



Empirical evidence of aggregate credit supply by South African banks since the introduction of international risk based capital regulation

Dissertation submitted in partial fulfilment of the requirements for the degree of Master of
Financial Management (Specialisation: Finance)

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March 2014

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Acknowledgements

I would like to thank my supervisor, Mr Phillip de Jager, for his advice and guidance. I am particularly appreciative of the freedom afforded to me to develop my own thinking while always being reminded to remain focussed in my writing.

My family deserves special mention for their love and support. My daughter Belen has inspired me to constantly improve and challenge myself. I am especially grateful to my wife, Leigh, for her unwavering support and motivation, without which this thesis would not have been possible.

Abstract

This paper reviews the empirical evidence of how South African banks have changed credit supply since the introduction of risk based capital regulation through the Basel Accords. The primary objective is to analyse empirical trends in on-balance sheet lending between 1994 and 2013 and to establish whether the propensity for banks to extend credit at the aggregate industry level can be partly attributed to the increased regulatory requirements of target capital adequacy ratios or is more dependent on other demand and supply side variables. The extent to which compliance with regulated capital reforms has been satisfied by contracting credit supply, increasing qualifying capital or changing the composition of on-balance sheet lending portfolios through substituting between risk weighted assets is analysed. Furthermore, the risk weighted assets component of capital adequacy is reviewed to more critically understand risk taking and arbitrage in both retail and commercial lending portfolios over the full observation period. A vector auto regression (VAR) model is used to test the dependency of bank lending on both bank specific and macroeconomic variables and to quantify their individual effects at the aggregate industry level.

Keywords: Bank lending, Basel Accords, capital regulation, credit extension, credit supply, risk based capital regulation

List of Acronyms used

Advanced Internal Ratings Based Approach.	A-IRB
Basel Committee on Banking Supervision	BCBS
Bank for International Settlements	BIS
Bank Holding Company	BHC
Capital adequacy ratio	CAR
Collateralised Debt Obligations	CDOs
Common equity Tier 1	CET1
Committed Liquidity Facility	CLF
Consumer price inflation	CPI
Credit Default Swaps	CDS
Domestic systemically important bank	D-SIB
Exposure at default	EAD
Financial Services Board	FSB
Foundation Internal Ratings Based Approach	IRB
Gross Domestic Product	GDP
High Quality Liquid Assets	HQLA
Impulse response functions	IRFs
Johannesburg Stock Exchange	JSE
Liquidity Coverage Ratio	LCR
Loan to Value	LTV
Loss given default	LGD
Mortgage Backed Securities	MBSs
National Credit Act	NCA
National Credit Regulator	NCR
Net Stable Funding Ratio	NSFR
Off-balance sheet	OBS
Ordinary least squares	OLS
Organisation for Economic Co-operation and Development	OECD
Over the Counter	OTC
Probability of default	PD
Quantitative Impact Studies	QIS
Return on Equity	ROE
Risk weighted assets	RWA
Small and Medium Enterprises	SME's

South African Reserve Bank

SARB

Special purpose vehicles

SPV's

Tangible common equity

TCE

Value at Risk

VaR

Vector auto regression

VAR

Table of Contents

I.	Introduction	1
II.	Literature Review	4
	a. Background	4
	b. The bank lending channel and bank capital channel hypotheses	5
	i. The bank lending channel	5
	ii. The bank capital channel	6
	c. The relationship between bank capitalisation and risk aversion	7
	d. The procyclicality of bank lending	8
	e. Global evidence of the impact of risk based capital regulation on bank lending	10
	i. Developed market evidence	10
	1. United States	10
	2. United Kingdom and Europe	13
	3. Asia and Japan	14
	ii. Emerging markets evidence	15
	iii. South African evidence	16
III.	Scope of Research	17
	a. Research objective	17
	b. Data description	17
	c. Research methodology	18
	d. Limitations of the study	19
IV.	The evolution of bank capital regulation	20
	a. The Basel Committee on Banking Supervision (BCBS)	20
	b. The Basel Accords	21
	i. Basel I	21
	1. Background	21
	2. Capital Adequacy Requirements	21
	3. Benefits of Basel I	22
	4. Criticism of Basel I	22
	ii. Basel II	24
	1. Background	24
	2. Structure	25
	3. Credit Risk	25

4.	Criticism of Basel II	26
iii.	Basel III	27
1.	An overview of the 2008 Financial Crisis	27
2.	Background	28
3.	Enhanced capital framework of Basel III	28
4.	Liquidity measures under Basel III	30
V.	An overview of the South African banking industry	32
a.	Regulatory Framework	32
b.	Structure of the banking industry	32
c.	Challenges facing the South African banking industry	34
d.	Implications of liquidity shortfalls in South African banks	35
VI.	Bank capital analysis	36
a.	Bank Capital Adequacy	36
b.	Qualifying Capital versus RWA	38
c.	Analysis of RWA	39
VII.	Empirical analysis of credit supply by South African banks	41
a.	Aggregate Credit Supply	41
b.	Retail versus Commercial credit supply	42
c.	Analysis of the retail credit supply	
i.	Retail portfolio composition	45
ii.	Retail Credit growth	46
d.	Analysis of the commercial credit supply	
iii.	Commercial portfolio composition	48
iv.	Commercial Credit growth	49
VIII.	Vector autoregression (VAR) model	51
a.	Background	51
b.	Empirical Methodology	51
IX.	VAR Results	53
a.	Model 1	53
i.	OLS Regression results	53
ii.	IRF Results	
1.	The relationship between bank lending and GDP	55

2.	The relationship between bank capital and bank lending	57
3.	The relationship of liabilities to the public and bank lending	57
4.	The relationship of other variables and bank lending	58
b.	Model 2	58
i.	OLS Regression results	59
ii.	IRF Results	59
X.	Conclusion	61
	Reference list	62
	Appendix A: Differenced CAR	67
	Appendix B: IRF Excess CAR	68

Section I

Introduction

The implementation of risk based capital regulation through the Basel Accords affects the capacity of banks to supply credit to the real economy. Banks with capital shortfalls can be expected to meet increased capital adequacy requirements by either issuing new equity, diversifying their lending portfolio away from higher risk weighted assets (RWA) or reducing the supply of bank loans (Barajas, 2005). It is generally accepted that raising additional equity comes at a higher cost and banks are more likely to meet increased capital adequacy requirements by reducing credit supply (Hyun and Rhee, 2010). Higher capital adequacy requirements also incentivise banks to substitute away from supplying credit to higher risk assets like commercial loans. Berger and Udell (1994) state that increased risk based capital requirements would result in poorly capitalised banks restricting credit to higher RWA and shifting the allocation of lending portfolios towards lower risk government securities. The requirement to hold additional capital for certain assets perceived to be higher risk would increase the cost of lending and banks could be less inclined to allocate capital towards those assets. It is therefore conceivable that increased capital adequacy reforms could result in a regulatory induced credit crunch where banks ration credit to higher risk lending and thereby reduce liquidity in the real economy.

A significant challenge with examining changes in bank lending behaviour over time is disentangling the supply side effects affecting the capacity of banks to provide credit from demand side factors in the real economy. Supply side factors could include bank capital levels and liabilities to the public while demand side factors would include macroeconomic variables like economic growth, interest rates and inflation which influence the borrowing capacity of households. The relationship between credit supply and credit demand appears inextricably linked and previous academic studies have delivered inconclusive results because of limitations in effectively isolating and differentiating between these individual effects. Albertazzi and Marchetti (2010) assert that conclusive evidence of a sustained reduction in bank credit supply being induced by risk based capital regulation is therefore still unavailable specifically because of these constraints. Furthermore, Peek and Rosengren (2000) argue that even where studies have been successful in identifying loan supply shocks the causal link between a slowdown in aggregate credit supply and negative spillover effects into the real economy has not been compellingly established due to additional credit demand being met through alternative funding sources. This view is consistent with Cumming and Nel (2005) who suggest that a contraction in aggregate credit supply because of increased risk based capital controls only manifests in reduced economic output if excess aggregate credit demand is not satisfied through non-bank institutions.

The implementation of Basel II in South Africa preceded the financial crisis in 2008 and corresponded to a period of significant slowdown in aggregate bank lending. Furthermore, the increased capital adequacy requirements of the framework were straddled by domestic credit legislation in the form of The National Credit Act (NCA) of 2007 and an economic recession in 2009, both of which could rationally be expected to affect the ability of banks to lend. Enhanced credit regulation results in more stringent lending criteria which, when combined with the perceived increased risk profile inherent in borrowers during economic downturns, could result in banks curtailing credit supply to reduce risk taking. According to Jackson et al. (1999) banks are more likely to contract credit supply during economic recessions given the higher probability that these periods will be characterised by increased bad debts and impairments. It can therefore be inferred that banks would choose to protect capital levels by reducing exposure to higher RWA and would therefore behave in a pro-cyclical manner by restricting credit extension when increased liquidity is most required in the real economy.

The evidence from previous academic studies indicates that regulatory induced credit contraction is more apparent in under capitalised banks. The intention of this paper is not to suggest that risk based capital requirements have resulted in a supply side contraction in credit extension by South African banks which have historically been well capitalised. However, the four standard deviation decline in bank lending coincides with the period over which revised capital adequacy requirements were being introduced through the Basel II Accord in 2008, and the extent to which revised capital reforms may have induced or exacerbated this decline is an important consideration. The declining trend in aggregate bank lending between 2006 and 2010 suggests that both supply and demand side factors could have influenced the willingness and capacity to banks to extend credit to the real economy. While no attempt is made to disentangle supply and demand effects, an important outcome of this paper is to both quantify and qualify fundamental determinants of bank lending between 1994 and 2013 and to examine key inflection points in credit supply over the observation period.

The following sections of this paper are structured as follows. Section II reviews the existing literature. It includes a discussion of how bank capital and bank lending theory, pro-cyclicality and risk taking by banks interact with credit supply. Evidence of the impact of risk based capital regulation on bank lending in both developed and emerging markets is considered. Section III details the scope of the research, overviews the research methodology, examines the data and identifies important limitations. Section IV introduces the Basel Committee on Banking Supervision (BCBS) and provides a summary of the three versions of the Basel Accords. The objectives of Basel I, II and III are reviewed with a further discussion on the key criticisms which ultimately resulted in policymakers revisiting the framework over the observation period. Section V provides an overview of the South African banking industry. It introduces both the regulatory and structural features of the financial system. Section VI analyses bank capital adequacy and addresses the manner in which banks

have complied with increased Basel solvency requirements by either adjusting or changing the composition of RWA, or by raising additional capital. Section VII examines the empirical trends in credit supply by South African banks between 1994 and 2013 and provides a qualitative analysis of the underlying fundamentals influencing those trends. Aggregate credit supply is segmented into retail and commercial lending components to further examine the way in which lending portfolios have changed over time as well as to identify risk taking by South African banks. Section VIII introduces and explains the vector autoregression (VAR) model. Section IX presents the VAR results and aims to quantify specific effects of both demand and supply side factors affecting the capacity and propensity for banks to lend. The objective is to provide additional context to the observed lending patterns observed in Section VII. Section X summarises important findings and concludes.

Section II

Literature Review

a. Background

A bank can finance its operations with funds provided by its owners or with borrowed money (Burhouse et al., 2003). Modigliani & Miller (1958) assert that the value of a firm is independent of its capital structure which would imply that debt and equity are perfect substitutes. A higher cost of equity financing relative to debt would therefore contradict the Modigliani-Miller theorem, and, if the implementation of bank capital adequacy regulation results in an increase in the marginal cost of bank lending, banks could respond by raising lending rates or contracting credit supply (Cosimano and Hakura, 2011). Banks can be expected to meet increased capital adequacy requirements by issuing new equity, reducing the supply of bank loans, or by diversifying their lending portfolio away from higher RWA like commercial loans towards traditional risk free assets like government bonds (Barajas, 2005). The implementation of risk based capital regulation would not be expected to significantly impact on the supply of banks credit if raising additional capital was not costly (Aiyar et al., 2012). According to Myers and Majluf (1984) the more senior debt instruments in a bank's capital structure are less affected by information asymmetries and banks therefore experience higher adverse selection costs for the raising of external equity. Jackson et al. (1999) state that the evidence shows banks are more inclined to respond to regulatory shocks by contracting credit supply in the short term due to the constricting nature of capital constraints and frictions in equity markets. Hyun and Rhee (2010) posit that the financial crisis of 2008 was exacerbated by banks reducing credit supply in an attempt to maintain minimum capital adequacy ratios. Further evidence can be demonstrated through the credit crunch in the US in the early 1990's, where the introduction of risk based capital regulation induced a reduction in credit supply by the US banks. The academic literature on the slowdown in bank lending in the US during the 1990 to 1991 recession is extensive and is examined further below. Although seminal contributions by Bernanke and Lown (1991), Berger and Udell (1994), Hancock and Wilcox (1994) and Furfine (1991) derive different outcomes, the premise of these contributions provide the foundation on which this thesis will explore the manner in which bank capitalisation, risk aversion and procyclicality interact with bank credit supply. A more recent strand of literature which has evolved relates to the existence of a bank capital channel, where the impact of regulatory shocks directly impacts bank capital and could therefore inhibit the ability of banks' to extend credit to the real economy. There is some symmetry between the bank capital channel and earlier research on

capital crunches by Bernanke and Lown (1991) where a reduction in bank lending is attributable to depleted bank equity¹.

b. The bank lending channel and bank capital channel hypotheses

The main distinction between the bank capital and bank lending channel is through the level at which they impact on banks' balance sheets. The impact of exogenous shocks adversely affects the supply of bank loans through constraints on liabilities (reserve deposits) under the lending channel and on bank equity under the capital channel. Both hypotheses are premised on establishing the effects of a change in monetary policy on the lending behaviour of banks and qualifying how the transmission mechanism manifests in the real economy. While the bank lending channel hypothesis is premised on an existence of financial frictions in debt markets, an important assumption under the bank capital channel is that equity markets are imperfect.

i. The bank lending channel

The bank lending channel hypothesis asserts that monetary policy affects the real economy by directly influencing the supply of loans by banks. A tightening in monetary policy impacts on credit extension by banks because the resultant decrease in reserve deposits cannot be completely offset by banks raising other types of funding like commercial paper or bonds through wholesale markets (Gambacorta and Mistrulli, 2003). Basically, the opportunity cost of holding reserve deposits increases with higher short term rates. A necessary condition for the validation of this channel is therefore that banks are constrained from issuing non-reservable liabilities and respond to monetary policy shocks to their reserves by changing lending practices. Under the bank lending channel an exogenous monetary policy shock directly impacts on banks' balance sheet liabilities through reserve deposits – there is no direct effect on bank capital. The existing literature does however consider the importance of bank capital due to imperfect information, agency problems and adverse selection in debt markets.

Studies by Kashyap and Stein (1995) and Stein (1998) argue that because debt markets are imperfect, investors use bank capital to determine an acceptable risk and return trade-off and require an increased premium for uninsured non-reserve liabilities. Bank capital is therefore used as a signalling mechanism and less capitalised banks can be expected to pay more for uninsured debt as the market perceives the credit risk of the issuer to be higher. This finding is confirmed by Kishan and Opiela (2000) who assert that banks with lower capital have less capacity to absorb future losses and the presence of information asymmetries makes it more difficult to protect lending exposure. It is

¹ Richard Syron (1991), president of the Boston Federal Reserve, specifically distinguished a capital crunch from a credit crunch and defined it as a shortfall in equity capital constraining the ability of banks to extend credit during the US recession in 1990 – 1991.

however worth noting that banks with a higher percentage of liquid assets have greater flexibility with regards to selling assets and are therefore able to insulate their loan portfolios from an excessive reduction in credit extension (Kashyap and Stein, 2000).

Evidence of a bank lending channel is also found in South Africa by Sichei (2005) who uses bank level data to demonstrate that bank size and capital levels have a significant effect on bank lending with better capitalised banks more able to absorb monetary policy shocks. These findings are consistent with recent a recent study on South African banks by Mishi and Tsegaye (2012) who assert that information asymmetries in smaller banks may constrain lending after a monetary policy shock. Larger banks are less sensitive to restrictive monetary policy and this finding is especially important in the context of the highly concentrated South African banking industry with four major banks dominating the commercial lending market. Ludi and Ground (2006) also study the bank lending channel in South Africa and find that credit supply by banks in the country is determined more by consumer demand than supply side factors.

The emphasis on the bank lending channel is especially important in the context of banks' liquidity and the proposed reform under the Basel III framework. The maturity mismatch between longer maturity assets against shorter maturity liabilities, greater dependence on wholesale and institutional funding and non-interest revenue has caused banks with increased funding liquidity risks to contract credit supply more during economic downturns (Gambacorta and Marques-Ibanez, 2011). Ivashina and Scharfstein (2010) also demonstrated that banks that had limited access to deposit funding reduced bank lending by more than banks with more diversified financing sources during the 2008 financial crisis. The financial crisis stressed the importance of bank liquidity and the effect of the bank lending channel in influencing credit supply to the real economy (BIS, 2011).

ii. The bank capital channel

The alternate hypothesis to the bank lending channel is the bank capital channel. This strand of literature is not as well developed but is important in the context of this paper as it directly addresses the impact of capital surpluses or shortfalls on bank lending. The bank capital hypothesis is premised on three fundamental assumptions – there is an imperfect market for bank equity and therefore additional capital raising is expensive for banks, banks are subject to maturity transformations where assets have a longer maturity than liabilities, and credit supply is constrained by the implementation of regulatory capital requirements (Van den Heuvel, 2001).

The bank capital channel arises through banks asset and liability management. Bank loans typically have a longer maturity than both deposit and wholesale funding sources and therefore the average maturity of assets is greater than liabilities (Gambacorta and Mistrulli 2003). The central thesis is that this structural maturity mismatch on banks' balance sheet results in a bank capital channel by which

monetary policy affects credit supply through its effect on equity. More restrictive monetary policy results in banks paying more on deposit funding while the restructuring of existing loans does not compensate for the higher interest payments. The impact of being short funded is therefore that both bank profitability and capital is decreased, and banks reduce credit supply in order to meet capital adequacy requirements as it is too costly to issue new equity (Van den Heuvel, 2007).

A shortcoming of the previous research under the bank lending channel is that, while their findings emphasise the importance of internal capital adequacy, their methodologies do not specifically examine the impact of regulated capital requirements. Therefore the third assumption indicated above has not been empirically tested. Van den Heuvel (2007) attempts to assess the impact of the risk based capital regulation under the Basel I framework on bank lending behaviour under the bank capital channel. He finds evidence that exogenous monetary policy shocks combined with the need to comply with risk based capital requirements resulted in less capitalised banks exhibiting a more significant reduction in lending relative to well-capitalized banks. This is consistent with the underlying assumptions of bank capital theory as suggested by Francis and Osborne (2009) where undercapitalised banks have no excess capital to shield credit supply from regulatory changes.

c. The relationship between bank capitalisation and risk aversion

As a key focus of this thesis is aimed at establishing the extent to which capital shocks through regulatory intervention interact with credit supply, a review of the literature considering how different levels of bank capital impact on the ability of a bank to extend credit to the real economy warrants further discussion. This is especially relevant in the context of the South African banking industry where banks have historically been well capitalised with capital adequacy ratios in excess of those proposed by the Basel Accords.

Banks are incentivised to increase expected returns by utilising increasing leverage or holding more liabilities relative to their capital base (Carnell, Macey and Miller 2009). Regulated capital adequacy ratios are therefore important to contain excessive balance sheet leverage and mitigate against aggressive risk-taking. The empirical evidence from behavioural finance studies also demonstrates that bankers do not necessarily have a better understanding of risk than the average investor with Kindleberger (1978) showing banker behaviour to be relatively myopic.

Studies by Flannery (1989) and Genotte and Pyle (1991) conclude that higher capitalised banks are more risk-averse. In the event of shocks to the banking system, excess capital provides a buffer against both actual and expected losses which suggests that well capitalised banks have increased loss absorbency capabilities relative to their weaker capitalised counterparts. On average these banks would therefore raise relatively lower loan loss provisions during economic recessions, and the lower

write-off of loans will result in better capitalised banks reducing lending on a smaller scale during periods of financial distress. Individual banks may choose to hold capital in excess of regulatory requirements to hedge against future periods of financial distress. The excess capital therefore serves as a type of contingent capital buffer to ensure compliance with capital adequacy regulations and also mitigates against the risk of supervisors assuming control of the bank (Repullo, 2000). This point is further re-iterated in later research by Peura and Keppo (2006) who suggest that banks hold these excess capital buffers because raising equity funding is expensive and random supervisory checks by regulators expose banks to the risk of closure. Elizalde and Repullo (2007) assert that by holding economic capital above regulated capital, banks minimise the risk of losing their charter in the event of bank failure.

The counterargument as presented by Rochet (1992) and Kim and Santamero (1988) is that well capitalised banks are less risk averse because of the underlying nature of their lending portfolios being relatively more risky. The introduction of risk based capital regulation under this hypothesis is actually counterintuitive since it can actually increase risk taking by banks as raising additional equity is expensive and banks may be inclined to search for yield in higher risk projects (Hellman, Murdock and Stiglitz, 2000). Kim and Santamero (1988) argue further that if risk weightings do not accurately reflect market risk the implementation of these regulatory standards would distort the riskiness of asset portfolios. This was a fundamental shortcoming of the Basel I framework where risk weightings were considered arbitrary and subjective (Burhouse et al., 2003). The implication based on this literature is that the safety and soundness of the banking system is better preserved by allowing banks to use their discretion in setting optimal internal capital requirements as opposed to regulators implementing more stringent standards.

The debate around banks capital levels has not been compellingly settled and both theoretical and empirical studies have not provided conclusive evidence that capital regulation has resulted in banks holding more capital than would have been voluntarily determined. This view is consistent with research by Jackson et al. (1999) where it was further asserted that minimum capital regulation under the Basel I Accord could have negative implications for the real economy if banks responded by constraining credit supply because of capital shortfalls. Banks experience increased loan loss provisioning and write-offs during economic downturns which lower capital through a depletion of equity. According to Gambacorta and Mistrulli (2003) the level of bank capital relative to the business cycle is an important determinant of banks lending behaviour. Banks with excess capital would need to reduce lending by less in recessions to not breach minimum capital adequacy regulations. Well capitalised banks are in a relatively better position to withstand periods of financial stress associated with economic downturns and the existence of a capital buffer provides more scope for these banks to meet regulated capital adequacy requirements.

d. The procyclicality of bank lending

Procyclicality in banks' lending behaviour and specifically the impact of capital regulation on the willingness of banks to extend credit under recessionary conditions has been the subject of extensive research by both researchers and regulators. Testing for procyclicality is not an objective of this study but a review of the literature pertaining to the impact of capital regulation on bank lending is included for the sake of completeness.

According to Rochet (2008) the use of capital regulation in the banking industry is inherently procyclical. Some authors argue that the banking system as a whole is inherently procyclical due to imperfect markets and assert that bank lending would fluctuate with the economic cycle even in the absence of capital regulation (Lowe, 2002; Amato and Furfine, 2004). The mechanism of procyclicality is observed as banks increase credit supply because of increased risk appetite during economic expansions and reduce lending through risk aversion during economic downturns and recessions. Credit losses are more prevalent during recessions which adversely affects capital levels and causes banks to reduce credit supply. Under the 1988 Basel Accord, capital adequacy requirements and risk weightings across asset categories were fixed, with all commercial or business loans being weighted at 100%. Although Basel I was considered procyclical, the introduction of a more risk sensitive framework under Basel II amplified this propensity for banks to lend more aggressively during expansions and contract credit supply in recessions (Rochet, 2008).

A number of studies reference the inherently procyclical nature of the Basel II Accord. According to Lowe (2002), although credit losses during recessions would require banks to adjust capital levels under both Basel I and Basel II, the more risk sensitive asset weightings under Basel II and the movement of existing loans to higher risk classes would require banks to raise additional capital or reduce lending to comply with capital adequacy regulation. Basel II could therefore amplify procyclicality as banks would revise loan ratings upwards during expansions causing RWA to decline and thereby providing scope to increase lending. Rating downgrades and increased credit losses during recessions will result in banks contracting credit supply more significantly under Basel II than under the Basel I framework.

Repullo and Suarez (2008) assert that banks are inclined to hold additional capital as a buffer for increased credit risk during recessionary periods and that existing bank capital levels are a fundamental determinant of future lending. Despite banks holding higher capital levels and building up capital buffers during economic expansions the implementation of Basel II would actually increase procyclicality. Their conclusions are that banks would reduce credit supply as the excess capital accumulated during expansions would be insufficient to compensate for the higher capital adequacy

requirements under Basel II during recessions. An important finding of this study is that banks are shown to be procyclical under risk based capital regulation and countercyclical for non-risk based capital regulation. Zhu (2008) also suggests that an increase in capital requirements in an economic downturn or recession could induce a credit crunch, thereby further exacerbating deteriorating economic conditions by reducing access to funding. The author demonstrates that under risk based capital regulation, weaker capitalised banks will have to reduce lending more to build up adequate capital buffers during economic expansions. This in turn leads to decreased volatility during economic downswings and therefore less procyclicality than better capitalised banks. Rochet (2008) also finds that banks hold capital levels in excess of the required regulated minimum to provide a hedge against future economic downturns or periods of financial distress. His findings were contrary to those of Repullo and Sanchez (2008) and Zhu (2008) and suggest that the impact of Basel II would not be very significant on banks' supply of credit but does concede that Basel II is inherently procyclical². His conclusions were that the excess capital buffer would adequately mitigate for the increased credit risk during recessions and consequently lending volumes should not be substantially reduced. Business cycle fluctuations can be normalised through the use of a capital buffer which should allow banks to maintain lending for a given volume of loans despite increased capital adequacy requirements under risk based capital regulations.

e. Global evidence of the impact of risk based capital regulation on bank lending

As the primary focus of this paper is to examine the credit supply of banks in South Africa following the introduction of global risk based capital regulation it is important to consider the findings of previous empirical research both in both developed and emerging market economies where similar studies have been conducted.

i. Developed market evidence

1. United States

Seminal research by Bernanke and Lown (1991) examines the causes of the slowdown in bank lending in the US and considers both state level and individual bank data in studying the decreasing appetite of banks towards borrowers in the early 1990's. Their results indicate that credit contraction was more attributable to demand as opposed to supply side factors. They find evidence that weak borrower balance sheets were highly leveraged and net worth would have reduced significantly as the

² Rochet (2008) also stated that the risk of IAS39 would not significantly impact on banks credit supply. IAS 39 is an International Accounting Standard addressing the market value accounting for financial derivatives and other assets comprising the trading book of banks.

recession in 1990 to 1991 depressed asset and property prices. Potential borrowers therefore appeared less creditworthy to banks as credit exposure could not be adequately collateralised against lower asset values and loan serviceability was adversely affected by weaker cash flow generation due to the recession. On the impact of both risk based Basel and un-weighted US based capital regulation, they find only modest effects for undercapitalised banks and no clear evidence is found of regulation significantly reducing lending. The authors reject the hypothesis of a supply side credit crunch and assert that if supply side factors were predominantly responsible for reduction in bank lending then there should be evidence of borrowers substituting away from primary bank lending toward alternative funding sources³. Their conclusions are that reduced lending was more attributable to a capital crunch hypothesis where falling property prices largely resulted in a decrease in bank capital due to the writing-off of bad loans and the subsequent reduction in equity book values.

An interesting finding of earlier research on the US credit crunch was the importance of un-weighted capital requirements imposed by US regulators in addition to the Basel I risk based capital regulation. The findings of Hancock and Wilcox (1994) show that risk based capital requirements had no effect in reducing lending in undercapitalised banks and observe that banks with risk weighted capital shortfalls actually increased lending towards higher risk weighted assets like commercial real estate and business loans. However, the additional requirements imposed on banks by US regulators to supplement regulated Basel I capital adequacy ratios had a more significant effect in constraining credit supply when compared to the original risk based capital standards. Their results show that banks with capital shortfalls relative to the unweighted capital standards imposed by US regulators displayed a more significant contraction in extending credit. The associated supervisory component of domestic banking regulation is examined by Furfine (2001) who uses US banking data to test how banks change the structure of their loan portfolios with and without capital regulation. The model incorporates an additional supervisory component where banks incur penalties for non-compliance with regulatory intervention. The results demonstrate that although capital regulation does influence the composition of loan portfolios, the introduction of rigid regulatory supervision exhibits a more significant effect on the structure of banks' balance sheets. Banks would be less inclined to deviate from regulatory requirements if there was a cost associated to breaching the reforms. The evidence therefore suggests that the sluggish growth in US bank lending in the early 1990's was attributable to both more stringent capital regulation as well as the stricter supervision framework which monitored the implementation. Wagster (1999) argues that asset shifting where banks substituted away from loans to US treasuries is regarded as the foundation of the credit crunch in the US. The introduction of capital ratios results in banks changing the mix of assets in their portfolios and asset allocation is

³ Alternative lending institution include debt capital markets where borrowers are able to access institutional investors and issue bonds, commercial paper and other debt products. Bernanke and Lown (1991) state that evidence from previous recessions' shows that reduced bank lending was accompanied by an increase in commercial paper issuance.

based on lowering portfolio risk by substituting away from higher risk assets like commercial loans to risk free assets like US treasury bonds. According to Wagster (1999), banks' would substitute away from riskier assets to minimise bankruptcy risk by reducing the cost of uninsured funding. His research was the first to include international banks and provides evidence that between 1990 and 1992 banks in the US, Canada and the UK were significantly lowering their loan exposure while increasing their holdings of government securities. He also attributes his findings to the increased supervision of banks in these three countries and therefore finds support for the higher regulatory scrutiny hypothesis where heightened supervision and evaluation of bank holding may have resulted in reduced loan supply. The theory is that regulators were concerned with the safety and soundness of the banking industry and mitigated system wide risks by imposing increased supervision measures. The implementation of heightened bank supervision by regulators on lending standards resulted in banks reducing the credit supply of higher risk commercial loans. Although he asserts that a shift in asset allocation in these countries is primarily supply driven, he agrees with the existing empirical literature that it is difficult to isolate supply and demand factors, and that both would need to be addressed to fully understand the substance of any credit contraction in commercial banking loans.

The majority of studies analysing the extent to which risk based capital regulation impacted on credit supply by US banks have generally found limited evidence of a lending slowdown being induced by more rigid capital controls. A notable exception is illustrated by Thakor (1996) in analysing the relationship between regulated bank capital to asset ratios on aggregate bank lending. The basis for his research is to consider US banks' substitution of commercial loans in favour of government bonds in the early 1990's. He examines the impact of risk based capital requirements on credit supply across multiple banks and focuses on the impact of the bank screening process. Based on the scope of the study he finds evidence that borrowers are rationed for credit at both the individual bank level as well as through the banking system as a whole. More stringent capital regulation therefore results in more credit rationing by banks and could actually serve to lower the willingness of banks' to screen risky borrowers. Increases in risk based capital requirements reduce aggregate bank lending, and banking systems with higher costs of capital are inclined to limit credit supply to a greater extent following the introduction of risk based capital standards.

There is consensus in the existing literature that existing bank capital levels are fundamental in determining bank lending behaviour following the introduction of risk based capital regulation. According to Furlong (1992), the implementation of risk based capital reforms can influence the capital structure of a bank capital and thereby affect its lending behaviour as minimum capital regulation is enforced. Undercapitalised banks, where actual capital levels fall below required target capital levels, could be incentivised to decrease loans in an attempt to comply with higher capital adequacy ratios. Better capitalised banks have the capacity to either maintain or increase credit supply without necessarily breaching the minimum capital requirements. He finds that lending growth is

positively related to capital to asset ratios, and that the correlation is greater for larger better capitalised banks. This result is consistent with earlier research by Keeley (1988), who demonstrates that banks with lower levels of capital grow more slowly than better capitalised banks. It is further asserted that the implementation of a more risk-based capital approach could affect the investment decisions of banks by structuring their lending portfolios in favour of low-risk weighted assets like US treasuries over riskier loans. These outcomes are consistent with later work by Berger and Udell (1994) who utilise time series analysis on US banks between 1979 and 1992 to assess whether the introduction of more stringent risk based capital regulations under Basel I contributed to the slowdown in commercial bank loans during the 1990 to 1991 recession. They fail to find conclusive evidence that US banks constrained credit supply through loans after the introduction of the 1988 Basel Accord and argue that if US banks did not increase portfolio reallocation from high risk loans to low risk securities after the introduction of Basel I, then risk based capital regulation cannot be responsible for the credit crunch in the US in the early 1990's. The authors state that the effects of risk based capital regulation on credit is more attributable to demand-side factors which are more difficult to both qualify and quantify through their model. Disentangling supply and demand side factors has proven to be a constraint in most models analysing the causality between risk based capital regulation and a contraction in aggregate bank lending, but some studies have qualified their findings in terms of underlying macroeconomic variables. Berrospide and Edge (2010) use multiple methodologies to examine the effects of bank capital on the lending behaviour of bank holding companies (BHC) over the period from 1990 to 2008. Applying panel data regression techniques they find that BHC capital to asset ratios only have a small effect on credit extension. Using a vector autoregression (VAR) model they find a more significant but still relatively modest effect on loan growth when employing macroeconomic time series and aggregate commercial bank data. Their results are consistent with previous studies in finding that a capital surplus or shortfall have only a limited effect of bank lending. The authors further demonstrate that the slowdown in credit growth during the financial crisis of 2008 is more attributable to macroeconomic shocks to GDP as opposed to shocks to the banking system through capital adequacy regulation⁴.

2. United Kingdom and Europe

Francis and Osborne (2009) study the evidence for the existence of a bank capital channel in the UK by examining a sample of around 200 UK banks between 1996 and 2007. They analyse banks internal capital ratios and attempt to establish how lending behaviour is affected by the implementation of more rigid capital regulation. Their findings show that over the observation period, banks with excess

⁴ Berrospide and Edge (2010) use GDP as a proxy for credit demand in regressing macroeconomic time series data for their vector autoregression (VAR) model. The authors qualify that their result as expected given that the financial crisis of 2007-08 was at least three times larger than the US recession of 1990-91.

capital relative to their target ratios experience higher growth in credit extension and lower growth in regulatory capital and tier 1 capital. The converse is that banks with capital deficits would need to increase their capital ratios and therefore reduce lending to meet these higher regulatory targets. Their empirical research shows only moderate effects of capital shortfalls on bank lending with a 1% increase in capital requirements in 2002 resulting in a 1.2% reduction in lending over a 4 year period. Gambacorta and Mistrulli (2003) study quarterly data on Italian banks between 1992 and 2001 and find more significant effects with the implementation of capital regulation and solvency ratios in excess of 8% reducing bank lending by 20% over a period of two years. Bank capitalisation is specifically defined as the amount of excess capital that banks hold in excess of the minimum required to meet implemented regulatory standards'. They find evidence of a bank lending channel and demonstrate that well capitalised banks have easier access to wholesale or non-deposit funding and lending is less sensitive to external shocks in the real economy. The lending behaviour of poorly capitalised banks is shown to be more procyclical than that of better capitalised banks. Well capitalised banks are also better able to withstand short term financial distress in borrowers without putting loans into default. These results are consistent with the theory that decreasing credit supply is less costly than raising equity capital especially under a risk-weighted capital framework. Further research on Italian banks by Albertazzi and Marchetti (2010) also find evidence of increased capital adequacy requirements resulting in larger less capitalised banks substituting away from riskier borrowers while smaller less capitalised banks did not reallocate portfolio assets away from riskier loans. The research incorporating both credit demand and credit supply is not particularly extensive. An explicit goal of Jimenez et al. (2010) is to disentangle the effects of credit demand and credit supply and to further separate the impact of bank capital and liquidity on the granting of loans. The authors follow the credit process of Spanish banks from loan origination to final approval in order to assess the impact of capital regulation on lending growth as well as the effects on the real economy. Their research shows that lower bank capital or liquidity requirements has a positive effect on credit extension by banks. This would suggest that higher capital requirements would constrain credit supply as banks would be less willing to lend. Linking the demand side evidence shows that the probability of a loan being successfully granted decreases with lower GDP growth and higher interest rates and that this effect is more pronounced when the lending banks have lower capital and liquidity.

3. Asia and Japan

Hyun and Rhee (2010) deviate from previous studies by analysing the capital structure of a bank on a cost neutral basis and not imposing any price on the issuing of new equity. Their results show that capital constrained banks have a preference for reducing credit supply over issuing new equity. Empirical evidence from Asian countries demonstrates that banks are more inclined to limit credit exposure to high risk weighted assets when their balance sheets are undercapitalised. These results are consistent with earlier research by Montgomery (2005) where the implementation of the Basel capital

reforms in international Japanese banks was also shown to cause banks to reduce higher RWA. Peek and Rosengren (2000) also analyse Japanese bank level data to establish that US subsidiaries of Japanese banks responded to losses in the holding companies by reducing credit supply in the US lending market. While this particular study focuses on an exogenous lending shock and does not directly reference the bank capital channel through a regulatory effect on bank capital, the authors demonstrate the willingness of Japanese banks to adjust lending as opposed to raising additional capital⁵. Further support for Japanese banks constraining credit supply is evidenced in a study by Woo (2003) who finds that Japanese banks with capital shortfalls exhibit a more significant reduction in lending behaviour given increased pressure from supervisors to comply with regulated capital adequacy requirements. An interesting observation from this study is that support for the credit crunch hypothesis is only found based on Japanese bank data for the late 1990's when the regulatory and supervision framework was significantly increased. The results show that up to 1995 poorly capitalised Japanese banks actually increased bank lending relative to better capitalised banks.

ii. Emerging markets

Hassan and Hussain (2006) use a cross sectional model and data from 11 developing countries to find that capital adequacy regulation did not result in undercapitalised banks increasing their capital ratios. Their findings suggest that developing countries reduced RWA as banks became more risk averse in their lending and thereby reduced overall portfolio risk. Barajas et al. (2005) also researched a cross-section of emerging market bank data. They find evidence that emerging market banks increased both average capital levels and credit extension since the implementation of the Basel I. The results show limited evidence supporting the credit crunch hypothesis where lending is constrained through increased regulation. Within their sample of banks, they observe that the more financially developed countries exhibited a stronger probability of credit contraction following the introduction of capital adequacy regulation. They do however concede that this outcome could be skewed by the European emerging market countries in the sample, since the finding was less significant when the sample included only Latin American and Caribbean observations. Their findings were generally inconsistent with Chiuri, Ferri and Majnoni (2002) who assert that the implementation of risk based capital regulations under the Basel Accord significantly constrained credit supply in less capitalised emerging economy banks, especially for those banks operating under only a domestic banking licence. The authors argue that foreign owned banks are less affected by capital adequacy requirements suggesting that these banks are able to absorb regulatory shocks. Their research also considers alternative funding sources outside of the banking sector and they argue that emerging market economies suffer from

⁵ Peek and Rosengren (2000) show that the effect on the US lending market was a consequence of the collapse of the real estate market in Japan. This resulted in a decline in real economic activity in the commercial real estate sector in the United States which ultimately spilled over into bank lending.

poorly developed capital markets. They therefore conclude that increased capital regulation may have resulted in an aggregate credit contraction in emerging market economies as alternatives to bank funding are less established than channels in developed countries.

iii. South African evidence

The literature examining the impact of capital adequacy regulation on bank credit supply in South Africa is not particularly extensive. The research most closely aligned with this paper is an examination of bank lending behaviour by Cumming and Nel (2005). The authors assert that banks only respond to capital regulation if they have capital shortfalls relative to required minimum ratios. Their paper finds that the implementation of the original Basel Accord increased capital adequacy ratios in South African banks and that this increase was met through the raising of additional capital instead of reducing credit supply. This is attributed to well developed capital markets which allow South African banks to raise equity. Risk based capital regulation will have a less than significant effect on bank lending. They do however indicate that outside of the four dominant banks, smaller emerging banks may have to reduce lending as capital markets are less accessible for these banks. The authors do find evidence of a slowdown in lending towards certain asset classes like private loans and mortgages and into safer lower risk assets. Although this has improved portfolio risk it does limit credit supply to the private sector. This is highlighted as a concern especially for funding of Small and Medium Enterprises (SME's) as non-investment grade companies can be crowded out by more restrictive bank lending practices after the introduction of risk based capital regulation.

Section III

Scope of Research

a. Research objective

The primary objective of this study is to understand how South African banks have altered aggregate credit supply over the 1994 to 2013 observation period and to establish whether;

1. the introduction of risk based capital regulation through the Basel Accords affected the capacity or propensity of banks to supply credit to the real economy, or if
2. the changes in aggregate bank lending are more attributable to other demand and supply factors.

A secondary objective of the study is also to analyse the extent to which South African banks have increased risk taking in both retail and commercial lending portfolios over the observation period.

b. Data description

Aggregate industry bank data was obtained from the South African Reserve Bank (SARB) website.

The relevant data series used are:

1. Monthly balance sheet data for the aggregate South African banking industry – DI900 and BA900 series.
 - DI 900 data is available from January 1993 to December 2007 and reporting standards are compliant with Basel I requirements.
 - BA900 data is available from January 2008 to June 2013. Monthly data was consolidated to allow comparison of balance sheets under the two reporting formats.
2. Quarterly capital adequacy data for the aggregate South African banking industry – DI400 and BA700 series. Monthly data for DI400 is only available from January 2001. To facilitate more reliable comparisons and be consistent between different periods, quarterly data has been used for the full 1994 to 2013 observation period for all capital adequacy calculations.
 - DI400 data is available from January 1994 to December 2007 and reporting standards are compliant with Basel I requirements.
 - BA700 data is available from January 2008 to June 2013.

The following additional data was also utilised in the study:

3. Inflation and interest rate data was sourced from the Statistics South Africa website.
4. Banking liabilities to the public and GDP data was sourced from Thompson Reuters Datastream.

c. Research methodology

The study is split into two periods. The first period is from 1994 to 2007 and findings are qualified under the Basel I capital framework where banks were required to maintain minimum capital adequacy ratios of 8%. South African banks were required to meet this standard by 1995 with the South African Reserve Bank (SARB) raising the target capital adequacy requirement to 10% in 2001. The second period runs from 2008 to 2013 with all findings being contextualised under the Basel II framework. An important qualification for all findings relating to RWA and credit supply over this period is that credit risk is measured under the Standardised Approach with all commercial lending being risk weighted at 100%.

The specific outcomes associated with the primary research objective are to focus on:

1. Bank capital adequacy
 - Analyse trends in capital adequacy ratios and examine whether these are attributable to an increase in qualifying capital or a reduction in RWA.
2. Credit supply
 - Assess the extent to which banks have been substituting between higher on-balance sheet RWA for lower on-balance sheet RWA.
 - Understand how banks have altered credit supply at the aggregate industry level and examine any differentiation between credit supply to the retail and commercial segments of the market.
 - Review both the composition and annual growth rates of banks lending in the retail and commercial segments and identify trends in credit supply across the primary lending categories in the portfolio. These include home loans, overdrafts and personal lending in the retail segment and commercial mortgages, overdrafts and term loans in the commercial segment.
3. Developing a VAR model using time series data to test the relationship between bank lending and capital adequacy over the observation period. The model will be further explained in Section VII.

d. Limitations of the study

1. Exclusion of off-balance sheet (OBS) lending.

- This paper only considers on-balance sheet lending and credit risk in the banking book. The analysis is undertaken at the aggregate industry level so does not include an analysis of bank holding company (BHC) data. The primary reason for isolating ‘vanilla’ on-balance sheet lending is because this encompasses the primary form of credit extension to the real economy in South Africa.

2. Data Consistency

- A constraint in analysing historical trends over the full observation period is that SARB reporting requirements are not consistent from Basel I, II and III. Basel I disclosures only required reporting of risk weighted credit exposure across the different weighting buckets with this amount used for capital adequacy calculations. Basel II distinguished between credit, operational, market, equity and other risk in terms of the SARB reporting requirements and risk weighted exposure is reported in aggregate across these categories for capital adequacy calculations. Basel III disclosure is also based on total risk weighted exposure but because only two periods of quarterly data to June 2013 is included in the following analysis, this is not expected to materially impact the findings of this paper.

Section IV

The evolution of capital adequacy regulation

a. The Basel Committee on Banking Supervision (BCBS)

The convergence of international bank capital regulation was largely based on the increase in cross-border lending between countries in the 1970's and the threat to the payments system which arose due to the increased foreign exposure of banks (Lall, 2009). Lower capital adequacy requirements in some countries provided opportunities for larger banks to gain a competitive advantage by extending credit in less regulated jurisdictions. The standardisation of capital regulation was predominantly founded on the need to protect the banking industry from the spillover effects of bank failure and the need to protect the global economy from the potential transmission of shocks which could arise from regulatory arbitrage (Barth et al., 2006). The failure of the West German bank, Bankhaus Herstatt, in June 1974 due to estimated losses of £200m from foreign exchange trading catalysed the need for an international standard of banking regulation. The BCBS was established at the end of 1974 following the distress in international banking and foreign currency markets (Heffernan, 2005). The Committee's initial members were composed of senior representatives of central banks and supervisory agencies from Belgium, Canada, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Spain, Sweden, Switzerland, the United Kingdom and the United States. Although the committee does not possess any legal authority, the initiative to implement an international framework of best practice by engaging with supervisors of member countries has largely resulted in a convergence in capital adequacy standards. The US bank and thrift crisis provided further impetus for governments and supervisory agencies to improve regulation and control risk taking in the banking system. In the early 1980s, the Committee became increasingly concerned that capital ratios of internationally active banks were deteriorating and that arbitraging capital ratios through cross border lending especially in heavily indebted Latin American countries could result in a contagion effect in the banking industry (Barth et al., 2006). Backed by the G-10 Governors, the Committee recognised the urgency of designing an international accord to improve the stability of the banking industry⁶. These efforts combined with the BCBS consensus to introduce a weighted approach to measuring both on and off-balance sheet (OBS) risk, eventually culminated in the adoption of a new global standard of bank capital adequacy (BIS, 2013).

⁶ The Group of Ten (G-10) consists of 11 developed countries, Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States which consult on global economic and financial policy matters (Investopedia, n.d.)

b. The Basel Accords

i. Basel I

1. Background

The 1988 Basel Capital Accord, more commonly referred to as Basel I, made an important contribution to the harmonisation of bank capital regulation by promoting the convergence of international capital standards and providing a framework by which banks can be assessed on a like-for-like basis. An agreement for the Basel Capital Accord (Basel I) was reached in July 1988 which was to be phased in and implemented by January 1993 (BIS, 1988). The focus of the accord was on capital adequacy and standardised definitions for credit risk (Santos, 2000). According to Jackson et al. (1999) the implementation of a standardised capital framework for internationally active banks was based on two primary objectives:

- To strengthen the safety and soundness and improve the overall stability of the international banking system through more robust capital adequacy requirements
- To minimise cross border inequalities between internationally active banks and to reduce any competitive advantage of arbitraging lower capital requirements in one country over another.

The Basel I framework was intended to make regulatory capital more risk sensitive, account better for OBS exposure and lower the disincentives for holding low risk liquid assets (Jackson et al., 1999). Basel I was designed for all countries comprising the G-10 with the scope of the framework only intended to encompass developed market economies. Emerging markets faced unique regulatory concerns and although they were explicitly excluded from the 1988 Accord, some of these countries also came to adopt the framework as the *de facto* standard of best banking practice (Barth et al., 2006; Balin, 2008).

2. Capital Adequacy Requirements

Basel I established a common set of capital adequacy standards for banks of participating countries. Risk weightings were determined by the both the type of credit and nature of the issuer with government debt assigned the lowest risk weighting. The 1988 Basel Accord focused exclusively on credit risk. Five primary risk categories were established for weighting bank assets ranging from a 'risk-free' 0% for OECD government or sovereign debt to 100% for any corporate debt exposure regardless of the underlying counterparty. Basel I required banks to manage their capital adequacy

where a minimum of 8% of a bank's RWA must be covered by Tier 1 and Tier 2 capital reserves⁷. Therefore a risk weighting of 20% would require at least 1.6% of the asset value to be held as capital (20% risk weighting x 8% minimum capital). An additional requirement was that Tier 1 capital comprise a minimum of 4% of a bank's RWA. (BIS, 1988; Balin, 2008). Minimum capital adequacy ratios could be achieved through banks issuing new equity, decreasing lending or changing the product mix of their portfolios by substituting higher risk assets for lower risk assets without altering the overall level of assets in the portfolio (Cumming and Nel, 2005).

3. Benefits of Basel I

Basel I has largely been credited for the international convergence of bank capital standards and providing an objective framework for risk based capital ratios (Santos, 2000). According to Burhouse et al. (2003) the risk based capital regulation framework provided by the 1988 Basel Accord has assisted in stabilising the international banking system. Bank safety and soundness is dependent on a variety of factors but the advancements under Basel I has enhanced the global competitiveness of banks through the implementation of uniform capital standards. Equivalent standards minimise the risk of arbitraging capital requirements in one jurisdiction over another in any cross border lending. The safety and soundness of the banking system is thereby greatly improved as banks, as well as creditors, depositors and general taxpayers, are able to benefit from a common set of regulations. For multinational banks conforming to a global capital standard is also less costly than having to adhere to specific regulatory requirements in the different countries in which their international branches are registered.

4. Criticism of Basel I

The design and conceptual shortcomings of Basel I have resulted in widespread industry criticism of the original 1988 accord. Financial innovation has created opportunities for regulatory capital arbitrage and increasing evidence of distortions in modern banking necessitated the supervisors and

⁷ Tier 1 or core capital is defined as common equity shares, disclosed reserves, non-cumulative preference shares, other hybrid equity instruments, retained earnings and minority interests in consolidated subsidiaries (excluding goodwill and other deductions)

Tier 2 capital consisted of an upper tier component which included cumulative perpetual preferred stock, loan loss allowances, undisclosed reserves, revaluation reserves, general loan loss reserves, hybrid debt instruments, cumulative preference shares. Lower Tier 2 capital was comprised of subordinated debt which included instruments like convertible bonds and cumulative preference shares.

Risk-adjusted assets is defined as the sum of the risk adjusted assets both on and off-balance sheet. On-balance sheet assets were assigned to one of five risk weighting buckets between 0% and 100%. Off-balance sheet credit exposure was weighted according to the underlying credit risk of the counterparty originally issuing the debt. These off-balance sheet contingent items included assets like letters of credit and derivatives which were typically traded over the counter (OTC) and were required to be converted to a credit equivalent for risk weighting purposes (Santos 2000).

regulators to question the effectiveness of the framework (Santos, 2000). The main criticisms of Basel I include:

One size fits all. There was no differentiation between established investment and commercial banks versus more retail oriented banks. All banks of participating countries were expected to comply with the minimum capital adequacy ratios with uniform standards applying to both economies with well-developed financial systems like the US and those OECD countries with less developed financial markets. Using equity as a measure of bank capital adequacy largely ignores the fact that countries have different degrees of access to capital markets (Heffernan, 2005).

The focus of Basel I was considered to be too narrow in that the accord only considered credit risk and largely ignored market and operational risk. In addition, the calibration of specific credit risk weightings implemented in Basel I were also considered too subjective and simplistic, with OECD government debt assigned a 0% weighted compared to commercial bank loans which carried a 100% risk weighting. Basel I did not explicitly cater for the adjustment to the risk weightings of developing countries' government debt. In the absence of an adequate developing market framework, the risk free status of government paper under Basel I also came to be applied in developing countries where the risk of sovereign default was considered relatively higher than in the majority of OECD countries. Furthermore, not all OECD countries credit risk could be considered equal in terms of a proxy for a 'risk free rate' (Barth et al., 2006). All corporate debt was assigned the same risk weighting regardless of the underlying credit risk of the issuer which means that a AAA rated counterparty would attract the same risk weighting as a BBB rated corporate issuer. Given that all commercial loans attracted the same risk weighting of 100%, banks were actually incentivised to pursue increased risk taking under Basel I. The higher returns available on riskier credit were appealing to banks since lending to a riskier counterparty required the same amount of capital to be set aside as for a counterparty with lower actual credit risk. Riskier lending therefore required the same amount of capital and provided greater upside in the form of higher returns. (Hogan and Sharpe, 1997).

Basel I gave banks the ability to engage in disintermediation of credit by shifting on-balance sheet assets with higher risk weighting requirements and securitising these off balance sheet at lower weights (Blundell-Wignall and Atkinson, 2010). The original Basel Accord incentivises risk taking by banks by shifting capital to less regulated categories and engaging in regulatory capital arbitrage. Mortgages and corporate loans could be securitised as Mortgage Backed Securities (MBSs) or Collateralised Debt Obligations (CDOs) respectively – the underlying mortgage for example is risk weighted at 50% but when the loan is packaged as a MBS the bank would assign a risk weighting of 20% if the issuer is an OECD bank. The best credits were often selected to be securitised which would ultimately result in a lower quality loan book on the balance sheet (Lybeck, 2011).

The introduction of the 1996 Market Risk Amendment also contributed significantly to capital arbitrage activity⁸. Banks were able to reduce regulatory capital requirements by arbitraging credit risk between the banking and trading book, whereby originating and marking credit lending facilities would attract a higher capital charge than investing in listed commercial paper or corporate bonds of a specific company. The lending facility would attract a charge of 8% while the capital requirement would be significantly lower following the market risk amendment (Jackson et al., 1999).

Market innovation occurred because of the discrepancies surrounding the ambiguity around the constituents of Tier 1 and Tier 2 capital. The treatment of OBS credit exposure was considered too simplistic in that no capital was specifically set aside for the possibility that debt instruments like longer maturity bonds could lose value due to interest rate and liquidity risk (Heffernan, 2005).

ii. Basel II

1. Background

The criticism of the 1988 Basel Accord resulted in the Basel Committee amending the original framework and proposing a new framework in 1999 which was to be phased in by the end of 2006. (Heffernan, 2005; Balin, 2008). This accord was formally titled “A Revised Framework on International Convergence of Capital Measurement and Capital Standards” but is more commonly referred to as Basel II. According to Lybeck (2011), the aims of Basel II were to provide regulators with more flexibility and move away from the more rigid ‘one size fits all’ approach of Basel I, introduce a more variable risk weighting to calibrate for actual or expected asset risk and to broaden the scope of the framework to include credit, market and operational risk. Banks were also encouraged to use more modern Value at Risk (VaR) models to calculate the probability of a given portfolio declining by more than a certain amount over a specified period of time (BIS, 2004). Larger more sophisticated banks with robust risk management systems were provided with the opportunity to use internally developed models to measure risk levels. Basel II therefore created a more risk sensitive framework for the calculation of a bank’s capital charges and also attempted to minimise the loopholes in the original Basel I framework for arbitraging minimum capital adequacy requirements (Balin, 2008).

⁸ The 1996 Market Risk Agreement which introduced a more direct treatment of off balance sheet items and applied a capital charge for the inherent market risk linked to all traded instruments

2. Structure

Basel II is premised on 3 pillars:

Pillar 1 is referred to as ‘Minimum Capital Requirements’ and outlines the quantitative requirements for the capital charges applicable to credit, market and operational risks. It improves on Basel I by providing a more granular approach to the credit risk weighting by more closely aligning the capital charges with the underlying credit risk of the bank’s assets.

Pillar 2 provides the regulatory framework for the interaction between banks and their national supervisors. No explicit regulation is provided and supervisors are afforded the discretion to oversee the implementation of internal rating based approaches and intervene in banks in the national jurisdictions as deemed appropriate. Conducting stress testing and implementing suitable capital buffers would be an example of expected intervention at the Pillar 2 level (Heffernan, 2005).

Pillar 3 focuses on market discipline and proposes guidelines on the provision of timely and transparent information for public record. Important disclosures included capital adequacy, risk exposure and internal calculation methods for deriving capital requirements (Heffernan, 2005).

A more comprehensive analysis of pillars 2 and 3 is outside the scope of this thesis. This paper focuses exclusively on the capital requirements of bank regulation as applicable to the credit risk component of Pillar 1 of the Basel II Accord.

3. Credit Risk

The measurement of credit risk was amended to reflect the shortcomings of Basel I with banks given the option of three approaches under Basel II:

- The Standardised Approach
- Foundation Internal Ratings Based Approach (IRB)
- Advanced Internal Ratings Based Approach.(A-IRB)

The standardised approach is a modification of the original 1988 Basel framework and was specifically tailored towards banks which were unable to implement their own internal ratings based models. Risk weightings were however amended from 0% for low risk credit exposure to 150% for very high risk credit exposure. The new approach in terms of measuring credit risk according to defined rating bands was implemented to largely disincentivise banks from increasing lending to lower rated counterparties. Ratings were provided by external and independent credit rating agencies and banks were required to set aside less capital for advancing credit to higher rated corporates and sovereigns as these are generally considered to be safer borrowing entities (Heffernan, 2005).

Basel II also introduced an IRB approach which allowed banks to utilise their own internally generated risk weighting systems subject to the approval of the national supervisor for the specific bank. Banks adopting this alternative IRB approach relied on more sophisticated models which required the use of internal credit ratings and borrower information to determine the amount of capital which needed to be set aside for different types of lending. Banks used predominantly quantitative models which relied on the differentiating and calculating credit risk based on

- Probability of default (PD) – the probability of a counterparty defaulting on its loan obligations.
- Exposure at default (EAD) – the expected credit exposure in the event of loan default.
- Loss given default (LGD) – the expected net loss to the bank in the event of default after adjusting for any security or collateral recovered from the borrower. The higher the quality and quantity of collateral, the lower the LGD.

By allowing banks to use their own risk rating systems, both the foundation and A-IRB approaches encourage banks to provide credit to counterparties considered lower risk. These loans are typically assigned lower risk weightings and therefore have lower probabilities of default. The lower risk weightings translate into lower capital charges or lower reserve requirements and therefore result in higher bank profitability (Balin, 2008). A further initiative under the A-IRB approach was to allow banks to utilise their own internally developed models to measure credit risk and thereby more closely align regulatory capital with the underlying risk exposure and minimise the incentive for arbitrage (Lall, 2009).

4. Criticism of Basel II

Procyclicality. Companies are more likely to require increased credit extension when the economy is in a downturn or recession and avail of less credit when the economy is performing well. Procyclicality refers to the propensity for banks to adjust their appetite for credit extension based on the economic cycle. Banks will generally have more appetite to advance credit when economic conditions are favourable to companies generating competitive returns and restrict credit when the economic cycle deteriorates. Companies experience reduced profitability, falling share prices, increased loan losses and default rates as well as ratings downgrades by third party credit rating agencies during economic downturns. The company will therefore be perceived to be more risky and banks would consequently restrict lending as capital regulation under Basel II would require more capital to be set aside for any credit advanced to the company. This behaviour by banks will have the effect of exacerbating the economic downturn by constraining access to credit when it could be argued that companies need banking facilities the most.

Securitisation. According to Heffernan (2005), the capital requirements of Basel II also provide an incentive for banks to shift or transfer credit risk off balance sheet. Banks become conduits of risk by originating the loan and then transferring the credit risk to yield seeking institutional investors. These loans are then securitised or pooled and assigned a rating by a credit rating agency. Investors therefore rely on the credit rating agencies to estimate the underlying credit risk of the securitised assets and can also purchase a type of insurance, known as a credit default swap (CDS) to hedge against the risk of default on the underlying debt. An associated concern was that, while credit rating agencies had developed models to certify the safety of individual companies, their models had not been tested for rating pooled assets where the specific intention of the originating banks was OBS credit risk transfer. The Standardised Approach of Basel II also relies heavily on credit rating agencies to estimate company credit risk and provide a rating which allows banks to price lending on a risk adjusted basis. Small and Medium sized enterprises (SME's) would typically not be rated and the reliance on rating agencies under Basel II regulations could increase lending premiums and thereby potentially crowd out lending towards SME's. (Cumming and Nel, 2005)

iii. Basel III

1. An overview of the 2008 Financial Crisis

The structural capital and liquidity reforms proposed under the Basel III framework resulted as a consequence of increased risk taking by banks through an arbitrage of leverage in the financial system. The period leading up to the financial crisis in 2008 was characterised by a build-up of leverage in the banking system which eventually culminated into an international solvency and liquidity crisis. The quality and quantity of banks capital had deteriorated significantly and market sentiment was adversely affected by liquidity constraints in the interbank market (Brunnermeier, 2009). This crisis had its origins in the US housing market which experienced substantial growth between 2001 through a combination of investors searching for yield and increased securitisation issuance (Priewe, 2010). Banks originated structured finance products like Collateralised Debt Obligations (CDO's) which were pools of income or cash generating assets packaged primarily for institutional investors. In the case of Collateralised Mortgage Obligations (CMO's) in the United States the underlying cash flows which were responsible for servicing the debt were highly geared US home owners. There was a material undervaluation of risk in the financial system with banks, credit rating agencies as well as pension funds, asset managers and hedge funds actively trading in what was classified as investment grade securities. The market appeared relatively liquid given the demand for these toxic assets with downside protection provided by credit default swaps (CDS) in the event that there was a default on repayment. Originating banks held most of their CDO exposure off-balance

sheet in special purpose vehicles (SPV's) which gave rise to the so called 'shadow banking' industry. The crisis was triggered when the underlying income streams became distressed through increased insolvencies and write downs of subprime mortgage and other real estate assets. In this context the crisis can be viewed as both a capital and credit crunch as overstated property assets were devalued and over leveraged households were unable to service their debt obligations which had been packaged as CDO's. The banking system was unable to cover the magnitude of credit and trading losses which had built up and the OBS exposure in the shadow banking industry threatened the stability of both the financial system and the real economy (BIS, 2010a). Developed market banks were particularly exposed with the existing Basel regulatory and supervisory framework not able to contain the level and complexity of financial innovation being employed in affected developed market investment banks. The vulnerability of the interbank market demonstrated that banks liquidity buffers were insufficient to mitigate systemic risk in the highly leveraged banking sector. Re-rating of credit risk led to an unwinding of leverage as impaired assets and loan losses reduced bank capital (equity) which resulted in banks behaving more pro-cyclically and contracting credit supply (BIS, 2010a).

2. Background

The Basel Committee introduced a reform package titled Basel III: A global regulatory framework for more resilient banks and banking systems in December 2010 (revised June 2011) which, together with Basel III: International framework for liquidity risk measurement, standards and monitoring, aims to address the shortcomings of the regulatory and supervisory framework exposed by the financial innovation and arbitrage endemic during the 2008 financial crisis. The overall objective of both capital and liquidity reforms is to strengthen the resilience of the banking industry by implementing improved risk management tools to mitigate the system risk and negative spillover effects into the real economy. There is also a strong emphasis on better governance and increased transparency to improve the integrity and robustness of the financial system as a whole (BIS, 2010a).

3. Enhanced capital framework of Basel III

The revised capital reforms of Basel III build on the three pillars of Basel II but introduce enhanced risk controls through a leveraged ratio to contain excessive risk taking. Additional capital buffers are introduced to minimise the systemic risks of procyclical lending behaviour and mitigate against the negative effects which arose from the contraction in credit supply that followed the 2008 financial crisis.

Increasing the quality and quantity of bank capital

Basel III places a stronger emphasis on identifying that part of the capital base that provides the highest form of loss absorbency in a going concern. The focus on regulatory capital is therefore predominantly on Tier 1 Capital and specifically tangible common equity (TCE) comprising primarily of common shares and retained earnings. The minimum common equity requirement Tier 1 (CET1) has been increased from 2% to 4.5% of RWA. Tier 1 capital is required to increase from 4% to 6% with the minimum total capital required remaining at 8%. Deductions from regulatory capital like goodwill and deferred tax assets must generally be made from CET1. The remaining tier 1 capital base must consist of instruments that are either subordinated or have full discretionary non-cumulative coupons without a redemption requirement at a specified maturity date (BIS, 2010a).

Introducing specific risk management controls

A capital conservation buffer of 2.5% has been introduced to ensure banks are able to build up additional capital outside periods of financial distress and are able to draw down on this excess capital in the event of losses during future periods. This buffer is composed of CET1 and banks are required to hold this in excess of minimum regulatory capital. The requirement for total common equity inclusive of this capital conservation buffer is 7%. Banks breaching this minimum level will be restricted from capital distributions like dividend payments, share buybacks, and discretionary staff bonus payments. The minimum regulatory capital is set at 6% for tier 1 over RWA and total capital of 8% over RWA at all times.

The BCBS has also introduced a countercyclical buffer of 0% to 2.5% of RWA. This has been designed to minimise the risk of procyclicality and protect the banking industry against potential future losses following periods of excess aggregate credit growth. National regulators are provided with the discretion to utilise the countercyclical buffer when system wide risk is judged to be building up to excessive levels. Regulators are required to monitor credit growth in their national jurisdictions and implement the buffer when the stability of the banking system is believed to be compromised. The buffer is therefore a mitigant to excessive risk taking and the percentage applied would depend on where banks are positioned in the credit cycle. It will be implemented as an extension of the capital conservation buffer and composed of CET1 capital.

The Basel Committee will also introduce a non-risk based leverage ratio to supplement risk weighted capital requirements. A minimum leverage ratio of 3% which is calculated as Tier 1 capital over total assets is being tested by the committee. The leverage ratio needs to be robust over a full credit cycle and complement the reformed capital requirements in constraining the build up of excessive leverage

in the banking system. It has been proposed to provide a simple, transparent and objective measure of risk and serve as a backstop to risk based capital requirements.

4. Liquidity measures under Basel III

Banks entered the financial crisis with insufficient liquidity in 2008 and the re-pricing of risk in overvalued asset markets accompanied by negative market perceptions of banks' liquidity management required central banks to intervene in money markets to address liquidity constraints (BIS, 2013). Basel III provides an enhanced liquidity framework by introducing two new global minimum standards for measuring funding liquidity. These standards are intended to make banks more resilient to potential funding disruptions in the short term as well as improve the stability of long term funding by addressing the structural liquidity mismatch between assets and liabilities on banks' balance sheets (BIS, 2010a). The primary reforms introduced under the enhanced liquidity framework are the Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR).

Liquidity coverage ratio (LCR)

The LCR is designed to improve short-term liquidity coverage and requires banks to hold sufficient high quality liquid assets (HQLA) to meet potential cash outflows arising from a stressed funding scenario, including a run on the bank or withdrawal of wholesale funding, over a time period of 30 days (BIS, 2010b).

$\text{LCR} = \frac{\text{Stock of High Quality Liquid Assets (HQLA)}}{\text{Net cash outflows over a 30-day period}} \geq 100\%$

The Basel Committee amended the definition of HQLA in January 2013 to incorporate level 2B assets which will be subjected to higher haircuts. The implementation of LCR will be phased in over 4 years with banks required to maintain a minimum LCR of 60% in 2015 with an incremental annual increase of 10% to the required 100% at the start of 2019. The LCR requirements divide HQLA into Level 1 assets and Level 2 assets. Level 1 assets comprise higher quality, more liquid assets like cash, bank reserves held at central banks and government bonds typically assigned a 'risk free' 0% weighting under Basel III credit standards. Level 2 Assets consist of relatively higher risk and more illiquid public and private sector securities like lower rated sovereign debt and corporate bonds. The original LCR standard required that private sector Level 2 Assets be limited to senior debt corporate securities with a minimum external credit rating of AA-. The revised LCR standards issued by the BIS broaden the scope of corporate securities eligible for inclusion in Level 2 Assets by differentiating between

Level 2A Assets which are consistent with the original Level 2 Assets Level 2B Assets which are eligible for inclusion under HQLA but will be subject to larger haircuts than Level 2A Assets and can comprise a maximum of 15% of a bank's HQLA after haircuts are applied. The original restriction of level 1 assets constituting a minimum of 60% of total HQLA and Level 2 assets a maximum of 40% still applies despite the expanded definition of Level 2 (BIS, 2013).

Net Stable Funding Ratio (NSFR)

The intention of the NSFR is to reduce the reliance on short-term wholesale funding and to encourage the use of more stable funding sources (BIS, 2010b). The intention is effectively to address maturity mismatches at banks by reducing the duration gap between longer dated assets and shorter term liabilities. Implementation is planned for January 2019 but the ratio is subject to further calibration before national regulators introduce the ratio in their domestic banking jurisdictions.

NSFR	=	$\frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}}$	>100%
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Section V

An overview of the South African banking industry

a. Regulatory Framework

South Africa belongs to the G-20 group of countries and is a member of the Bank for International Settlements (BIS) with the South African Reserve Bank (SARB) implementing the Basel II framework in 2008. The financial services industry is well developed with robust regulatory requirements which were adopted to comply with international best practice following the emergence of the country from political isolation under its apartheid policies. The implementation of more institutional regulation in the South African banking sector prior to the 1980's resulted in banks being over regulated. The De Kock Commission was initiated by government in 1987 to recommend structural reforms following concerns that more bank specific regulation had caused the industry to lag market central banks and supervisors migrating towards the Basel I standards. This culminated in the Banking Act of 1990 which introduced risk management standards consistent with those observed in international markets (Botha and Makina, 2011). The structure of the South African financial market has resulted in the adoption of the 'twin peaks' model of financial regulation where there is a deliberate separation of regulatory function between regulators – one addressing the safety and soundness objectives and the other focussing on consumer protection and transparency. The objective is to create a more resilient financial system supported by the initiatives of prudential regulation, stability and market integrity through appropriate conduct of market participants. The twin peaks system is underpinned by maintaining autonomy in line with these objectives but also providing intermediary channels to resolve issues of conflict should they arise. The SARB is the supervisory authority responsible for prudential regulation and regulating deposit taking institutions, while the Financial Services Board (FSB) is responsible for independently regulating the business conduct of non-deposit taking institutions. The integrity of the financial system is further enhanced by the National Treasury and the National Credit Regulator (NCR) which regulates credit extension in both bank and non-bank financial institutions (Financial Sector Regulation Bill, 2013).

b. Structure of the banking industry

The structure of the South African market is differentiated from most developed markets to the extent that the banking sector is less fragmented with four established commercial banks holding around 85% of total banking industry assets (IMF, 2010). The industry is highly concentrated with a Herfindahl-Hirschman Index (H-Index) of 0.187 at the end of December 2011 (South African Reserve Bank, 2011). Standard Bank [JSE:SBK], Absa⁹ [JSE:ASA], FirstRand [JSE:FSR] and Nedbank

⁹ ABSA Group Limited [ASA] renamed to Barclays Africa Group Limited [JSE:BGA] on 2 August 2013.

[JSE:NED] are the dominant banks in the country and the main providers of credit to both households and corporates. This concentration does introduce a degree of systemic risk into the banking sector but this is mitigated to a significant extent by stringent regulation by the SARB. The South African banking industry was less affected by the 2008 financial crisis than its developed market peers due to the stability of the financial system (Mboweni, 2008). The South African experience demonstrates the advantages of a prudent regulatory system and stringent risk controls to prevent negative externalities from spilling over from the banking sector into the real economy. This was further evidenced through the absence of any banking failures or need for liquidity support from government (Singh, 2010).

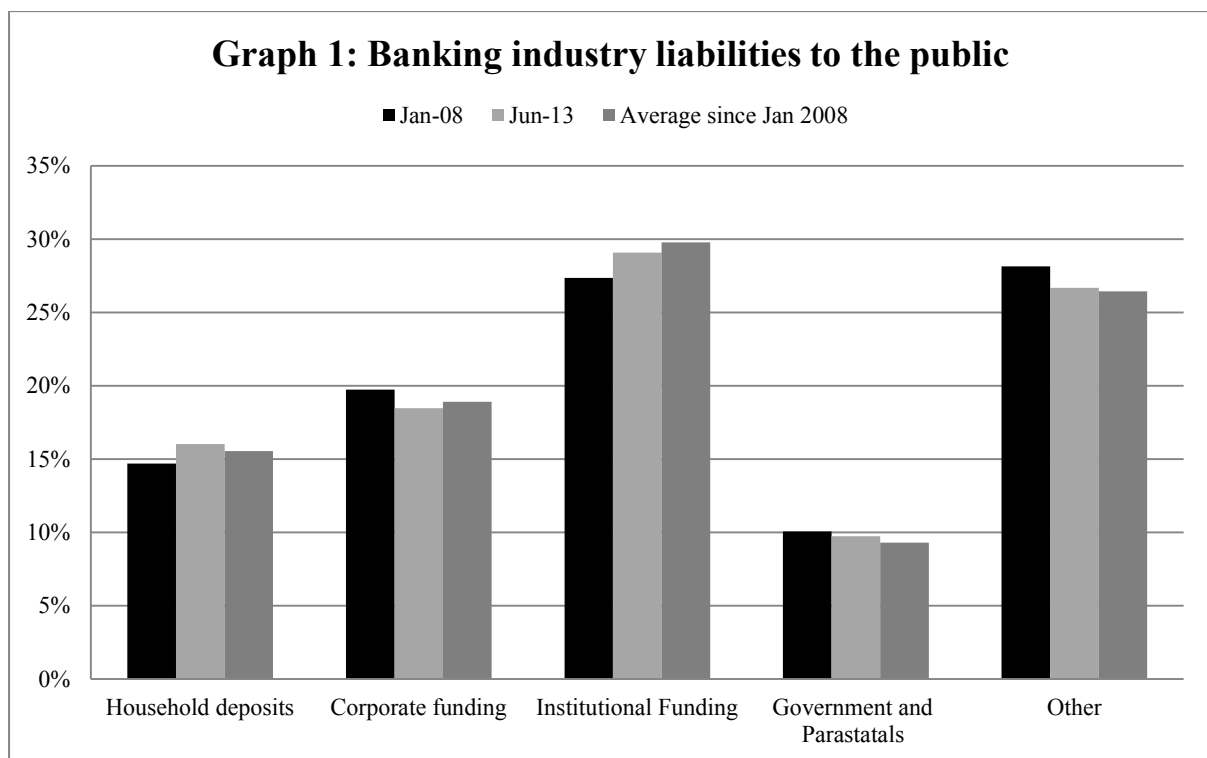
Important structural features which insulated the country from the effects of the crisis:

- South Africa has a closed loop system with a well-developed interbank market to cater for bank funding requirements. The structure of money markets from an exchange control perspective largely constrains market liquidity by preventing significant capital outflows from the country.
- The SARB imposes strict regulatory requirements on all registered banks in the country and is able to mitigate the risk of contagion by curtailing excessive risk taking by individual banks.
- Securitisation and lending through Special Purpose Vehicles (SPV's) or conduits is also highly regulated.
- The SARB proactively managed the credit risks of the 2008 financial crisis by investigating a sample of South African banks in 2007 to establish exposure to the US sub-prime mortgage market. (Mboweni, 2008)
- Leverage ratios are relatively low in South African commercial banks peaking between 16% and 20% in 2006 across the main four banks (RMB Morgan Stanley, 2012).
- The banking sector introduced important structural reforms to prevent the negative spillover effects of increased risk taking into the real economy. These include early implementation of the Basel II framework in January 2008 and the introduction of the National Credit Act (NCA) in 2007 which restricted excessive credit growth at the individual consumer and household level. Further initiatives include the implementation of best practice for corporate governance in the form of the King 2 Code. (Moody's Report, 2011).

These structural reforms have assisted in managing credit risk in the banking sector and largely hedged the country against the 2008 financial crisis as banks did not have to unwind excessive balance sheet leverage or write-off toxic assets to the same extent as their developed market counterparts.

c. Challenges facing the South African banking industry

The main challenge facing the South African banking industry, given its effect on credit supply as examined in this paper, is the overreliance on institutional funding. The Basel Accords have historically had a strong focus on bank capital but the experience of the 2008 financial crisis has reiterated the need to complement capital regulation with a liquidity framework which mitigates the risk of both retail and institutional funders withdrawing from the market. This is especially relevant in South Africa where money markets are characterised by low levels of discretionary household savings and a concentration risk towards institutional funding. Concerns around these inefficiencies were highlighted by Ivashina and Scharfstein (2010) who demonstrated that banks with limited access to deposit funding reduced bank lending by more than banks with more diversified financing sources during the 2008 financial crisis.



Source: SARB, Author's own calculations.

Graph 1 above looks at how South African banks have changed their funding mix since 2008. Institutional funding through pension funds, insurers, fund managers, and units trusts make up around 30% with corporates the second biggest contributor of bank funding. Banks are heavily reliant on private sector funding with corporate and institutional funders making up 49% of average liabilities over the last 5 years and household deposits only averaging 16%. On the evidence of the existing liability mix, the structure of the South African money market will make it difficult for banks to meet more rigid Basel III liquidity ratios without intervention or support by the SARB.

d. Implications of liquidity shortfalls in South African banks

Liquidity constraints in South African banks have prompted the SARB to approve the provision of a Committed Liquidity Facility (CLF) from which banks can draw down to meet the LCR requirements of Basel III. Quantitative Impact Studies (QIS) conducted by the BIS on seven South African Banks revealed shortfalls for the majority of participating banks in complying with LCR requirements. These shortfalls can largely be attributed to the structural nature of the South African money market and an over-reliance on shorter maturity wholesale or institutional funding as well as a limited pool of qualifying assets to meet HQLA requirements. Banks will be required to meet Level 1 assets with the CLF providing the shortfall banks require to meet net cash flows under a 30-day stressed scenario (denominator in LCR) up to a maximum of 40%. The SARB CLF will be implemented from 2013 and banks will be required to pay commitment fee regardless of whether the facility is availed of. The CLF is intended to effectively bridge South African banks during the phase in period to 2019 (South African Reserve Bank, 2012a).

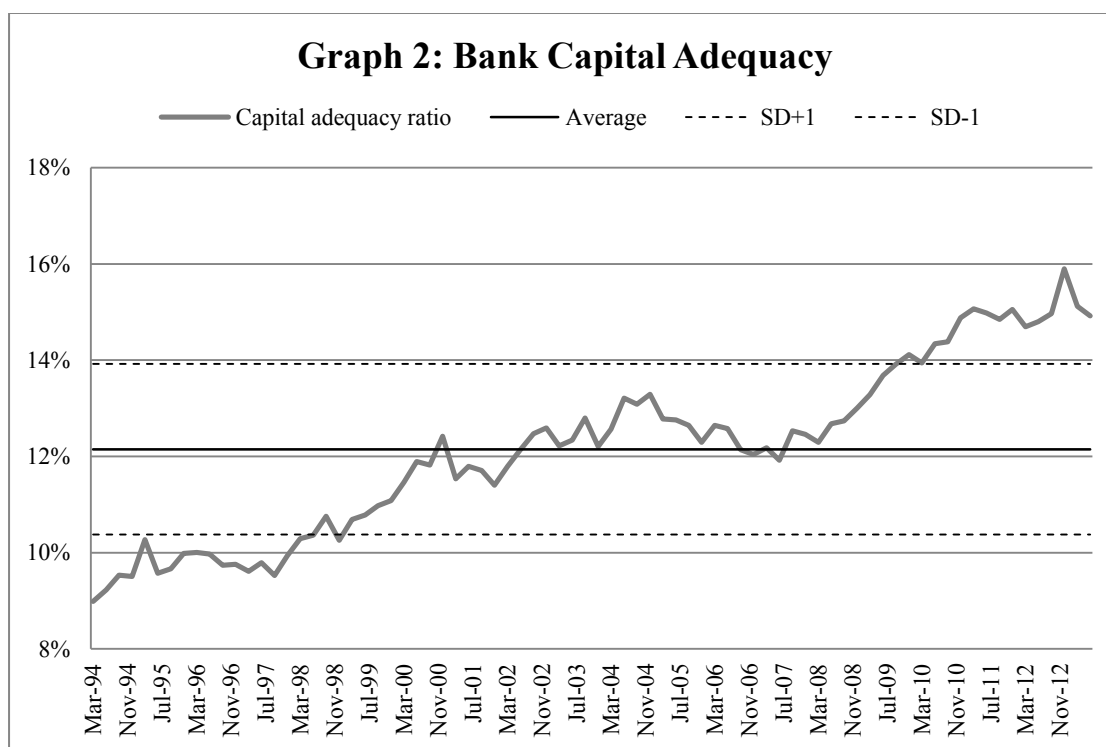
Banks will struggle to meet the NSFR unless requirements are amended prior to implementation in 2019. All the main South African commercial banks are negatively gapped – short funded with asset duration exceeding liability duration. Basel III incentives banks to shorten the duration between assets and liabilities and substitute away from extensive liquidity transformations where shorter term liabilities are utilised to fund longer term assets. It is also important to consider the cost of sourcing longer term funding which is less readily available through either the retail or institutional market. Although this paper makes no attempt to quantify any pass-through from higher funding into lending costs, it would not be unexpected for banks to increase lending rates to protect net interest margins. The shape of a normal yield curve is upward sloping with longer dated maturities yielding more than shorter maturities, thereby leading to a higher cost of funding for banks should they need to lengthen their funding profiles. Banks would be more willing to supply credit at higher interest rates but aggregate lending could fall if consumers are not willing to pay the increased liquidity premiums. The shortage of alternative credit funding sources in South Africa means that most borrowers are price takers. Both corporate bond and commercial paper markets have grown significantly over the last ten years but are not as deep and liquid as those in developed market economies.

Section VI

Bank Capital Analysis

a. Bank Capital Adequacy

South African banks were expected to be compliant with the minimum 8% capital adequacy ratio proposed by Basel I by 1995 with this minimum being increased to 10% in 2001 (Cumming and Nel, 2005). Basel II was introduced in January 2008 with the SARB imposing an additional 1.5% capital buffer (Pillar 2a) to the regulated 8% prescribed by the BCBS for systemic risk. The SARB is also able to utilise its national discretion to impose additional idiosyncratic buffers (Pillar 2b) on domestic banks depending on the risk profile of the individual bank (IMF, 2010). Basel III was introduced in January 2013 on a phased in approach to 2019. National discretion allows the SARB to impose more stringent capital standards on South African banks with additional requirements including a 2% buffer under Pillar 2a with scope for revision when appropriate. The SARB has discouraged individual banks from disclosing additional capital requirements for Pillar 2b as these are bank specific and not directly comparable across industry peers. The domestic systemically important bank (D-SIB) capital requirements have not been finalised but the SARB has indicated that standards will be determined by the systemic importance of individual banks and phased in over a 3-year period between 2016 and 2019. The SARB has however advised that the maximum capital ratio (excluding any bank specific or countercyclical buffers) a D-SIB will be required to maintain will amount to 14% (South African Reserve Bank, 2012b).

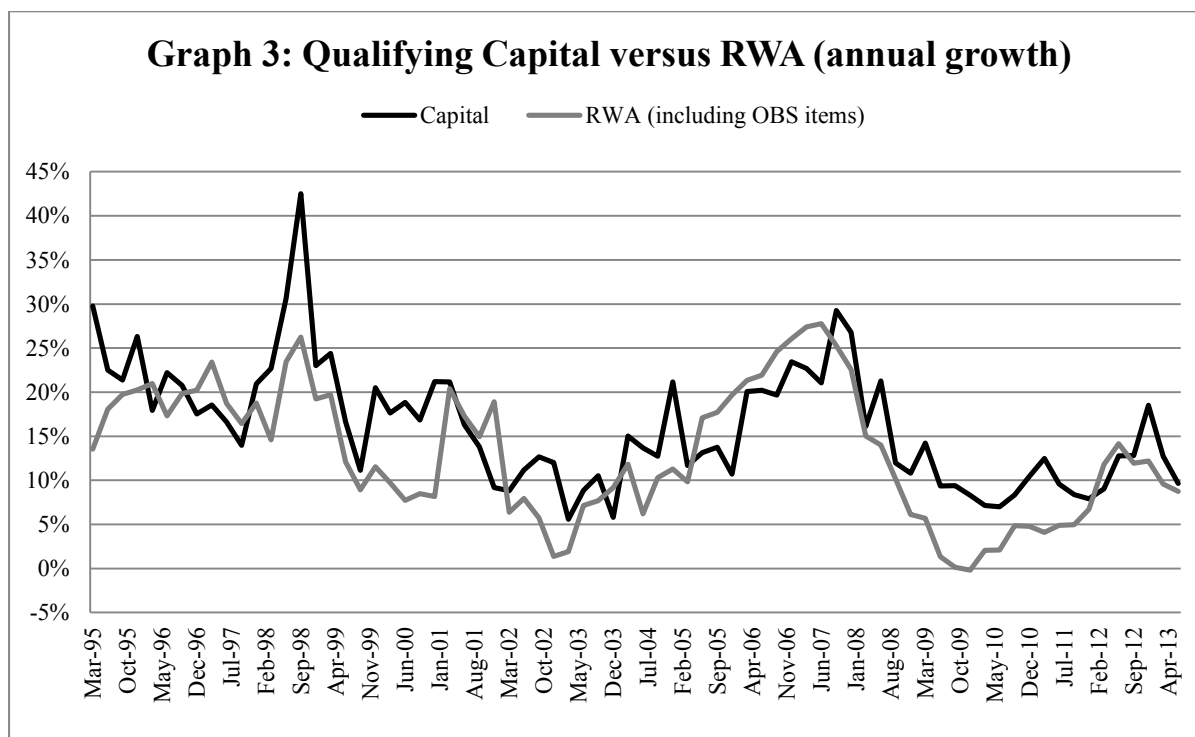


Source: SARB, Author's own calculations.

South African banks were fully compliant with the minimum 8% capital adequacy requirement under Basel I implementation by 1995 with this ratio increasing relatively consistently until the end of 2000 despite the absence of any additional capital adequacy regulation. Capital ratios were in excess of 12% in 2000 so the increased capital requirement of 10% introduced in 2001 would not require South African banks to raise additional capital, restructure their asset portfolios towards lower RWA or contract credit supply. The capital adequacy ratio experienced a gradual decline between 2005 and the beginning of 2008 as regulators were finalising the framework for the Basel II accord. South African banks were however still well capitalised leading up to the global financial crisis with a capital adequacy ratio (CAR) of around 12% when Basel II was implemented in 2008. The SARB implemented an industry assessment period from 2006 where the transition from Basel I to Basel II and the overall effect on the banking system would be assessed and amended based on the findings of a QIS (South African Reserve Bank, 2004). The CAR requirements were however still based on the existing Basel I framework so the reduction in capital ratios was not premised on any global or domestic regulatory intervention. An interesting observation is the significant increase in capital ratios between 2008 and 2011. Banks were already fully compliant with Basel II capital adequacy requirements which would suggest that other factors influenced the 3% increase in the capital ratio to 15% in 2011. In the year prior to Basel III implementation in January 2013, the CAR again increased to peak at 15.9% in December 2012. A possible reason for South African banks holding excess capital could be due to the lack of a deposit insurance scheme in the country which has been highlighted as a significant shortcoming in the domestic banking industry (IMF, 2010). Consistent with the view of Kashyap and Stein (1995), higher capital levels are used as a signalling mechanism to mitigate investor concerns on the riskiness of uninsured non-reserve liabilities. A simpler explanation is that South African banks hold excess capital for increased loss absorbency which according to Francis and Osborne (2009) shields credit supply from regulatory changes. The structure of domestic banks' balance sheets will also be significantly influenced by more stringent regulation by the national regulator as was evidenced by Furfine (2001) in the US banking sector.

As illustrated above, South African banks have historically been well capitalised with an average capital adequacy ratio of 12% since 1994. However, an important consideration is how South African banks have achieved higher capital adequacy ratios. The following section will assess whether banks have simply increased qualifying capital or changed the composition of their portfolios by adjusting risk weighted assets (RWA).

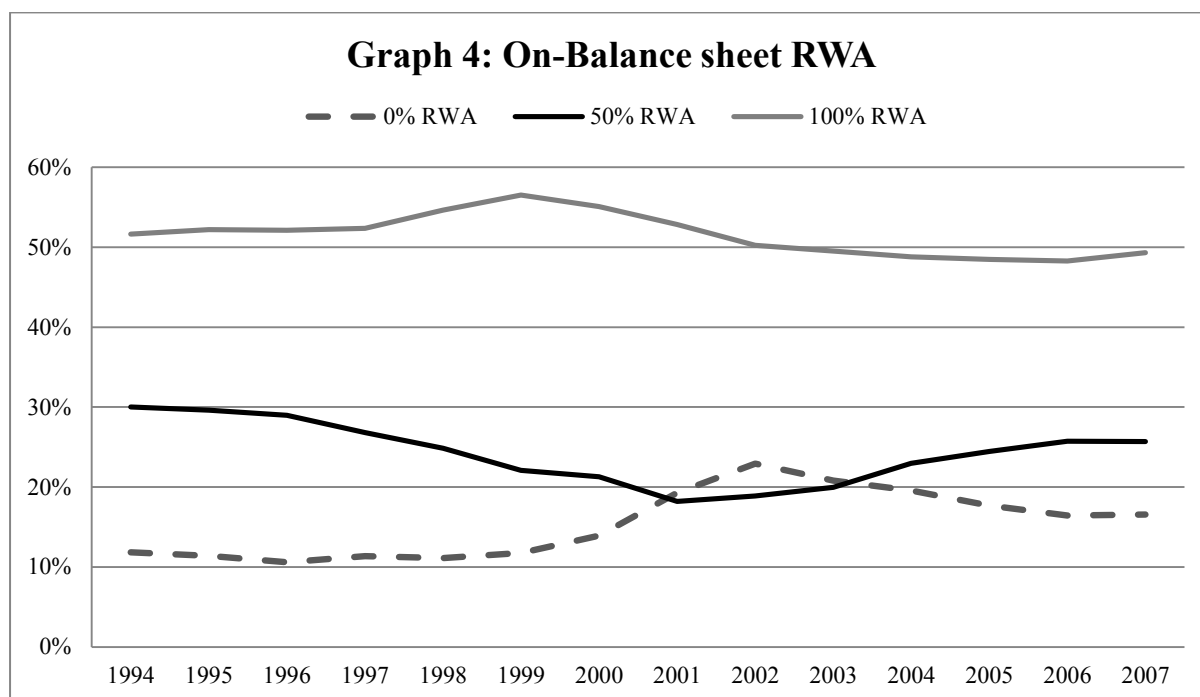
b. Qualifying Capital versus RWA



Source: SARB, Author's own calculations.
Total RWA includes off-balance sheet (OBS) items

An analysis of the components of the capital adequacy ratio has shown that banks have grown qualifying capital by an average of 16% and RWA by 13% a year over the full observation period. In short, South African banks have on average increased capital adequacy ratios by raising additional capital as opposed to reducing on-balance sheet lending. The evidence over the full period would suggest that the increase in bank capital adequacy ratio from 8% in 1994 to almost 16% in 2013 was driven by increases in qualifying capital as opposed to significantly adjusting RWA. This finding would support the conclusions by Cumming and Nel (2005) that South Africa has well developed capital markets for the raising of equity. The graph above shows that the only period South African banks were growing RWA faster than capital on a sustained basis was between 2005 and 2007. As expected the decline in the CAR between 2005 and 2007 was driven by this trend. The period between 2008 and 2010 represents a sustained period of qualifying capital falling by a slower rate than RWA and was a fundamental driver in the CAR increasing by around 3%. It's important to mention that banks struggled to raise additional capital over this period and the increasing CAR is more attributable to a significant slowdown in the annual growth rate of RWA's. The period also corresponds to a considerable slowdown in credit supply which will be further assessed later in this paper.

c. Analysis of RWA



Source: SARB, Author's own calculations.

Graph 4 above is an illustration of the risk weighted composition of bank loans expressed as a percentage of total on-balance sheet RWA. The 5%, 10% and 20% risk weighting categories have historically made up less than 10% of on-balance sheet RWA and have been excluded from the following analysis given the insignificant weightings in domestic banking portfolios. Post Basel I implementation banks were substituting away from 50% RWA with this trend largely continuing to 2001. Banks were already holding excess capital buffers by 1995 so the reduction in 50% RWA cannot be attributed to the requirement to comply with the minimum 8% capital adequacy proposed under the Basel I framework. The 2% increase in the capital adequacy ratio between 1998 and 2000 was driven by banks substituting away from 100% RWA towards 0% RWA. Effectively banks were substituting riskier commercial loans for government securities. Although this trend cannot be attributed to specific regulatory intervention, this is the only period in this study where evidence of loan contraction in favour of holding lower RWA can be found. This is consistent with Wagster (1999) who found that banks in the US, UK and Canada were reducing loan exposure in favour of government securities between 1990 and 1992 without any evidence of reduced lending being attributable to capital regulation. Furthermore, Wagster (1999) ascribed his findings to increased supervision by regulators as opposed to the actual capital adequacy requirements. It is possible that the higher 10% minimum capital ratio imposed by the SARB in 2001 could have induced banks to hold excess capital. The increasing trend in 0% RWA was reversed in 2002 with the Graph 4 showing a clear inflection point where banks continued to lower exposure to these assets leading up to the

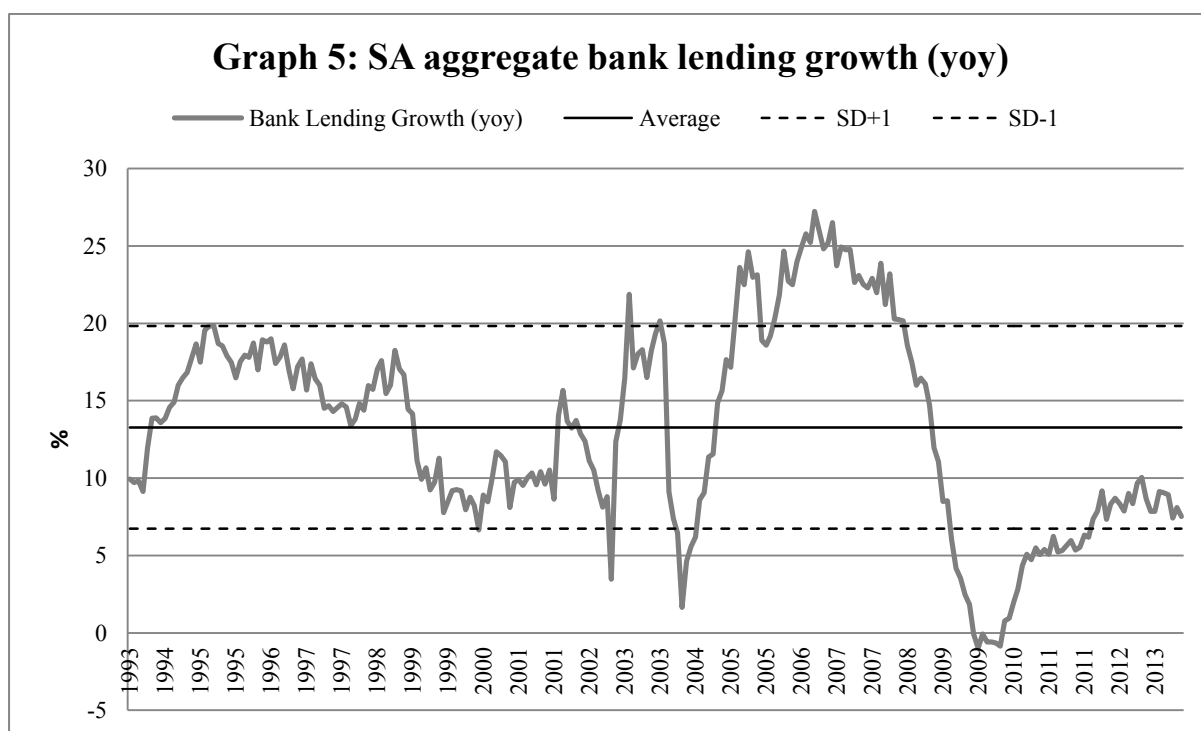
implementation of Basel II. The trend in 50% RWA shows the opposite trend with banks actively increasing exposure to residential mortgages in the lead up to Basel II. This trend will be examined further through an analysis of the aggregate retail lending portfolio. Based on the evidence it can be concluded that banks were increasing risk taking between 2002 and 2006 by substituting away from 0% RWA in favour of 50% RWA. This trend in RWA would support the argument as presented by Rochet (1992) and Kim and Santamero (1988) that well capitalised banks are less risk averse as South African banks were holding capital well in excess of regulated minima which provided the scope to increase exposure to both 50% RWA as well as aggregate RWA as evidenced in Graph 3. The trend in 100% RWA which comprises predominantly commercial lending has remained relatively static between 2002 and 2007. This trend will be more comprehensively assessed through an analysis of the aggregate commercial lending portfolio. Unfortunately the RWA analysis presented above does not provide an insight into which specific assets were being substituted in lending portfolios. The analysis is also constrained by different reporting methods under Basel I and II not allowing a consistent comparison of RWA after 2007. The following section on credit supply will attempt to overcome this challenge by identifying the primary products in banking lending portfolios and analysing trends over the full observation period.

Section VII

Empirical analysis of credit supply by South African banks

a. Aggregate Credit Supply

An analysis of bank credit supply is the primary focus of this paper and the evidence presented below will explore significant trends in bank lending in the context of bank capital adequacy and also assess the appetite of banks to increase risk taking by either altering credit supply or substituting between different lending products. An important question is whether any credit crunch has been induced by risk based capital regulation or whether the propensity for banks to extend credit is more attributable to other demand and supply factors.



Source: SARB, Thomson Reuters Datastream, Author's own calculations.

Definitions: yoy = year-on-year growth, SD+1 = One standard deviation above the average, SD-1 = One standard deviation below the average.

Total gross lending includes retail and commercial advances. At the aggregate industry level banks actually increased lending during the early stages of Basel I. The evidence would suggest that compliance with the Basel I required 8% capital ratio in 1995 did therefore not occur due to a contraction in aggregate credit supply. The general trend of declining growth in bank lending between 1995 and 2000 occurred in the absence of any risk based capital regulation impacting on-balance sheet lending. The market risk amendment to Basel I in 1996 would have a limited effect given that

banks were capitalised ahead of regulated minimum capital ratios. A significant slowdown in bank lending is evidenced between 2006 and 2010. The magnitude of the change in lending over the period is highlighted using basic standard deviation analysis which demonstrates that at the aggregate industry level the slowdown in bank lending amounted to a four standard deviation decline. This trend is supported by the earlier evidence presented in Graph 3 of declining growth rates of RWA between mid 2007 and 2010. Aggregate bank lending growth exhibits an accelerated decline from 2008 when Basel II reforms were introduced. The evidence would suggest that the credit crunch was not however induced by the implementation of risk based capital regulation. Although bank capital adequacy also increased substantially between 2006 and 2010, the slowdown in aggregate credit supply is unlikely to have resulted from increased capital requirements as South African banks were already holding excess capital buffers above the minimum 10% requirement. The fact that banks were well capitalised would suggest that regulation has not impacted on credit supply at the aggregate industry level and that lending trends could be more attributable to a combination of both demand and supply side factors which materially impacted on lending growth over the observation period. It is more probable that bank lending trends can be explained in terms of macroeconomic factors like GDP growth, inflation and interest rates which affect both consumers and providers of credit in different ways. The dependency of bank lending on these variables will be explored further under the VAR model in Section IX of this paper. The accelerated decline in bank capital in 2008 also warrants a more quantitative analysis under the VAR model before any causality between capital regulation and a slowdown in bank lending is dismissed.

b. Retail versus Commercial credit supply

The primary focus of the analysis of retail and commercial lending portfolios is to establish the extent to which banks were substituting between products and understand risk taking on a more granular level than presented under the RWA analysis shown earlier. To understand the changes that have occurred in industry lending portfolios it is important to break down the retail and commercial segments into their core lending products and to observe how the product mix has changed following the introduction of risk based capital regulation. The period between 2008 and 2013 is of particular interest, not only due to Basel II capital reforms being introduced, but also because the analysis of RWA presented earlier does not extend to this period due to changes in reporting standards under Basel II. Observing how banks have altered the composition of lending portfolios will provide a good approximation of risk taking by banks over this period. Analysis of trends in retail versus commercial lending will also provide context to the changes in capital adequacy ratios around the time of Basel II implementation, specifically the decline of the CAR between 2004 and 2007 and increase of the ratio between 2007 and 2012.



Source: SARB, Author's own calculations.

At the industry level, the split between retail and commercial lending has remained relatively unchanged over the last 20 years with higher risk-weighted commercial advances slightly higher at around 55% of total bank lending. Despite retail lending making up a lower percentage of the industry lending book, retail mortgage lending (home loans) has historically accounted for approximately 30% of total banking industry assets. These numbers are consistent with the on-balance sheet RWA analysis presented earlier with residential mortgages weighted at 50% and commercial lending assigned a risk weighting of 100%.

Graph 6 above suggests that commercial lending has been more volatile than retail lending with greater cyclical fluctuations evident over the full observation period. The risk weighting categories under both Basel I and the Standardised Approach of Basel II rate commercial lending as riskier than retail lending. Under Basel I all claims on corporates were assigned a 100% risk weighting with this also being the normal risk weighting under the Standardised Approach of Basel II. Unless banks assigned counterparty credit ratings of above A- to corporates, the Standardised Approach resulted in commercial lending being assigned a minimum 100% risk weight for capital adequacy calculations. By contrast, retail mortgage lending, which has historically comprised 70% of total retail lending was assigned a 50% risk weighting under Basel I and a 35% to 50% risk weighting under the Standardised Approach of Basel II depending on the Loan to Value (LTV) of the credit facility. Based on these rating methodologies under the existing regulatory framework, it would be fair to conclude that

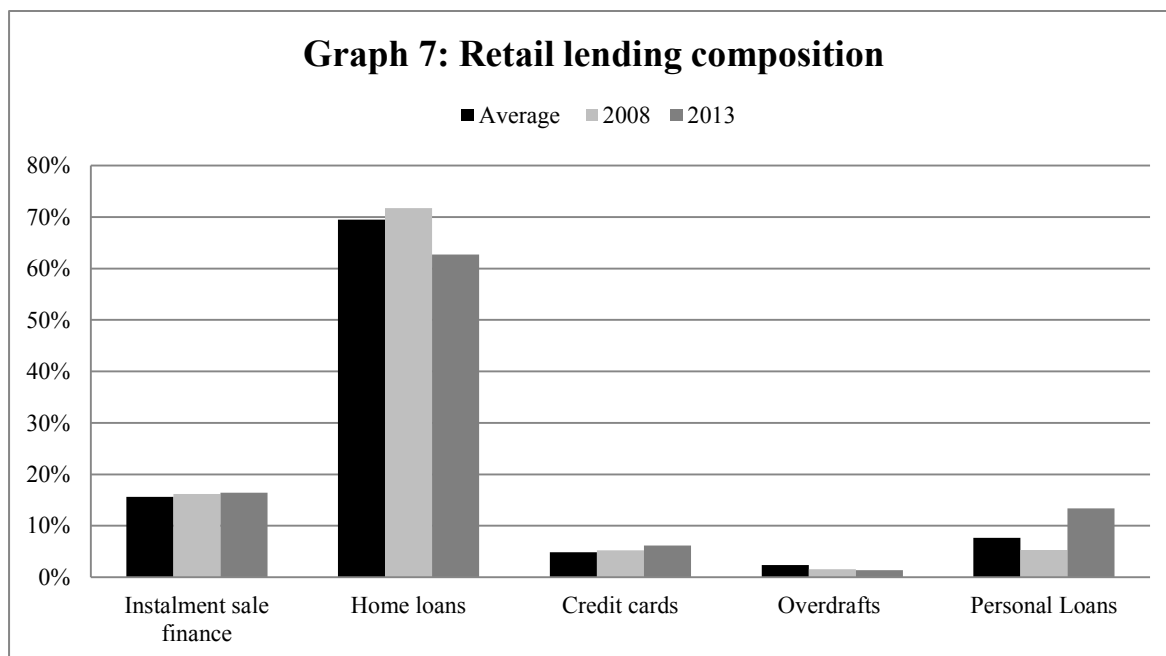
commercial lending is riskier than retail lending and an increasing propensity to extend credit to the commercial segment would represent increased risk taking by well capitalised South African banks.

The general trend of retail lending for the first five years after the introduction of Basel I was a relatively significant slowdown in credit extension. The slowdown corresponds to a decline in 50% RWA in Graph 4 which is comprised of residential mortgages under the Basel I framework. This would suggest that banks were decreasing mortgage lending between 1995 and 2000. Significant slowdowns in retail credit supply also occurred between the end of 2001 and 2002 as well as from 2006 to 2010. The latter period corresponds with the SARB phase in of Basel II in the domestic banking industry with final implementation taking place in January 2008.

Between 1996 and 2000 banks were growing commercial lending faster than retail. The accelerated commercial lending growth evidenced between 1997 and 1999 is consistent with the increase in 100% RWA shown in Graph 4. The evidence of commercial lending provides a similar outcome to retail lending with regards to the apparently limited effect of capital reforms on credit extension and points to other demand and supply factors being more influential on the ability and willingness of banks to lend. The slowdown in commercial credit extension lagged the retail segment by around 6 months in 2006 but an interesting observation is the significantly more pronounced slowdown between 2008 and 2009. The accelerated slowdown observed in aggregate industry bank lending appears to be more attributable to a slowdown in commercial bank lending. Commercial lending has however increased more rapidly than retail lending since 2011 and has effectively led the recovery at the aggregate industry level, but compared to the historical average shown in Graph 5, this remains relatively weak. To fully understand the drivers underlying this trend it is important to examine the banks' product mix across lending portfolios in both retail and commercial segments.

c. Analysis of the retail credit supply

i. Retail portfolio composition

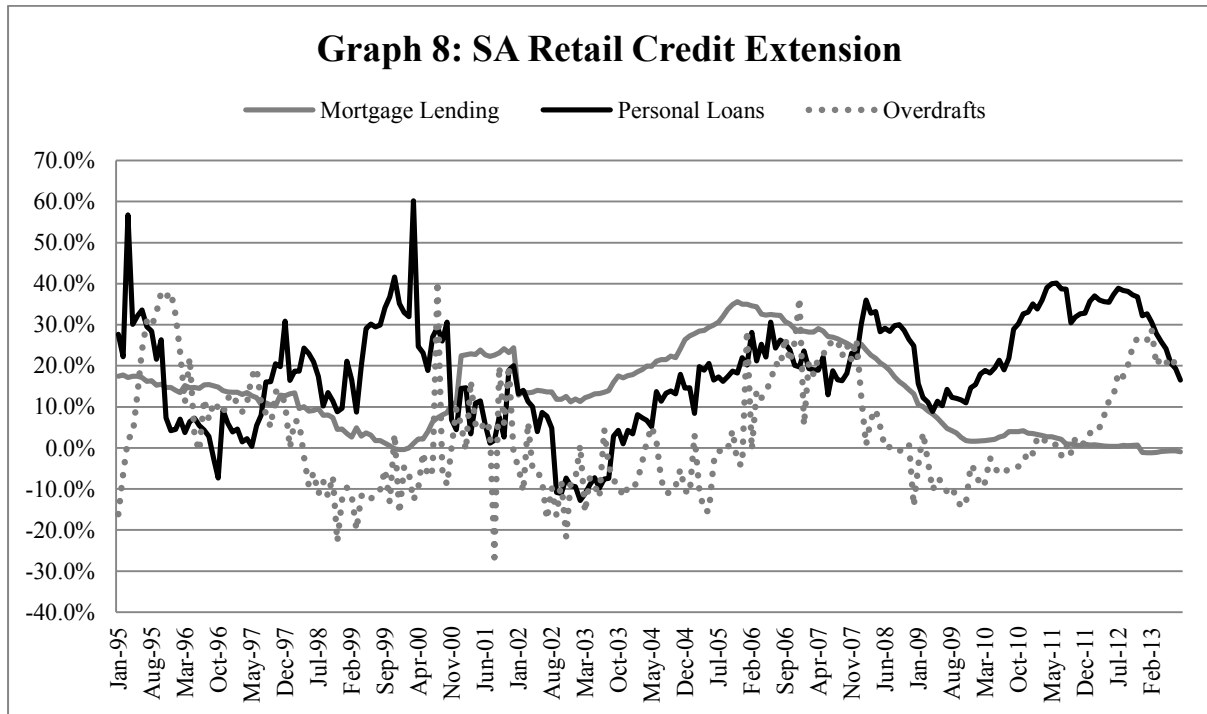


Source: SARB, Author's own calculations.

Graph 7 above shows that banks have significantly decreased exposure to the home loans segment of the market. Home loans have historically accounted for around 70% of banks retail assets and have decreased from 72% to 63% following the introduction of Basel II in January 2008. Banks have substituted away from longer dated mortgage lending towards personal loans, which includes unsecured lending to individuals and households. The contribution of other products to the total retail lending portfolio has remained relatively unchanged since the introduction of risk based capital reforms. The evidence would suggest that since the implementation of Basel II in 2008, banks were substituting away from lower 50% RWA, in the form of residential mortgages, towards higher RWA in the form of personal retail loans which are weighted between 75% and 100% under the Standardised Approach of Basel II. Personal lending increased from 5% of bank retail portfolios in 2008 to 13% in 2013 but the increase occurred over a period when banks increased capital adequacy levels to almost 16%. Well capitalized banks were however still increasing risk taking in retail lending portfolios by substituting away from longer maturity home loans towards shorter maturity retail personal loans. This finding would further support the conclusion that well capitalised banks are more risk seeking. It should be mentioned that in no way do these findings suggest that the changing composition of bank retail portfolios is purely attributable to supply side bank specific factors. Demand for retail credit extension will be significantly affected by a variety of factors which would

affect the ability of households and individuals to service their debt obligations incurred through the granting of bank credit.

ii. Retail Credit growth



Source: SARB, Author's own calculations.

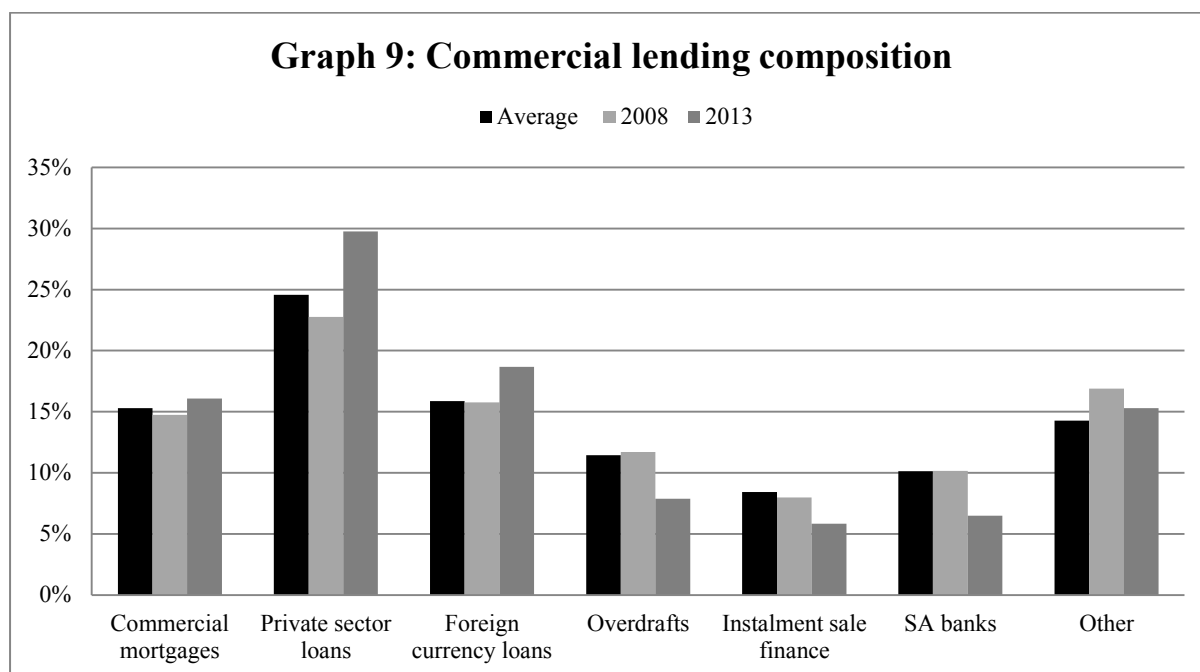
An interesting observation is the significant decline in personal loans at the start of the observation period which is not captured by the RWA analysis concluded earlier. These assets attracted risk weightings of 100% under Basel I so it would appear as though banks were significantly decreasing exposure to retail loans in the early stages of Basel I implementation. A possible explanation for the declining growth trend not being evidenced in the RWA calculation could be due to personal lending making up a relatively small percentage of the retail lending portfolio at less than 10% over the observation period. Banks were already compliant with the Basel I capital requirements of 8% in 1995 so the decrease in personal loans is not considered significant. Since the introduction of Basel II in 2008, the composition of banks retail lending portfolios has shifted towards shorter dated funding. As previously stated, home loans have accounted for 70% of retail lending since 1994 so the retail segment will experience a significant slowdown if banks are contracting credit supply to mortgage lending. This is evident in the declining trend in total retail lending growth since 2006. It can also further be stated that, based on the earlier analysis of capital adequacy, an increase in mortgage lending between 2003 to 2006 corresponds to a reduction in the capital adequacy ratio, and the

subsequent slowdown in mortgage lending between 2006 and 2012 ties into a significant increase in the ratio.

Banks were shifting the composition of retail lending portfolios more towards higher risk personal loans between 2009 and 2012. An analysis of retail credit extension shows that banks have significantly increased supply towards both personal lending and overdrafts over this period. Because of the 70% concentration of mortgage lending in the retail lending portfolio, the increased lending growth in these two assets did not have a material impact on the general decline in retail lending since 2006. Personal loans includes unsecured lending which has increased significantly in South Africa with annual growth rates peaking slightly above 40% in 2011, while home loan growth has failed to recover since declining from annual growth rates of 36% in 2006. The evidence suggests that excessive growth in retail personal loans between 2009 and 2012 has resulted in South African banks increasing risk taking by substituting away from residential mortgages towards personal loans. This has fuelled the debate around a potential bubble in unsecured lending in the South African economy as highly leveraged households are liable for debt repayments of up to 32% interest based on thresholds rates determined by the National Credit Regulator as at June 2013. A full analysis of the unsecured lending market is beyond the scope of this paper as the market is dominated by two smaller banks, Capitec [JSE:CPI] and African Bank [JSE:ABL] but it is possible that increased risk taking could be more concentrated in these predominantly micro-lending banks as opposed to being applicable to the industry as a whole.

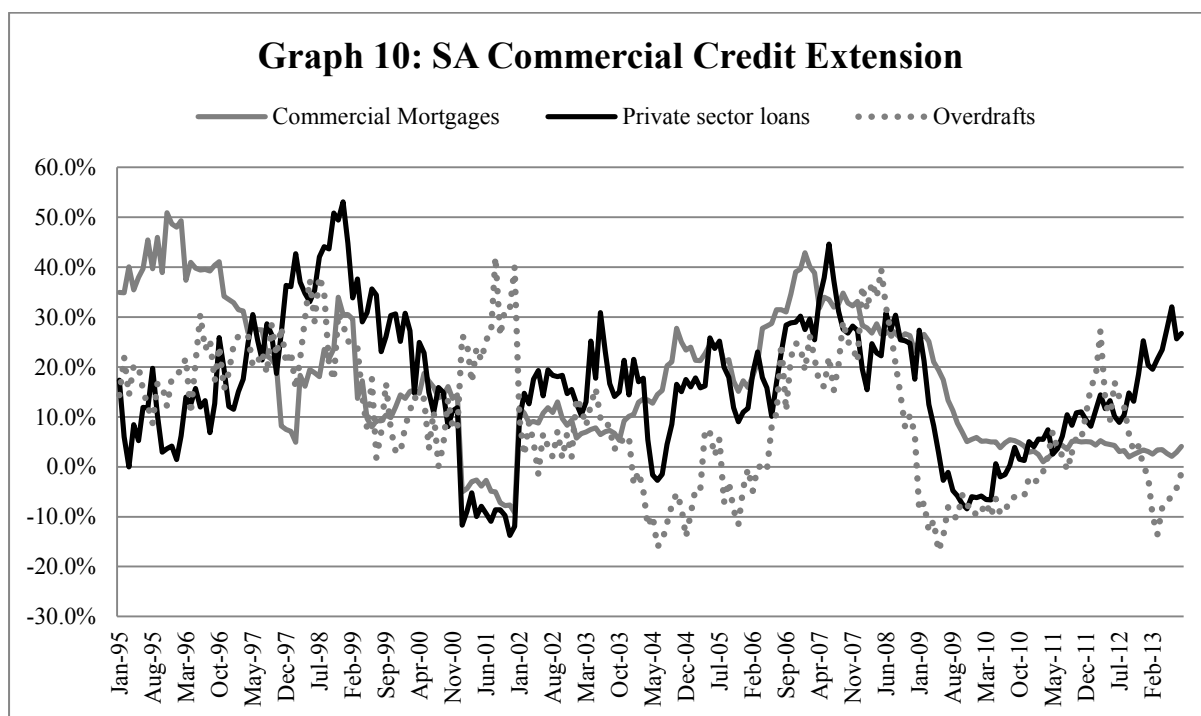
d. Analysis of the commercial credit supply

i. Commercial portfolio composition



Source: SARB, Author's own calculations.

In the commercial lending segment banks have significantly increased exposure to private sector loans over the last 5 years with the weighting in commercial portfolios increasing from 23% in 2008 to 30% in 2013. This is also higher than the average of 25% that private sector loans have comprised over the full observation period between 1994 and 2013. Given that commercial lending makes up 55% of aggregate industry lending, the evidence would suggest this banks have focused on this asset to lead the recovery exhibited in industry credit supply between 2010 and 2013. It is surprising to note that overdrafts have reduced as a percentage of commercial lending portfolios especially leading up to Basel III where there is an increased emphasis of matching asset and liability duration. Overdraft facilities are usually shorter maturity assets reviewed on an annual basis by banks and should therefore be relatively easier to match against shorter maturity funding which is more readily available in the domestic money market. The lower overdraft contribution can potentially be ascribed to Basel III liquidity requirements only being phased in from 2013 and more stringent liquidity requirements not yet impacting on bank lending portfolios. Commercial mortgage lending has largely been maintained in line with historical averages since 1994. Commercial mortgages are usually extended against the term of the underlying property lease and typically provided at lower LTV's than home loan credit. They are however viewed as riskier assets under the Basel framework.



Source: SARB, Author's own calculations.

ii. Commercial credit growth

Falling capital adequacy ratios between 2003 and 2006 were driven in part by increases in 50% RWA as demonstrated earlier. The significant increase in commercial mortgages and private sector loans, between 2004 and 2007 were the other important contributors to the falling capital adequacy ratio and increasing of 100% RWA. It can be observed that banks significantly increased credit supply through private sector loans from 2010. The supply argument is premised on the healthier state of South African companies borrowing at a low point in the domestic interest rate cycle with SARB BA900 liability data to June 2013 showing non-financial corporate deposits of around R580bn. This can be contrasted to the retail segment where household balance sheets were significantly leveraged in 2008 with household debt to disposable peaking at around 83%. From an affordability perspective it would be rational to infer that banks would perceive corporate borrowers to be less risky. It should be remembered that all commercial lending, unless assigned a counterparty credit rating of above A-, will be risk weighted at 100%. Therefore based on the increasing credit supply at the aggregate industry level since 2010, it would be fair to conclude that banks have increased risk taking primarily through the commercial lending segment and specifically through private sector loans. As demonstrated previously, increased risk taking in retail lending portfolios through higher exposure to personal loans is largely negated by their small composition in retail lending portfolios. By contrast private sector loans make up 30% of commercial lending and is therefore able to directly influence the growth in industry lending at the aggregate level. It is worth noting that despite increased risk taking

through commercial lending since 2010, banks were also improving their balance sheets by holding capital buffers ahead of both Basel II and Basel III requirements.

Section VIII

Vector autoregression (VAR) model

a. Background

The empirical trend analysis of credit supply presented in the previous section has been unable to establish any impact of risk based capital regulation on lending by South African banks. To fully understand the underlying determinants of bank lending over the observation period a VAR model is used. The model considers both demand and supply side variables and quantifies the individual effects of these variables on bank lending growth in South Africa. Previous studies have attempted to measure the causal effect of bank capital on loan growth using panel data analysis. However, panel data estimation potentially suffers from survivorship bias which results in downward biased estimates (Berrospide and Edge, 2010). To overcome this problem many papers have employed a VAR model to study the effects of bank capital on loan growth.

b. Empirical Methodology

For the estimation of the effect of bank capital on loan growth a slightly modified version of the VAR model considered by Lown and Morgan (2006) and Berrospide and Edge (2010) is used. The model aims to analyse the effect of five key variables as determinants of bank lending. Bank supply side variables used are the aggregate capital adequacy ratio and the growth rate of bank liabilities to the public. Macroeconomic variables included are quarterly real GDP growth, consumer price inflation and the prime lending rate. The last three variables are standard monetary policy VAR components which allow the interaction between the real economy and bank lending to be examined. Furthermore, the variables interact in an endogenous manner which means that each variable may be a determinant of another variable.

The time period under consideration extends from Basel I to Basel III. This allows for the sample to be split into two periods: 1994:Q1 to 2007:Q4 with Basel I as the regulatory framework, and 2008:Q1 to 2013:Q2 with Basel II as the dominant framework (Basel III data is only included for two quarters). Three regressions are run to test the dependency of the growth rate of loans on the five key independent variables mentioned above. The first regression covers the entire sample period from 1994:Q1 to 2013:Q2, the second from 1994:Q1 – 2007:Q4 and the third from 2008:Q1 to 2013:Q2.

The VAR model is largely viewed as ‘*atheoretic*’ as it assumes less prior information (Sims, 1980).

Consider a simple bivariate system given by

$$y_t = b_{10} - b_{12}z_t + \gamma_{11}y_{t-1} + \gamma_{12}y_{t-1} + \varepsilon_{yt} \quad (1)$$

$$z_t = b_{20} - b_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon_{zt} \quad (2)$$

where the two variables y and z are assumed endogenous and stationary; ε_{yt} and ε_{zt} are uncorrelated white noise disturbances with standard deviations σ_y and σ_z respectively. Equations (1) and (2) therefore constitute a first-order VAR as the longest lag length is one. The structure of the system is such that current values of z are allowed to affect y , and vice versa. So using equation (2) as an example, the coefficient $-b_{21}$ is the contemporaneous effect of a unit change of y_t on z_t and γ_{21} is the effect of a unit change in y_{t-1} on z_t . Shocks of ε_{yt} affect y directly but z indirectly. In the first-order autoregressive model given above by (1), the stability condition implies that the sum of γ_{11} and γ_{12} be less than one in absolute value. The right hand side of equations (1) and (2) are comprised of predetermined variables. The error terms are assumed to be serially uncorrelated and have constant covariance. Because each equation in the system has identical right-hand side variables, the equations can be estimated using ordinary least squares (OLS). Sims (1980) argues that it is very difficult to accurately describe the regression output of the estimated systems as the addition of successive lags leads to varying coefficients over time. VAR coefficients are not usually quantified but the results are presented for the sake of completeness. Due to the endogenous relationships between the variables under consideration, the regression coefficients are not entirely reliable predictors of the effects of the independent variables on the dependent variable. Impulse response functions (IRFs) are calculated to evaluate the effect of shocks on the variables of interest. The IRFs may be interpreted as the instantaneous effect of a one-standard deviation change in the independent variable on the dependent variable (for example, a one standard deviation change in bank capital adequacy on loan growth). IRFs may be plotted to visually represent the behaviour of the variables of interest to the various shocks. VAR models impose key assumptions on the time-series being analysed. All variables are assumed stationary. A time series is considered to be stationary if its mean and variance do not vary systematically over time (Gujarati, 2003). Where variables are not stationary, the resulting IRF will be invalid, and convergence (and stability) conditions will not be met. Where a time series is not stationary, one can difference the series to render it stationary. Differencing is the technique of subtracting current values of the time series from previous values ($y_t - y_{t-1}$). This technique was applied on the data.

Section IX

VAR Results: Estimation of the effect of bank capital ratios on loan growth

Two separate models are used to test the dependency of bank capital on loan growth. The first model is based on bank capital in the current period less bank capital in the previous period, while the second employs the difference between actual and target capital ratios as the input variable.

a. Model 1

The first model estimated is given by

$$\Delta\%Loans_t = \alpha\Delta\%Loans_{t-1} + \beta\Delta\%realgdp_{t-1} + \delta inflation_{t-1} + \theta Liabilitiespublic_{t-1} + \gamma prime_{t-1} + \tau CAR_{t-1} + \varepsilon_t$$

In this estimation, differencing is represented by capital adequacy values in the current period less capital adequacy values in the previous period (i.e. a one period change in capital adequacy). The estimation results for the effect of the above variables on loan growth are reported in Table 1 below.

Table 1: OLS regression estimations – Model 1

	Full period	1994-2007	2008-2013
Loan growth	0.1809236 (0.1831344)	-0.559629 (0.2122695)	0.2030339 (0.3004556)
Capital Adequacy Ratio	-0.9027399 (0.5674087)	-0.7398156 (0.6443281)	-0.5238533 (0.6474809)
Growth of bank liabilities to the public	0.3264536 (0.1767728)*	0.3703205 (0.1870926)**	-0.192854 (0.2920279)
Quarterly Real GDP growth	0.2009551 (0.0882196)**	0.0994002 (0.1139446)	-0.1188396 (0.1353782)
Inflation rate	-0.1368367 (0.1529456)	-0.20503 (0.1581699)	1.001061 (0.3268275)***
Prime Interest rate	-0.0688773 (0.2080876)	-0.0307678 (0.2177342)	1.494866 (0.6202055)**

Source: SARB, Thompson Reuters Datastream, Author's own calculations.

***, ** and * denotes significance at the 2%, 5% and 10% level.

i. OLS Regression results

- Over the full observation period 1994 to 2013 the most significant variable affecting the growth rate of loans is the quarterly GDP growth rate, followed by the growth rate of liabilities to the public. All other macroeconomic variables were insignificant. The insignificance of bank capital is contrary to Berrospide and Edge (2010) who find more significant but still modest effects of

bank capital on loan growth using macroeconomic time series and aggregate commercial banking data.

- Between 1994 and 2007 the only significant variable affecting loan growth was growth rate of liabilities to the public which provided a relatively similar result as shown for the full observation period.
- The last period 2008 to 2013 has Basel II as the dominant policy framework. This period was characterised by relatively lower volatility in both inflation and interest rates and these two variables are identified as the most significant determinants of bank lending.

The conflicting results obtained over the three periods highlight the constraints identified by previous researchers in isolating the relative importance of specific variables on bank lending growth. This is consistent with earlier findings by Albertazzi and Marchetti (2010) and Jackson et al. (1999) that isolating specific demand and supply effects on bank lending have been difficult to demonstrate. Capital adequacy is shown to be insignificant across all three periods used in the regression analysis. This finding is especially relevant for the interpretation of lending behaviour around the time of Basel II in South Africa where a significant slowdown in credit supply was evidenced and the domestic economy experienced a recession in 2009. Bank capital levels however still remained above the regulated minima. This study therefore supports the conclusions of Gambacorta and Mistrulli (2003) that well capitalized banks are in a relatively better position to withstand periods of financial stress associated with economic downturns and the existence of a capital buffer provides more scope for these banks to meet regulated capital adequacy requirements.

An important finding is the significance of bank liabilities to the public on bank lending, not only because it emphasises the need to maintain adequate liquidity, but also because of the focus of Basel III placing greater reliance on retail deposits. The impact of banking liabilities is modelled as a supply side variable to the extent that banks propensity to lend is determined by the amount of funding available at different points in the credit cycle. As previously evidenced, retail deposits are not easily available in the South African financial system and, depending on how stringent regulators are in imposing enhanced liquidity reforms, could constrain credit supply if banks struggle to attract retail funds going forward.

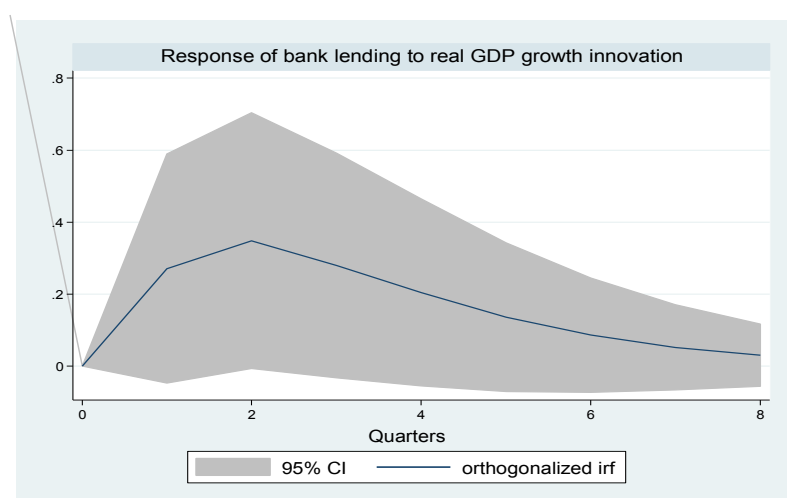
The importance of GDP on bank lending over the full observation period is expected. Consistent with the approach by Berrospide and Edge (2010), this is modelled as a demand side variable in the regression. As stated earlier, this paper makes no attempt to disentangle bank specific supply side variables from more demand centric economic variables as the endogeneity of the model is premised on all variables interacting with each other. However, the result under the IRFs will allow the effects of these variables on bank loan growth to be quantified to a certain extent. Although bank capital

adequacy was shown to be insignificant in all three periods in the OLS regression analysis an attempt will however be made to quantify this effect under the IRFs.

ii. IRF Results

The principal focus of IRF analysis is to identify those variables which are most influential in affecting bank lending and to attempt to quantify the insignificance of capital ratios on credit supply.

1. The relationship between bank lending and GDP

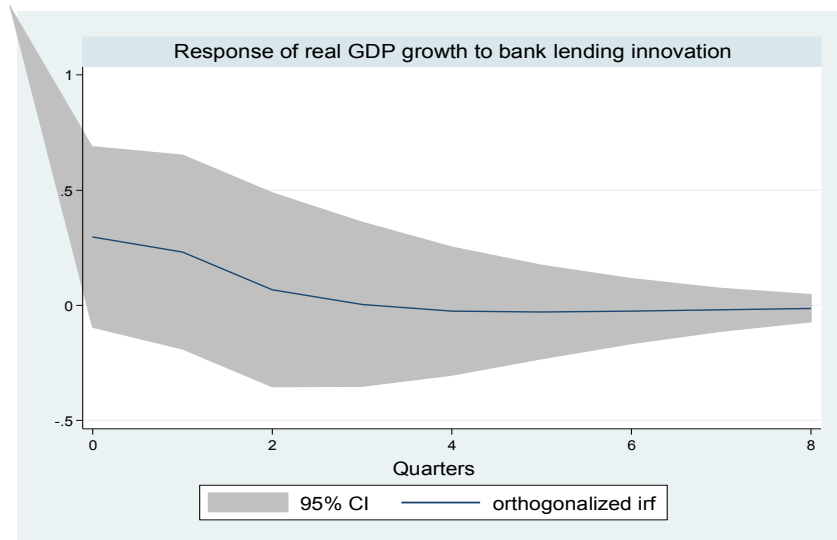


Source: SARB, Thomson Reuters Datastream, Author's own calculations.

A macroeconomic shock as represented by a one standard deviation increase in real GDP growth increases bank lending over both the first and second quarters following the increase. Bank lending increases by almost 0.4% over the first two quarters but retreats to its longer term trend thereafter.

These results are consistent with findings by Jimenez et al. (2010) where the probability of loans being granted increases with higher GDP. Because the model has not specifically tested for procyclicality the results do not allow this study to conclude that South African banks significantly altered bank lending in economic downturns, but the IRF analysis does support the earlier findings of this study. The empirical evidence of negative lending growth in both the aggregate and retail portfolio as presented in Graphs 5 and 6 during the 2009 recession would however indicate that banks actively reduced risk taking and were less inclined to lend when economic prospects are poor. The propensity for banks to increase lending during periods of strong economic growth are premised on borrowers being perceived as less risky. Higher GDP growth implies higher household income levels and increased corporate earnings through higher productivity levels in the economy, which

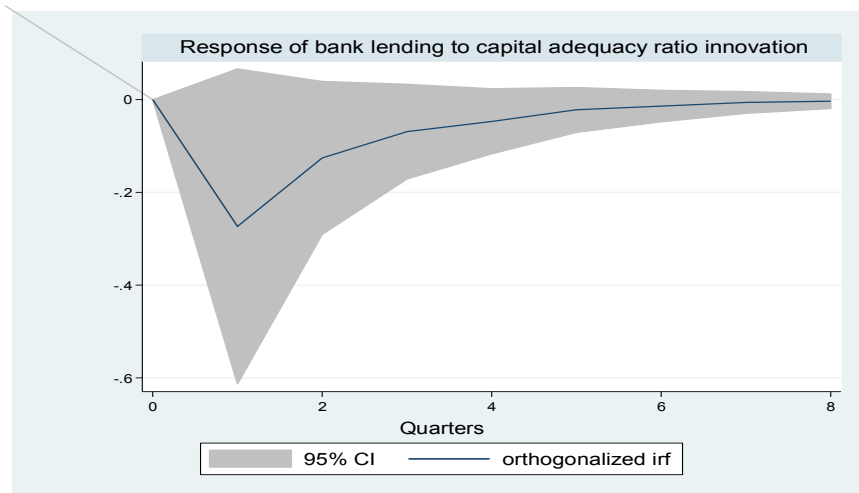
theoretically should improve the ability of borrowers to service debt. Furthermore, the spike in lending growth over the first two quarters and reversion to the mean shortly afterwards would support the hypothesis of Kindleberger (1978) that banks are relatively myopic in their assessment of risk.



Source: SARB, Thompson Reuters Datastream, Author's own calculations.

Shocking the real economy with a one standard deviation contraction in bank lending produces the most pronounced short term effect of all the IRF functions examined. The impact of an increase in bank lending is immediate with a 0.3% spike in real GDP growth. However this is not sustained and the effect of a one standard deviation increase in bank lending on GDP growth appears to fall to zero by the end of four quarters or one year. This suggests that the reinforcing relationship between economic growth and bank lending may be fairly strong in the South African economy. Excess liquidity of bank funding provided to the real economy results in borrowers immediately increasing short term consumption. The evidence would suggest that households and corporates are more disposed to spending additional funds as opposed to allocating to discretionary savings.

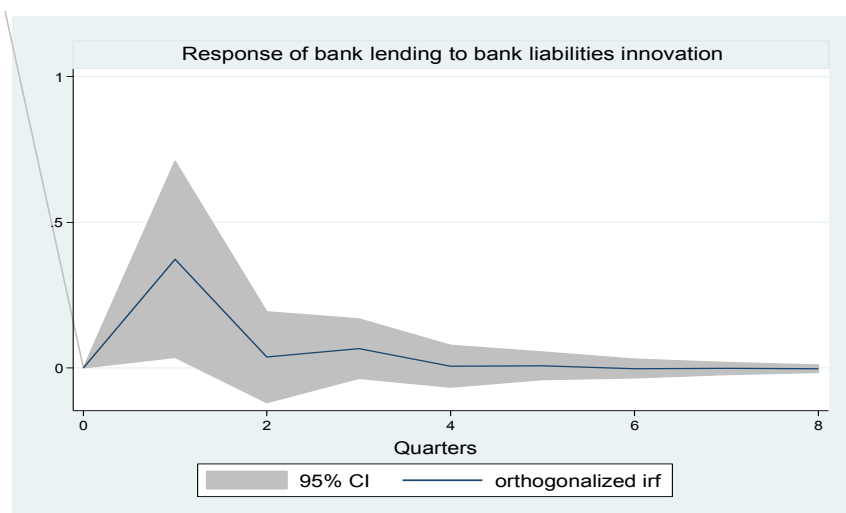
2. The relationship between bank capital and bank lending



Source: SARB, Thompson Reuters Datastream, Author's own calculations.

A regulatory shock represented by a one standard deviation increase in bank capital adequacy requirements negatively impacts on bank lending as banks are seen to contract lending by up 0.3% in the first quarter after the shock. The average annual growth rates of aggregate bank lending between 1994 and 2013 amounted to approximately 13% as shown in Graph 5 earlier. To further quantify the insignificance of bank capital on lending, a one standard deviation change in bank capital amounting to 1.8% will only cause banks to reduce lending by 0.3% in the quarter of the change with the effect moving through the system and normalising by the end of two years.

3. The relationship of liabilities to the public and bank lending.



Source: SARB, Thompson Reuters Datastream, Author's own calculations.

The importance of liabilities to the public in the context of the South African banking system has already been discussed. According to the IRFs, a one standard deviation increase in banking liabilities

will cause banks to increase lending in the quarter of the liquidity shock, but interestingly, mean reversion occurs rapidly in the next quarter. This could be indicative of existing balance sheet management norms at the aggregate level by South African banks where the inability to attract and retain ‘stickier’ retail deposits has resulted in banks taking advantage of short term excess liquidity by allocating capital to acquiring new lending assets.

4. The relationship of other variables and bank lending.

Appendix A shows the IRFs of prime lending rate and inflation on bank lending.

Over the long term an increase in the prime lending rate causes bank lending to fall albeit at a rather small rate. The negative relationship between bank lending and the prime interest rate may appear counter-intuitive as one would expect banks to increase lending when the opportunity of greater profit is presented through increasing margins. However, this is consistent with the bank lending channel, where according to Gambacorta and Mistrulli (2003) a tightening in monetary policy impacts on credit extension by banks because the resultant decrease in reserve deposits cannot be completely offset by banks raising other types of funding like commercial paper or bonds through wholesale markets. Jimenez et al. (2010) also found that loan growth is positively related to lower interest rates.

b. Model 2

Model 2 is a slightly modified version of model 1. The results are consistent with Model 1.

$$\Delta\%Loans_t = \alpha\Delta\%Loans_{t-1} + \beta\Delta\%realgdp_{t-1} + \delta inflation_{t-1} + \theta Liabilitiespublic_{t-1} + \gamma prime_{t-1} + \tau ExCAR_{t-1} + \varepsilon_t$$

The second estimation is run by replacing the first-differenced capital holdings with the excess of capital holdings relative to the minimum statutory requirements. All other variables are identical to the first model.

Table 1: OLS regression estimations: Model 2

	Full period	1994-2007	2008-2013
Loan growth	0.1456525 (0.1841977)	-0.0848086 (0.2119476)	0.1965113 (0.3044694)
Excess capital holdings	-0.1644925 (0.2883089)	-0.333476 (0.5387465)	-0.497123 (0.2057213)
Growth of bank liabilities to the public	0.3894429 (0.1740807)**	0.4084732 (0.1847371)**	-0.1722153 (0.2947944)
Quarterly Real GDP growth	0.2045544 (0.0896587)**	0.0947437 (0.1149323)	-0.1190321 (0.1413831)
Inflation rate	-0.132885 (0.1551864)	-0.2051087 (0.1595949)	1.02343 (0.330126)***
Prime Interest rate	-0.1035486 (0.2101782)	-0.0590113 (0.2183349)	1.495089 (0.6440872)**

Source: SARB, Thompson Reuters Datastream, Author's own calculations.

***, ** and * denotes significance at the 2%, 5% and 10% level.

i. OLS Regression results

The results of the estimations for model 2 are very similar to model 1 and the interpretation of results is therefore identical to the arguments presented earlier.

- Consistent with Model 1, over the full observation period 1994 to 2013 the most significant variable affecting the growth rate of loans is the quarterly GDP growth rate, followed by the growth rate of liabilities to the public. All other variables including bank capital adequacy are shown to be insignificant.
- Between 1994 and 2007 the only significant variable affecting loan growth was growth rate of liabilities to the public which provided a relatively similar result to that shown in Model 1.
- During the last period 2008 to 2013, inflation and interest rates are again identified as the two variables most significant in determining bank lending. However, changes in the inflation rate have smaller impacts in the second model while changes in the prime interest rate have larger impacts.

ii. IRF Results

The IRF results are shown in Appendix B.

The response of bank lending to a one standard deviation increase in real GDP appears to be the same between the two estimations. A change in bank lending on real GDP growth appears to have a similar impact in the second model to the first. The response of bank lending to a change in excess capital holdings affirms the fact that South African banks are already well capitalised and would not necessarily have to contract lending substantially should there be a regulatory change in the capital

adequacy requirement. At most, bank lending could contract by 0.1% over the short term, but the effect is minimal and remains fairly flat over the period. This effect is smaller than in Model 1 but as previously detailed, the capital adequacy changes are shown to be negative and insignificant on the growth rate of loans. Because model 2 specifically addresses actual capital levels relative to regulated minima, this study also supports the conclusions by Cumming and Nel (2005) that banks only respond to capital regulations if they have capital shortfalls relative to required minimum ratios.

Section X

Conclusion

The principal objective of this paper is to analyse empirical trends in on-balance sheet lending in South African banks and to establish whether the propensity for banks to extend credit at the aggregate industry level can be partly attributed to the increased regulatory requirements of target capital adequacy ratios or is more dependent on other demand and supply side variables. The extent to which compliance with regulated capital reforms has been satisfied by contracting credit supply, increasing qualifying capital or changing the composition of balance sheet lending portfolios through substituting between risk weighted assets (RWA) have been analysed. The results of this study find that risk based capital regulation through the Basel Accords has been insignificant in impacting on credit supply by South African banks. This can be ascribed to banks holding capital in excess of regulated target ratios by either the BCBS or the national regulator. It can furthermore be asserted that on average South African banks have complied with target capital adequacy ratios by raising additional capital as opposed to substituting higher RWA for lower RWA or by contracting aggregate credit supply. The only sustained period in the study which corresponded to a reversal of this trend, and where evidence of increased risk taking can be observed, was between 2005 and 2007 when domestic banks were significantly increasing exposure to 50% RWA through aggressive growth in residential mortgage lending. Evidence of increased risk taking is also found in retail personal lending portfolios but it is possible that this could be more indicative of smaller micro-lending institutions as opposed to being characteristic of the industry in aggregate. The four standard deviation decline in bank lending which originated prior to the implementation of Basel II in 2008 was neither induced or exaggerated by capital reforms, and can be attributed to both demand and supply side factors influencing the propensity of banks to lend. Credit supply is significantly affected by liabilities to the public which is heavily concentrated towards institutional funding in South Africa as retail deposits have historically been more difficult to attract as discretionary savings levels are relatively low. Credit demand is influenced more by the business cycle with the evidence presented in the VAR analysis reinforcing that the relationship between economic growth and bank lending may be fairly strong in the South African economy.

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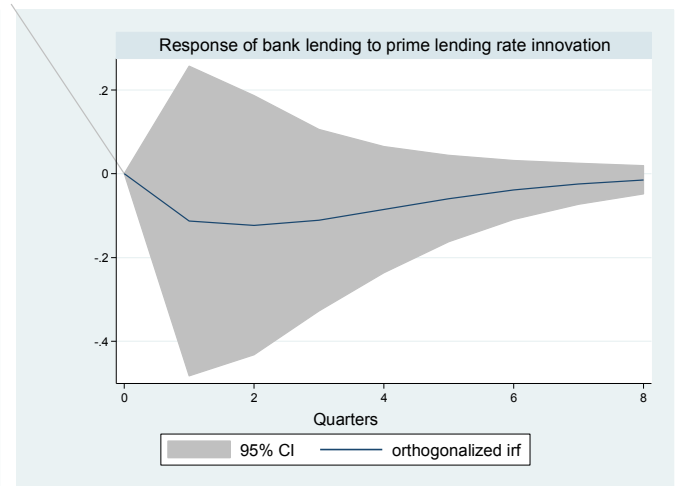
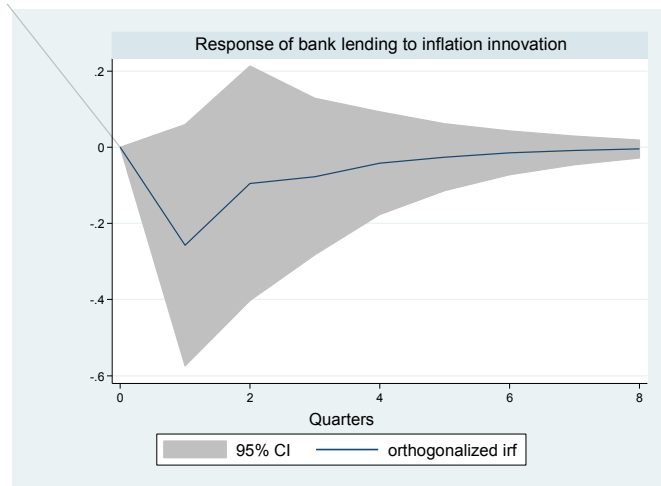
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Appendix A – Differenced CAR



Appendix B – IRF Excess CAR

