frameworks is the main cause of credit bubbles and financial crises.

2.4.1 Countercyclical capital buffers

As discussed above, the primary objective of countercyclical capital buffers is to achieve the broader macroprudential goal of curtailing excessive credit

extension by financial institutions during periods of booming economic conditions. Ren (2011) reviews prudential measures that can be adopted to deal with procyclicality and discusses issues in designing and implementing such measures. He suggests that, because of the limited practical experience with countercyclical prudential measures, developing countries, in particular, should experiment with different instruments while carefully monitoring and evaluating their effectiveness over time before it becomes mandatory to implement them. Borio et al. (2010, 2011) assess the performance of different variables as anchors for setting the level of the countercyclical capital buffers using a use signal extraction method. They find that the gap between the ratio of credit to gross domestic product and its long term trend performs best, given that it captures the build-up of systemic vulnerabilities that consequently lead to financial crises. Andersen et al. (2013) review the performance of the ratio credit to gross domestic product gap as a reference guide in setting the countercyclical capital buffers and find that it works well in providing an advance signal of episodes of banking system distress in the United Kingdom.

On the contrary, Repullo and Saurina (2011) note that Basel III does not address credit procyclicality because the key macroeconomic variable on which it is based, the deviation of the ratio of credit to gross domestic product from its trend, is negatively correlated with economic growth in many developed countries, a finding that is consistent with Giannone et al. (2012). They argue that the reason for this is because credit growth lags the business cycle, particularly during economic downturns. They conclude that mechanically applying the countercyclical capital buffers based on the deviation of the ratio of credit to gross domestic product from its long term trend would reduce capital requirements during economic expansions and increase them during the periods of economic contraction, exacerbating procyclicality of bank capital regulation. Nigam (2013) evaluates the effectiveness of the countercyclical capital buffers and the ratio of credit to gross domestic product and finds that, although widely used in developed economies, this macroprudential tool does not perform well as a measure of systemic credit risk in Uganda.

While the majority of empirical studies investigate the performance of credit extension as a reference guide for the implementation of countercyclical capital buffers, some studies assess the procyclicality of the countercyclical capital buffers themselves. Gersl and Jakubik (2010) argue that the countercyclical capital buffers can be procyclical in that credit extension can lead to feedback effects where financial institutions increase their lending during the economic upturns and reduce it during economic downturns to maintain the required capital adequacy ratio further adversely affecting the economic cycle. They simulate this for the Czech banking sector and find that the procyclical feedback effect of the countercyclical capital buffers becomes important under certain assumptions, including when the volume of risk weighted assets of most banks are a function of the probability of default as well as when banks use the probability of default estimates responding directly to the phase of the economic cycle when calculating the capital requirements.

2.4.2 Credit extension measurement

The use of the Hodrick Prescott filter proposed by the Basel Committee on Banking Supervision is also questioned by some studies. Gersl and Seidler (2012) examine whether private sector credit is excessive in the context of the countercyclical capital buffers in selected Central and Eastern European countries. They find that private sector credit constructed using the proposed Hodrick Prescott filter is not necessarily a suitable indicator of excessive credit growth in Central and Eastern European countries. Edge and Meisenzahl (2011) investigate the suitability of the gap between the ratio of credit to gross domestic product and its long term trend in real time for accumulating countercyclical capital buffers in the United States and also come to the same conclusion, by examining the magnitudes of the revisions between real time and final estimates of credit to GDP ratio gap and how quickly revisions tend to be realised using different detrending methods, including the Hodrick Prescott filter and band pass filters. They find that the ex post revisions to credit to gross domestic product ratio gap are substantial and as large as the gap itself in some instances. Real time estimates of economic variables differ from the final estimates because they are subject to revisions when new data becomes

available. They explain that that the main source of these revisions are the unreliability of end of sample estimates associated with the Hodrick Prescott filter rather than from revised estimates of the underlying data. Kelly et al. (2013) study the steady state relationship between private sector credit and economic growth in Ireland using an alternative method to the Hodrick Prescott filter that is based on a Markov switching framework. They also examine a counterfactual scenario where credit is restricted to growth consistent with the level of deposits arguing that credit is historically closely linked with the level of deposits even though this link has broken in recent years. They find that restricting credit expansion to grow with deposits could have yielded significantly greater benefits relative to the countercyclical capital buffers proposed by the Basel Committee on Banking Supervision.

In South Africa, the South African Reserve Bank (2011) examines the countercyclical capital buffers and their possible application in South Africa using the gap between the ratio of credit to gross domestic product and its long term trend as proposed by the Basel Committee on Banking Supervision and concludes that this common reference guide for excessive credit extension has promise of being a useful tool as a guide for the implementation of the countercyclical capital buffers in South Africa. It argues that the expansionary phases of credit extension correspond with the business cycle upturns but do not peak with them, as inferred from the plot of the two variables. However, it warns that this guide should be used with caution, and not mechanically or uniformly, consistent with the same suggestion by Giannone et al. (2012) and Repello and Saurina (2011). It also warns that being a ratio, the gap between the ratio of credit to gross domestic product and its long term trend is affected by the gross domestic product denominator behaviour and not only by developments in credit extension, which has important implications for the implementation of the countercyclical capital buffers. In South Africa, Van Vuuren (2012) suggests that the Hodrick Prescott filter calculation proposed by the Basel Committee on Banking Supervision makes credit to gross domestic product an unsuitable indicator for the countercyclical capital buffers consistent with Edge and Meisenzahl (2011) and Gersl and Seidler (2012).

2.5 Conclusion of the Literature Review

The empirical literature to understand the sources and consequences of financial crises and the remedial measures to avert future crises has increased significantly since the recent financial crisis. Empirical evidence on credit procyclicality is mixed, with the majority of studies finding evidence of procyclicality across a number of developed and emerging economies as well as across different financial crises. In line with this evidence, the South African literature generally lends support to procyclical credit extension. However, some studies find that the gap between credit to gross domestic product and its long term trend may not be a suitable indicator for setting the level of the countercyclical capital buffers. The Hodrick Prescott filter calculation proposed by the Basel Committee on Banking Supervision is also questioned by some studies in that it may not necessarily be appropriate given its end point problem and its sensitivity to the ex post revisions of many macroeconomic time series. The following hypotheses are proposed based on the majority of the findings and conclusions in the literature.

2.5.1 Hypothesis 1:

The gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend increases during periods of expansions in the economic cycle or during periods when the deviation of economic cycle from its long term trend is positive, while the opposite is true during periods of contractions in the economic cycle or during periods when the deviation of economic cycle from its long term trend is negative.

2.5.2 Hypothesis 2:

The gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend increases during upturns in the economic cycle or during periods when the deviation of economic cycle from its long term trend is increasing, while the opposite is true during downturns in the economic cycle

or during periods when the deviation of economic cycle from its long term trend is decreasing.

3. CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses research methodology. It commences by discussing the research paradigm, the methodological approach and the description of the data. This is followed by a discussion on data analysis and interpretation as well as the limitations of the study. Finally, validity and reliability are discussed.

3.2 Research paradigm

The stylised observed behaviour of many macroeconomic variables is that they exhibit asymmetric features over time. Hamilton (2005) provides evidence of dramatic breaks in the behavior of macroeconomic indicators during financial crises, while Sims and Zha (2004) and Davig (2004) provide evidence of abrupt changes in the behavior of macroeconomic indicators due to shifts in government policy. According to van Dijk et al. (2002), Hamilton (2008) and Borio et al. (2011), the fluctuations in macroeconomic variables tend be different during the periods of booms and bursts, where expansions and upturns in these variables are gradual and protracted, while contractions and downturns abrupt and dramatic. This study uses a regime switching modeling framework to estimate the relationship between the deviation of the ratio of credit to gross domestic product from its long term trend over the economic cycle in South Africa.

To capture these stylised observed behaviour of many macroeconomic variables, the models with regime switching features where a regime switch happens when the regime switching variable crosses a certain threshold, were proposed by Terasvirta (1994), who outlined the steps involved in specifying and estimating them. Terasvirta (1998) and van Dijk et al. (2002, 2003) also provide a survey of the recent developments related to these models. Van Dijk et al. (2002) argue that the interest in nonlinear time series models has increased steadily over the past decades. This is particularly the case in

applications to economic time series where models that allow for state dependent or regime switching behaviour are most popular. In the literature, Bouvatiery et al. (2011) provide evidence that credit procyclicality is nonlinear, depending on economic conditions by estimating a smooth transition regression models for a sample of 17 OECD countries. Thus regime switching models of various forms are suitable to exploit these observed asymmetric dynamics in macroeconomic indicators.

3.3 Methodological approach

The methodological approach comprises specification of the Logistic Smooth Transition Autoregressive model to capture the stylised asymmetric features in the proposed macroeconomic variables over time. This is because the Logistic Smooth Transition Autoregressive model captures the fluctuations in macroeconomic variables that tend to be different during the periods of economic booms and bursts.

3.3.1 Logistic Smooth Transition Autoregressive model

The variants of the Logistic Smooth Transition Autoregressive model are specified to study the behaviour of credit as a percentage of gross domestic product over the economic cycle. Assuming two regimes, the Logistic Smooth Transition Autoregressive model is specified as follows

$$Y_t = \begin{cases} \beta_L + \beta_{L1} Y_{t-d} + \ldots + \beta_{Lm} Y_{t-(m-1)d} \left(1 - G\left(Z_t, \gamma, \theta\right)\right) + \varepsilon_t, & Z_t \le \theta \\ \beta_H + \beta_{H1} Y_{t-d} + \ldots + \beta_{Hm} Y_{t-(m-1)d} \left(G\left(Z_t, \gamma, \theta\right)\right) + \varepsilon_t, & \theta < Z_t \end{cases} \quad (1)$$

where

$$G = P(Z_t, \gamma, \theta) = \left(1 + \exp - \gamma\left(Z_t - \theta\right)\right)^{-1} \quad (2)$$

and

$$Z_t = \phi_1 X_t + \phi_2 X_{t-1} + ... + \phi_m X_{t-(m-1)d} \quad (3)$$

Y_t is the regime switching variable, X_t is a transition variable, while G is the monotonic transition function that is bounded between 0 and 1, specified as a logistic function with a threshold variable. Z_t is the smoothing parameter, $\gamma \leq 1$, determines the speed and smoothness of transition between regimes, and θ measures the threshold location. The model parameters are β, while the threshold parameters are ϕ. m is the embedding dimension, d is the time delay, while L and H are the 'low' and 'high' regimes, respectively.

The Logistic Smooth Transition Autoregressive model can take different forms, depending on how the logistic function $G(Z_t, \gamma, \theta)$ is specified, resulting in different types of regime switching behaviours. In the event that the transition variable is in levels $Z_t = X_{t-d}$, the model distinguishes between periods of positive and negative values of the transition variable hence the model behaves differently during expansions and contractions in the transition variable. Enders and Granger (1998) also suggest that the model can distinguish between periods of upturns and downturns in the transition variable when the transition variable is first differences $Z_t = \Delta X_{t-d}$ hence the model behaves differently when the transition variable is increasing and when it is decreasing. For a more detailed discussion on specification and the various forms of Threshold Autoregressive models, see Terasvirta (1994,1998), van Dijk et al. (2002, 2003).

3.3.1 Hodrick Prescott filter

According to Hodrick and Prescott (1997), growth theory in macroeconomics hypothesises that the trend component of economic time series varies smoothly over time and that the cyclical variations in economic time series arise because of anticipated and unanticipated shocks. However, Ley (2006) argues that the trend and cyclical components are not observable hence any method used to

decompose an economic time series into these components must begin by defining the trend and, by implication, the cycle. Several methods are used to decompose the economic time series into the trend and cyclical components. These include the Kalman filter, the Hodrick Prescott (1997) filter and the Baxter and King (1999) filter, among others. Step 2 in the guide for operating the countercyclical capital buffers by the Basel Committee on Banking Supervision (2010b, 2011a) proposes the use of the Hodrick Prescott (1997) filter to extract the long term trend of the ratio of credit to gross domestic product. In particular, the Basel Committee on Banking Supervision proposes the use of a one sided Hodrick Prescott filter with a high smoothing parameter of 400 000 to control the smoothness of the adjusted trend series.

The Hodrick Prescott filter can be one sided or two sided. The difference between a one sided and a two sided Hodrick Prescott filters emanates from treatment of the first and the last data points in a time series. According to Kaiser and Maravall (1999), a two sided Hodrick Prescott filter starts with the first data point in a time series and ends with a lag at the end of the data series, while the opposite is true for a one sided Hodrick Prescott filter. The reason for the lag at the end of the data series is because the two sided Hodrick Prescott filter depends on future values of the underlying data series in constructing the current value of the trend series. Given that the two sided Hodrick Prescott filter ends with a lag at the end of the data series, this induces the so called end point problem, where, according Gerlach Kristen (2011), the economic time series smoothed by the Hodrick Prescott filter tend to approach the underlying data series at the beginning and at the end of the estimation period. The Basel Committee on Banking Supervision (2010b, 2011a) proposes the use of a one sided Hodrick Prescott filter to circumvent the end point problem. Ley (2006) argues that the smoothing parameter is set, based on the frequency of the underlying data series in practice. The rule of thumb is to use the smoothing parameter of 100 for annual data, 1 600 for quarterly data and 14 400 for monthly data. The trend component approximates the actual series when the smoothing parameter approaches zero, while it becomes linear when the smoothing parameter approaches infinity. The Hodrick Prescott filter has weaknesses and these are discussed in the limitations of the study.

3.4 Data description

Monthly data spanning the period January 2000 to December 2012 is used. This data is sourced from the South African Reserve Bank database. The gap between the ratio credit to gross domestic product and its long term trend is constructed based on the detailed step by step guidelines proposed by the Basel Committee on Banking Supervision (2010b). Step 1 involves calculating the aggregate private sector credit as a percentage of gross domestic product, while step 2 involves calculating the deviation of credit as a percentage of gross domestic product from its one sided Hodrick Prescott trend using a smoothing parameter of 400 000. The choice of the gap between credit as a percentage of gross domestic product and its long term trend as a common reference guide for setting the countercyclical capital buffers is motivated by the proposals of the Basel Committee on Banking Supervision (2010b, 2011a). This common reference guide for countercyclical capital buffers attempts to ensure that financial institutions have adequate capital to maintain a steady flow of credit in the economy in periods of financial distress and to prevent future financial crises given that excessive credit extension has been identified as one of the main causes of the financial distress.

In a similar manner, the economic cycle is measured as the difference between the coincident business cycle indicator and its Hodrick and Prescott trend using the normal smoothing parameter of 14 400 for monthly data. The business cycle indicators are economic measures that track the economic activity such that they rise during the expansionary phase of the economic cycle and fall during the contractionary phase such that they coincide with the peaks and troughs in the economic cycle. The South African Reserve Bank constructs the coincident business cycle indicator at monthly frequency by combining various indicators of economic activity, including the aggregate indicators of production, sales, income and employment, into a single indicator of the turning points in the economic cycle in South Africa. The choice of this variable is motivated by the observation of the Basel Committee on Banking supervision (2010a, b, 2011a) that the upturns in the economic cycle are characterised by strong credit extension whereas the downturns in the economic cycle are characterised by

restrained credit extension. The empirical literature also provides stylised evidence that credit extension is procyclical. This literature includes Jeong (2009), Angelini and Penetta (2009), Jorda et al. (2010) and Guo and Stepanyan (2011), among others.

3.5 Data analysis and interpretation

The data is analysed by estimating the Logistic Smooth Transition Autoregressive models with various forms of nonlinearity. The estimation is implemented in the R package, tsDyn, by Aznarte et al. (2013). This package estimates the nonlinear time series models with regime switching. The Logistic Smooth Transition Autoregressive model is specified as follows

$$CRT_Gap_t = \left(\beta_L + \beta_{L1} CRT_Gap_{t-d} + ... + \beta_{Lm} CRT_Gap_{t-(m-1)d}\right)\left(1 - G\left(Z_t, \gamma, \theta\right)\right) + \left(\beta_H + \beta_{H0} CRT_Gap_{t-d} + ... + \beta_{Hm} CRT_Gap_{t-(m-1)d}\right)\left(G\left(Z_t, \gamma, \theta\right)\right) + \varepsilon_{t+s} \quad (4)$$

where CRT_Gap_t is the deviation of the ratio of credit to gross domestic product from its long term trend. The following transition functions are: the first transition function is specified as $G = \left(1 + \exp - \gamma\left(ECN_CY_t - \theta\right)\right)^{-1}$ where the transition variable is the economic cycle or the gap between the coincident business cycle indicator and its long term trend, ECN_CY_t; the second transition function is specified as $G = \left(1 + \exp - \gamma\left(\Delta ECN_CY_t - \theta\right)\right)^{-1}$ where the transition variable is the change in the gap between coincident business cycle indicator and its long term trend or the change in the economic cycle, ΔECN_CY_t. As discussed above, the first transition function distinguishes between periods of booms and bursts in the transition variable. The transition variable in this instance is the levels of the gap between the coincident business cycle indicator and its long term trend or the change in economic cycle, while the second transition function distinguishes between periods of upturns and downturns in the transition variable. The transition variable in this instance is the first difference of the gap

between the coincident business cycle indicator and its long term trend or the change in economic cycle.

Given the specified Logistic Smooth Transition Autoregressive models with various forms of nonlinearity, the following hypotheses will be tested where the null hypothesis is that the $\beta_i = 0$ against the alternative hypothesis that $\beta_i \neq 0$ as well as the null hypothesis that $\theta = 0$ against the alternative hypothesis that $\theta \neq 0$. The first hypothesis relates to the coefficients of the model that measure the statistical significance of the gap between credit to GDP ratio and its long term trend when the economic cycle is in boom and a burst as well as when the economic cycle is in an upturn and a downturn. The later hypotheses relate to the statistical significance of the threshold locations, which define the values of the transition variable, in both the levels, ECN_CY_t, and the changes, ΔECN_CY_t, in the economic cycle.

3.6 Limitations of the study

The limitations of this study comprise the estimation of credit to gross domestic product gap using the Hodrick Prescott filter, the endogenous determination of model thresholds and the absence of fully fledged financial crises in South Africa in the recent past.

The Hodrick Prescott filter is a model free, atheoretic statistical approach to decompose a time series into its trend and cyclical components. As such, it is not grounded in economic theory. The lack of economic theoretical grounding is also a common problem with other popular filters, such as the Kalman filter, and the band pass filters, such as the Baxter King filter. As such, there is lack of guidance on the size of the smoothing parameter for different types of macroeconomic data as well as different frequencies of such data. There is also the end point problem when using the Hodrick Prescott filter such that the trend of the time series tends to approach the mean of the data towards the end of the sample. The Hodrick Prescott filter calculation proposed by the Basel Committee on Banking Supervision is also questioned by some studies, such as Gersl and Seidler (2012) and Edge and Meisenzahl (2011), on the grounds that

it is not necessarily a suitable indicator of excessive credit growth and its sensitivity to the ex post revisions of many macroeconomic time series and the availability of new data points.

The other less serious limitation relates to the specification of thresholds when estimating the variants of the Logistic Smooth Transition Autoregressive models to study the dynamic behaviour of credit as a percentage of GDP over the economic cycle. Economic booms are associated with positive values of the economic gap variable, while economic bursts are associated with negative values of the economic gap variable. Since the location of the thresholds in transition variables are determined endogenously by the model and are not user defined, the model may find thresholds at levels of the transition variable that are not necessarily associated with either economic booms or bursts. There has also not been an occurrence of a fully-fledged financial crisis in South Africa, hence this may put a need to study financial crises that may never materialise into question. However, the cross country shocks and spillovers from the countries that were affected during the recent financial crisis have been significant enough to warrant South Africa to be concerned and to be prepared if such crises were to occur domestically.

3.7 Validity and reliability

The concerns about the validity and reliability relate to estimation of the gap between the ratio of credit to gross domestic product and its long term trend using the Hodrick Prescott filter, the location of the thresholds in transition variables that are not user defined but determined endogenously by the model as well as the data used in this study. The estimation of the gap between the ratio of credit to gross domestic product and its long term trend using the Hodrick Prescott filter has received criticism. Edge and Meisenzahl (2011) and Gersl and Seidler (2012), among others, have found that it may not necessarily be an appropriate indicator to determine the level of the countercyclical capital buffers. This is because of the end point problem and the sensitivity to the ex post revisions of many macroeconomic time series when using the Hodrick Prescott filter. This is pertinent, given that the countercyclical capital buffer

decisions may be based on ex ante estimates of the deviation credit from Hodrick Prescott trends which can be revised ex post. This can result in miscalculation of the underlying common reference guide and hence the countercyclical capital buffers themselves. The deployment of countercyclical capital buffers based on false signals can lead to capital shortfalls at financial institutions which can result in unintended costs to the economy.

However, among the filters that are commonly used to decompose most economic time series into its trend and cyclical components, the Hodrick Prescott filter is the most popularly used filter in empirical economic literature. To substantiate its popularity, the Basel Committee on Banking Supervision (2011b) has proposed its use despite its well-known weaknesses. Ravn and Uhlig (2002) also argue that the Hodrick Prescott filter will remain one of the standard methods for detrending economic time series, despite the availability of sophisticated band pass filters such as the Baxter King filter. To circumvent the problem of selecting the appropriate size of the smoothing parameter, rules of thumb are used, particularly at different data frequencies. It is also possible to circumvent the end point problem. The Basel Committee on Banking Supervision (2010b) proposes the use of a one sided Hodrick Prescott filter, while Mise et al. (2005) proposes forecasting additional data points at the end of the data series to correct the end point problem.

On the empirical model adopted in this study, the specified Logistic Smooth Transition Autoregressive model determines the location of the thresholds in transition variables endogenously. Such locations of the thresholds are not user defined hence the model may find thresholds at levels of the transition variable that are not necessarily associated with economic booms or bursts. However, it is possible to define the characteristics of the underlying variable based on the location of the threshold on ingenuity and by making reference to various well defined cyclical properties of macroeconomic indicators. For instance, economic time series tend to grow rapidly when the economy is overheating, while the opposite is true during periods of rapid economic decline. Given the threshold location, such periods can be defined as booms and recessions, respectively, such that the regime switch can occur between the periods of normal economic

growth as opposed to periods of either a boom or a recession. On validity and reliability of the variants of the Logistic Smooth Transition Autoregressive model, various econometric diagnostic tests are used to ensure the robustness of the estimated results, including the goodness of fit tests and nonlinearity tests.

On the data used in this study, the validity and reliability of the data is not of primary concern, given that the study uses data from a reputable source, the South African Reserve Bank. Institutions such as Statistics South Africa and the South African Reserve Bank disseminate official statistics, typical of national statistics offices and central banks around the world. As such, data collected by these institutions goes through rigorous validity and reliability testing to ensure that it is correct. The validity and reliability of data disseminated by these institutions is important given that this data is used in the formulation and implementation of important policy decisions.

4. CHAPTER 4: PRESENTATION OF RESULTS

4.1 Introduction

This chapter presents the empirical results. It commences with the discussion of the descriptive statistics and the measures of model adequacy. This is followed by the presentation of the parameter estimates pertaining to the hypotheses for the different specifications of the transition variable. Last is the summary of the results.

4.2 Descriptive statistics

The descriptive statistics of the main variables are presented in Table 1. The evolutions of the main variables are depicted in Figure 1. The gap between credit as a percentage of GDP, and its long term trend decreased from 2000 reaching an all-time low in early 2002. It then increased sharply and remained high to late 2003, where it subsequently fell until mid-2004. There is a sustained increase in gap between credit as a percentage of GDP and its long term trend from mid-2004 till early 2009, where it fell abruptly and remained range bound until 2012. The economic cycle declined from 2000 to late 2003. It then increased steadily, reaching a peak in early 2008. It subsequently fell abruptly to mid-2009 where it increased again to 2012.

4.3 Measures of model adequacy

The specified variants of the Logistic Smooth Transition Autoregressive model were estimated using the R package, tsDyn, by Aznarte et al. (2013), as stated above. The estimated results and the measures of model adequacy are presented in Table 2. The Logistic Smooth Transition Autoregressive model is specified in an autoregressive manner necessitating the determination of the number of lags for the the autoregressive model. Lags selection involved using the Akaike Information Criterion, the Bayesian Information Criterion and the Hannan Quin Information Criterion. They all pointed to the lag order of 2 in the

autoregressive model. However, the lag order of 1 was used in the estimation of the specified variants of the Logistic Smooth Transition Autoregressive model because the coefficients for the lag order of 2 were consistently statistically insignificant in estimation across all the models.

The following tests for model adequacy were implemented to assess the robustness of the estimated Logistic Smooth Transition Autoregressive models. These included the test for non-linearity test of full order Logistic Smooth Transition Autoregressive model against full order Autoregressive model, the Residual variance, the Akaike Information Criterion and the Mean Absolute Percentage Error, which is the forecasting accuracy measure. The Akaike Information Criterion and the Residual variance choose the model with the second transition function, which distinguishes between periods of upturns and downturns in the economic cycle, as the best model amongst the specified alternatives. The Mean Absolute Percentage Error points to the model with the first transition function, which distinguishes between periods of positive and negative growth in the economic cycle, as the model with the best forecasting performance.

Non-linearity in the full order Logistic Smooth Transition Autoregressive model is accepted for both models with the first and the second transition function compared to the respective full order Autoregressive model. Although not reported here, the Terasvirta's neural network test for non-linearity pointed to non-linearity in both the gap between credit to GDP ratio and its long term trend and the economic cycle measure. As discussed above, the specified Logistic Smooth Transition Autoregressive model determines the location of the thresholds in transition variables endogenously, such that such locations of the thresholds are not user defined. To determine the threshold location of the Logistic Smooth Transition Autoregressive model, a grid search is implemented. According to Aznarte (2008), the grid search involves estimating the model for a grid of different values of the threshold variable and taking the best fit as the threshold estimate.

4.4 Results pertaining to Hypothesis 1

The results pertaining to hypothesis 1, where the model is specified with the first transition function, are reported in the first panel in Table 2. Recall that the first transition function is specified as $G = \left(1 + \exp - \gamma \left(ECN_CY_t - \theta\right)\right)^{-1}$ where the transition variable is the economic cycle or the gap between the coincident business cycle indicator and its long term trend, ECN_CY_t. As discussed above, this first transition function distinguishes between periods of booms and bursts in the transition variable. The transition variable in this instance is the level of the gap between the coincident business cycle indicator and its long term trend or the change in economic cycle.

According to the results, the grid search finds a statistically significant threshold at 3.1 percent. Thus the deviation of credit to GDP ratio from its long term trend behaves differently when the economic cycle is greater than the threshold level of 3.1 percent compared to when it is below or equal to this threshold level. The deviation of credit to GDP ratio from its long term trend increases by a statistically significant 65.9 percent, relative to its recent past in the low regime, or when the economic cycle is below 3.1 percent. In the high regime, or when the economic cycle is above 3.1 percent, the deviation of credit to GDP ratio from its long term trend decreases by 11.0 percent relative to its recent past. However, this is statistically insignificant. The parameter that measures the speed and smoothness of transition between regimes in the threshold variable is 0.58 and is statistically significant. This implies a relatively smooth and slow speed of adjustment between the high and the low regimes. However, it is important to note that the statistical significance of this variable is often not a concern and is seldom reported. Thus, the parameter measuring the speed and smoothness of transition is often allowed to be dimension free as suggested by Terasvirta (1994), given that its size points to the various forms of the transition function.

4.5 Results pertaining to Hypothesis 2

The results pertaining to hypothesis 2, where the model is specified with the second transition function, are reported in the second panel in Table 2. Recall that the second transition function is specified as $G = \left(1 + \exp - \gamma \left(\Delta ECN_CY_t - \theta\right)\right)^{-1}$ where the transition variable is the change in the gap between coincident business cycle indicator and its long term trend or the change in the economic cycle. The second transition function distinguishes between periods of upturns and downturns in the transition variable. The transition variable in this instance is the first difference of the gap between the coincident business cycle indicator and its long term trend or the change in economic cycle.

According to the results, the grid search finds a statistically significant threshold at 0.1 percent. Thus the deviation of credit to GDP ratio from its long term trend behaves differently when the change in the economic cycle measure is greater than the threshold level of 0.1 percent compared to when it is below or equal to this threshold level. The deviation of credit to GDP ratio from its long term trend increases by a statistically significant 97.5 percent, relative to its recent past in the low regime, or when the change in economic cycle is below or equal to 0.1 percent. In the high regime, or when the change in economic cycle is above 0.1 percent, the deviation of credit to GDP ratio from its long term trend decreases by a statistically significant 20.8 percent relative to its recent past. The parameter that measures the speed and smoothness of transition between regimes in the threshold variable is 106.7 but statistically insignificant. This implies a relatively high and abrupt speed of adjustment between the high and the low regimes. However, as discussed above, the statistical significance of this variable is often not a concern and is seldom reported and hence it is often allowed to be dimension free, given that its size points to the various forms of the transition function.

4.6 Summary of the results

The deviation of credit to GDP ratio from its long term trend increases by a statistically significant 65.9 percent, relative to its recent past when the economic cycle is below or equal to 3.1 percent. However, the relationship is statistically insignificant above this threshold. The deviation of credit to GDP ratio from its long term trend increases by a statistically significant 97.5 percent, relative to its recent past when the change in economic cycle is below or equal to 0.1 percent. The deviation of credit to GDP ratio from its long term trend decreases by a statistically significant 20.8 percent relative to its recent past below this threshold.

5. CHAPTER 5: DISCUSSION OF THE RESULTS

5.1 Introduction

This chapter discusses the empirical results for the hypotheses that were tested in this study. The similarities with related literature are discussed next, followed by the discussion on the implications for the countercyclical capital buffers.

5.2 Descriptive statistics and model diagnostics

As discussed above, the following tests for model adequacy were implemented to assess the robustness of the estimated Logistic Smooth Transition Autoregressive models. These included the test for non-linearity test of full order Logistic Smooth Transition Autoregressive model against full order Autoregressive model, the Residual variance, the Akaike Information Criterion and the Mean Absolute Percentage Error, which is the forecasting accuracy measure. The Akaike Information Criterion and the Residual variance choose the model with the second transition function, which distinguishes between periods of upturns and downturns in the economic cycle, as the best model amongst the specified alternatives. The Mean Absolute Percentage Error points to the model with the first transition function, which distinguishes between periods of positive and negative growth in the economic cycle, as the model with the best forecasting performance. Non-linearity in the full order Logistic Smooth Transition Autoregressive model is accepted for both models with the first and the second transition function compared to the respective full order Autoregressive model.

5.3 Discussion pertaining to Hypothesis 1

The threshold location for the model where the transition variable is the level of the economic cycle is at 3.1 percent. The estimated model points out that the deviation of Credit to GDP ratio from its long term trend behaves differently when the economic cycle is below or equal to 3.1 percent and when it is above

this threshold level. The values of the economic cycle above this threshold location can be interpreted as booming economic conditions, while the values of the economic cycle below this threshold location can be interpreted as periods of normal economic conditions and periods of economic bursts. Based on this definition, the booming economic conditions were experienced between August 2006 and November 2008, as well as from May 2012 to the end of the sample period in South Africa, while the rest of the time is associated with both the periods of normal economic conditions and periods of economic bursts.

According to the first hypothesis, the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend was expected to increase during periods of expansions in the economic cycle, while the opposite is true during periods of contractions in the economic cycle. The empirical results reveal a statistically significant positive relationship of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend during the normal fluctuations in the economic cycle and also during the economic cycle busts. However, such a relationship cannot be established during the economic cycle booms. This implies that the relationship of gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend and the economic cycle is broken during the booming periods in the economic cycle. Thus the hypothesis that the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend was expected to increase during periods of expansions in the economic cycle, while the opposite is true during periods of contractions in the economic cycle is only satisfied in the event of the normal fluctuations in economic cycle and during the economic cycle bursts, while the hypothesis is not satisfied during the periods of booming economic conditions.

5.4 Discussion pertaining to Hypothesis 2

The threshold location for the model where the transition variable is the change in the economic cycle is at 0.1 percent. However, this threshold location is reasonably close to zero. As such, the conventional definition of the threshold location that is discussed in the methodology is maintained. According to the

conventional definition of the threshold location, the model distinguishes between periods of upturns and downturns in the transition variable. Equivalently, the model behaves differently when the transition variable is increasing and when it is decreasing. Based on this definition, the periods of upturns in the economic cycle were generally experienced between November 2003 and March 2008, as well as between August 2009, and the end of the sample period in South Africa. In the same manner, the periods of downturns in the economic cycle were generally experienced from the beginning of the sample period to November 2003 as well as between March 2008 and August 2009.

According to the hypothesis, the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend is expected to increase during upturns in the economic cycle, while the opposite is true during downturns in the economic cycle. The empirical results reveal a statistically significant positive relationship of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend relative to its recent past during the upturns in the economic cycle. The empirical results further reveal a statistically significant negative relationship of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend relative to its recent past during the downturns in the economic cycle. This implies that the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend increases during the periods when the economic cycle is increasing. The gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend also increases during the periods in which the economic cycle is decreasing so that the ratio of aggregate private sector credit keeps increasing even in the event of the downturn in the economic cycle so that it is countercyclical. Thus the hypothesis that the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend increases during periods of upturns in the economic cycle is satisfied, while the opposite is true during periods of downturns in the economic cycle.

5.5 Similarities with related literature

As discussed in the literature review, empirical evidence on credit procyclicality is mixed, with the majority of studies finding evidence of credit procyclicality across a number of developed and emerging economies and across different financial crises. In a similar study, Bouvatiery et al. (2011) investigate credit procyclicality using a nonlinear framework for a sample of 17 OECD countries. Their study provides evidence of nonlinear credit procyclicality depending on economic conditions, among others. More specifically, they find that credit extension is more procyclical in extreme booms and busts in the economic cycle in Canada, the United Kingdom and the United States. This finding is similar to the finding in this study as far as credit procyclicality in extreme bursts in the economic cycle, whereas the difference arises from the fact that this study finds strong procyclicality during the periods of normal fluctuations in the economic cycle while this relationship is broken during the periods of extreme booms in the economic cycle.

Bouvatiery et al. (2011) further find that credit procyclicality is less pronounced in one or both extreme regimes in Australia, Belgium, France, Finland, the Netherlands, Norway, and Spain where credit procyclicality is statistically insignificant during the boom phases of the economic cycle in Spain and Finland. This finding is similar to the finding in this study where the empirical results reveal a statistically insignificant relationship between the ratio of aggregate private sector credit to gross domestic product gap from its long term trend and the economic cycle in South Africa during the extreme booms in the economic cycle. As far as the second hypothesis is concerned, no study in the literature models the behaviour of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend over the economic cycle, using the similar model as the one that is used in this study. However, Bouvatiery et al. (2011) finds that credit extension becomes countercyclical in Norway during the extreme booms and bursts in the economic cycle. This is almost similar to the finding in this study where the ratio of aggregate private sector credit keeps increasing even in the event of the downturn in the economic cycle so that it is countercyclical.

The other studies that find credit procyclicality, albeit without distinguishing between the different phases of the economic cycle, include Jeong (2009) for Korea, Angelini and Penetta (2009) for the 6 major developed economies, Jorda et al (2010) for 14 advanced countries. Other similar studies include Huidrom et al. (2010) for G7 countries, Bouvatiery et al. (2011) for 17 OECD countries, Xu (2012) for 33 advanced and emerging market economies, Guo and Stepanyan (2011) for emerging market economies as well as Repullo and Saurina (2011) for developed economies. In South Africa, Fourie et al. (2011) and Akinboade and Makina (2009,2010) present evidence of credit procyclicality for South Africa. However, these studies do not use the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend as suggested by the Basel Committee on Banking Supervision (2010b). On the contrary, Bebczuk et al (2011) fail to find evidence of credit procyclicality in 144 countries, while Bertay et al. (2012) fail to do so in high income countries.

5.6 Implications for countercyclical capital buffers

The main problem of this study was to establish the behaviour of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend over the economic cycle in South Africa. This was motivated by the recent proposals by the Basel Committee on Banking Supervision to use credit extension as a common reference guide to determine the level of the countercyclical capital buffers for financial institutions. Based on the findings, the use of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend as a common reference guide to determine the level of the countercyclical capital buffers for financial institutions may be problematic in South Africa.

The reason the common reference guide that is proposed by the Basel committee on Banking Supervision (2010b) to determine the level of the countercyclical capital buffers for financial institutions may be problematic in South Africa is because the empirical results reveal that the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend is procyclical during the periods of the normal fluctuations in the

economic cycle and during the periods of economic cycle buts. However, this relationship of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend and the economic cycle is broken during the periods of economic cycle booms. The empirical results further reveal that the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend is procyclical during the periods of upturns in the economic cycle, whereas it becomes countercyclical during the periods of downturns in the economic cycle.

Given these observed dynamics in the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend, the conclusion that its use as a common reference guide to determine the level of the countercyclical capital buffers for financial institutions may not be appropriate in South Africa. This conclusion is supported by a number of studies in other countries, including Gersl and Jakubik (2010), Giannone et al. (2012), Repello and Saurina (2011), Meisenzahl (2011), Gersl and Seidler (2012) and Nigam (2013). However, this is in contrast to Borio et al. (2010, 2011) and Andersen et al. (2013) who conclude that the gap between the ratio of credit to gross domestic product and its long term trend performs best given that it captures the build-up of systemic vulnerabilities that consequently lead to financial crises.

In particular, Repello and Saurina (2011) argue that the fact that credit usually lags the business cycle, especially in downturns, compounds the problem. The empirical results provide evidence of this behaviour in the ratio of aggregate private sector credit to gross domestic product gap from its long term trend over the economic cycle in South Africa where credit extension grows during the periods of economic upturns, and also during the periods of economic downturns. The implication for this observed behaviour in the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend relative to the economic cycle is that mechanically applying the suggested reference guide for implementation of countercyclical buffers would tend to increase capital requirements during the economic downturns so that it

may end up exacerbating rather than improving the procyclicality of credit extension with dire consequences for the South African economy.

5.7 Conclusion

The empirical results reveal a statistically significant positive relationship of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend, relative to its recent past during the normal fluctuations in the economic cycle and also during the economic cycle busts, while such a relationship cannot be established during the periods of economic cycle booms. The empirical results further reveal a statistically significant positive relationship of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend relative to its recent past during the upturns in the economic cycle, while such relationship turns negative during the economic cycle downturns. As a result, the conclusion is that the use of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend as a common reference guide to determine the level of the countercyclical capital buffers for financial institutions may not be appropriate in South Africa. This is because the suggested reference guide for implementation of countercyclical buffers would tend to increase capital requirements during the economic downturns so that it may end up exacerbating rather than improving the procyclicality of credit extension with dire consequences for the South African economy.

6. CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter discusses the conclusions, the recommendations and suggests avenues for further research.

6.2 Conclusions of the study

The purpose of this study was to examine the behaviour of credit extension over the economic cycle in South Africa, to assess its usefulness as a reference guide for implementing the countercyclical capital buffers for financial institutions. The study was motivated by the suggestions by the Basel Committee on Banking Supervision at the Bank for International Settlements which has identified credit extension as one of major causes of financial crises and hence proposed the implementation of the countercyclical capital buffers for financial institutions using credit extension as a common reference guide to limit credit procyclicality and its associated systemic and economic risks.

The study finds that the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend is procyclical during the normal fluctuations in the economic cycle and also during the economic cycle busts, while such a relationship is broken during the economic cycle booms. It also finds that the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend is procyclical during the upturns in the economic cycle, while it becomes countercyclical during the periods of downturns in the economic cycle. Although only one study in the literature uses a similar method to study the behaviour of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend relative to the economic cycle, the findings in this study show similarities and are consistent with the other studies on procyclicality of credit extension during the normal, extreme bursts and upturns in the economic cycle, while the

opposite is true during the extreme booms and downturns in the economic cycle. The conclusion is that the use of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend as a common reference guide to determine the level of the countercyclical capital buffers for financial institutions, may not be appropriate in South Africa. This is because the suggested reference guide for implementation of countercyclical buffers would tend to increase capital requirements during the economic downturns so that it may end up exacerbating rather than improving the procyclicality of credit extension with dire consequences for the South African economy.

6.3 Recommendations

The recommendation based on the observed behaviour of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend over the business cycle is that South Africa should abandon the proposal to implement countercyclical capital buffers for financial institutions using credit extension as a common reference guide to limit credit procyclicality and its associated systemic and economic risks. Otherwise, similar to other studies, this reference guide for implementing the countercyclical capital buffers should be used with caution, and not mechanically or uniformly. Another suggestion is that South Africa should experiment with different instruments, while carefully monitoring and evaluating their effectiveness over time before it becomes mandatory to implement them because of the limited practical experience with countercyclical prudential measures as suggested by Ren (2011). Another worthwhile recommendation is to restrict credit extension to grow with deposits, as suggested by Kelly et al. (2013), after finding that it could have yielded significantly greater benefits relative to the countercyclical capital buffers proposed by the Basel Committee on Banking Supervision.

6.4 Suggestions for further research

Future research could study behaviour of disaggregated credit extension by the sources of credit and by the uses of credit. Understanding the cyclical behaviour

of other economic aggregates, over and above one proposed reference guide that is based on credit extension by the Basel Committee on Banking Supervision (2010b) is another avenue for future research.

REFERENCES

Akinboade O. A. & Makina, D. (2010). Econometric Analysis of Bank Lending and Business Cycles in South Africa, *Applied Economics*, 42(29), p. 3803-3811.

Akinboade O. A. & Makina, D. (2009). Bank Lending and Business Cycles: South African Evidence, *African Development Review*, 21(3), p. 476-498.

Andersen, H., Giese, J., Bush, O., Castro, C., Farag, M. & Kapadia, S. (2013). *The Credit-to-GDP Gap and Complementary Indicators for Macroprudential Policy: Evidence from the UK,* Conference on Financial Stability Analysis: Using the Tools, Finding the Data, Cleveland: Federal Reserve Bank of Cleveland.

Angelini, P. & Panetta, F. (2009). *Financial Sector Pro-Cyclicality Lessons from the Crisis*, Occasional Paper 44, Rome: Bank of Italy.

Athanasoglou, P. & Daniilidis, I. (2011). *Procyclicality in Banking Industry: Causes, Consequences and Response*, Working Paper 139, Athens: Bank of Greece.

Aznarte, A. L., Di Narzo, A. F. & Stigler, M. (2013). *tsDyn: Nonlinear Time Series Models with Regime Switching.* R package, Version 0.9-32.

Basel Committee on Banking Supervision. (2010a). *Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems*. Basel Committee on Banking supervision, Basel: Bank for International Settlements.

Basel Committee on Banking Supervision. (2010b). *Guidance for National Authorities Operating the Countercyclical Capital Buffer*. Basel Committee on Banking supervision, Basel: Bank for International Settlements.

Basel Committee on Banking Supervision. (2011a). *Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems*. Basel Committee on Banking supervision, Basel: Bank for International Settlements, Revised Version.

Basel Committee on Banking Supervision. (2011b). *The Transmission Channels Between the Financial and Real Sectors: A Critical Survey Of The Literature*. Basel Committee on Banking supervision, Basel: Bank for International Settlements, Revised Version.

Basel Committee on Banking Supervision. (2012). *The Policy Implications of Transmission Channels Between the Financial System and the Real Economy*. Basel Committee on Banking supervision, Basel: Bank for International Settlements, Revised Version.

Baxter, M. & King, R. (1999). Measuring Business Cycles: Approximate Band-Pass Filters For Economic Time Series. *Review of Economics and Statistics*, 81(4), p. 575-593.

Bertay, A., Demirguç-Kunt, A. & Huizinga, H. (2012). *Bank Ownership and Credit Over the Business Cycle: Is Lending by State Banks Less Procyclical*. Working Paper 6110, Washington DC: World Bank.

Borgy, V., Laurent, C. & Jean-Paul, R. (2009). *Asset-Price Boom-Bust Cycles and Credit: What is the Scope of Macro-Prudential Regulation?* Working Paper 263, Basel: Bank for International Settlements.

Borio, C., Drehmann, M., Gambacorta, L., Jiminez, G. & Trucharte, C. (2010). *Countercyclical Capital Buffers: Exploring Options*. Working Paper 317, Basel: Bank for International Settlements.

Borio, C., Drehmann, M. & Tsatsaronis, K. (2011). *Anchoring Countercyclical Capital Buffers: The Role of Credit Aggregates,* Working Paper 355*, Basel:* Bank for International Settlements.

Bouvatiery, V., Lopez-Villavicencioz, A. & Mignonx, V. (2011). Short-Run Dynamics in Bank Credit: Assessing Nonlinearities in Procyclicality, *Banking and Insurance e-Journal*.

Brei, M., Gambacorta, L. & Goetz, P. (2011). *Rescue Packages and Bank Lending.* Working Paper 357, Basel: Bank for International Settlements.

Clement, P. (2010). The Term Macroprudential: Origins and Evolution, *BIS Quarterly Review.* Basel: Bank for International Settlements.

Davig, T. (2004). Regime-Switching Debt and Taxation, *Journal of Monetary Economics*, 51(4), p. 837-859.

Davis (2009). *Theories of Financial Instability and their Practical Relevance,* Course on Financial Instability. Tallinn: Estonian Central Bank.

Edge, R. & Meisenzahl, R. (2011). *The Unreliability of Credit-to-GDP Ratio Gaps in Real-Time: Implications for Countercyclical Capital Buffers*, Working Paper 2011-37, Washington DC: Federal Reserve Board.

Enders, W. & Granger, C. W. J. (1998). Unit-Root Tests and Asymmetric Adjustment with an Example Using the Term Structure of Interest Rates, *Journal of Business and Economic Statistics*. 16(3), p. 304-311.

European Banking Federation. (2011). *Credit Cycles and Their Role in Macroprudential Policy*. Report to Economic and Monetary Affairs Committee, Brussels: European Banking Federation.

European Central Bank. (2012). Money and Credit Growth after Economic and Financial Crises: A Historical Global Perspective, *Monthly Bulletin*, Frankfurt: European Central Bank, p. 69-85.

Fourie, L., Botha, I. & Mears, R. (2011). Credit extension in South Africa: A business cycle perspective for the period 1985 to 2009, *African Journal of Business Management*, 5(34), p. 13074-13083.

Gerlach-Kristen, P. (2011). The Global Output Gap: Measurement Issues and Regional Disparities. *Quarterly Review*, Basel: Bank for International Settlements, p. 29-37.

Gersl, A. & Jakubik, P. (2010). Procyclicality of the Financial System and Simulation of the Feedback Effect*, Financial Stability Report*, Prague: Czech National Bank, p. 110-119.

Gersl, A. & Seidler, J. (2012). *Excessive Credit Growth as an Indicator Of Financial (In)Stability and its Use in Macroprudential Policy*. Working Paper 42541, Munich: Munich Personal RePEc Archive.

Giannone, D., M. Lenza, & L. Reichlin (2012). *Money, Credit, Monetary Policy and the Business Cycle in the Euro Area.* Discussion Paper 8944, London: Centre for Economic Policy Research.

Hamilton, J. D. (2005). What's Real About the Business Cycle? *Review*, 87(4), St. Louis: Federal Reserve Bank of St. Louis, p. 435-452

Hamilton, J. D. (2008). Regime-Switching Models, in Durlauf, S. and Blume, L. (eds.), *New Palgrave Dictionary of Economics*, 2nd ed. London: Palgrave McMillan.

Huidrom, R., Kose, A. & Otrok, C. (2010). *Do Credit Shocks Matter? A Global Perspective.* Working Paper 10/261, Washington DC: International Monetary Fund.

Jeong, H. (2009). *The Procyclicality of Bank Lending and its Funding Structure: The Case of Korea*. Bank of Korea International Conference on The Credit Crisis: Theoretical Perspectives and Policy Implications.

Goodhart, C. & Hofmann, B. (2008). House Prices, Money, Credit, and the Macroeconomy, *Oxford Review of Economic Policy*, 24(1), p. 180-205

Guo, K. & Stepanyan, V. (2011). *Determinants of Bank Credit in Emerging Market Economies.* Working Paper 11/51, Washington DC: International Monetary Fund.

Hodrick, R. & Prescott, E. C. (1997). Postwar U.S. Business Cycles: An Empirical Investigation, *Journal of Money*, Credit, and Banking, 29(1), p 1-16

Hollo, D., Kremer, M. & Lo Duca, M. (2012). *CISS: A Composite Indicator of Systemic Stress in the Financial System*. Working Paper 1426, Frankfurt: European Central Bank.

International Monetary Fund. (2011). *Macroprudential Policy Tools and Frameworks,* Update to G20 Finance Ministers and Central Bank Governors. Washington DC: International Monetary Fund.

Jorda, O., Schularick, M. & Taylor, A. (2011). *When Credit Bites Back: Leverage, Business Cycles, and Crises.* Working Paper 17621, Massachusetts: National Bureau of Economic Research.

Jorda, O., Schularick, M. & Taylor, A. (2010). *Financial Crises, Credit Booms, and External Imbalances: 140 Years of Lessons*. Working Paper 16567, Massachusetts: National Bureau of Economic Research.

Kaiser, R. & Maravall, A. (1999). Estimation of the Business Cycle: A Modified Hodrick-Prescott Filter. *Spanish Economic Review*, 1(2), p. 175-206.

Kelly, R., McQuinn, K. & Stuart, R. (2013). *Exploring the Steady-State Relationship Between Credit and GDP for a Small Open Economy: The Case of Ireland.* Working Paper 1531, Frankfurt: European Central Bank.

Ley, E. (2006). *The Hodrick-Prescott Filter,* Knowledge Brief for Bank Staff. Washington DC: The World Bank.

Mise, E., Kimand, T. H. & Newbold, P. (2005). On Suboptimality of the Hodrick-Prescott Filter At Time Series Endpoints, *Journal of Macroeconomics*, 27(1), p. 53-67.

Nigam, K. (2013). *Credit-To-GDP as a Forward Looking Indicator of Systemic Credit Risk: A Critical Evaluation Using Data from Uganda*. Working Paper 11/2013, Kampala: Bank of Uganda.

Ravn, M. O. & Uhlig, H. (2002). On Adjusting the Hodrick-Prescott Filter for the Frequency Of Observations, *Review of Economics and Statistics*, 84(2), p. 371-375.

Ren, H. (2011). *Countercyclical Financial Regulation*. Working Paper 5823, Washington DC: World Bank.

Repullo, R. & Saurina, J. (2011). *The Countercyclical Capital Buffer of Basel III: A Critical Assessment.* Discussion Paper DP8304, Madrid: Bank of Spain.

Schularick, M. & Taylor, A. (2009). *Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870–2008*. Working Paper 15512, Massachusetts: National Bureau of Economic Research.

Sims, C. A. & Zha, T. (2004). Were There Regime Switches in U.S. Monetary Policy? *American Economic Review*, 96(1), p. 54-81.

South African Reserve Bank. (2011). *Note on the Countercyclical Capital Buffer and its Possible Application in South Africa*. Financial Stability Review, Pretoria: South African Reserve Bank, p. 43-50.

Tan, T. (2012). *Determinants of Credit Growth and Interest Margins in the Philippines and Asia*. Working Paper 12/123, Washington, DC: International Monetary Fund.

Taylor, A. (2012). *External Imbalances and Financial Crises*. Working Paper 18606, Massachusetts: National Bureau of Economic Research, December.

Terasvirta, T. (1994). Specification, Estimation and Evaluation of Smooth Transition Autoregressive Models, *Journal of the American Statistical Association*, 89(425), p. 208-218.

Terasvirta, T. (1998). Modelling Economic Relationships with Smooth Transition Regressions, in A. Ullah and D.E.A. Giles (eds.), *Handbook of Applied Economic Statistics*. New York: Marcel Dekker, p. 507-52.

Van Dijk, D., Terasvirta, T. & Franses, P. (2002) Smooth Transition Autoregressive Models: A Survey of Recent Developments. *Econometric Reviews,* 21(1), p. 1-47.

Van Dijk, D., Terasvirta, T., Stefan, L. & Lundbergh, S. (2003). Time-Varying Smooth Transition Autoregressive Models, *Journal of Business & Economic Statistics*, 21(1), p. 104-121.

Van Vuuren, G. (2012). Basel III Countercyclical Capital Rules: Implications for South Africa, *South African Journal of Economic and Management Sciences*, 15(3), p. 309-24.

Vousinas, G. L. (2012). *The Transmission Channels between Financial Sector and Real Economy in Light of the Current Financial Crisis: A Critical Survey of the Literature.* Working Paper 18, Basel: Bank for International Settlements.

Xu, T. (2012). *The Role of Credit in International Business Cycles*, Working Paper 12-36, Ottawa: Bank of Canada.

APPENDIX A

Table 1: Descriptive Statistics

	Credit to GDP Ratio Gap	Output Gap
Mean	-0.275956	-0.095886
Median	-1.484437	0.044168
Maximum	12.57422	8.370497
Minimum	-10.4947	-9.897661
Std. Dev.	5.001492	4.077444
Skewness	0.749512	-0.092239
Kurtosis	2.885887	2.755195
Jarque-Bera	14.69062	0.610752
Probability	0.000646	0.736846

Table 2: Logistic Smooth Transition Autoregressive models results

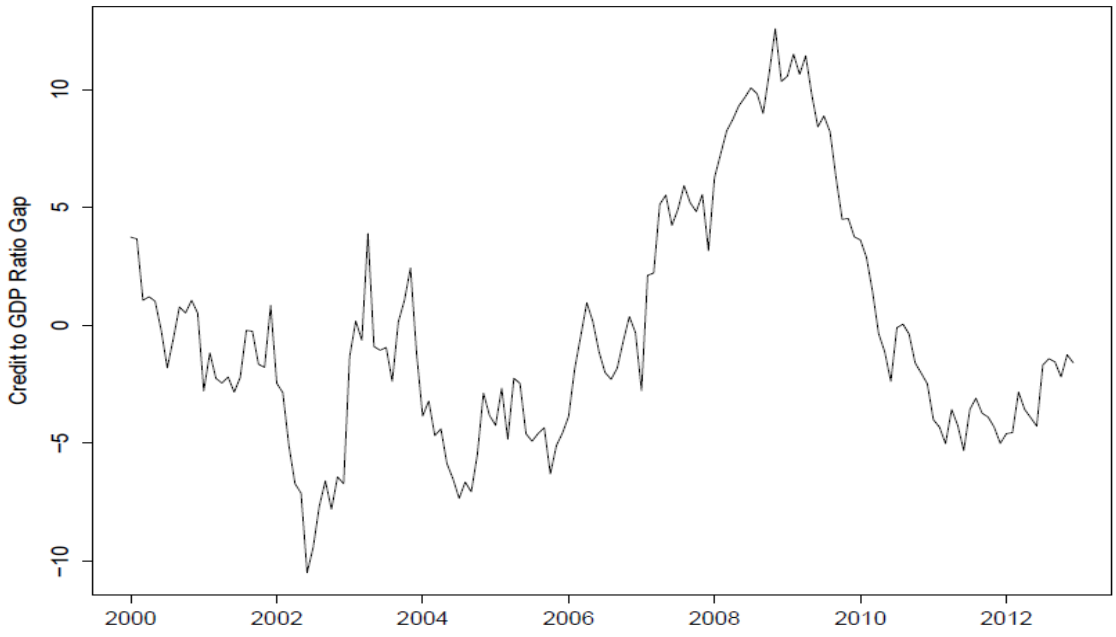
	Model with the first transition function		Model the second transition function	
	Coefficient	**Std error**	**Coefficient**	**Std error**
β_L	-2.073590	0.547265***	-0.150497	0.203631
β_{L1}	0.658740	0.076443***	0.974952	0.038518***
β_H	7.627031	2.703389***	0.025678	0.343488
β_{H1}	-0.109868	0.243946	-0.207716	0.071492**
γ	0.581739	0.302906*	106.6609	121.3058
θ	3.071610	1.252083**	0.089820	0.019246***
AIC	280.0000		223.0000	
$MAPE$	143.1000		152.4000	
$\mathrm{Re}sid_Var$	5.570000		3.855000	
$NonLin_test$	20.28300	0.134500	2.376000	0.125300

The first transition function is specified as $G = \left(1 + \exp - \gamma \left(ECN_CY_t - \theta\right)\right)^{-1}$ where the transition variable is the economic cycle or the gap between the coincident business cycle indicator and its long term trend, ECN_CY_t. The second transition function is specified as $G = \left(1 + \exp - \gamma \left(\Delta ECN_CY_t - \theta\right)\right)^{-1}$ where the transition variable is the change in the gap between coincident business cycle indicator and its long term trend or the change in the

economic cycle, ΔECN_CY_t. Statistical significance codes: *** = 1%, ** = 5%, * = 10%, AIC is the Akaike Information Criterion, $MAPE$ is the Mean Absolute Percentage Error, $\mathrm{Re}sid_Var$ is the Variance of the Residuals, $NonLin_test$ is the Non linearity test of full order Logistic Smooth Transition AutoRegressive model against full order AutoRegressive model, which is the F-test with associated p-values.

APPENDIX B

Figure 1: Evolution of the main Variables



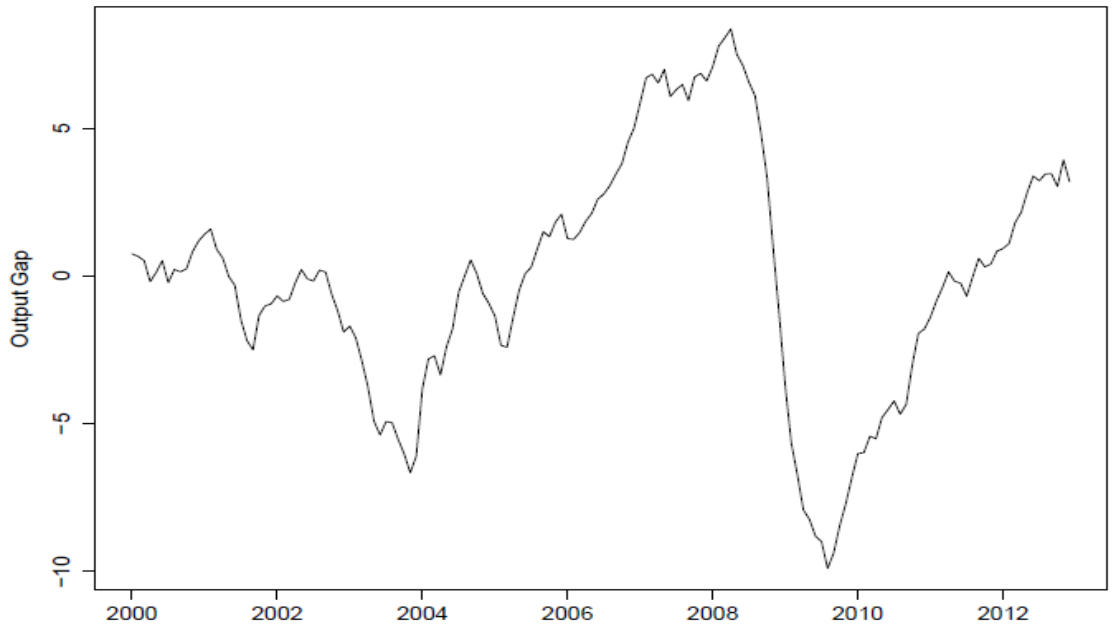


Table 3: Consistency matrix

Consistency matrix

Research problem: The main problem of this study is to examine the behaviour of the gap between the ratio of aggregate private sector credit to gross domestic product and its long term trend over the economic cycle in South Africa					
Sub problem	**Literature Review**	**Hypotheses**	**Source of data**	**Type of data**	**Analysis**
Establish how credit extension behaves during periods of expansions and contractions in the economic cycle	Basel Committee on Banking Supervision (2010a,b,2011b), Bouvatiery et al. (2011), Jeong (2009), Angelini and Penetta (2009), Jorda et al (2010), Huidrom et al. (2010), Xu (2012, Guo and Stepanyan (2011), etc.	• Credit extension increases during periods of expansions in the economic cycle, while the opposite is true during periods of contractions in the economic cycle	South African Reserve bank database	Secondary, time series data	Hodrick Prescott filter and Logistic Smooth Transition Autoregressive model
Establish how credit extension behaves during periods of upturns and downturns in the economic cycle	Basel Committee on Banking Supervision (2010a,b,2011b), Bouvatiery et al. (2011), Jeong (2009), Angelini and Penetta (2009), Jorda et al (2010), Huidrom et al. (2010), Xu (2012, Guo and Stepanyan (2011), etc.	• Credit extension increases during upturns in the economic cycle, while the opposite is true during down in the economic cycle	South African Reserve bank database	Secondary, time series data	Hodrick Prescott filter and Logistic Smooth Transition Autoregressive model