MAF006 Has risk based capital regulation negatively affected aggregate credit supply by South African banks?

Neethling, SB., de Jager, P & Parsons, S
University of Cape Town

Abstract

Risk based capital regulation seeks to create stability within the global banking system by imposing minimum capital requirements on banks. These requirements have been increased several times since first implemented. It is important to understand the impact that these requirements may have on the lending supply by banks, since a contraction in supply could have unintended consequences for the economy, particularly in economic downturns. 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 between 1994 and 2013 in order to establish the extent to which changes in industry level credit supply can be attributed to the increased regulatory requirements of target capital adequacy ratios or to 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 substitution 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. This paper finds that there is no significant link between changes in risk based capital regulation and aggregate lending by banks.

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

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 may either issue new equity, diversify their lending portfolios away from assets with higher risk weighting or reduce 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 in favour of 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.

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, behaving in a pro-cyclical manner by restricting credit extension when increased liquidity in the real economy is most required.

It is therefore conceivable that 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.

The purpose of this paper was to examine the empirical evidence of the South African banking industry to determine the extent to which there is evidence that the introduction of and changes to the risk based capital adequacy requirements of the Basel Accord influenced aggregate lending.

The paper is structured as follows: Section II provides an overview of the Basel Accord and the various amendments since its initial implementation. Section III reviews the existing literature on risk based capital regulation. Section IV details the scope of the research, overviews the research methodology, examines the data and identifies important limitations. Section V 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. Section VI 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. Section VII introduces and explains the vector autoregression (VAR) model. Section VIII 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. Section IX summarises important findings and concludes.

Section II: The Basel Committee on Banking Supervision (BCBS)

Basel I

Basel I established a common set of capital adequacy standards for banks of participating countries. The 1988 Basel Accord focused exclusively on credit risk. Risk weightings were determined by both the type of credit and the nature of the issuer. Five primary risk categories were established for weighting bank assets, ranging from a ‘risk-free’ 0% for Organisation for Economic Co-operation and Development (OECD) government or sovereign debt to 100% for corporate debt. The sum of all assets multiplied by their respective risk weightings determined that bank’s risk weighted assets (RWA). 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 reserves[15]. An additional requirement was that Tier 1 capital comprise a minimum of 4% of a bank's RWA. (BIS, 1988; Balin, 2008).

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), and for assisting in stabilising the international banking system (Burhouse et al., 2003). However it was criticised for being too narrowly focused on credit risk, largely ignoring market and operational risk. In addition, the calibration of specific credit risk weightings implemented in Basel I were considered too subjective and simplistic. This effectively incentivised to pursue increased risk taking under Basel I (Hogan & Sharpe, 1997).

Basel II

The criticism of the 1988 Basel Accord resulted in the Basel Committee proposing a new framework in 1999 which was to be phased by the end of 2006. (Heffernan, 2005; Balin, 2008). The most significant changes for the purposes of this paper were the introduction of a more variable risk weighting to calibrate for actual or expected asset risk, and the broadening of the scope of the framework to include credit, market and operational risk (Lybeck, 2011). Banks were encouraged to use more modern Value at Risk (VaR) models, including internally developed models, to measure risk levels (BIS, 2004). Basel II therefore created a more risk sensitive framework for the calculation of a bank's capital charges while attempting to close the arbitrage loopholes in the original Basel I framework (Balin, 2008).

Basel II has been criticised for being procyclical, since in a downturn or recession borrowers will be perceived as more risky, and therefore require more capital to be set aside. This disincentive to lend could potentially exacerbate an economic downturn by constraining access to credit when it is most needed. The reliance of Basel II on credit rating agencies also continued to encourage the transfer of credit risk off balance sheet (Heffernan, 2005), where the underlying credit risk was much harder to determine.

Basel III

In the aftermath of the 2008 financial crisis Basel III introduced both capital and liquidity reforms to strengthen the resilience of the banking industry, 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 (BIS, 2010a).

Enhanced risk controls through a leveraged ratio aim to contain excessive risk taking, while additional capital buffers are introduced to minimise the systemic risks of procyclical lending

[15] 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 cumulative perpetual preferred stock, loan loss allowances, undisclosed reserves, revaluation reserves, general loan loss reserves, hybrid debt instruments, and cumulative preference shares, as well as subordinated debt which included instruments like convertible bonds and cumulative preference shares.

and mitigate against the negative effects which arose from the contraction in credit supply that followed the 2008 financial crisis.

Section III: Literature Review

Background

Banks are incentivised to increase expected returns by utilising increasing (Carnell, Macey & Miller 2009). Regulated capital adequacy ratios are therefore important to contain excessive leverage and mitigate against aggressive risk-taking. In the event of shocks to the banking system, excess capital provides a buffer against both actual and expected losses.

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 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 were not costly (Aiyar, et al., 2012). However 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 (Jackson et al., 1999).

Banks experience increased loan loss provisioning and write-offs during economic downturns which lower capital through a depletion of equity. Banks would need to reduce lending in recessions to not breach minimum capital adequacy regulations. It has been suggested that this may have exacerbated 2008 financial crisis (Hyun & Rhee, 2010). Poorly capitalised banks are in a relatively worse position to withstand periods of financial stress associated with economic downturns since the absence of a capital buffer provides little protection against breaching regulated capital adequacy requirements without reducing lending.

a International evidence of the impact of risk based capital regulation on bank lending

Empirical evidence of the impact of risk based capital regulation is mixed. Seminal research by Bernanke and Lown (1991) examined the causes of the slowdown in bank lending in the US in the early 1990's. Their results indicate that credit contraction was more attributable to the deterioration of the balance sheets of highly leveraged borrowers as asset and property prices fell. They find only modest effects for undercapitalised banks and no clear evidence of regulation significantly reducing lending.

Hancock and Wilcox (1994) show that risk based capital requirements had no effect in reducing lending in undercapitalised US 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.

Furfine (2001) used US banking data to 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.

Wagster (1999) argues that the introduction of capital ratios resulted in banks changing the mix of assets in their portfolios by substituting away from higher risk assets like commercial loans to risk free assets like US treasury bonds. His research 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.

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.

Berger and Udell (1994) 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.

Francis and Osborne (2009) examined a sample of around 200 UK banks between 1996 and 2007 and found that over the observation period, banks with excess capital relative to their target ratios experience higher growth in credit extension and lower growth in regulatory and tier 1 capital. 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. Further research on Italian banks by Albertazzi and Marchetti (2010) finds larger less capitalised banks substituting away from riskier borrowers while smaller less capitalised banks did not reallocate portfolio assets away from riskier loans.

Hyun and Rhee's (2010) analysis of Asian banks shows that capital constrained banks have a preference for reducing credit supply over issuing new equity, and that Asian 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 data to establish that US subsidiaries of Japanese banks responded to losses in their holding companies by reducing credit supply in the US lending market.

Hassan and Hussain (2006) use data from 11 developing countries to find that capital adequacy regulation did not result in undercapitalised banks increasing their capital ratios. 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. These findings were generally inconsistent with those of 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.

b South African evidence of the impact of risk based capital regulation on bank lending

The literature examining the impact of capital adequacy regulation on bank credit supply in South Africa is not particularly extensive. Cumming and Nel (2005) 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. 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 find evidence of a slowdown in lending towards certain asset classes like private loans and mortgages and into lower risk assets.

c Identifying supply and demand side factors

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 panel data regression techniques to identify that bank holding company (BHC) capital-to-asset ratios only have a small effect on the lending behaviour of US BHC's over the period from 1990 to 2008. 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. They further demonstrate that the slowdown in credit growth during the financial crisis of 2008 is more attributable to macroeconomic shocks to GDP than to shocks to the banking system through capital adequacy regulation[16].

Section IV: 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 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, sourced from the Statistics South Africa website.
4. Banking liabilities to the public and GDP data, sourced from Thompson Reuters Datastream.

[16] Berrospide and Edge (2010) use GDP as a proxy for credit demand in regressing macroeconomic time series data for their vector autoregression (VAR) model.

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 bank lending in the retail and commercial segments and identify trends in credit supply across the primary lending categories in the portfolio.
3. Develop a VAR model using time series data to test the relationship between bank lending and capital adequacy over the observation period.

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 and 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.

e Data Consistency

A constraint in analysing historical trends over the full observation period is that SARB reporting requirements are not consistent across 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 are included in the analysis, this is not expected to materially impact the findings of this paper.

Section V: Bank capital analysis

a Banking industry liabilities

The main challenge affecting credit supply in the South African banking industry is its overreliance on institutional funding. The 2008 financial crisis led to the Basel III amendments that complement capital regulation with a liquidity framework which mitigates the risk of both retail and institutional funders withdrawing from the market.

Graph 1 demonstrates the reliance of the South African banking industry 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.

b 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 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 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, with national discretion for additional requirements including a 2% buffer with scope for revision when appropriate. The SARB has advised that the maximum capital ratio (excluding any bank specific or countercyclical buffers) that a domestic systemically important bank (D-SIB) will be required to maintain will amount to 14% (South African Reserve Bank, 2012b).

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. With capital ratios in excess of 12% in 2000, the increase in required capital to 10% in 2001 would not have required South African banks to take remedial action. The capital adequacy ratio experienced a gradual decline between 2005 and the beginning of 2008, coinciding with the finalisation of 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.

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, peaking at 15.9% in December 2012.

A possible reason for this 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 over the riskiness of uninsured non-reserve liabilities. A simpler explanation is that South African banks hold excess capital for increased loss absorbency, which shields credit supply from regulatory changes (Francis and Osborne, 2009). 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 in Graph 2, 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).

c Qualifying Capital versus RWA

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.

Graph 3 shows that the only period during which South African banks were growing RWA faster than capital on a sustained basis was between 2005 and 2007. 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 is 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. This period also corresponds to a considerable slowdown in credit supply which will be further assessed later in this paper.

d Analysis of RWA

Graph 4 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 therefore been excluded from the analysis. Subsequent to 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 requirement.

The 2% increase in the capital adequacy ratio between 1998 and 2000 was driven by banks substituting away from 100% RWA towards 0% RWA. 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's (1999) observation of similar actions by US, UK and Canadian banks between 1990 and 1992, which were ascribed to increased supervision by regulators rather than capital adequacy requirements. It is also possible that the higher 10% minimum capital ratio imposed by the SARB in 2001 could have induced banks to hold excess capital in order to maintain consistent excess buffers.

The increasing trend in 0% RWA was reversed in 2002, with 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 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.

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 preventing 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 VI: Empirical analysis of credit supply by South African banks

a Aggregate Credit Supply

The evidence presented below will explore significant trends in bank lending in the context of bank capital adequacy and will 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 there is any evidence that credit reduction 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. Total gross lending includes retail and commercial advances. At the aggregate industry level banks actually increased lending during the early stages of Basel I (see Graph 5). The evidence would therefore suggest that compliance with the Basel I required 8% capital ratio in 1995 did therefore not result in 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.

A significant slowdown in bank lending is evident between 2006 and 2010. The magnitude of the change amounted to a four standard deviation decline. This is consistent with the declining growth rates of RWA between mid-2007 and 2010 previously identified. 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, banks were already holding excess capital buffers above the minimum 10% requirement. This suggests that lending trends could be more attributable to a combination of both demand and supply side factors such as GDP growth, inflation and interest rates, which materially impacted on lending growth over the observation period. This will be explored further under the VAR model in Section VIII 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

An analysis of retail and commercial lending portfolios seeks to establish the extent to which banks were substituting between products during the observation period. 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 between 2004 and 2007 and increase between 2007 and 2012.

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 around 55% of total bank lending.

Graph 6 suggests that commercial lending has been more volatile than retail lending, with greater cyclical fluctuations evident over the full observation period. Under both Basel I and the Standardised Approach of Basel II commercial lending was assigned a 100% risk weighting, whereas 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 Basel II depending on the Loan to Value (LTV) of the credit facility. Based on these rating methodologies, it would be fair to conclude that an increasing propensity to extend credit to the commercial segment would represent increased risk taking by 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 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 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 these trends it is important to examine the banks' product mix across lending portfolios in both retail and commercial segments.

Analysis of the retail credit supply

a Retail portfolio composition

Graph 7 shows that banks have significantly decreased exposure to home loans, which 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 increasing risk taking by 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%. This finding would further support the conclusion that well capitalised banks are more risk seeking.

i Retail credit growth

Since the introduction of Basel II in 2008, the composition of banks' retail lending portfolios has shifted towards shorter dated funding. With home loans accounting for 70% of retail lending since 1994, this shift accounts for the declining trend in total retail lending growth since 2006 (Graph 6). Similarly, the increase in mortgage lending between 2003 and 2006 corresponds to a reduction in the capital adequacy ratio, while the subsequent slowdown in mortgage lending between 2006 and 2012 ties into a significant increase in the ratio (Graph 2).

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 (see Graph 8). 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 include 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 points to the excessive growth in retail personal loans between 2009 and 2012 that subsequently resulted in the collapse of African Bank in 2014.

b Analysis of the commercial credit supply

i Commercial portfolio composition

Given that commercial lending makes up 55% of aggregate industry lending, the increase in private sector loans over the observation period (see Graph 9) would suggest that banks have focused on this asset to lead the recovery exhibited in industry credit supply between 2010 and 2013 (Graph 5).

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.

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 should be easier to match against the shorter-maturity funding that 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.

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 also 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 (see Graph 10). Given that household balance sheets were significantly leveraged in 2008 with household debt to disposable income peaking at around 83% this suggests that private sector loans were at the time considered less risky, notwithstanding that such lending attracted a default risk weighting of 100%. In contrast to the relatively small percentage of total within the retail lending portfolio, private sector loans make up 30% of commercial lending and are therefore able to directly influence the growth in industry lending at the aggregate level.

It is worth noting that despite increased risk taking in 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 VII: 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 further explore 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 sample is 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 y_{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 y_{11} and y_{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, 2002). 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 VIII: VAR Results - Estimation of the effect of bank capital ratios on loan growth

The VAR model is based on bank capital in the current period less bank capital in the previous period and tests the dependency of bank capital on loan growth.

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

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)[17].

The estimation results for the effect of the above variables on loan growth are reported in Table 1.

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 for the full observation period.
- 2008 to 2013 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

[17] A second model, using the difference between actual and target capital ratios as the input variable, was also employed. The results of this model were consistent with those of the first model, and are therefore not analysed in this paper.

growth (e.g. Albertazzi and Marchetti (2010) and Jackson et al. (1999)). 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 capitalised banks are in a relatively better position to withstand periods of financial stress associated with economic downturns, and that 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 Basel III places greater reliance on retail deposits. The impact of bank 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. Retail deposits are not easily available in the South African financial system and, depending on how stringent regulators are in imposing enhanced liquidity reforms, this 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 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 from demand side 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.

i 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 confirm the insignificance of capital ratios on credit supply.

1. The relationship between bank lending and GDP (Graphs 11 & 12)

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 are 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 during these times.

Shocking the real economy with a one standard deviation change 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 appears to fall to zero by the end of 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 discretional savings.

2. The relationship between bank capital and bank lending (Graph 13)

A regulatory shock in bank capital adequacy requirements has an insigificantly negative impact on bank lending, as banks contract lending by up 0.3% in the first quarter after the shock, and the effect moves through the system and normalises by the end of two years. This serves to confirm the findings of the empirical trend analysis, which failed to establish any impact of risk based capital regulation on lending by South African banks.

3. The relationship of liabilities to the public and bank lending (Graph 14)

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 (Graph 15)

Over the long term an increase in the prime lending rate causes bank lending to fall albeit at a rather small rate. This is consistent with Gambacorta and Mistrulli's (2003) findings that 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.

Section IX: 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 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.

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.

The four standard deviation decline in bank lending which originated prior to the implementation of Basel II in 2008 was neither induced nor exaggerated by capital reforms, and is more attributable to both demand and supply side factors influencing bank lending at that time. 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 discretional 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.

Reference list

Aiyar, S., Calomiris, C & Wieladek, T. 2012. *Does Macro-Pru leak? Evidence from a U.K. Policy Experiment.* National Bureau of Economic Research (NBER) Working Paper No 17822. Cambridge, Massachusetts.

Albertazzi, U. & Marchetti, D. 2010. Credit Supply, Flight to Quality and Evergreening: An Analysis of Bank-Firm Relationships after Lehman. Bank of Italy Working Paper No.756. Rome, Italy.

Balin, B. 2008. *Basel I, Basel II, and Emerging Markets: A Nontechnical Analysis.* The Johns Hopkins University School of Advanced International Studies (SAIS). Washington D.C.

Barajas, A., Chami, R. & Cosimano, T. 2005. *Did the Basel Accord Cause a Credit Slowdown in Latin America?* International Monetary Fund (IMF) Working Paper No 38. Washington D.C.

Bank for International Settlements (BIS). 1988. *International convergence of capital measurement and capital standards.* Basel Committee on Banking Supervision Working Papers. Basel, Switzerland.

Bank for International Settlements (BIS). 2004. *International convergence of capital measurement and capital standards: A revised framework.* Basel Committee on Banking Supervision Working Papers. Basel, Switzerland.

Bank for International Settlements (BIS). 2010. *Basel III: A global regulatory framework for more resilient banks and banking systems*. Basel Committee on Banking Supervision Working Papers. Basel, Switzerland.

Berger, A. & Udell, G. 1994. Did Risk-based Capital Allocate Bank Credit and Cause a "Credit Crunch" in the United States? *Journal of Money, Credit, and Banking.* 26(3): 585-628.

Bernanke, B. & Lown, C. 1991. The Credit Crunch. *Brookings Papers on Economic Activity*. 2: 204-39.

Berrospide, J. & Edge, R. 2010. The Effects of Bank Capital on Lending: What Do We Know, and What Does it Mean? FEDS Working Paper No. 44. Washington, D.C.

Burhouse, S., Feid, J., French, G. and Ligon, K. 2003. *Basel and the Evolution of Capital Regulation: Moving Forward, Looking Back.* Federal Deposit Insurance Corporation. Washington, DC.

Carnell, R., Macey, J. & Miller, G. 2009. *The law of banking and financial institutions*. 4th edition, Aspen Publishers. New York.

Chiuri, M., Ferri, G., & Majnoni, G. 2002. The Macro-Economic Impact of Bank Capital Requirements in Emerging Economies: Past Evidence to Assess the Future. *Journal of Banking and Finance.* 26: 881-904.

Cumming, S. & Nel, H. 2005. Capital controls and the lending behaviour of South African banks: Preliminary findings on the expected impact of Basel II. *South African Journal of Economics*. 73(4): 641-656.

Francis, W. & Osborne, M. 2009. *Bank Regulation, Capital and Credit Supply: Measuring the Impact of Prudential Standards.* UK Financial Services Authority Occasional Paper No. 36. London, UK.

Furfine, C. 2001. Bank Portfolio Allocation: The Impact of Capital Requirements, Regulatory Monitoring and Economic Conditions. *Journal of Financial Services Research. 20: 33-56.*

Gambacorta, L. & Mistrulli, P. 2003. *Bank Capital and Lending Behavior: Empirical Evidence for Italy.* Bank of Italy Working Paper 486. Rome, Italy.

Gujarati, D. 2002. *Basic Econometrics*. 4th Edition. McGraw-Hill. New York, USA.

Hancock, D. & Wilcox, J. 1994. Bank Capital and Credit Crunch: The Roles of Risk-Weighted and Unweighted Capital Regulations. *Journal of the American Real Estate and Urban Economics Association*. 22: 59-94.

Hassan, K. & Hussain, M. 2006. *Basel II and Bank Credit Risk: Evidence from Emerging Markets*. Networks Financial Institute Working Paper. No 10/2006. Indiana, USA.

Heffernan, S. 2005. *Modern Banking*. The Wiley Finance Series. West Sussex, England.

Hogan, W. & Sharpe, I. 1997. Prudential Regulation of the Financial System: A Functional Approach.
Agenda. 4: 15–28.

Hyun, J-S. & Rhee, B-K. 2011. Bank capital regulation and credit supply. *Journal of Banking and Finance*. 35(2): 323-30.

International Monetary Fund (IMF). 2010. South Africa: Detailed Assessment of Compliance on Basel Core Principles for Effective Banking Supervision. IMF Country Report No 10/353.

Jackson, P., Furfine, C., Groeneveld, H., Hancock, D., Jones, D., Perraudin, W., Radecki, L. & Yoneyama, M. 1999. *Capital Requirements and Bank Behaviour: The Impact of the Basle Accord.* Basel Committee on Banking Supervision Working Papers No 1. Basel, Switzerland.

Jimenez, G., Ongena S., Peydro J., & Saurina, J. 2010. *Credit Supply: Identifying Balance-Sheet Channels with Loan Applications and Granted Loans.* Centre for Economic Policy Research Discussion Paper No. 7655. London, UK.

Kashyap, A. & Stein, J. 1995. *The Impact of Monetary Policy on Bank Balance Sheets.* Federal Reserve Bank of Chicago (FRB) Chicago Economic Note. Chicago, USA.

Kim, D. & Santomero, A. 1988. Risk in Banking and Capital Regulation. *Journal of Finance*. 43: 1219-1233.

Lall, R. 2009. *Why Basel II failed and why any Basel III is doomed*. Global Economic Governance Programme Working Paper 2009/52. Oxford, UK.

Lown, C. & Morgan, D. 2006. The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Survey. *Journal of Money, Credit and Banking* 38: 1575-1597.

Lybeck, J. 2011. *A Global History of the Financial Crash of 2007-2010*. Cambridge University Press. Cambridge.

Montgomery, H. 2005. The effect of the Basel Accord on bank portfolios in Japan. *Journal of the Japanese and International Economies.* 19: 24–36.

Peek, J. & Rosengren, E. 2000. Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States. *American Economic Review*. 90(1): 30-45.

Rochet, J. 1992. Capital Requirements and the Behaviour of Commercial Banks. *European Economic Review*. 36: 733-62.

Santos, J. 2000. *Bank Capital Regulation in Contemporary Banking Theory: A Review of the Literature.* Bank for International Settlements Working Papers No 90. Basel, Switzerland.

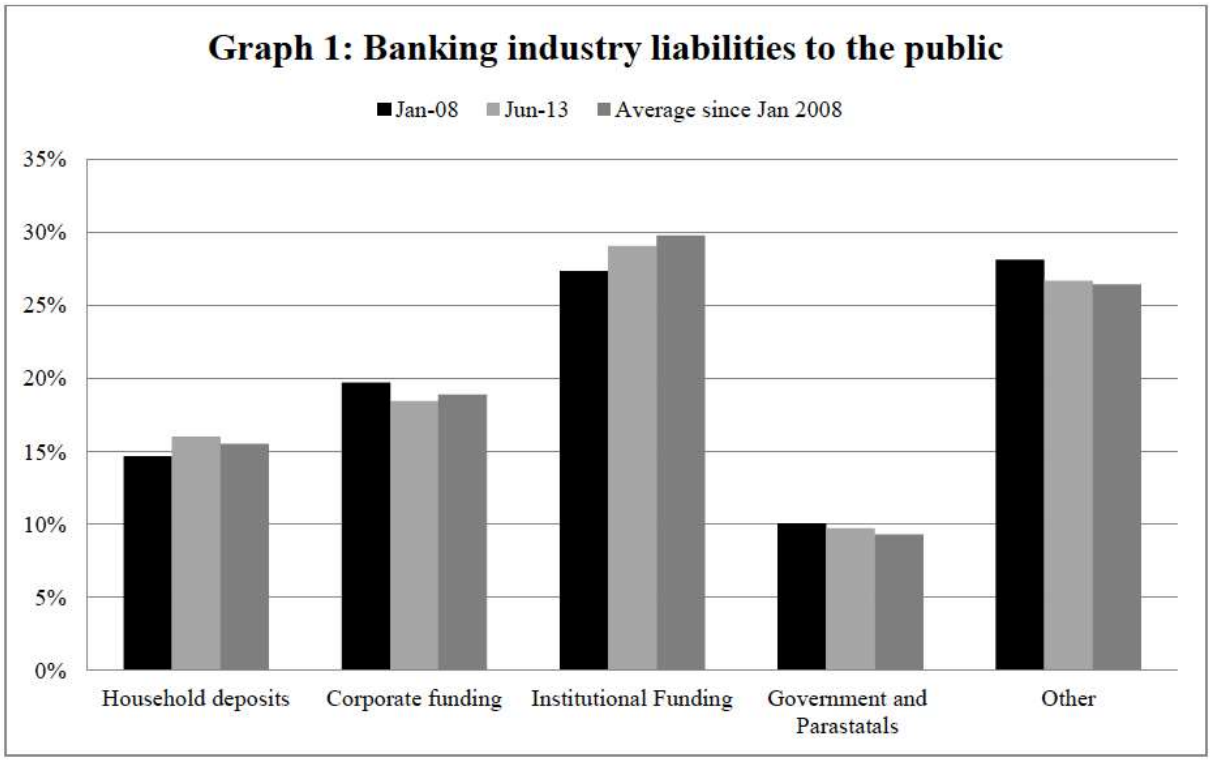
Sims, C. 1980. Macroeconomics and Reality. *Econometrica.* 48: 1-48.

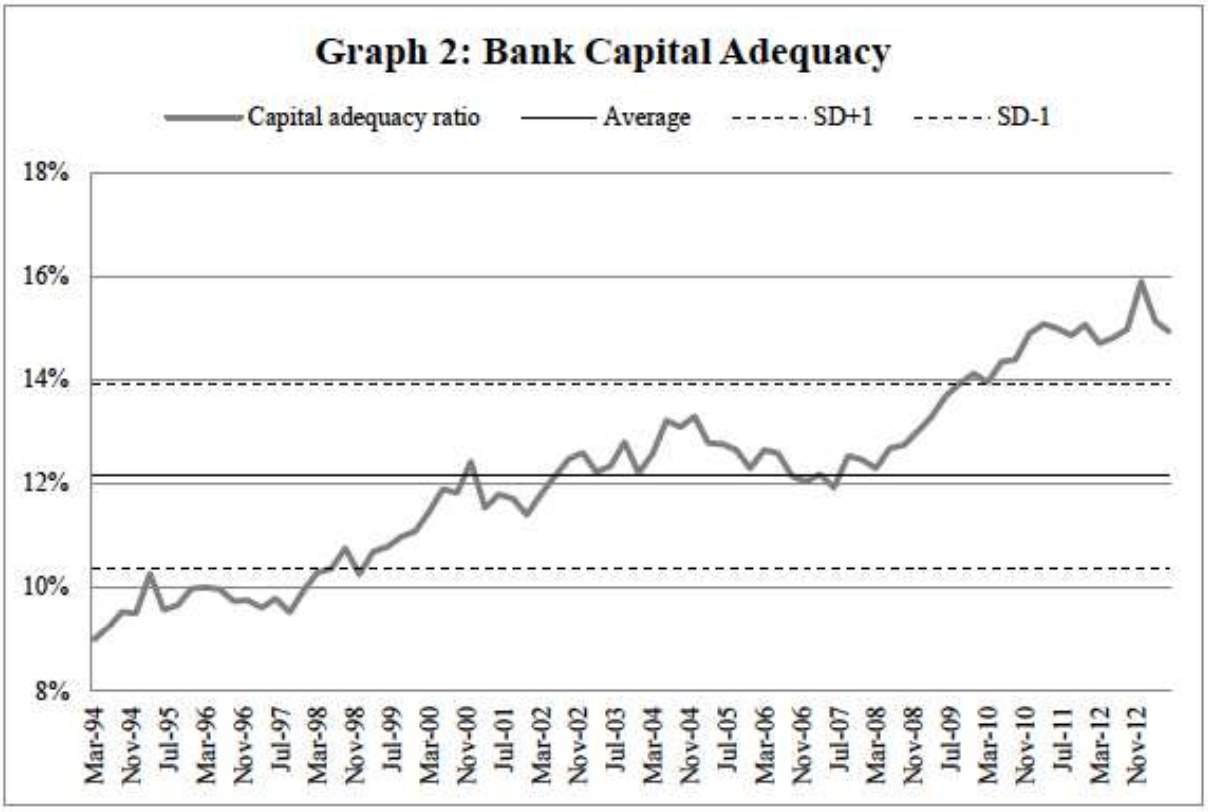
South African Reserve Bank. 2012. Guidance Note 9/2012: Capital framework for South Africa based on the Basel III framework. Pretoria: South Africa.

Thakor, A. 1996. Capital Requirements, Monetary Policy, and Aggregate Bank Lending: Theory and Empirical Evidence. *Journal of Finance*. 51: 279-324.

Wagster, J. 1999. The Basle Accord of 1988 and the International Credit Crunch of 1989-1992. Journal of Financial Services Research. 15(2): 123-143.

Appendix I: Graphs and Tables





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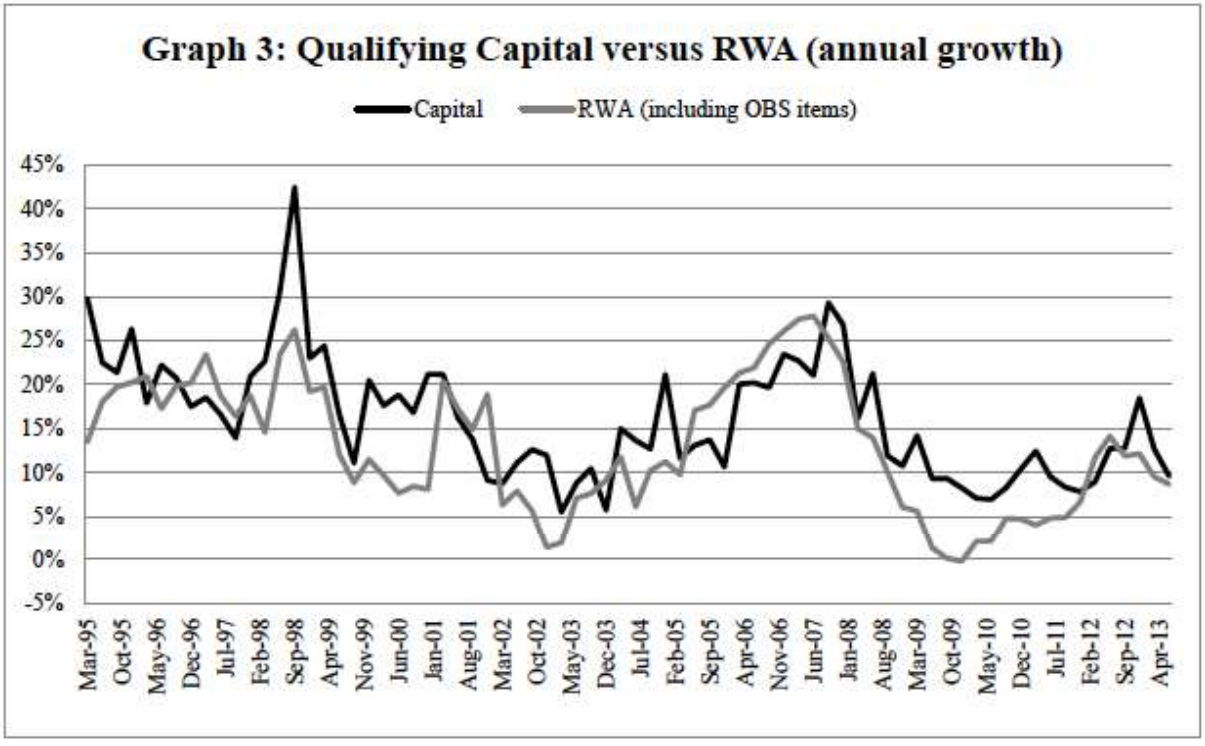
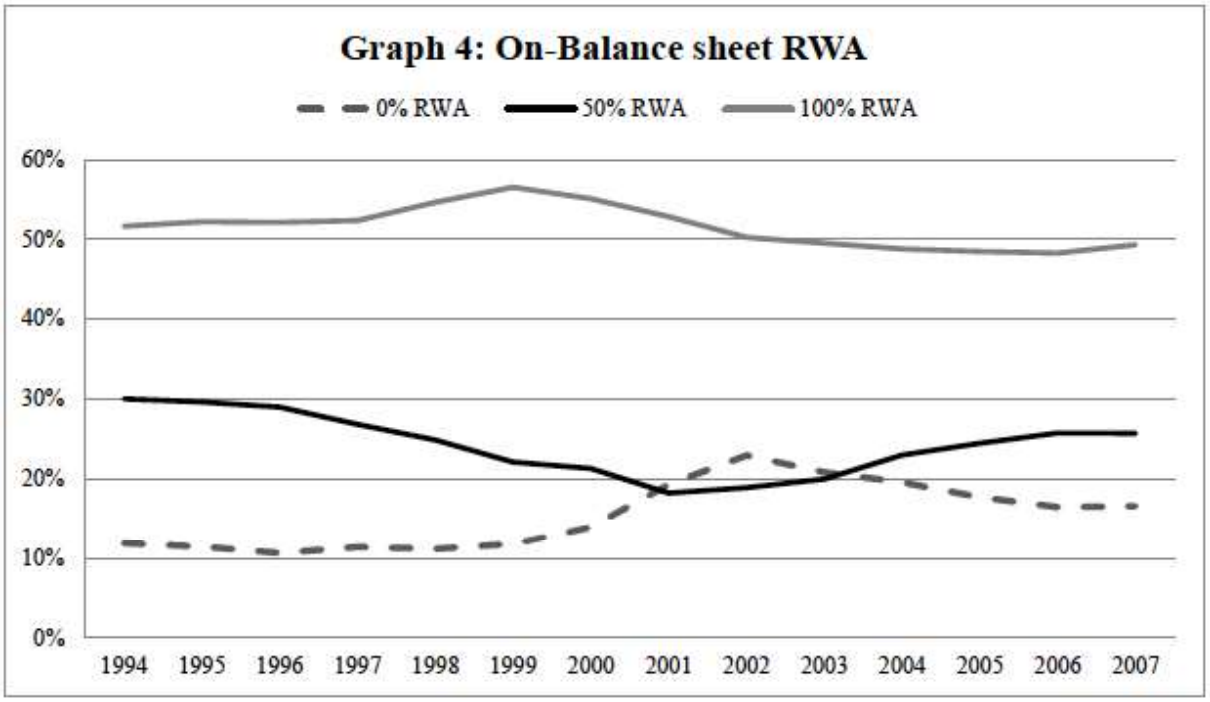


Source: SARB, Author's own calculations.
Total RWA includes off-balance sheet (OBS) items



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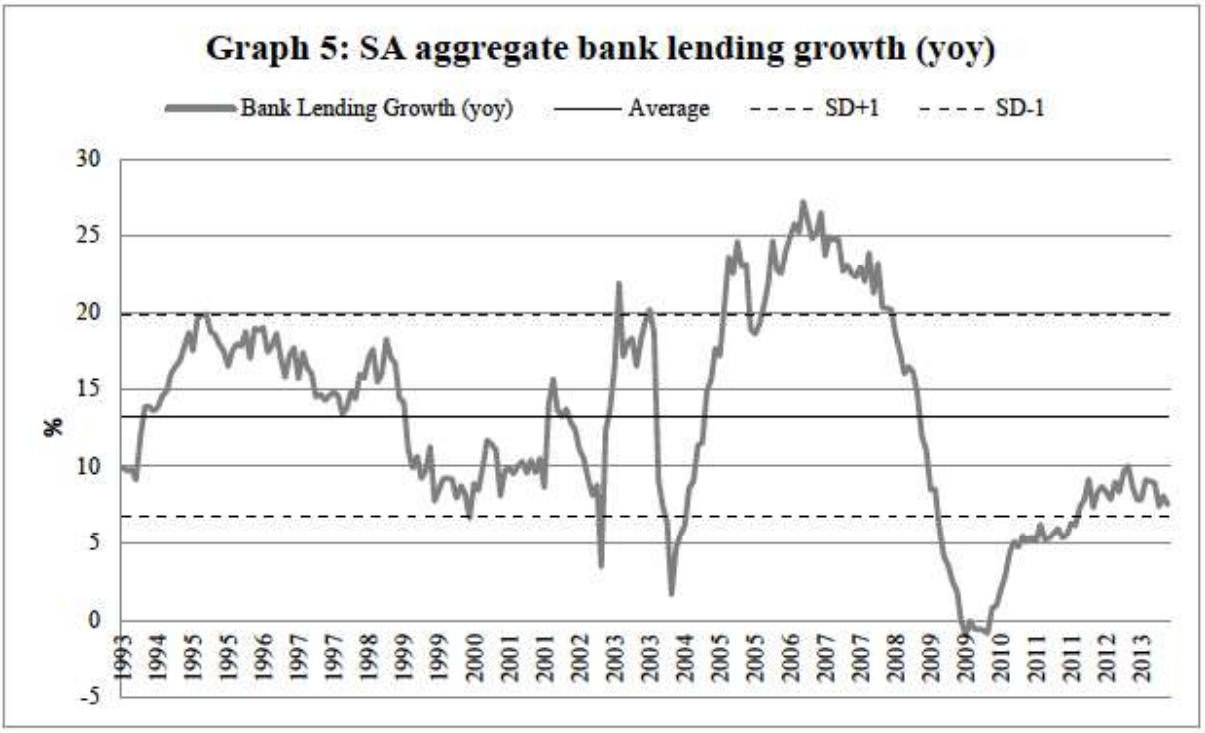
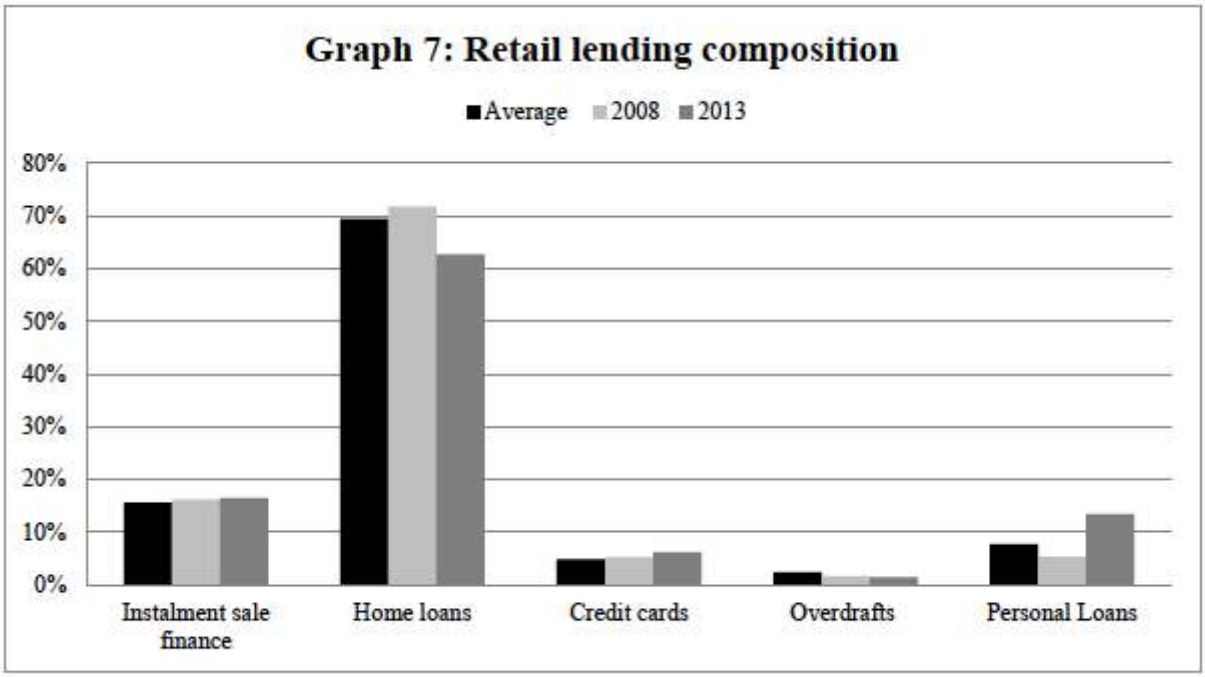


Source: SARB, Thompson Reuters Datastream, Author's own calculations.
Definitions: yoy = year-on-year growth, SD+1 = One standard deviation above the average, SD-1 = One standard deviation below the average.

Source: SARB, Author's own calculations.



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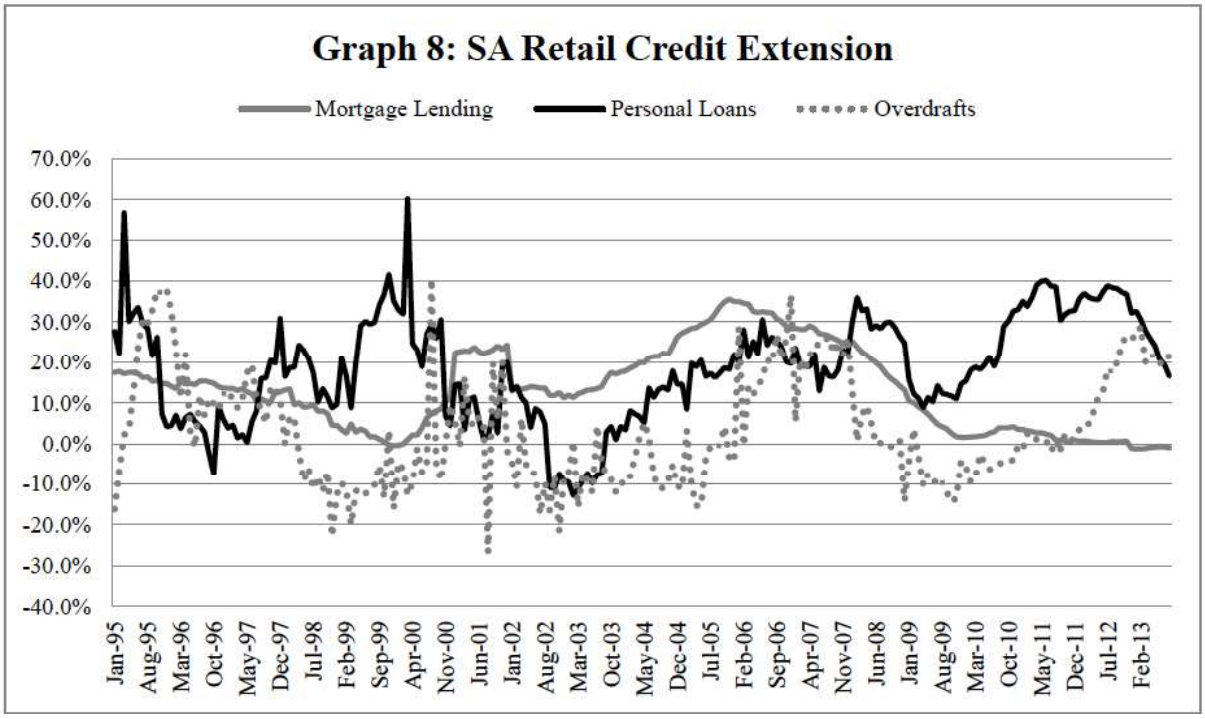

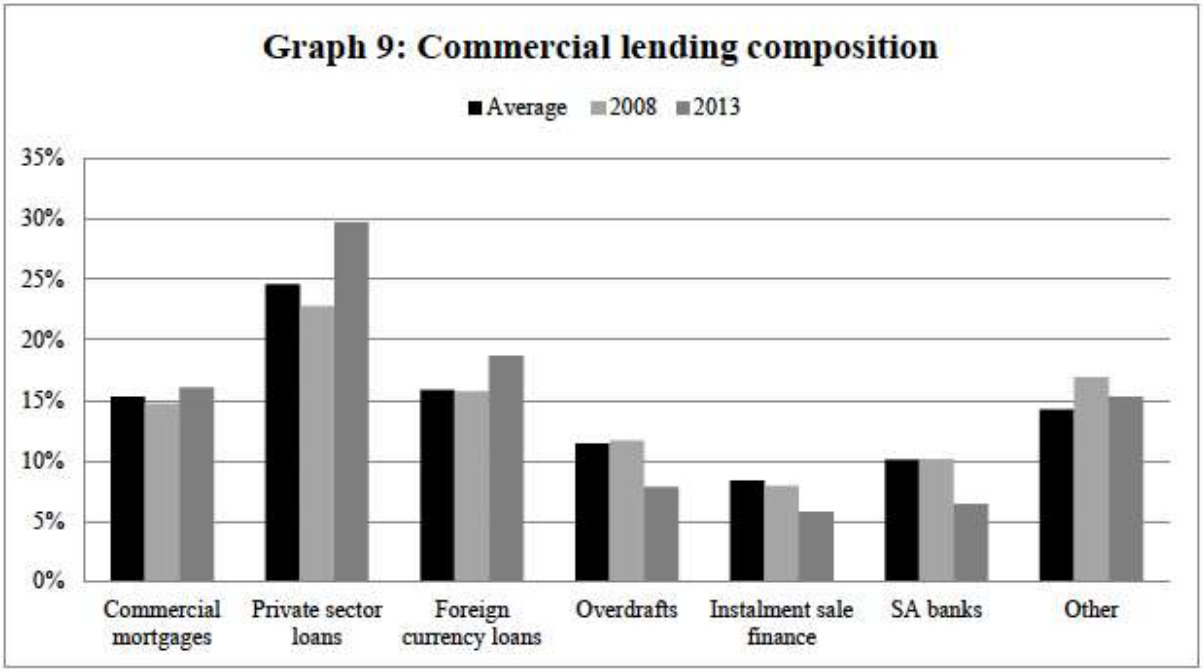

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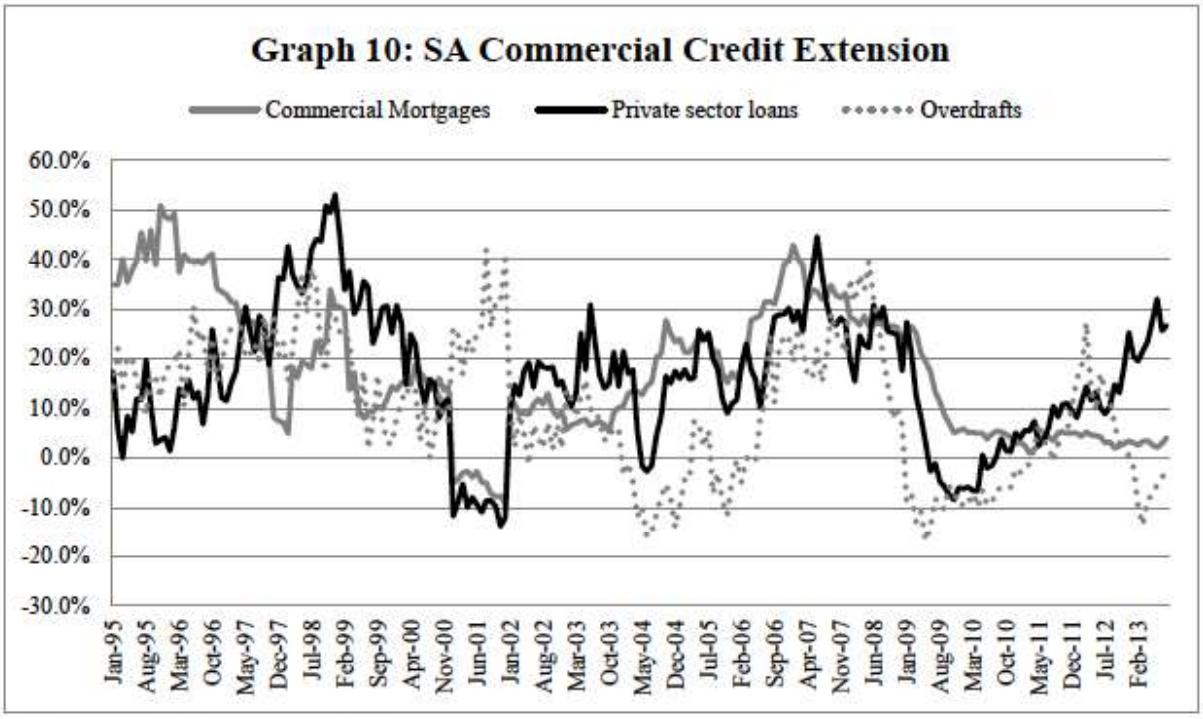
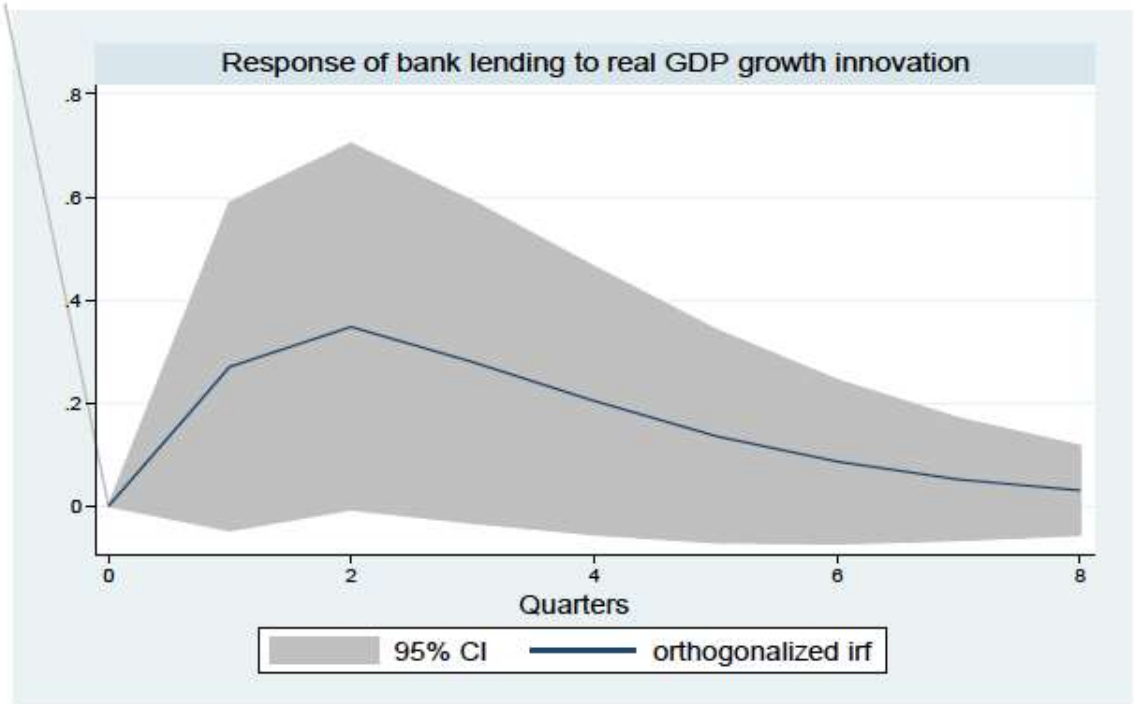


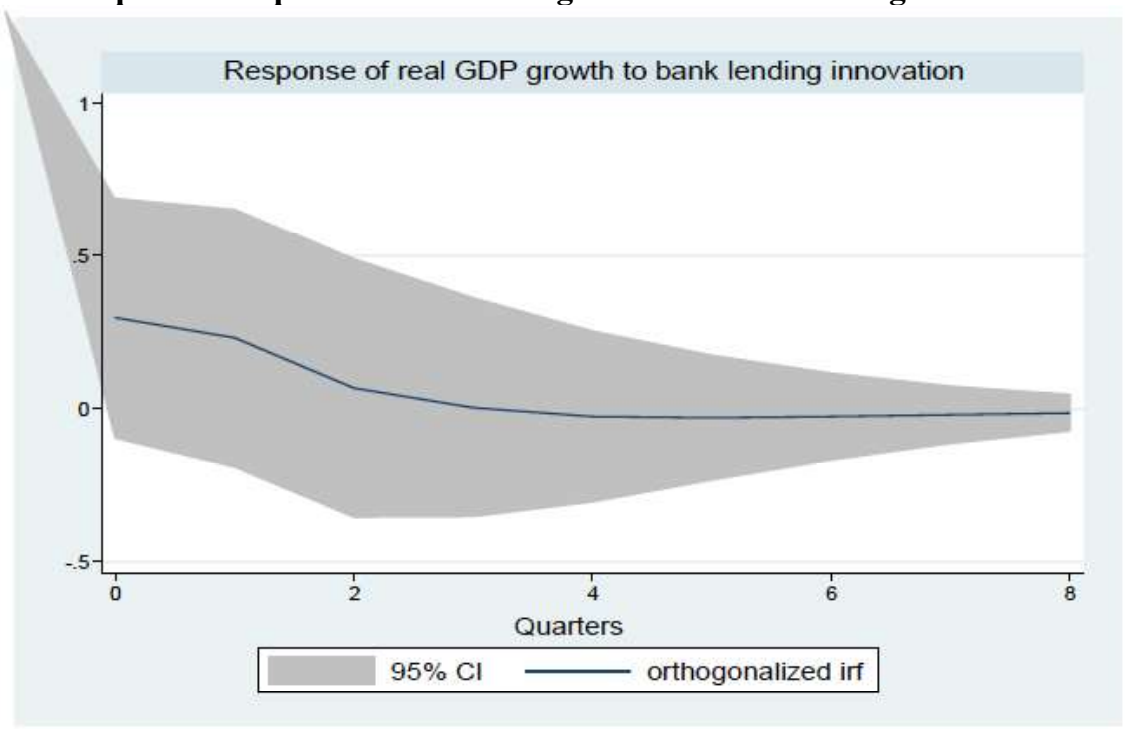
Source: SARB, Author's own calculations.

Graph 11: Response of banking lending to real GDP growth innovation



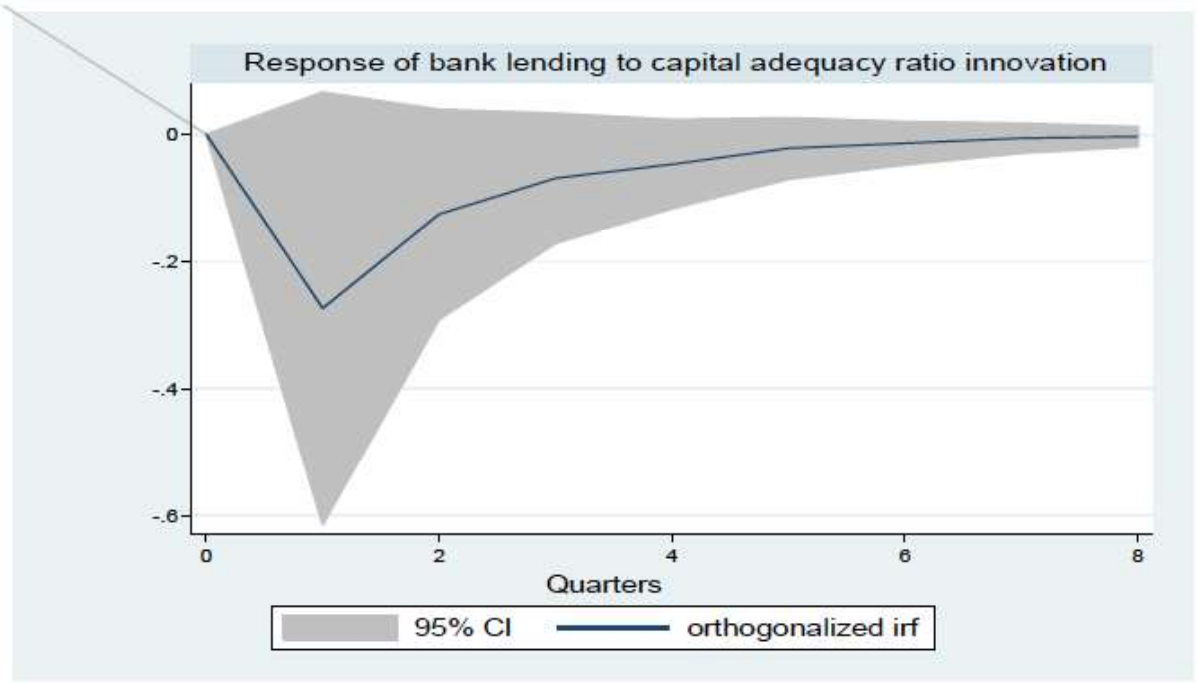
Source: SARB, Thompson Reuters Datastream, Author's own calculations.

Graph 12: Response of real GDP growth to bank lending innovation



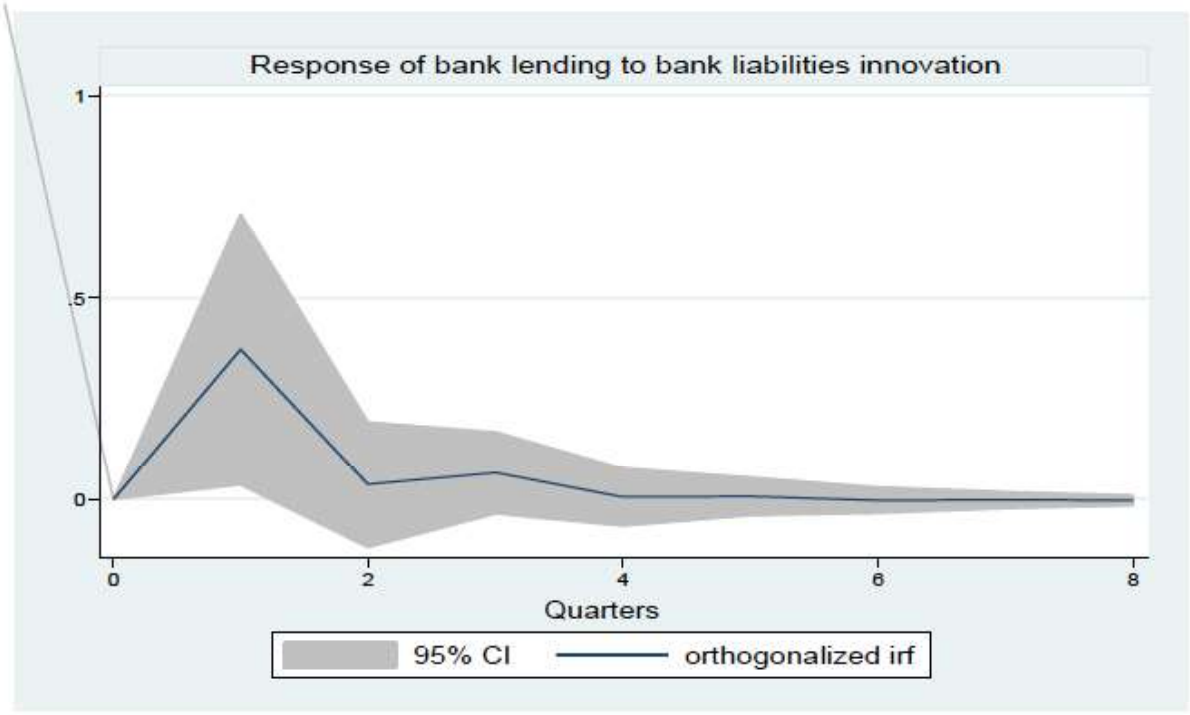
Source: SARB, Thompson Reuters Datastream, Author's own calculations.

Graph 13: Response of bank lending to capital adequacy ratio innovation



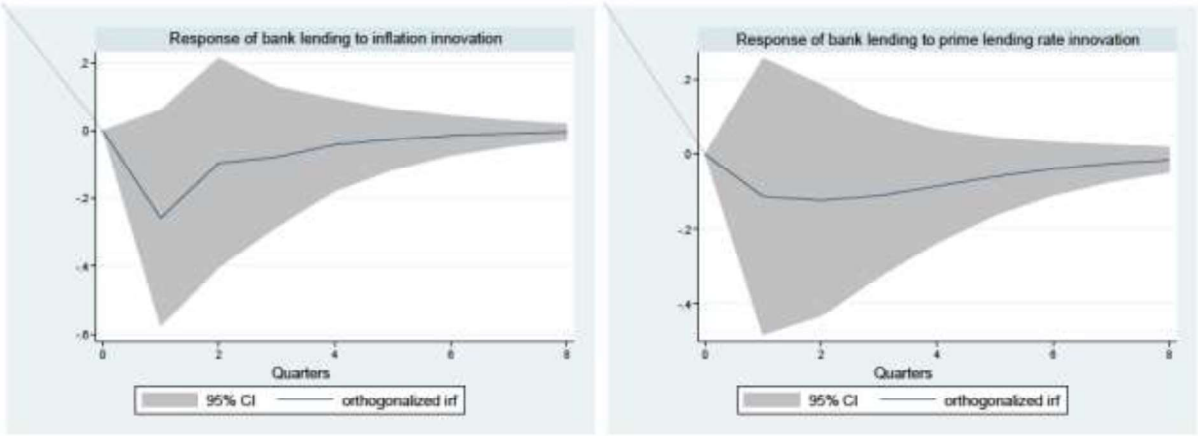
Source: SARB, Thompson Reuters Datastream, Author's own calculations.

Graph 14: Response of bank lending to bank liabilities innovation



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

Graph 15: Response of bank lending to inflation and prime lending innovation



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

Table 1: OLS regression estimations – Model 1

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

Source: SARB, Thompson Reuters Datastream, Author's own calculations.
***, ** and * denotes significance at the 2%, 5% and 10% level.