South African Reserve Bank Working Paper Series WP/25/09

Problem loans in South African banks

Trust R. Mpofu

Authorised for publication by Konstantin Makrelov

7 August 2025

South African Reserve Bank

South African Reserve Bank Working Papers are written by staff members of the South African Reserve Bank and, on occasion, by consultants under the auspices of the South African Reserve Bank. The papers deal with topical issues and describe preliminary research findings and develop new analytical or empirical approaches in their analyses. They are solely intended to elicit comments and stimulate debate.

South African Reserve Bank Working Papers are externally refereed.

Information on South African Reserve Bank Working Papers can be found at
https://www.resbank.co.za/en/home/publications/Papers/working-papers.

Enquiries relating to the Working Paper Series can be addressed to:
Head: Economic Research Department
South African Reserve Bank
P O Box 427
Pretoria 0001

Tel. +27 12 313 3911

Problem loans in South African banks

Trust R. Mpofu*

Abstract

This paper investigates the impact of capital requirements regulations on problem loans in South Africa following the adoption of Basel II in 2008 and the implementation of Basel III between 2013 and 2019. Using dynamic panel techniques employing the difference and system generalised method of moments over the period 2000–2022, the study suggests that capital requirements regulations seem to increase problem loans in general. However, interacting the capital regulation index with the Lerner index, the results indicate a negative and significant effect. This suggests that capital requirements regulations are effective in reducing problem loans for banks with moderate market power. The results also show that both macroeconomic and bank-specific factors drive problem loans.

JEL classification

E44, G21, G38

Keywords

Problem loans, capital regulations, competition, South African banks

* School of Economics, University of Cape Town. Email: trust.mpofu@uct.ac.za.

1. Introduction

The financial crises of 2008/09 and 1997/98 together with the banking crises in the 1980s and early 1990s have shown that banks may experience problems due to credit risk (problem loans), which has negative consequences for the entire economy. The 2008/09 global financial crisis showed the importance of macroprudential regulation for a stable banking sector and thus the full implementation of Basel II and Basel III regulations to prevent future devastating effects of problem loans. The 2008/09 crisis also renewed academic researchers' and policymakers' interest in the causes of problem loans. However, any policy response to resolve problem loans first needs to identify their underlying drivers. As such, this study examines the following research question: what is the effect of capital requirements regulations on problem loans? The adoption of Basel II by South African banks in 2008 and the implementation of Basel III between 2013 and 2019 create a unique opportunity to examine this question.

Although the determinants of problem loans have been analysed in South Africa, to the best of my knowledge no study has examined the effects of capital requirements regulations on problem loans. Investigating problem loans in South Africa is important because there has been an increase in non-performing loans (one of the proxies of problem loans) for all the banks since 2017Q3, which poses credit risk in the banking sector. Bank risks are detrimental because developing economies rely on bank credit for investment, which is a key component of economic growth. Moreover, a sound banking sector is important in limiting economic downturns associated with financial panics and prevents adverse budgetary consequences for the government. Prudential regulations are meant to protect the banking sector by inducing banks to invest wisely (Murinde and Yaseen 2004; Naceur and Omran 2011).

Another motivation for this study is that the literature finds mixed results on the relationship between problem loans and capital requirements regulations. This is probably due to not having satisfactory data on different bank-level variables – for example, having large samples to separate banks into different categories like low-capital banks, big local banks, foreign banks and state-owned banks. Most studies find a negative relationship between these two variables: in other words, increasing regulations reduces problem loans (see Barth, Caprio and Levine 2004; Fernandez and Gonzalez 2005; Pasiouras, Gaganis and Zopounidis 2006; Agoraki, Delis and Pasiouras 2011).

Capital is important for banks for several reasons. Capital serves as the last line of defence against a bank's insolvency given that any losses a bank suffers could be written off against capital. Even when insolvency becomes unavoidable, capital might protect depositors and creditors to some degree. Lastly, capital allows a bank to grow and diversify. This implies that better-capitalised banks will have fewer problem loans.

Other studies like Beatty and Gron (2001) indicate that capital regulation variables only have significant effects on low-capital banks. Barth, Caprio and Levine (2008) find that the capital regulation index plays an insignificant role in driving a banking crisis. Another strand of the literature indicates that capital requirements may increase risk-taking behaviour (see Blum 1999; Calem and Rob 1999, as cited by Pasiouras, Gaganis and Zopounidis 2006).

This study uses bank-level data for a single country to study the determinants of bank loans. Some studies that analyse the impact of macroeconomic factors on problem loans use cross-country panel analysis. Although panel analysis is advantageous in increasing the data points, especially in developing countries with data availability problems, it tends to generalise the results, which is not good for policy recommendations given the heterogeneity in country characteristics. This study focuses on a single country to address this issue. Using bank-level data helps improve on the studies by Fofack (2005), Nikolaidou and Vogiazas (2017) and Mpofu and Nikolaidou (2018) for South Africa that use the aggregate banking sector and thus neglect bank heterogeneity.[1]

Although problem loans are influenced by both macroeconomic and banking sector factors, most studies tend to consider only macroeconomic variables (e.g. Espinoza and Prasad 2010; Havrylchyk 2010; Nkusu 2011; Klein 2013; Mpofu and Nikolaidou 2018). One possible reason for more focus on macroeconomic variables is that many

---

[1] Fofack (2005) and Mpofu and Nikolaidou (2018) use cross-country panel analysis that includes South Africa as one of the countries analysed.

studies find that macroeconomic instability induces banking sector distress. Another reason is data availability problems with banking sector variables, which limits research in most developing countries. South African studies like Havrylchyk (2010) and Nikolaidou and Vogiazas (2017) also find that macroeconomic factors are the main drivers of problem loans. This study uses a relatively longer time period than Havrylchyk (2010) and Nikolaidou and Vogiazas (2017).

Employing the difference and system generalised method of moments (GMM) estimators over the period 2000–2022, the study shows that capital requirements regulations increase problem loans in general, but for banks with moderate market power this effect is significantly reversed. The results also show that both macroeconomic and bank-specific factors drive problem loans in South Africa.

The rest of the paper is organised as follows. Section 2 presents a review of the literature. Section 3 defines the data and explains the methodology used. Section 4 presents the results and section 5 provides the conclusion.

2. Literature review

2.1 Capital requirements and problem loans

Using a model with imperfect competition and moral hazard, Hakenes and Schnabel (2011) show theoretically that the banks' choice between the standardised and the internal ratings-based approach under Basel II led to competitive distortions in the banking sector. These competitive distortions give larger banks a competitive advantage and lead smaller banks to take higher risks, which may raise aggregate risk in the banking sector. This suggests that competition should be one of the explanatory variables in the regression equations.

Agoraki, Delis and Pasiouras (2011) argue that capital requirements influence competition and risk-taking behaviour in several ways. First, high initial capital stringency requirements impose entry barriers for new firms, which in turn restricts competition and allows existing banks to accumulate power. Second, high capital requirements are associated with higher fixed costs that fewer banks can afford. Third, higher capital adequacy requirements lead banks to set stricter acceptance criteria for issuing new loans. Hellmann, Murdock and Stiglitz (2000) argue that banks tend to not engage in excessive risk taking when operating using their own capital (i.e. the capital-at-risk effect). However, they also argue that banks may be encouraged to take more risks to restore their profits and franchise due to the high costs of holding capital (i.e. the franchise-value effect).

Empirically, most studies find support in favour of capital regulations – that is, increasing capital regulations reduces problem loans (e.g. Barth, Caprio and Levine 2004; Fernandez and Gonzalez 2005; Pasiouras, Gaganis and Zopounidis 2006; Agoraki, Delis and Pasiouras 2011). However, Beatty and Gron (2001) indicate that capital regulation variables have significant effects on low-capital banks only and not other banks. Odour, Ngoka and Odonga (2017) also find that higher capital requirements significantly increase financial instability in Africa for smaller banks only. This risk-taking behaviour is also found by Blum (1999) and Calem and Rob (1999), as cited by Pasiouras, Gaganis and Zopounidis (2006). Barth, Caprio and Levine (2008) find that the capital regulation index plays an insignificant role in driving a banking crisis. Beck, Demirguc-Kunt and Levine (2006) and Delis and Staikouras (2011) find evidence that capital regulations play an insignificant role in reducing risk in the banking sector. Hence, capital requirements regulations do not have a significant effect in preventing problem loans nor do they encourage them.

Salas and Saurina (2003) use dummies as proxies of changes in capital regulations, where a value of 1 is used during the periods when the regulations were implemented and 0 otherwise. They find significant results of capital deregulations influencing risk in Spanish banks. Similarly, Chen (2007) uses a dummy variable to find the impact of bank deregulations on credit risk in the euro area.

Overall, the empirical evidence shows mixed results for how capital requirement ratios or regulations influence problem loans. In other words, some studies find significant results while others find insignificant results. Such findings further motivate the need for more empirical work on the impact of capital regulations on problem loans. This study contributes to the literature that analyses the impact of capital regulations, applying both a dummy variable to capture capital regulations, as done by Salas and

Saurina (2003) and Chen (2007), and a constructed index that relates to capital regulations, as done by Agoraki, Delis and Pasiouras (2011).

2.2 Other determinants of problem loans

The empirical literature that analyses the drivers of problem loans is based on theoretical frameworks of the financial accelerator theory – as discussed in Bernanke and Gertler (1989), Kiyotaki and Moore (1997) and Bernanke, Gertler and Gilchrist (1999) – or the life-cycle consumption model (Lawrence 1995). These studies link macroeconomic factors and problem loans. In this line of research, it has been found that during an economic expansion problem loans decrease, as both consumers and firms have sufficient streams of income and revenue to service their debts. But, as the boom period continues, credit is extended to lower-quality debtors, with problem loans rising when the recession phase sets in.

Using the theoretical life-cycle consumption model, Lawrence (1995) introduces the probability of default and derives a model that states that borrowers with low incomes have higher rates of default because of the increased risk of unemployment and the failure to settle their debts. Unemployment rate adversely influences the cash flow of households and increases the debt burden. On the other hand, an increase in the unemployment rate may signal a decrease in production by firms due to a drop in effective demand, which could lead to a reduction in revenues and raise debt burdens to firms (Castro 2013).

Given the above, the general macroeconomic environment is fundamental in explaining the evolution of problem loans. Examples of studies that concentrate on the influence of macroeconomic factors on problem loans include Nkusu (2011) for 26 advanced countries; Castro (2013) for Greece, Ireland, Portugal, Spain and Italy; Beck, Jakubik and Piloiu (2015) for 75 advanced and developing countries; Havrylchyk (2010) for South Africa; and Mpofu and Nikolaidou (2018) for 22 sub-Saharan African (SSA) countries. These studies find a significant and negative effect of the gross domestic product (GDP) growth rate on non-performing loans. Nkusu (2011) and Castro (2013) also find a positive and significant effect of the unemployment rate, while Mpofu and Nikolaidou’s (2018) study of SSA finds an insignificant effect of the unemployment variable. All these studies state that macroeconomic factors are the main drivers of problem loans (see Fofack 2005 for selected SSA countries; Nikolaidou and Vogiazas 2017 for selected SSA countries; Espinoza and Prasad 2010 for Gulf countries; Louzis, Vouldis and Metaxas 2012 for Greece; and Klein 2013 for Central, Eastern and Southeastern European countries).

The other macroeconomic variable commonly used in empirical work is the interest rate. The interest rate influences problem loans because it affects the debt burden of borrowers. The literature shows that rising interest rates increase the debt burden, which then leads to an increase in problem loans (see Fofack 2005; Espinoza and Prasad 2010; Nkusu 2011; Warue 2012; Castro 2013; Beck, Jakubik and Piloiu 2015). Other studies like De Bock and Demyanets (2012) and Mpofu and Nikolaidou (2018) find this variable insignificant.[2]

Another strand of the literature investigates the relationship between bank-specific factors and problem loans given that macroeconomic factors are exogenous to the banking industry. This follows the idiosyncratic features of each bank regarding efforts to improve efficiency, risk management and profitability. All this is likely to affect problem loans differently. As such, Berger and DeYoung (1997) examine the links among problem loans, cost efficiency and bank capitalisation. They explain the causality from cost efficiency to problem loans using the 'bad management' hypothesis. This hypothesis states that low cost efficiency is a signal of poor management practices, which results in poor loan underwriting, monitoring and control, thus leading to an increase in problem loans.

Another hypothesis by the same authors is 'skimping', which suggests a positive relationship between high cost efficiency and problem loans. They argue that high efficiency could reflect that few resources are allocated to monitor lending risks and thus may result in a rise in problem loans in the long run. Berger and DeYoung (1997) also discuss the 'moral hazard' hypothesis (see also Keeton and Morris (1987)). This hypothesis is that low capitalisation of banks increases the riskiness of banks' loan

---

2 Other macroeconomic variables that have been found not to be robust in the literature include the inflation rate and the real exchange rate. However, this study does not discuss them because when running regressions they were found to be insignificant in different model specifications.

portfolio, leading to a rise in problem loans in the long run following the moral hazard incentives of bank managers.

3. Data and methodology

This paper uses annual bank-level data over the period 2000–2022 for a sample of seven South African banks (First National Bank, Standard Bank Group, Absa Group, Nedbank Group, Investec, Capitec Bank and Sasfin Holdings) and selected macroeconomic data. The data are obtained from Bloomberg for the bank-level dataset while a selected macroeconomic dataset is obtained from the World Bank's World Development Indicators and the International Monetary Fund's (IMF's) International Financial Statistics. Data availability is a major limitation when dealing with developing countries. This study also struggled with this issue, hence the unbalanced panel. Nonetheless, this sample covers most South African banks in terms of their total assets. For example, the five largest banks (Standard Bank, First National Bank, Nedbank, Absa and Investec) accounted for 87.4% of banking sector assets in 2004 and 90% in 2019 (IMF 2022; SARB 2004).

The literature (see Beck, Jakubik and Piloiu 2015; Mpofu and Nikolaidou 2018) suggests four measures used to proxy problem loans, namely expected default frequencies, loan loss provisions, loss given default and non-performing loans. However, due to data availability, the most used measures of problem loans in the empirical literature are loan loss provisions and non-performing loans. As such, this study uses non-performing loans to proxy problem loans.

The variables are defined as follows: the dependent variable is non-performing loans (npl), which is measured as the ratio of non-performing loans to total (gross) loans in percentages.

Explanatory variables are as follows: real GDP growth rate (rgdpgr) is the annual percentage growth rate of real GDP based on constant 2015 prices. Unemployment rate (unemp) is the total unemployment rate as a percentage of the total labour force. Lending interest rate (lrate) is the real bank interest rate that usually meets the short- and medium-term financing needs of the private sector.

Bank-specific variables include return on assets (roa), which is net income divided by average total assets, in percentage. Bank competition (lerner) is calculated based on a bank-level Lerner index (see the annexure for the calculations).

The study has three measures of capital requirements. First is the capital regulation index (capindex), which is constructed following the approach by Barth, Caprio and Levine (2001, 2006, 2008, 2013) and using the World Bank regulations and supervision surveys since 1999. The capital regulation index measures the initial and overall capital stringency. Initial capital stringency determines whether some sources of funds considered as regulatory capital include assets besides cash or government securities and borrowed funds. Initial capital stringency also considers whether the regulatory authorities verify these sources. On the other hand, overall capital stringency examines whether different types of risks and value losses are considered when calculating the regulatory capital. The capital regulation index can take values between 0 and 10, with higher values indicating more stringent capital regulation. A full description of how to calculate this index is provided in the annexure.

Second is the tier 1 capital ratio (tier1capr), which is tier 1 capital ratio to risk-weighted assets, in per cent. Third is the use of dummies following studies like Salas and Saurina (2003) and Chen (2007). For this measure, Basel 2 is a dummy for the implementation of Basel II capital requirements, with 1 = 2008–2012 and 0 otherwise. Basel 3 is a dummy for the implementation of Basel III, with 1 = 2013–2019 and 0 otherwise. The capital regulation index enters the model specification with a lag following the time frames it takes to make laws and implement them – in other words, it is treated as predetermined. The tier 1 capital ratio enters the model specification contemporaneously because it is treated as endogenous, while the Basel dummies will not enter with a lag and are treated as exogenous. Descriptive statistics for all the variables are shown in Table 1.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. dev	Min	Max
npl	133	3.860	2.728	0.003	16.258
roa	158	2.174	2.251	-0.502	11.212
capindex	154	8.273	1.012	7	10
lerner	151	0.287	0.094	-0.010	0.516
rgdpgr	161	2.352	2.554	-6.342	5.604
unemp	161	24.152	2.691	19.51	29.88
lrate	161	10.925	2.447	7.042	15.75
tier1capr	154	15.893	9.838	5	83.4
Basel 2	161	0.217	0.414	0	1
Basel 3	161	0.304	0.462	0	1

Note: Variables are defined as follows: npl = non-performing loans to total loans in %. rgdpgr = real GDP growth rate in %. unemp = unemployment rate. lrate = real lending interest rate. roa = return on assets in %. lerner = Lerner index. capindex = capital regulation index. tier1capr = Tier 1 capital adequacy ratio. Basel 2 and Basel 3 are dummy variables. Basel 2 takes the value 1 for 2008–2012 and 0 otherwise. Basel 3 takes the value 1 for 2013–2019 and 0 otherwise.

To inform the model specification, preliminary analysis is carried out to establish the stationarity of all the variables used. I apply the Fisher-ADF and Fisher-PP tests to test the stationarity of the variables because the Fisher-type tests do not require a balanced panel. If the two tests do not agree, I apply the Im-Pesaran-Shin (IPS) test because this test also does not require the use of a balanced panel. The results shown in Table A1 in the annexure indicate that all the variables are stationary in levels using the Fisher-ADF except for the unemployment rate variable, which is I (1) – that is, it is stationary after first differencing. The Fisher-PP shows that all the variables are stationary in levels except the lending rate, Lerner index and unemployment rate, which are I (1). Further applying the IPS, the results show that the unemployment rate, Lerner index and the Tier 1 capital ratio are I (1) while the rest are I (0). Only stationary variables are used when running the regressions.

In analysing the determinants of problem loans, with the main objective of investigating capital regulations, a dynamic panel model is adopted to account for omitted variables and the persistence of problem loans. The adopted model is as follows:

$$ploans_{it} = \alpha_0 + \alpha_1 ploans_{it-1} + \alpha_2 regulations_t + \alpha_3 Lerner_{it} + \alpha_4 X_{it} + \alpha_5 M_t + \varphi_i + \varepsilon_{it}, \qquad (1)$$

where *ploans* denotes problem loans proxied by non-performing loans to total (gross) loans. The subscripts i = 1, …, 7 and t = 2000, …, 2022 refer to the cross-sectional and time series elements of the data respectively. $regulations_t$ refers to one of the proxies for capital requirements regulation – that is, the capital regulation index or tier 1 capital ratio or the Basel dummies. Lerner refers to the Lerner index, which captures bank competition. X_{it} refers to bank-specific variables. M_t refers to macroeconomic variables. φ_i is a time-invariant unobserved bank-specific effect. α_{0-5} are coefficients to be estimated, and ε_{it} is the error term.

To estimate equation (1), I use Arellano and Bond's (1991) one-step difference GMM for several reasons. First, the one-step GMM estimator tends to be less biased than the two-step estimator in small samples (this study also has a small sample size), as argued by Judson and Owen (1999) and Arellano and Bond (1991).

Second, it is possible that reverse causality prevails between problem loans and regulations because of financial instability (note the instability faced by medium to small banks and some bank consolidation over the period 1994Q4–2003Q1). As such, the supervisory authorities might have reacted by setting new rules and taking new measures to smooth the turmoil, which will be reflected in the regulatory indices. Hence, the GMM accommodates the possible endogeneity between problem loans and regulations by means of appropriate instruments. This method transforms the data to first differences to remove the fixed effect element and uses the regressors from periods other than the current period as instruments. Following Arellano and Bond's (1991) method, the differences of the strictly exogenous explanatory variables are instrumented with themselves while the lagged dependent variable as well as predetermined and endogenous variables are instrumented with their lagged levels. All macroeconomic variables are treated as strictly exogenous because they enter the regression equation with at least one lag, following studies like Castro (2013) and Klein (2013). The use of strictly exogenous variables helps avoid a huge number of instruments given that this study has just seven cross-sectional units in the sample. Bank competition (Lerner index) and the capital regulation index are treated as predetermined and enter the regression equation with one lag. New regulatory practices are likely to affect problem loans with a lag given the time frames taken to establish new banking laws or develop new policy initiatives and transform them into sound banking practices. This is the reason why the study uses a lag of the capital regulation index.[3] Return on assets and the tier 1 capital ratio are treated as endogenous and enter the regression equation contemporaneously. The validity of the instruments is verified by a Sargan test.

Third, the GMM estimator can address the problems of some traditional panel data estimators such as pooled ordinary least squares (OLS), fixed effects and random effects. Baltagi (2008) argues that the pooled-OLS estimator is biased and inconsistent even when the error term is not serially correlated in a dynamic panel model. The random effects estimator is also biased in a dynamic panel model (Castro 2013). The fixed effects model allows controlling unobserved heterogeneity across banks. However, this approach may give rise to Nickell's (1981) bias (dynamic panel bias), which results from the possible endogeneity of the lagged dependent variable and the fixed effects in the error term, especially in small panels.

However, some studies (e.g. Blundell and Bond 1998; De Bock and Demyanets 2012; Klein 2013) argue that the difference GMM has a weakness of providing estimations with low precision when the sample period has 'small T' and high persistence. To address this concern, I also estimate a system GMM.

4. Results

The findings from the regression analysis are shown in Tables 2 and 3. Table 2 shows the results applying the difference GMM estimator while Table 3 presents the results applying the system GMM estimator. The Arellano-Bond test for autocorrelation of the residuals confirms that there is no serial correlation given insignificant p-values. The validity of the instruments is also confirmed by insignificant p-values for the Sargan test – that is, p-values greater than 0.05.

---

3 The results are robust to different lag specifications. Using two lags does not change the sign and significance of the results.

Table 2: Difference GMM regression results

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged dependent variable	0.718*** (0.049)	0.704*** (0.054)	0.649*** (0.047)	0.596*** (0.046)	0.559*** (0.043)	0.605*** (0.048)	0.653*** (0.045)
RGDP growth	-0.231* (0.119)	-0.228* (0.123)	-0.152 (0.130)	-0.241* (0.129)	0.115 (0.104)	-0.241* (0.129)	-0.172 (0.132)
Unemployment rate change	0.139* (0.081)	0.160* (0.088)	0.123 (0.080)	0.111 (0.078)	0.078 (0.078)	0.108 (0.080)	0.125 (0.079)
Real interest rate	0.275*** (0.079)	0.232*** (0.078)	0.392*** (0.105)	0.386*** (0.100)	0.272** (0.108)	0.372*** (0.101)	0.385*** (0.105)
Lerner index	3.000 (5.276)	-1.512 (3.459)	6.264 (5.200)	7.588 (6.041)	5.737 (6.041)	6.872 (5.973)	6.108 (5.287)
Lerner index^2		42.457 (50.194)					
Capital regulations	0.487*** (0.110)	0.492*** (0.100)					
Return on assets	-0.968*** (0.294)	-0.878*** (0.204)	-1.034*** (0.362)	-0.985** (0.415)	-0.982** (0.482)	-0.939** (0.382)	-1.045*** (0.308)
Tier 1 capital ratio			0.072** (0.032)				0.052 (0.036)
Basel 2 dummy				0.850*** (0.279)		0.739*** (0.253)	
Basel 3 dummy					-0.323 (0.228)	-0.175 (0.247)	
Tier 1 capital ratio*Basel 2 dummy							0.009 (0.009)
Tier 1 capital ratio*Basel 3 dummy							-0.000 (0.015)
constant	-3.388*** (1.053)	-3.128*** (0.704)	-1.459* (0.814)	-0.154 (0.289)	0.604 (1.070)	-0.019 (0.317)	-1.050 (0.928)
Number of obs	111	111	111	111	111	111	111
AR (1)	0.1247	0.1201	0.1596	0.1625	0.1804	0.1661	0.1571
AR (2)	0.3530	0.3543	0.3333	0.4004	0.4002	0.3969	0.3442
Sargan test	0.4592	0.6429	0.1403	0.1431	0.0942	0.1391	0.1744

Table 3: System GMM regression results

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged dependent variable	0.731*** (0.074)	0.740*** (0.061)	0.717*** (0.048)	0.714*** (0.033)	0.739*** (0.054)	0.715*** (0.033)	0.725*** (0.043)
RGDP growth	-0.264 (0.167)	-0.268 (0.167)	-0.249 (0.200)	-0.380* (0.201)	-0.240 (0.198)	-0.383* (0.203)	-0.205 (0.164)
Unemployment rate change	0.146 (0.124)	0.173 (0.121)	0.132 (0.099)	0.157 (0.117)	0.164 (0.129)	0.159 (0.120)	0.128 (0.094)
Real interest rate	0.194* (0.107)	0.177 (0.112)	0.408*** (0.114)	0.239** (0.115)	0.264** (0.126)	0.239** (0.116)	0.419*** (0.125)
Lerner index	-3.098 (3.741)	-6.777** (3.233)	4.174 (4.791)	-1.653 (4.258)	-3.616 (3.941)	-1.922 (4.282)	4.193 (4.923)
Lerner index^2		110.337** (55.456)					
Capital regulations	0.421*** (0.098)	0.437*** (0.087)					
Return on assets	-0.131 (0.102)	-0.168 (0.120)	-0.814*** (0.163)	-0.155 (0.102)	-0.122 (0.083)	-0.150 (0.095)	-0.809*** (0.135)
Tier 1 capital ratio			0.174*** (0.021)				0.182*** (0.035)
Basel 2 dummy				1.131*** (0.282)		1.071*** (0.310)	
Basel 3 dummy					-0.375 (0.246)	-0.115 (0.251)	
Tier 1 capital ratio*Basel 2 dummy							-0.016 (0.028)
Tier 1 capital ratio*Basel 3 dummy							0.001 (0.020)
Constant	-3.481** (1.387)	-3.491*** (1.273)	-3.660*** (0.817)	-0.312 (0.735)	-0.601 (0.828)	-0.247 (0.659)	-3.983 (1.091)
Number of obs	118	118	118	118	118	118	118
AR (1)	0.1376	0.1328	0.1553	0.1465	0.1487	0.1477	0.1527
AR (2)	0.3031	0.3023	0.2875	0.3533	0.3272	0.3558	0.2803
Sargan test	0.0733	0.4156	0.0705	0.1110	0.0619	0.1167	0.1114

Given that equation (1) in section 3 is a dynamic model, I begin by interpreting the lagged dependent variable. Columns 1–7 in Table 2 show that the coefficients for this variable are statistically significant and range from 0.559 to 0.718. This suggests relative high persistence and that a shock to problem loans is likely to have a prolonged effect on the banking system. The same results of relative high persistence in the lagged dependent variable are shown in Table 3, which now ranges from 0.714 to 0.740.

Using the capital regulation index to measure capital requirements, the results show a positive and significant association between capital regulations and problem loans. These results are robust across all specifications (the coefficients are 0.487 in column 1 and 0.492 in column 2 of Table 2 using difference GMM, and 0.421 in column 1 and 0.437 in column 2 of Table 3 using system GMM). These results are robust to using a different lag length for the capital regulation index (see Table A2 in the annexure).[4]

This result suggests that banks make more risky loans as capital regulations become stricter, a finding that is consistent with the theoretical results of Hellmann, Murdock and Stiglitz (2000). However, this finding is different to that in Agoraki, Delis and Pasiouras (2011), Barth, Caprio and Levine (2004) and Pasiouras, Gaganis and Zopounidis (2006), who find that increasing capital regulations reduces problem loans. Agoraki, Delis and Pasiouras (2011) find that capital regulations increase problem loans for banks with sufficient market power. Beck, Demirguc-Kunt and Levine (2006) and Delis and Staikouras (2011) find insignificant results between these two variables.

Following Agoraki, Delis and Pasiouras (2011), another regression specification includes an interaction between the Lerner index and capital regulation index. These results are shown in columns 9 (using the difference GMM) and 10 (using the system GMM) of Table A2 in the annexure. In both cases, the results show positive and significant coefficients for the capital regulation index, and negative and significant coefficients for the interaction term. This suggests that capital requirements are only effective in reducing problem loans for banks with moderate market power.

Following studies by Salas and Saurina (2003) and Chen (2007), this study also uses dummy variables to find the impact of capital regulations on problem loans. The results show that the coefficients for the Basel 2 dummy variable when entered on its own are

---

4 However, the coefficients for the capital regulation index are insignificant when this variable is used contemporaneously, suggesting, as mentioned earlier, that new regulations affect problem loans with a lag given the time it takes to make laws and implement them.

positive and significant as well as robust across estimation techniques. Column 4 in Table 2, which uses difference GMM, shows the value of 0.850, while Table 3, which uses system GMM, shows the value of 1.131. These results are similar to the use of the capital regulation index explained earlier. However, the coefficients for the Basel 3 dummy variable are insignificant when they enter on their own (see column 5 of Tables 2 and 3). Entering Basel 2 and Basel 3 together in an equation, the results still show positive and significant coefficients for Basel 2 and insignificant coefficients for Basel 3 (see column 6 in Tables 2 and 3).

The tier 1 capital adequacy ratio has positive and significant coefficients using both the difference GMM and system GMM estimators. The coefficients are 0.072 in column 3 of Table 2 and 0.174 in column 3 of Table 3. This result supports the finding above that riskier loans are offered as capital regulations increase. Interacting the tier 1 capital adequacy ratio with the Basel 2 and 3 dummies, the results are insignificant in all specifications. However, my results differ from those of Pillay and Makrelov's (2025) study, which finds that excess capital requirements reduce lending for all sectors. Their study also finds that actual capital requirements have a negative effect on lending. The analysis in this paper differs in several respects from theirs: this study uses fewer banks; the dependent variable in this study is based on non-performing loans to total loans whereas their study is based on economic sector credit extension; and this study uses a different panel analysis method (difference and system GMM versus fixed effects in their study).

Next, I interpret macroeconomic variables and bank-specific variables. Studies like Carey (1998) argue that the most important systematic factor that drives problem loans is the state of the economy. Following this and the theoretical literature of life-cycle consumption models (for empirical evidence, see, for example, Lawrence (1995) and Louzis, Vouldis and Metaxas (2012)), the primary macroeconomic determinants of problem loans are the real GDP growth rate, the unemployment rate and the real lending interest rate. The results in Table 2 (columns 1, 2, 4 and 6) and Table 3 (columns 4 and 6) indicate that when the real GDP growth rate increases, problem loans decrease significantly. These results suggest that a 1 percentage point increase in the real GDP growth rate leads to a decrease in problem loans by about 0.23–0.24 percentage points (see Table 2) using the difference GMM. Using the system GMM, the problem loans decrease by 0.38 percentage points (see Table 3), all else being equal. These findings are similar to those in Havrylchyk (2010), Nkusu (2011), Agoraki, Delis and Pasiouras (2011), Castro (2013), Klein (2013), Beck, Jakubik and Piloiu (2015), Mpofu and Nikolaidou (2018) and Erdas and Ezanoglu (2022), among others.

The unemployment rate coefficients are all positive and only significant when applying the difference GMM (see Table 2, columns 1 and 2). However, they are insignificant in columns 3 to 7 of Table 2 and all columns of Table 3, which applies the system GMM. The significant coefficients suggest that a 1 percentage point increase in the unemployment rate leads to an increase of problem loans by about 0.14–0.16 percentage points, all else being equal. These results are expected given that an increase in the unemployment rate negatively affects households' ability to service their debts.

The findings show a positive and significant association between the real lending interest rate and problem loans that is robust across all specifications (whether difference GMM or system GMM). The finding indicates that a 1 percentage point increase in the real lending interest rate increases problem loans by about 0.23–0.39 percentage points using difference GMM (see Table 2) and by about 0.19–0.42 percentage points using system GMM (see Table 3), all else being equal. The results for real GDP, the unemployment rate and the real interest rate suggest that problem loans tend to increase when the general economic environment deteriorates.

There is also a negative and significant association between problem loans and return on assets that is robust across all specifications (whether difference or system GMM). These results suggest that good performance reduces problem loans. Bank competition proxied by the Lerner index is insignificant in all model specifications in Table 2, while it is only significant in column 2 of Table 3 with a negative sign.

5. Conclusion

The 2008/09 global financial crisis indicated the importance of macroprudential regulation for a stable banking sector. This crisis also renewed interest in the causes of problem loans and their effect on the economy. This paper empirically examined the drivers of problem loans proxied by non-performing loans to total (gross) loans in South Africa. To determine the impact of bank capital regulation on problem loans, the study used a capital regulation index, the tier 1 capital adequacy ratio and dummy variables. Estimations were carried out using a dynamic panel model over the period 2000–2022 employing both the difference and system GMM estimators.

The results indicate that stricter capital regulations increase problem loans for the seven large banks in South Africa in general, but for banks with moderate market power this effect is significantly reversed. The results also show that both macroeconomic and bank-specific factors influence the behaviour of problem loans in South Africa’s banking sector. In terms of policymaking, these results suggest that capital regulations alone may not be adequate to control problem loans.

One limitation of the study is the difficulty of finding large datasets on all banks in South Africa. This means it is not possible to analyse the effects of capital regulations on small and medium banks compared to big banks.

Annexure

Lerner index calculation

The Lerner index is obtained from the following equation:

$$L_{it} = \frac{(P_{it} - MC_{it})}{P_{it}} \quad \text{(A1)}$$

where P_{it} is the price of bank i's output (proxied by the ratio of total income to total assets) at time t. MC_{it} is the marginal cost of bank i at time t estimated based on the following translog cost function:

$$\ln\left(\frac{TC}{W3}\right)_{it} = \alpha_0 + \alpha_1 lny_{it} + 0.5\alpha_2 (lny)_{it}^2 + \alpha_3 ln(\frac{W1}{W3})_{it} + \alpha_4 ln(\frac{W2}{W3})_{it} + \alpha_5 \ln(\frac{W1}{W2})_{it} \ln\left(\frac{W2}{W3}\right)_{it} + 0.5\alpha_6 [ln(\frac{W1}{W3})_{it}]^2 + 0.5\alpha_7 [ln(\frac{W2}{W3})_{it}]^2 + \alpha_8 lny_{it} ln(\frac{W1}{W3})_{it} + \alpha_9 lny_{it} ln(\frac{W2}{W3})_{it} + T + \varepsilon_{it} \quad \text{(A2)}$$

where TC is total costs (proxied by interest and non-interest expenses), y is bank output (proxied by total assets), and Wi is the price of input i. Three inputs are used: ratio of interest expenses to total customers deposits and short-term funding (W1); ratio of personnel expenses to total assets (W2); and ratio of non-interest expenses to total assets (W3). I follow the literature by imposing restrictions – that is, I normalise prices by dividing TC, W1 and W2 by W3. T is trend.

Equation (A2) is estimated using stochastic frontier models. Estimation of equation (A2) is carried out for the whole panel of banks because of the small sample size, so individual-bank-level estimations may provide poor results. The coefficient estimates from equation (A2) are then used to estimate the marginal cost for each bank as follows:

$$MC_{it} = \frac{TC_{it}}{TA_{it}} [\alpha_1 + \alpha_2 ln(TA_{it}) + \alpha_8 \ln\left(\frac{W1}{W3}\right) + \alpha_9 \ln\left(\frac{W2}{W3}\right)] \quad \text{(A3)}$$

where TA is total assets. Using the marginal cost from equation (A3), the bank-specific Lerner indices are then obtained using the formula in equation (A1).

Description of capital regulation index

The index answers the following 10 questions: (1) Is the capital-asset ratio risk weighted in line with Basel guidelines? (2) Does the minimum capital-asset ratio vary as a function of an individual bank's credit risk? (3) Does the minimum capital-asset ratio vary as a function of market risk? (4–6) Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital: (a) market value of loan losses not realised in accounting books? (b) unrealised losses in securities portfolios? (c) unrealised foreign exchange losses? (7) What fraction of revaluation gains is allowed as part of capital? (8) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (9) Can the initial disbursement or subsequent injections of capital be done with assets other than cash or government securities? (10) Can initial disbursement of capital be done with borrowed funds? Add 1 if the answer is yes to questions 1–6 and 8, 0 otherwise. For question 7, add 1 if the fraction is less than 0.75 and 0 otherwise. For questions 9–10, add 1 if the answer is no and 0 otherwise. As such, the minimum possible value is 0 and the maximum possible value is 10. Larger values of this index indicate more stringent capital regulation.

Table A1: Panel unit root tests

Variable	Fisher-ADF Inverse normal	Fisher-PP Inverse	IPS
npl	-5.482***	-1.942**	-2.270**
roa	-5.355***	-4.627***	-1.945**
capindex	-5.361***	-1.377*	-1.889**
lerner	-4.711***	-1.174	-1.161
d.lerner		-8.913***	-5.313***
rgdpgr	-5.794***	-7.076***	-2.439**
unemp	-1.244	-1.493*	2.919
d.unemp	-5.953***	-14.093***	-2.670**
lrate	-5.234***	-1.056	-1.712**
d.lrate		-6.814***	
Tier1 capital ratio	-3.512***	-1.829**	0.004
d.tier1 capital ratio			-6.563***

Notes: The Im-Pesaran-Shin (IPS) unit root tests do not require the use of a balanced panel and are performed over the available data considering a constant and one lag in all regressions. The null hypothesis is that "all panels contain unit roots". The Fisher-type unit-root tests are based on augmented Dickey–Fuller (Fisher–ADF) tests with drift and one lag in all regressions and Phillips–Perron (Fisher–PP) tests with one lag in all regressions. The null hypothesis is that "all panels contain unit roots". The Fisher-type tests do not require a balanced panel because the tests are conducted for each panel individually before combining the p-values from those tests to produce the overall test. The statistics are reported, and respective p-values are represented by the stars. ***, ** and * indicate rejection of the null hypothesis at 1%, 5% and 10% respectively. A d before a variable name refers to the first difference of the variable.

Table A2: Difference and system GMM results for different lags for capital regulation index

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	capital regulations$_{t-2}$				capital regulations$_t$	
	Difference GMM		System GMM		Difference GMM	
Lagged dependent variable	0.678*** (0.021)	0.670*** (0.037)	0.699*** (0.052)	0.708*** (0.039)	0.724*** (0.054)	0.696*** (0.062)
RGDP growth	-0.262* (0.134)	-0.283** (0.140)	-0.311 (0.190)	-0.328* (0.187)	-0.168 (0.118)	-0.156 (0.124)
Unemployment rate change	0.110 (0.074)	0.123 (0.075)	0.104 (0.109)	0.123 (0.103)	0.161 (0.159)	0.160 (0.150)
Real interest rate	0.284*** (0.081)	0.230*** (0.085)	0.191** (0.092)	0.163 (0.100)	0.319*** (0.088)	0.293*** (0.095)
Lerner index	3.754 (5.176)	-1.231 (3.798)	-1.742 (3.589)	-6.010* (3.432)	0.517 (5.259)	-2.132 (3.509)
Lerner index^2		81.851 (54.118)		140.363** (55.919)		-5.277 (45.413)
Capital regulations	0.430*** (0.128)	0.514*** (0.153)	0.486*** (0.114)	0.542*** (0.131)	0.286 (0.213)	0.196 (0.176)
Return on assets	-0.867*** (0.286)	-0.797*** (0.207)	-0.118 (0.103)	-0.156 (0.126)	-0.945*** (0.291)	-0.846*** (0.194)
Constant	-2.950*** (1.036)	-3.209*** (0.984)	-3.776*** (1.441)	-4.010*** (1.446)	-2.392 (1.721)	-1.446 (1.109)
Number of obs	111	111	118	118	104	104
AR (1)	0.1221	0.1134	0.1324	0.1254	0.1438	0.1384
AR (2)	0.3410	0.3439	0.3266	0.3175	0.3809	0.3982
Sargan test	0.4354	0.7000	0.0958	0.5158	0.3184	0.4329

Notes: The models are estimated with robust standard errors. ***, ** and * indicate the 1%, 5% and 10% level of significance respectively. Robust standard errors are in brackets. Number of. obs = the number of observations.

Table A2: Continued

Variable	(7)	(8)	(9)	(10)
	capital regulations$_t$		Lerner*capital regulations$_{t-1}$	
	System GMM		Difference GMM	System GMM
Lagged dependent variable	0.722*** (0.068)	0.726*** (0.068)	0.721*** (0.038)	0.727*** (0.062)
RGDP growth	-0.194 (0.171)	-0.198 (0.170)	-0.244** (0.117)	-0.278* (0.164)
Unemployment rate change	0.084 (0.213)	0.141 (0.231)	0.154** (0.071)	0.165 (0.105)
Real interest rate	0.247** (0.114)	0.241** (0.114)	0.261*** (0.074)	0.179* (0.100)
Lerner index	-6.235* (3.484)	-7.077** (3.560)	55.122** (19.211)	61.358** (25.808)
Lerner index^2		59.484 (56.638)		
Capital regulations	0.063 (0.269)	0.107 (0.267)	0.595*** (0.115)	0.557*** (0.098)
Return on assets	-0.107 (0.104)	-0.142 (0.128)	-0.951*** (0.320)	-0.117 (0.106)
Lerner*capital regulations			-6.142*** (2.108)	-7.552** (2.982)
Constant	-1.200 (2.315)	-1.511 (2.269)	-4.161*** (0.864)	-4.456*** (1.050)
Number of obs	111	111	111	118
AR (1)	0.1629	0.1596	0.1273	0.1382
AR (2)	0.3564	0.3515	0.3595	0.3138
Sargan test	0.1127	0.2041	0.4589	0.1066

Notes: The models are estimated with robust standard errors. ***, ** and * indicate the 1%, 5% and 10% level of significance respectively. Robust standard errors are in brackets. Number of. obs = the number of observations.

References

Agoraki, M E K, Delis, M D and Pasiouras, F. 2011. 'Regulations, competition and bank risk-taking in transition countries'. *Journal of Financial Stability* 7(1): 38–48.

Arellano, M and Bond, S. 1991. 'Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations'. *The Review of Economic Studies* 58(2): 277–297.

Baltagi, B. 2008. *Econometric analysis of panel data*. 4th ed. Chichester, UK: John Wiley & Sons.

Barth, J R, Caprio, G and Levine, R. 2001. 'The regulation and supervision of banks around the world: a new database'. In *Integrating emerging market countries into the global financial system,* edited by R E Litan and R Herring. Brookings-Wharton Papers in Financial Services, Brookings Institution Press. 183–240.

Barth, J R, Caprio, G and Levine, R. 2004. 'Bank regulation and supervision: what works best?' *Journal of Financial Intermediation* 13, 205–248.

Barth, J R, Caprio, G and Levine, R. 2006. *Rethinking bank regulation: till angels govern*. New York: Cambridge University Press.

Barth, J R, Caprio, G and Levine, R. 2008. 'Bank regulations are changing: for better or worse?' *Comparative Economic Studies* 50(4): 537–563.

Barth, J R, Caprio, G and Levine, R. 2013. 'Bank regulation and supervision in 180 countries from 1999 to 2011'. *Journal of Financial Economic Policy* 5(2): 111–219.

Beatty, A L and Gron, A. 2001. 'Capital, portfolio, and growth: bank behavior under risk-based capital guidelines'. *Journal of Financial Services Research* 20(1): 5–31.

Beck, T, Demirguc-Kunt, A, and Levine, R. 2006. 'Bank concentration, competition and crisis: first results' *Journal of Banking and Finance* 30(5): 1581–1603.

Beck, R, Jakubik, P and Piloiu, A. 2015. ‘Key determinants of non-performing loans: new evidence from a global sample’. *Open Economies Review* 26: 525–550.

Berger, A and DeYoung, R. 1997. ‘Problem loans and cost efficiency in commercial banks’. *Journal of Banking & Finance* 21: 849–870.

Bernanke, B and Gertler, M. 1989. ‘Agency costs, net worth, and business fluctuations’. *American Economic Review* 79(1): 14–31.

Bernanke, B, Gertler, M and Gilchrist, S. 1999. ‘The financial accelerator in a quantitative business cycle framework’. In *Handbook of macroeconomics*, edited by J B Taylor and M Woodford. Amsterdam: Elsevier. 1341–1393.

Blum, J. 1999. ‘Do capital adequacy requirements reduce risks in banking?’ *Journal of Banking and Finance* 23(5): 755–771.

Blundell, R W and Bond, S R. 1998. ‘Initial conditions and moment restrictions in dynamic panel data models’. *Journal of Econometrics* 87(1): 115–143.

Calem, P and Rob, R. 1999. ‘The impact of capital-based regulation on bank risk-taking’. *Journal of Financial Intermediation* 8(4): 317–352.

Carey, M. 1998. ‘Credit risk in private debt portfolios’. *Journal of Finance* 53: 1363–1387.

Castro, V. 2013. ‘Macroeconomic determinants of the credit risk in the banking system: the case of the GIPS’. *Economic Modelling* 31: 672–683.

Chen, X. 2007. ‘Banking deregulation and credit risk: evidence from the EU’. *Journal of Financial Stability* 2(4): 356–390.

De Bock, R and Demyanets, A. 2012. ‘Bank asset quality in emerging markets: determinants and spillover’. IMF Working Paper 12/71.

Delis, M D and Staikouras, P K. 2011. ‘Supervisory effectiveness and bank risk’. *Review of Finance* 15(3): 511–543.

Erdas, M L and Ezanoglu, Z. 2022. ‘How do bank-specific factors impact non-performing loans: evidence from G20 countries’. *Journal of Central Banking Theory and Practice* 11(2): 97–122.

Espinoza, R and Prasad, A. 2010. ‘Nonperforming loans in the GCC banking system and their macroeconomic effect’. IMF Working Paper 10/224.

Fernandez, A I and Gonzalez, F. 2005. ‘How accounting and auditing systems can counteract risk-shifting of safety nets in banking: some international evidence’. *Journal of Financial Stability* 1(4): 466–500.

Fofack, H. 2005. ‘Nonperforming loans in sub-Saharan Africa: causal analysis and macroeconomic implication’. World Bank Policy Research Working Paper 3769.

Hakenes, H and Schnabel, I. 2011 ‘Bank size and risk-taking under Basel II’. *Journal of Banking and Finance* 35(6): 1436–1449.

Havrylchyk, O. 2010. ‘A macroeconomic credit risk model for stress testing the South African banking sector’. South African Reserve Bank Working Paper Series, WP/10/02.

Hellmann, T, Murdock, K and Stiglitz, J. 2000. ‘Liberalization, moral hazard in banking, and prudential regulation: are capital requirements enough?’ *American Economic Review* 9(1): 147–165.

International Monetary Fund. 2022. ‘South Africa: Financial sector assessment program-financial system stability assessment’. Washington DC: IMF

Judson, R and Owen, L. 1999. ‘Estimating dynamic panel data models: a guide for macroeconomists’. *Economics Letters* 65(1): 9–15.

Keeton, W R and Morris, C S. 1987. 'Why do banks' loan losses differ'. *Economic Review* 72: 3–21.

Kiyotaki, N and Moore, J. 1997. 'Credit cycles'. *Journal of Political Economy* 105(2): 211–248.

Klein, N. 2013. 'Non-performing loans in CESEE: determinants and impact on macroeconomic performance'. IMF Working Paper 13/72.

Lawrence, E. 1995. 'Default and the life cycle model'. *Journal of Money, Credit and Banking* 27(4): 939–954.

Louzis, D. P, Vouldis, A T and Metaxas, V L. 2012. 'Macroeconomic and bank-specific determinants of non-performing loans in Greece: a comparative study of mortgage, business and consumer loan portfolio'. *Journal of Banking & Finance* 36(4): 1012–1027.

Mpofu, T R and Nikolaidou, E. 2018. 'Determinants of credit risk in the banking system in sub-Saharan Africa'. *Review of Developing Finance* 8(2): 141–153.

Murinde, V and Yaseen, H. 2004. 'The impact of Basel Accord regulations on bank capital and risk behaviour: evidence from the Middle East and North Africa (MENA) region'. Third International Conference of the Centre for Regulation and Competition (CRC) on Pro-Poor Regulation & Competition: Issues, Policies and Practices, Cape Town, 7–9 September.

Naceur, S B and Omran, M. 2011. 'The effects of bank regulations, competition, and financial reforms on banks' performance'. *Emerging Markets Review* 12(1): 1–20.

Nickell, S. 1981. 'Biases in dynamic models with fixed effects'. *Econometrica* 49(6): 1417–1426.

Nikolaidou, E and Vogiazas, S. 2017. ‘Credit risk determinants in sub-Saharan banking systems: evidence from five countries and lessons learnt from Central East and South East European countries’. *Review of Developing Finance* 7: 52–63.

Nkusu, M. 2011. ‘Nonperforming loans and macrofinancial vulnerabilities in advanced economies’. IMF Working Paper 11/161.

Odour, J, Ngoka, K and Odonga, M. 2017. ‘Capital requirements, bank competition and stability in Africa’ *Review of Development Finance* 7: 45–51.

Pasiouras, F, Gaganis, C and Zopounidis, C. 2006. ‘The impact of bank regulations, supervision, market structure, and bank characteristics on individual bank ratings: a cross-country analysis’. *Review of Quantitative Finance and Accounting* 27(4): 403–438.

Pillay, N and Makrelov, K. 2025. ‘The lending implications of banks holding excess capital’. *South African Journal of Economics* 93(1): 27–42.

Salas, V and Saurina, J. 2003. ‘Deregulation, market power and risk behaviour in Spanish banks’. *European Economic Review* 47(6): 1061–1075.

SARB. 2004. ‘The South African banking sector: an overview of the past 10 years’. Address by Mr TT Mboweni, Governor of the South African Reserve Bank, at the year end function, Johannesburg, 14 December.

Warue, B N. 2012. ‘The effects of bank specific and macroeconomic factors on nonperforming loans in commercial banks in Kenya: a comparative panel data analysis’. *Advances in Management and Applied Economics* 3(2): 135–164.