

**Analyzing Financial Risk Management in Banks:
Evidence of Liquidity, Credit and Capital Risk in
South Africa**

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ABSTRACT

The purpose of this study is to investigate the factors influencing financial risk management in South African banks during the period of 2006 – 2011 as banks are considered as trust worthy institutions for depositors and investors. This study investigates the significance of return on assets, return on equity, capital adequacy ratio, operating efficiency ratio, gearing ratio, networking capital, loan loss reserves, bank size, ownership and cash with liquidity, credit, and capital risk management in South African banks. The study found out that ownership structure of the banks is not an influencing factor on financial risk management. In addition, the size of the banks is the major factor influencing financial risk system in South Africa.

Keyword: Risk Management, Liquidity Risk, Credit Risk, Capital Risk, South Africa

ÖZ

Bu çalışmanın amacı 2006-2011 yılları arasında Güney Afrika bankalarının finansal risk yönetimini etkileyen faktörleri incelemektir çünkü bankalar mevduat sahipleri ve yatırımcılar tarafından en güven duyulan kurumlar olarak kabul edilir. Bu çalışma Güney Afrika bankaları için varlık getirisinin, sermaye getirisinin, sermaye yeterliliği ve işletme yeterliliği oranının, çalışma sermayesinin, kredi zararı rezervinin, banka büyüklüğünün, mülkiyet ve nakit paranın, kredi ve sermaye risk yönetiminin önemini incelemektedir. Bu çalışmanın sonucuna göre bankaların mülkiyet yapısı finansal risk yönetimini etkileyen bir faktör değildir. Buna ek olarak Güney Afrika'da banka büyüklüğünün finansal risk sistemini etkileyen en önemli faktör olduğu saptanmıştır.

Anahtar Kelimeler: Risk Yönetimi, Likidite Riski, kredi Riski, Sermaye Riski, Güney Afrika

To my parents

Mr. Tanyi Arrey Samuel

&

Mme Ebai Lydia Egbe

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LIST OF ABBREVIATIONS

GDP:	Gross Domestic Product
ROA:	Return on asset
ROE:	Return on equity
CAR:	Capital adequacy ratio
EFF:	Management efficiency ratio
ASQ:	Asset quality ratio
LQR:	Liquidity ratio
LSIZE:	Natural logarithm of total assets
CPR:	Capital Risk
BKS:	Bank Size
GER:	Gearing Ratio
NIM:	Net Interest Margin
NWC:	Net Working Capital
E-VIEWS:	Econometric views
OWS:	Ownership
OPER:	Operating Efficiency Ratio
LLR:	Loan Loss Reserves

Chapter 1

INTRODUCTION

1.1 Background of the Study

The great depression in 1930's that brought about the global financial crisis in 2007 resulted to international distress to almost all major banks including banks in South Africa inculcating shortage of capital. As a result of this financial crisis, banks with higher risk exposure had less capital, greater reliance on short term market financing and aggressive credit growth. As a result, some aspects of risks in banks such as operational risk, credit risk and liquidity risk are affected.

An illustration of the effect of the financial crisis on operational risk can be seen from Bernard Madoff who as a CEO of a security firm in US got arrested for securities fraud and money laundry worth of \$ 50millions in December 2008 (Seal 2009).The financial crisis also had severe shock on bank liquidity in which many banks were unable to create sufficient liquidity and had to receive government support or probably face default.

The major concern of South African banks should be to protect them from risk that may tarnish their reputation. The ability of banks to maintain such reputation is directly linked to their ability to fight against events that can arise from factors such as poor

governance of the risk management process and bank's employment practices. As a result, an effective risk manager may identify these different factors that may have impact on the reputation of the bank.

To generalize, the financial crisis had a serious impact on major bank risks in different aspects and it is very important for banks in South Africa to reform their international risk management process in order to avoid such crises affecting them.

1.2 Objective of the Study

The core objective of this study is to find out the factors that are significantly affecting financial risk, evidence of liquidity, capital, and credit worthiness of the banks of South Africa for a period of 2006 – 2011 and also to determine if the size of the banks is a common factor influencing financial risk. This study will also look into the outcome of management efficiency components such as market risk, interest sensitive gap, operating efficiency, profitability and credit exposure in the South African banking industry by identifying the different types of risks that may arise as well as the regulating principles and strategies in mitigating such risks. Also, this work will rely on South African banks to implement an effective management process by ensuring that banks only engage those risks that are acceptable and adequate to its existing assets as well as forming an appropriate banks portfolio of assets and liabilities.

1.3 Scope of the Study

The study will be based on financial data of 12 banks made up of domestically owned banks and foreign owned banks taking into consideration their risk efficiency

determined by the bank –specific factors. This risk efficiency will be analyzed using the panel data model to investigate if the management efficiency is adequate to overcome its capital, credit and liquidity requirements of the bank.

1.4 Organizational Structure

This study will be made up of six chapters and the structure of my work is as follows:

Chapter 1 is the introduction part. It consists of the background of the study, the objective of the study and the organizational structure.

Chapter 2 is the general perspective of the South African banking industry. It consists of past history and transitions from regulated to re –regulated era. Adding to this, are the regulatory authorities in South Africa; as well as the different types of risks faced by banks and their mitigation.

Chapter 3 is the literature review indicating the past findings and results of the topic. It also provides an overview of the term risk management.

Chapter 4 shows the methodology used in carrying out the analysis. Here, a panel data methodology will be employed to show the time series evidence of the bank specific factors.

Chapter 5 analyzes critically the results and findings from chapter 4.

Chapter 6 gives a conclusion of the findings recommendations and conclusion of the study.

Chapter 2

PERSPECTIVE OF SOUTH AFRICAN BANKING INDUSTRY

2.1 The South African Banking Sector

The South African banking sector is regulated by the South African Reserve bank (SARB). By December 2003, there were 22 commercial banks consisting of 17 locally controlled banks, 15 local branches of foreign banks and 2 mutual banks. As of 2012 statistics obtained from SARB¹ there are 16 commercial registered banks(of which 10 locally controlled banks), 3 mutual banks, 1 co-operative bank, 13 branches of foreign banks, 2 banks closed to liquidation which were Islamic bank limited and Regal treasury private bank limited and 44 foreign banks with approved local representative office.

By law, all registered banks in South Africa may take deposits while credit unions and co –operatives regulated by SACCOL² (Savings and credit Co-operative league of South Africa) are exempted from this deposit. The 4 largest banks (ABSA, FIRST RAND, INVESTEC, NED BANK) had total assets summing to R2,676 million amounting to 84.4 % of the overall banking industry assets (SARB statistics

¹ <http://www.resbank.co.za/Research/Statistics/Pages/Statistics-Home.aspx>

²² www.saccol.org.za/contact.php

2008) indicating higher concentration which may lower competition. The top four banks performed extremely well with respect to international bench mark of efficiency and non-performing loans. South Africa has performed well as compared to other countries in terms of profitability over a sustained period but this difference has narrowed down in recent years due to an increase in international banks average returns and an increase in operating costs for the local banks.

The South African banking can be categorized into locally controlled, foreign controlled banks and branches of foreign banks as shown below.

Table 1. South African Banks

No	BANKS	CATEGORY	DATE ESTABLISHE
1	ABSA BANK	Foreign bank	1991
2	FIRST RAND BANK	Domestic bank	1998
3	INVESTEC BANK	Domestic bank	1974
4	ALBARAKA BANK	Foreign bank	1989
5	NED BANK	Domestic bank	1888
6	BIDVEST BANK LIMITED	Domestic bank	2000
7	CAPITEC BANK	Domestic bank	2001
8	GRINDROD BANK	Domestic bank	1994
9	IMPERIAL BANK SOUTH AFRICA	Domestic bank	1996
10	HABIB OVERSEAS HABIB OVERSEAS	Foreign bank	1941
11	MERCANTILE BANK	Foreign bank	1987
12	SASFIN BANK	Domestic bank	1951
13	TEBA BANK	Domestic bank	1975
14	AFRICAN BANK LIMITED	Domestic bank	1998
15	STANDARD BANK OF SOUTH AFRICA	Domestic bank	1962
16	HBZ BANK LIMITED	Foreign bank	1995
17	SOUTH AFRICAN ATHEN	Foreign bank	1947

The number of fully registered banks in South Africa increased steadily from 35 in 1994 to a peak of 44 in 2000. This was due to the liberalization of the external account and of banking regulation regarding foreign participants. Between 2001 to 2002, the number of locally registered banks fell below 35. This was accounted for by the decline in the smaller banks that were bought by larger banks as a result of the consolidation in the industry including imperial bank, Mercantile Lisbon bank, Mc carthy bank while poor financial management resulted to the dissolve of others such as Royal treasury bank and SAAMBOU (the seven largest banks in terms of assets at that time) and others Brait merchant bank , Cardiz investment bank and corpcapital bank did not even apply for renewal of their licenses at the end of 2002.

Despite the global economic turmoil experienced in 2008 in the international financial markets and the domestic economic development, the South African banking system maintained their stability with adequate funds and profitable. Looking at the trend of the South African registered banks in 2008 we can conclude the following statistics (SARB 2008 REPORT):

- The banking sector capital adequacy ratio increased from 11.8% to 13 % at the end of 2008.
- They was an increased from 8.9% to 10.2% at the end of 2008 for tier 1 capital adequacy
- From January till the end of December, the South African total banking sector assets witness an increased from R2, 663 billion to R3, 170 billion at the end of December.

- At the end of December 2008, total banking sector liabilities resulted to R2, 989 billion.
- They was a 1.62% in return on assets (January 2008 1.39%).
- Return on equity resulted to 28.7 % at the end of December (January 2008 24.1%).

The South African banking sector level of concentration evaluated using the Herfindahl-Hirschman index amounted to 0.189 at the end of December 2003(December 2007 0.190) accounted for by the total domination of the four largest banks as a result of their market shares.

Basel II was implemented with effect from 2008 with IMF reporting that the implementation process in South Africa has been of high standard supported by competent supervisory and professional staff and a strong buy-in from the sector and as well as reflecting a higher degree of compliance with the criteria (SARB REPORTS).

South Africa is one of the countries out of the European Union that is currently regarded having AML (anti – money laundering) and CFT (combating of the financing for terrorism) corresponding to the European systems.

2.2 The Regulatory Authorities

The money sector in South Africa is regulated by both bank and non- bank financial institutions such as South African Reserve bank (SARB), National Credit Regulation (NCR) and Financial Service Board (FSB).

2.2.1 South Africa Reserve Bank (SARB)

The South African reserve bank (SARB) is the central bank of the republic of South Africa and plays an important role in banking regulation and maintaining of price stability and the value of the South African currency in the interests of balance and sustainable economic growth.

SARB was established in 1921 in terms of a special ACT of parliament, the currency and the banking Act in 1920(Act No 31 of 1920). Before SARB was established, commercial banks in South Africa were responsible for issuing the bank notes to the public with the only requirement of converting the bank notes held by the public into gold when these bank notes were table at their branches. However, after the First World War, the commercial banks whose profits were made by converting bank notes into gold in South Africa and selling the gold in London could no longer make profits due to the increase in price of the gold. As a result, the commercial banks as a means of protecting their financial viability requested the government to release them from this obligation of converting bank notes into gold which later lead to the creation of the South African reserve bank that open its door for business for the first time in June 1921.

Since 1921, SARB currently has some 650 Shareholders and has been served by 8 Governors with the current governor GILL Marcus the first woman to lead the bank. The South African reserve bank is responsible for;

- Assisting the South African government.
- Providing information on monetary policy and issues concerning the economic to the South African population.
- Ensuring that the banking and financial systems meets the requirements of the need of the South African people.
- In maintaining a minimum reserve balances those South African banks must hold on account with the reserve bank.

2.2.2 National Credit Regulation

National credit regulator is another regulator authority in South Africa established under the national Act 34 of 2005 responsible for the regulation of the South African credit industry. It focuses on educational research policy development, registration of industry and investigation of complaints. National credit regulator is also responsible for the registration of credit providers, credit bureau and debt counselors. It is responsible for researching the credit market and monitoring the cost of credit to identify factors that may undermine access to credit and consumer protection as well as re-enforcing the Act and advising the government on policy and legislation.

The objectives of National credit Act (NCA) are to regulate credit information and promote a consistent enforcement frame work to consumer credit and to avoid unfair credit and credit-market practices.

2.2.3 Financial Service Board (FSB)

The financial service board (FSB) is the south African government regulatory body responsible mainly for non- banking financial service industry in south Africa.FSB established in 1990 with head quarters in Pretoria, south Africa with approximately 411 employees as of 2009(Wikipedia) is responsible for non banking financial intermediaries such as retirement funds, financial services provider, capital markets and friendly societies.

2.3 Mitigations of Risks faced by Banks

A bank that is run on the principle of avoiding all risks or as many of them as possible will be a stagnant institution and will not adequately serve the legitimate credit needs of its society while a bank that takes excessive risks or credit is more likely (Malik Delaware). During the process of financial intermediation, banks are faced with different type of financial and non financial risks. Thus, banks should pay a lot of importance in improving their ability in identifying, measuring and monitoring all the risks undertaken.

The modern banking system can be faced with the following type of risks:

Interest Rate Risk

Interest rate risk is the exposure of institution financial conditions to adverse movements in interest rates. The net interest income or net interest margin (NIM) of banks is dependent of these movements. Any mismatches in the cash flows either in the liabilities side or assets side or repricing dates expose banks to NII or NIM. Hence, Benjamin, Bhanu, et al (1999) examine how interest rates and interest rate exposures affect the level of acquisition activity in the banking industry using a sample of 477 large mergers

from 1980 to 1994 and came out with the conclusion that the level of acquisition activity is more positively correlated with equity indices and move negatively correlated with interest rates in banks than for non – banks. Also, banks can be face with the following type of interest rate risk:

- **GAP or Mismatch Risk** It arises from holding assets and liabilities with different principal amounts, maturing dates or reprising dates.
- **Basis Risk** This is the risk that the interest rate of different assets, liabilities and off- balance sheet items may change in different magnitude. That is, if the variation in interest rates result to NII to expand, the bank will experience favorable basic shifts otherwise the basis risk will move against the bank.
- **Price risk** This risk arises when assets are sold before their maturity dates.
- **Reinvestment risk** Any uncertainty with respect to interest rate where future cash flows could be reinvested is called reinvestment risk.

Interest rate risk can be measured by using different technologies such as maturity gap analysis, duration gap analysis, simulations and value at risk. In a well functioning risk management system, the hedging and measurement of interest rate risk often depend on the segmentation of the balance sheet. That is, the bank should position the balance sheet into trading and banking book in order to acquire an effective management.

Liquidity Risk

Liquidity risk arises in banks when long term assets are funded by short term liabilities thereby resulting to refinancing risk. Michiru Sawada(2009) carried out a research on the impact of a liquidity shock induced by depositors behavior on bank portfolio management during financial crisis in a system lacking deposit insurance and came out

with the conclusion that banks reacted to liquidity shock sensitively through an increase in the cash holdings not by liquidating bank loans but by selling securities in the financial market. Banks can be face with the following type of liquidity risks:

- **Funding risk** It occurs as a result of an urgent need to replace cash due to anticipated withdrawal.
- **Time risk** It arises when performing assets are transforming into non – performing assets.

Liquidity risk in the banking sector can be measured using any of these key ratios :

Loans/total assets, loans/core deposits, Loan losses/net loans, purchase funds/total assets.

Credit Risk

This is a risk in which the borrower will not be able to repay or meet his obligations with respect to debt, hedging and financial transactions under the terms of the original agreement. Credit risk depends on both internal and external factors. Some of these external factors are foreign exchange rates, interest rates, the state of the economy and government policies. Tobias C. and Uhde (2012) carry out a research on credit risk securitization and bank soundness in Europe and provide empirical evidence that credit risk securitization has a negative impact on the issuing bank financial soundness. They also came out with the notion that there is a negative impact of securitization on banks profitability and capital environment as well as a positive relationship between securitization the issuing banks return volatility. A good management process of credit risk should involve:

- Measuring the risk through credit scoring.

- Quantifying the risk through estimating expected loan losses.
- Controlling the risk through a loan review mechanism and portfolio management.

Market Risk

Market risks as the primary challenge risk of banks occur due to different changes in market variables such as equity price, interest rate risk and foreign exchange risk and equity price. The management of such a risk should be concerned with the top management of banks since it takes the form of other risks such as liquidity risk, interest rate risk, equity price risk and foreign exchange risk. Such a top management should report the review mechanism, have a clear auditing system and clearly define the market risk management policies.

Ownership Risk

This is another critical risk faced by banks which may arise when the owners, shareholders and senior management of the bank are unfit for their respective roles or due to their dishonesty. Thierno Amadou Barry et al in 2010 analyze the ownership structure and risk-taking in publicly held and privately owned banks using ownership data for a sample of European commercial banks. They found out that in privately owned banks, ownership structure is significant in explaining risk differences while in publicly held banks changes in ownership structure do not affect risk-taking. And that market forces seems to align the risk taking behavior of publicly held banks so that ownership structure is no longer a determinant in explaining risk differences.

Operational Risk

This is a risk that arises from the lack of an effective internal control and auditing procedures. It has a link between credit and market risks. Actually, there is no collaborative approach measuring operational risk in the banking sector and hence evaluating it requires evaluating the probability of both the operational loss and the potential size of the loss. Operational risk can be mitigated using internal controls, internal audit and insurance. Jianping Li et al in 2011 carry out a research to quantify the mitigation of the insurance as a risk mitigant in operational risk management for commercial banks and came out with the conclusion that despite the uncertainties associated with the insurance policy such as counter party default, payment uncertainty and liquidity risk, insurance indeed improve the operational risk profile for banks and lower the capital requirements to some extent.

Country Risk

This is a risk that arises from the economy, social and political environment of the borrower's country. It is most apparent when lending to foreign government agencies. Krzysztof Jackowicz et al in 2012 examined the impact of political factors on the behavior and performance of commercial banks in 11 central European countries using unique data set of commercial banks and political factors from 1995 to 2008 and they found out that state-owned banks have smaller net interest income during the years of parliamentary elections as a result of a lower interest rates charge on loans

Chapter 3

LITERATURE REVIEW

3.1 Overview of Risk Management

Risk management system is a pro –active action in the present for the future. That is, managing the changes before the risk manages. Risks on its self can be viewed as an adverse impact on profitability of several distinct sources of uncertainty. Risk management as commonly perceived does not mean minimizing risk rather the goal of risk management is to optimize risk-reward trade-off. Risk management is a discipline at the heart of every bank and it involves: identification, measurement, monitoring and controlling.

A risk management policy work involves the scope of risks to be managed, the process and the procedures to manage the risks and the responsibilities of individuals involved.

However, an effective management frame work should;

- Clearly define risk policies and the procedures covering risk identification, measurement, monitoring, reporting and control.
- Function in such a way that a set up can be build to control overall risk management at banks such as a bank risk management committee (RMC).
- Ensuring that the bank implement only those risks that are acceptable and adequate to its existing assets.

- Creating an efficiency management system of both assets and liabilities.
- Making sure that bank have adequate portfolio of assets and liabilities.
- Ensuring that the bank activities should be normal in terms of any crisis.

3.2 Risk Management in Banks

Risk management prevents a bank from suffering un- acceptable loss and preventing the bank to damage its competitive position in the economy. Its function should be bank specific determine by the size and quality of balance sheets, professional man power and the risk management system(MIS) status in place in that bank. South Africa as an engine of growth for the African continent need risk management in its banking sector to ameliorate its emerging markets. An effective risk management process in banks depends on efficient computerization, MIS and net working capital of the branch activities. The objectives of risk management is not to prohibit or prevent risk taking activity but to ensure that the risks are consciously taken with full knowledge, clear purpose and understanding in order to be measured and mitigated.

The risk management committee is responsible for carrying out control of the bank risk management system. This committee is in charge of reporting directly to the supervision board of the bank as well as responsible for;

- Stating the requirements at each stage of the risk management process.
- Reporting directly to the supervision board.

- Providing instructions to the risk management department within defined periodical periods.

The risk management system will be organized by the risk management department responsible for the day-to-day activity of the system and whose structure shall be determined by the organization and management structure of the bank. This department is made up of the following sections;

- Management section of operation risk.
- Management section of market and liquidity risk.
- Management section of credit risks and economic analysis.

The risk management department is responsible for;

- Defining internal rules of risk management.
- Developing the information content received from the different sections in order to carry out the risk management process.
- Responsible for defining all the risks each department will or can encounter.
- Submitting reports to the risk management committee.



Figure 1. Risk Management Organization Structure

The risk management processes in banks have five main processes;



Figure 2. Bank Risk Management Process

Identification: In this process, we need to understand the principal fundamental risk involved in the bank and to established the bank risk appetite which consists of;

- Earnings volatility in comparison to targets
- Capacity to absorbed unexpected losses
- Desired dividend payout levels

Assess: Here,

- We established the process of analyzing business level risk.
- Agreed and implement measurement and reporting standards and methodologies.

Control: In this process,

- We monitor controls and adherence to risk direction and limits.
- Ensure that risk management practices and conditions are appropriate for the business environment.
- Established key control processes and practices including limit structures and reporting standards.

Report: In this process,

- We interpret and report on risk exposures, concentrations and risk –taking outcomes that is interpreting and reporting on sensitivities and key risk indicators.

Challenge: Here,

- We assess new risk return opportunities.
- Advise on ways to optimize the banks risk profile.
- Review and challenge risk management practices.

3.3 Studies on Risk Management

In recent years, there have been studies published on risk management in general but the focus of my study will be on three financial risks: liquidity, credit and capital risk. Here is a summary of the conclusions of some related studies.

Liquidity risk arises in banks when long term assets are funded by short term liabilities thereby making the liabilities subject to refinancing risk. Cornett, Mcnutt et al (2011) in their paper entitled “liquidity risk management and credit supply in the financial crisis” found that liquidity at banks dried up during the period of 2007-2009 financial crisis due to the frozen of interbank markets and the collapse of asset-backed and mortgage-backed securities market. They also found out that during this financial crisis, banks with more securitized assets and loans holdings increase their holdings of liquid assets and decrease lending while banks that depends merely on stable sources of funding (deposits and equity) maintain their lending as compared to other banks.

Muhammad, Sadaqat et al (2011) examined liquidity risk management between conventional and Islamic banks of Pakistan in the period of 2006-2009 employing

descriptive, correlation and regression analysis. In their study they use bank size, net working capital, return on assets, capital adequacy ratio and return on equity as explanatory variables for liquidity risk. From their findings, they realize a positive but insignificant relationship of the size and net working capital with liquidity risk in both conventional bank and Islamic banks. Also return on assets in Islamic banks and capital adequacy ratio in conventional banks are positive at 10 % significant level. They also found out that conventional banks in Pakistan had better profitability, liquidity risk management and tend to consider projects with long –term financing than Islamic banks operating in Palestine.

Huensel and Krahnert (2007) investigated whether the use of credit risk transfer instruments affect risk taking by large international banks. Taking into consideration data set from the European collateralized debt obligations (CDO, s). They found out that CDOs tend to increase the systematic risk of the issuing bank. Also, that credit securitization goes hand in hand with an increase in the risk appetite of the issuing bank.

Salas and Sauria (2002) examine the effects of credit risk on Spanish banks in the period of 1985-1997 by using panel data to compare the determinants' of problem loans(credit risk) between Spanish commercial and saving banks with respect to macro-economic and individual bank level variables. They consider GDP, firm and family indebtedness, inefficiency, portfolio competition, size, net interest margin, capital ratio and market power to be the independent variables of credit risk. The main results of this study brought about important bank supervisory policy issues in fighting against credit risks.

These are the use of bank level variables as early warning indicators, the advantages of bank mergers from different sectors and the role of banking competition and ownership.

Shrives and Dahl (1992) investigated the relationship between risk and capital in commercial banks in a large sample of banks and came out with a positive relationship between changes in risk and capital. They found out that bank owners and manager's private incentives work well in limiting the total risk exposure of the bank and that changes in bank capital over the study period have been risk-based.

Schwermann et al (2007) investigated how deposit –loan synergies resulted in managing bank liquidity risk. In this study, transactions deposit helps banks hedge liquidity risk from unused loan commitments. That is, banks with high level of transactions deposit do not face high risk regardless of their exposure on the asset side. This study also reverses the traditional notion stated by Diamond and Dybvig (1983) of liquidity risk in banks which state that that “Runs from depositors is a cause of trouble for the bank.

Gatev and Strahan (2006) carried out a research to find out the advantages for banks to hedge liquidity risk with respect to commercial paper market. They found out that banks are more supply with funds when borrowing in the market is expensive with the evidence that both liquid assets and loans tend to grow faster at banks when the commercial paper bill spread widens and rates on large CD, s fall. Hence, funding flows into the banking system as a result of the high spread since government supports to banks urge the willingness of investors to hold deposits.

Calem and Rob (1993) studied the impact of capital-based regulations on risk faced by bank by assessing quantitatively the impact of recent regulatory developments to bank capital using empirical data from the banking sector from the period of 1984-1993. They came out with a U-shaped relationship between capital and risk –taking. That is, as bank capital increases, it first result to less risk then high risk and that ex-ante well capitalized banks induce more risk-taking when flat or risk-based capital requirements are increased.

Sasaki et al (2002) investigate the effect of risk- based capital standard on 87 major Japanese banks and this was between 1990 and 1993. From this study, they realize that as Japanese stock prices fell, banks capital gains as part of tier II capital became smaller. This result was consistent with the view of Japanese economic journal (2002) that banks with lower capital ratios tend to use more subordinated debts(tier II) and reduce lending.

In (1995) Hancock et al carried out a research on bank capital shocks with respect to securities, loans and capital using quarterly data for individual banks. In response to capital shocks, they realize that banks adjusted their holdings of securities and capital more rapidly than they adjusted their holdings since securities were more likely than loans to be traded in a well - developed secondary market. They also found that capital shocks cause banks with capital short falls to contract more fasters in 1990s than in 1980s.

Hussein et al (2007) examined the degree at which banks in United Arab Emirates (UAE) and foreign banks uses risk management practices in hedging against different types of risk by comparing the risk management practices between the two set of banks. They found that foreign exchange risk, credit risk and operating risk are the most important risk affecting UAE commercial banks and that risk identification, and risk assessment and analysis are the most influencing variables in risk management practices.

Mohammad et al (2011) carry out a research investigating the significance of firm size, net working capital, return on equity, capital adequacy and return on asset with liquidity risk management between conventional and Islamic banks of Pakistan using four year period between 2006-2009 and found out that capital adequacy ratio in conventional banks and ROA in Islamic banks is found to be positive and significant at 10% significance level.

Rudra (2009) in her paper entitled “Are bank stocks sensitive to risk management” based on data from Indian banks realized that risk management capabilities has been improving over time and conclude that returns on banks stock are sensitive to risk management capabilities.

In December (2001) Cebenoyan et al carry out a study to test how active management of bank credit risk exposure through marketing loan sales can bring about the initiative that banks that markets loan sales for risk management purposes rather than to influence their holding of loans tend to hold less capital than other banks and make more risky

loans as a percentage to total assets. Also, that holding size, leverage, lending activities constant, banks active in the loans sales market have lower risk and higher profits than other banks. Finally, banks that expand their management ability for credit risk tend to function with greater leverage and may lend more of their assets to borrowers that are risky.

Jeitchko and Jeung (2004) examine the incentives of risk in banks and contradict to traditional view which says well capitalized banks are less inclined to increase assets risk since option value of deposit insurance decreases with capitalization and they came out with the conclusion that they are three main agents (deposits insurers, shareholders and managers) that influence banks risk levels.

Pais and Stork (2010) in a research paper analyze the Australia systemic banking risk and attempt to determine if this risk increased with the recent global crisis using the univariate value at risk and extreme value theory to measure banks. They found that credit crisis significantly increased the probability of a bank crashing.

In 1999, Altunbas et al investigates the impact of risk and quality factors on banks cost by using the stochastic cost frontier methodology using a sample of Japanese commercial banks between 1993 and 1996 with loan-loss provision being used as an output quality and financial capital, liquidity ratio included to control risk. They came out with the conclusion that optimal bank size is considerably smaller when risk and

quality factors are taken into account when modeling the cost characteristics of Japanese banks.

Stein et al (1996) in a research paper use the evaluation of proprietary trading operations and the pricing of un hedge-able derivatives positions to come out with the notion that value –maximizing banks have a well – founded concern with risk management and that not all the risks they face can be frictionless hedged in the capital market. Hence, this approach shows that bank-level risk management considerations should factor into the pricing of those risks that cannot be easily hedged.

Strahan and Cebenoyan (2004) investigated the effect of active management of bank credit risk exposure with respect to sales loans, capital structure, lending, profits and risk. From this, they stated that banks that restructured their loan portfolio exposures by buying and selling loans hold less capital and make more risky loans as a percentage of total assets than other banks. Their results suggest that banks that improve their ability to manage credit risk may end up with higher leverage and as a result lend more of their assets to riskier borrowers. Hence that improvement of risk management in banking sector should increase credit availability rather than reducing risk.

Gennotte and Pyle (1991), analyze the effects of deposits guarantees on banks loans portfolio. As a result, they said capital are not a substitute for risk monitoring and controlling but may imply an increased need for more surveillance. Also that tightening

the capital constraint even leads to an increase in the probability of default, financial instability and higher expected cost of transferring assets to regulatory agencies.

Barnhill et al (2009) examined the effects of measuring integrated market and credit risk in bank portfolios; taking into consideration a set of hypothetical banks operating in South Africa as of June 1999. They realized that credit quality of a bank portfolio is one of the most important risk factor and that there is a reduction benefit of diversifying the loan portfolio across different regions of the economy. That those banks with high credit risk and concentrated portfolio tend to have high risk of failure especially during the period of financial crisis whereas banks with lower credit risk and widely diversified loan portfolio most likely to fail even during volatile periods.

Chapter 4

METHODOLOGY AND VARIABLE DESCRIPTION

4.1 Data Collection

This empirical study will be carried out on a sample of 12 banks consisting of 7 locally-controlled banks and 5 are foreign-controlled bank. Data was retrieved from the bank scope to derive financial ratios of the variables over the period of 2006 – 2011. The financial ratios from the bank scope are used to calculate and evaluate liquidity, credit and capital risk management of banks in South Africa. Below is a list of banks selected among the numerous banks in South Africa for this study.

Table 2. List of Banks Included in the Study

No	Locally Controlled Banks	T.assets (million)/Rank	Foreign Controlled Banks	T.assets (millions)/Rank
1	NEDBANK LIMITED	613540 /4	ABSABANK LIMITED	742436 /2
2	FIRSTRAND BANK LIMITED	690314 /3	MERCANTILE BANK LIMITED	6090 /10
3	AFRICAN BANK LIMITED	46025 /7	ALBARAKA BANK	3246 /16
4	GRINDROD BANK LIMITED	3457 /15	HABIB OVERSEAS BANK	1032 /19
5	STANDARD BANK OF SOUTH AFRICA	921689 /1	SOUTH AFRICAN BANK OF ATHENS	1653 /18
6	GBS MUTUAL BANKS	797 /20		
7	VBS MUTUAL	253 /21		

4.2 Model Specification and Variable Description

4.2.1 Model Specification

This empirical study which is based on two types of banks: locally- controlled banks and foreign controlled banks will be analyze using three financial risks as dependent variables and bank specific determinants' considered as explanatory variables. Below is an illustration showing the dependent and explanatory variables.

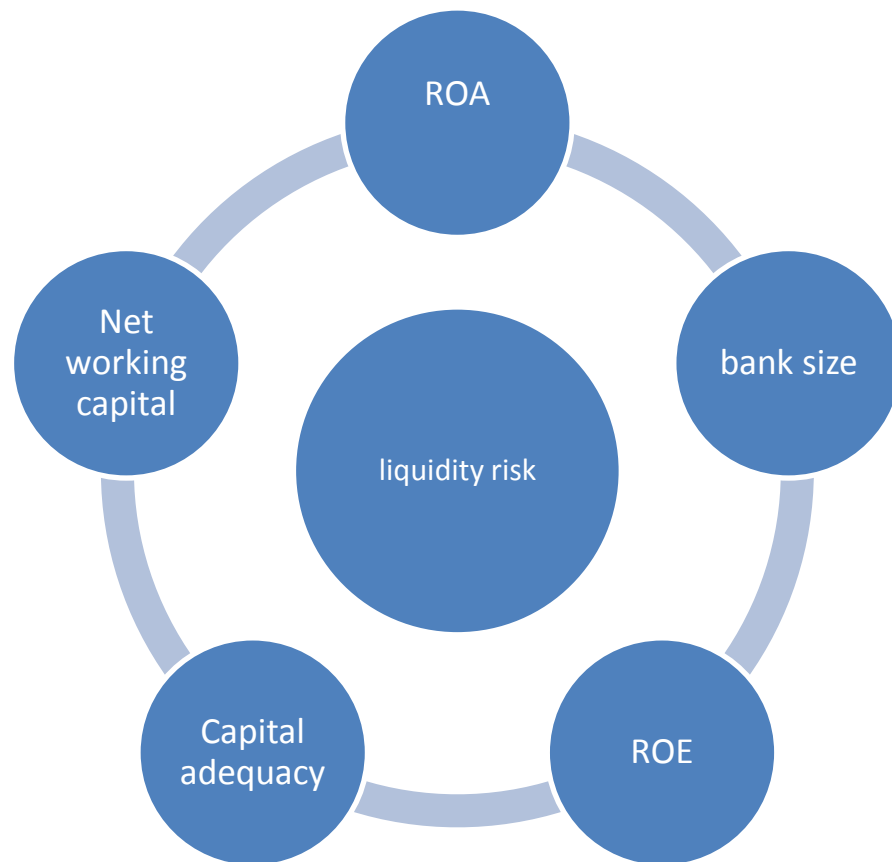


Figure 3. Independent Variables for Liquidity Risk

From the diagram above, the circle in the center represents the dependent variable (liquidity risk) while the smaller circles surrounding it are the independent variables (ROA, Bank Size, ROE, Net Working Capital and Capital adequacy).

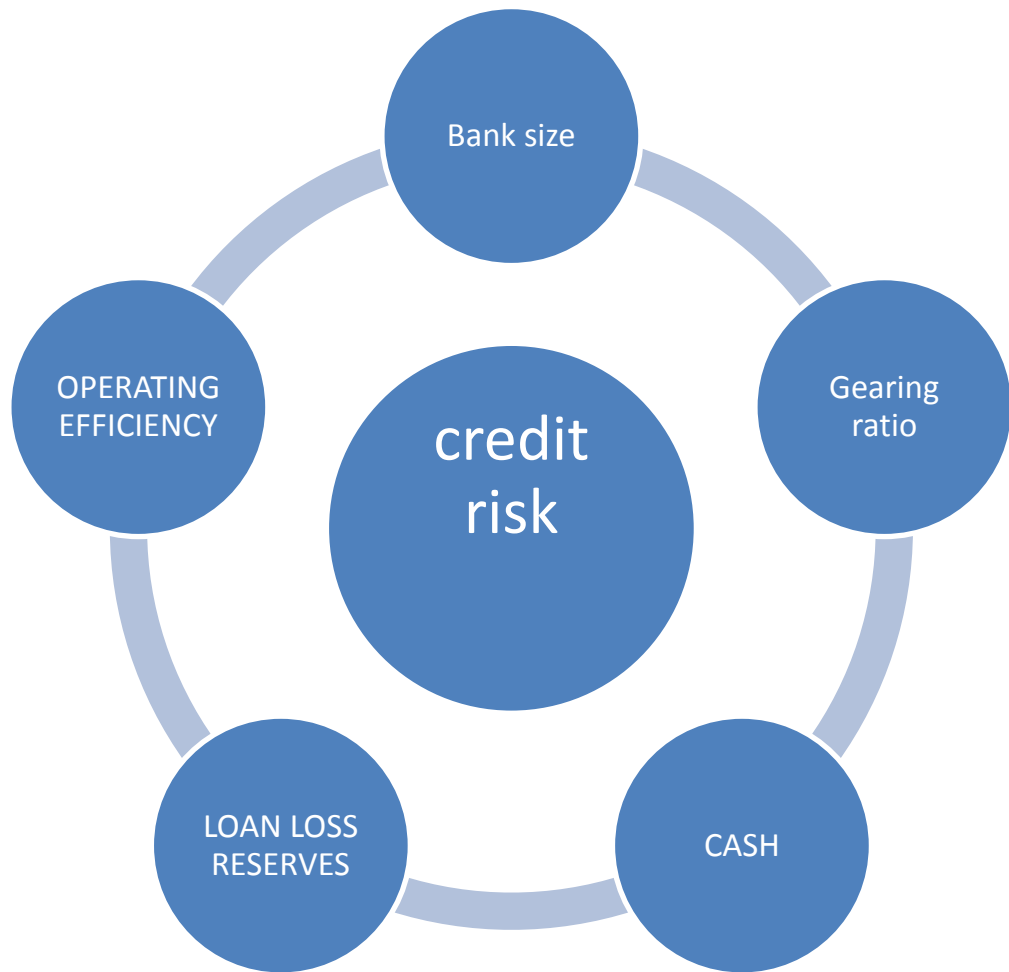


Figure 4. Independent Variables for Credit Risk

Also, the center circle is the dependent variable (credit risk) while the other five smaller circles surrounding it are the explanatory variables (Cash, Loan Loss Reserves, Operating Efficiency, Bank Size, Gearing Ratio)



Figure 5. Independent Variables for Capital Risk

The circle in the center consist of the dependent variable (capital risk) while the independent variables consist of Cash ,Operating Efficiency, Bank Size, Loan Loss Reserves and ROA are the smaller circles.

4.2.2 Variable Description

Credit Risk

In this study, debt-to-asset ratio would be use to measure credit risk which indicates how much the bank depends on debt to finance its assets.

Gearing Ratio

As an important variable for credit risk, it will be measured as debt-to-equity ratio which explains the bank credit quality. That is, gearing ratio tells us the proportion of equity and debt the bank is utilizing in financing its assets.

Operating Efficiency

This ratio indicates how successfully banks manage internally their assets and liabilities in hedging against their risk dimensions. In this study, Net interest revenue to average asset will be use as a proxy for measuring operating efficiency of the banks.

Bank Size

The logarithm of total asset will be use as the tool of measuring the size of the bank as conferred by Aggarwal and Jacques (2000).

Cash In this study, cash would be used to recognize the fact that banks with greater cash as a percentage of total assets have greater liquidity, less risk and less need for capital. Cash will be use as a proxy for measuring liquid assets.

Loan Loss Reserves

Loan loss reserve is use as a proxy for asset quality with high loan loss reserve values being associated with lower credit risk and a resulting low need for capital. Loan loss reserve is approximated as the ratio of loan loss reserve to gross loans with an expected negative effect on the risk.

Return on Assets

Return on assets will be employed as a proxy for gauging liquidity and capital risk. This ratio tells us how well – organized banks are using their assets to make earnings. It is measured as bank net income to total assets.

Return on Equity

Return on equity will be employed as a proxy for gauging for liquidity risk. This ratio indicate how banks use their share holder's equity in maximizing their earnings. It is measured as banks net income to share holder's earnings.

Liquidity Risk

Liquidity risk view as the risk of a funding crisis can result due to activities such as large charge off and currency crisis. A high liquidity ratio means there is existence of liquid assets and hence less risk and more assurance to depositors while low liquidity ratio indicate poor financial activities in the bank.

4.2.3 Methodology

For this research, correlation matrix, fixed and random effect regression analysis will be utilized in the presentation and analysis of empirical results; as well as comparing the effects of the explanatory variables on capital, liquidity and credit risks. The fixed effect panel data regression analysis will be carried out using E-VIEWS while Random effect panel data regression analysis will be carried out using STATA 10.X version 4.1.

The descriptive statistics will show the mean, standard deviation, maximum and minimum values of all variables used in the study. The mean values will tell us about the central tendency of the values of each variable while standard deviation values would tell us how disperse the values are away from their average.

After analyzing the descriptive statistics, the Pearson correlation matrix is developed in which its coefficients are used to determine the degree of correlation between the

independent variables. The issue of multicollinearity problem is address at this stage; taking into consideration the research view of Kennedy (2008) which states that multicollinearity is a problem when the correlation problem is above 0.80. At this stage, our goal is to ensure that our variables are perfectly independent; that is no existence of multicollinearity. If the explanatory variables happen to be dependent (multicollinearity), a vector Auto regression model will be conducted probably at lag 1, lag 2... thereby increasing the number of observations in order to eliminate the multicollinearity problem.

Additionally, the fixed effect will be used to explore the relationship between the independent and dependent variables within the banks; with each having its own characteristics that may influence the independent variables. When using the fixed effect model, we will assume that the banks error terms are uncorrelated with the independent variables. Also, we assume that the time invariant characteristics should be unique for each bank and should not be corrected with other banks characteristics. That is, the error term and constant term of banks should not be correlated since the banks are different from each other. If for instance, the error and constant terms of banks are correlated between banks then the fixed effect model will not be an appropriate model for analyzing our results since our inferences will not be correct. One side effect of the fixed effect model is that it cannot be used to find out time -invariant causes on explanatory variables. Hence such a model can be mitigated by using the random effect model.

In using random effect, we start by assuming that the variations across banks are random and uncorrelated with the independent variables as is the case with the fixed effect model. Hence if we can find characteristics across banks having influence on our dependent variables then random effect model is a perfect model. One peculiar advantage of implementing the random fixed effect is that time invariant variables such as personnel can be considered while with fixed effect; these variables are absorbed by the intercept term. Random effect model assume that the error term is not corrected with the independent variable which enables the time invariant variables to act as an explanatory variable.

To finally decide which of the two model (fixed or random) is more appropriate for analyzing our results, we will run a test called Hausman test. In running the hausman test, we consider the null hypothesis to be the random effect model while the alternative hypothesis the fixed effect model (Green 2008). Here,

Ho: assume the unique errors (μ) are not correlated with the independent variables.

Ha: assume the unique errors are correlated with the dependent variables.

The test will be run by carrying each of random or fixed effect separately and then perform the hausman test. If the expression $\text{prob} > \chi^2$ from the hausman test is less than 5% then the fixed effect is more appropriate in analyzing our results otherwise the random effect is desirable.

A balance panel data will be used for the regression analysis. Before conducting the regression analysis, a unit root test may be done to test the stationary of the data's.

The economically expressed form of fixed and random effect model regression is:

$$Y_{it} = \beta_1 X_{it} + \alpha_i + \mu_{it} \quad (\text{fixed effect model}) \quad (\text{eq.1})$$

$$Y_{it} = \beta_1 X_{it} + \alpha_i + \mu_{it} + \varepsilon_{it} \quad (\text{Random effect model}) \quad (\text{eq.2})$$

Where:

Y_{it} is the dependent variable where i is the bank and t the time

α_i is the intercept for each bank.

X_i represent the independent variables at time i .

β_1 represent the coefficient of the independent variable.

μ_{it} represent the error term.

ε_{it} represent the within-bank error term.

But in the case of this study, the research models are as follows taken into considerations the variables.

Model (A): Liquidity risk

$$\text{Liquidity risk} = \alpha + \text{SBK } \beta_1 + \text{NWC } \beta_2 + \text{ROE } \beta_3 + \text{CAR } \beta_4 + \text{ROA } \beta_5 + \varepsilon$$

Model (B): Credit risk.

$$\text{Credit risk} = \alpha + \text{SBK } \beta_1 + \text{GER } \beta_2 + \text{CASH } \beta_3 + \text{OPR } \beta_4 + \text{LLR } \beta_5 + \varepsilon$$

Model (C): Capital risk.

$$\text{Capital risk} = \alpha + \text{SBK } \beta_1 + \text{ROA } \beta_2 + \text{CASH } \beta_3 + \text{OPR } \beta_4 + \text{LLR } \beta_5 + \varepsilon$$

Where $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ represent the appropriate change in the financial risk resulting from the independent variables.

Table 3. Summary Table for Variables and Measurements

	VARIABLES	SYMBOLS	PROXIES
DEPENDENT	Liquidity Risk	LQR	Net loans/Total assets
	Credit Risk	CDR	Total debt/Total assets
	Capital Risk	CPR	Equity/Total assets
INDEPENDENT VARIABLES	Return on Assets	ROA	Net income/Total assets
	Return on equity	ROE	Net income/Total assets
	Bank Size	BKS	Logarithm of Total assets
	Gearing Ratio	GER	Total debts/Total equity
	Net Working Capital	NWC	Current assets less current liabilities/Total assets
	Operating Efficiency	OPR	Net Interest Income/Average Assets
	Loan Loss Reserves	LLR	Loan loss reserves/Gross loans
	Cash	CASH	Net Loans/Total assets
DUMMY VARIABLES	Ownership	OWS	OWS=1 if ownership is domestic and =0 if ownership is foreign

Chapter 5

EMPIRICAL ANALYSIS AND RESULTS

The analyses of the results will be done using descriptive statistics, Pearson correlation matrix and random effect model estimates. In order to confirm utilization of this model as our perfect model, the Hausman test will be implemented to confirm this hypothesis by basically testing whether the unique errors (μ_i) are correlated with the regressors. Hence our model will be accepted if the individual heterogeneity of the banks is uncorrelated with the explanatory variables.

Looking at the results of the Hausman test, it confirms the hypothesis that the observed banks individual characteristics are uncorrelated with the three financial risks (liquidity, credit, and capital risk). Hence our analysis will be concentrated only on the estimates provided by the random effect model. The random effect results for each of our financial risks produce a probability of F- statistics denoted by $\text{prob} > \chi^2(\text{chi-square statistics})$ of 0.0000 indicating that our model is perfectly working. Since this value is less than 1%, 5%, 10% it shows that all the coefficients used in the in the model are different from zero and hence an indication of a perfect model. Thus, this model can be utilized to derive possible variables significantly influencing financial risk in South African banks. As can be seen from the R-Squares values of each of the random effect tables, our independent variables used in the study are influencing their respective dependent

variables (liquidity, credit and capital risk) by approximately 58% , 57%, and 39% respectively.

5.1 Empirical Results

5.1.1 Descriptive & Pearson Correlation Statistics

The descriptive statistics indicated in Table (4, 5,and 6) show the mean, the standard deviation, minimum and maximum values of each of the variables used in the study. The mean value measure the central tendency of the variables while the standard deviation tell us how dispersed our variables are away from their average. In each of the tables (5.1, 5.2, 5.3), the first variables are the dependent variables while the rest of them are the independent.

Table 4. Summary Statistics for Liquidity Risk

Descriptive statistics				
	Minimum	maximum	mean	Std.deviation
Liquidity	24.3600	85.8900	65.2191	14.893
risk	3.2100	12.2200	7.9482	3.1711
ROA	-9.1700	38.9000	16.1496	10.6552
ROE	-1.2400	8.9600	1.6154	1.5446
BKS	0.9200	27.0900	11.2647	6.5048
CPR	-0.6200	0.2300	-0.0123	0.1942
NWC	-0.6200	0.2300	-0.0123	0.1942
OWN	0.0000	1.0000	0.5833	0.4965

Table 5. Summary Statistics for Credit Risk

Descriptive statistics				
	Minimum	maximum	mean	Std.deviation
Credit risk	0.7300	0.9600	0.8806	0.06914
BKS	3.2100	12.2200	7.9426	3.1661
OPER	0.0000	0.6800	0.1218	0.1785
GEAR	1.7000	29.4600	5.2897	5.3179
LLR	2.6900	23.2600	10.4704	5.4601
CASH	0.1900	20.1900	3.0042	4.7429
OWN	0.0000	1.0000	0.6667	0.4747

Table 6. Summary Statistics for Capital Risk

Descriptive statistics				
	Minimum	maximum	mean	Std. deviation
Capital risk	4.3000	27.0900	11.2632	6.4094
BKS	-1.2400	8.9600	1.5714	1.5247
CASH	0.0000	0.6800	0.1218	0.1785
LLR	1.7000	29.4600	5.2906	5.3176
OPER	0.1600	20.1900	2.9636	4.7183
ROA	3.2100	12.4400	7.9468	3.1719
OWN	0.0000	1.0000	0.5833	0.4965

The person correlation coefficient is indicated in table (7, 8, and 9) for liquidity, credit and capital risk respectively. Each of this table shows the degree of correlation between the independent variables. The matrix shows a high positive correlation between loan loss reserves and operating efficiency ratios and also between capital adequacy ratio and ROA of 0.76 and 0.62 respectively. In general, our matrix explains that multicollinearity among our variables are absent as suggested by Kennedy (2008) that multicollinearity is a problem when the correlation coefficient is over 0.80, which is not the case in our results.

Table 7. Liquidity Risk Coefficient for Multicollinearity Check

	<i>LOR</i>	<i>BKS</i>	<i>ROE</i>	<i>ROA</i>	<i>CPR</i>	<i>NWC</i>	<i>OWN</i>
<i>LQR</i>	1.00						
<i>BKS</i>	0.6694	1.00					
<i>ROE</i>	0.1845	0.4283	1.00				
<i>ROA</i>	-0.1078	-0.1413	0.0033	1.00			
<i>CPR</i>	-0.2548	-0.3923	0.0251	0.6252	1.00		
<i>NWC</i>	0.4816	0.2419	0.0003	0.1341	0.2316	1.00	
<i>OWN</i>	0.0334	0.2258	-0.0878	0.4429	-0.2260	-0.3489	1.00

Table 8. Credit Risk Coefficient for Multicollinearity Check

	<i>CDR</i>	<i>BKS</i>	<i>CASH</i>	<i>OPER</i>	<i>GEAR</i>	<i>LLR</i>	<i>OWN</i>
<i>CDR</i>	1.00						
<i>BSK</i>	0.4894	1.00					
<i>CASH</i>	-0.0284	-0.3726	1.00				
<i>OPER</i>	-0.4259	-0.1065	0.1162	1.00			
<i>GEAR</i>	0.8144	0.5202	-0.1086	-0.5000	1.00		
<i>LLR</i>	-0.3567	0.0450	0.0897	0.7629	-0.3376	1.00	
<i>OWN</i>	0.0346	-0.2017	-0.4465	0.1344	0.0725	0.1858	1.00

Table 9. Capital Risk Coefficient for Multicollinearity Check

	<i>CPR</i>	<i>BKS</i>	<i>ROA</i>	<i>CASH</i>	<i>OPER</i>	<i>LLR</i>	<i>OWN</i>
<i>CPR</i>	1.00						
<i>BKS</i>	0.3667	1.00					
<i>ROA</i>	0.4528	-0.1372	1.00				
<i>CASH</i>	0.1055	-0.3917	0.3104	1.00			
<i>OPER</i>	0.3260	-0.0772	0.5724	0.1197	1.00		
<i>LLR</i>	0.3032	0.0666	0.4559	0.0823	0.7129	1.00	
<i>OWN</i>	-0.2495	-0.0348	-0.1692	-0.3942	0.1231	0.2259	1.00

5.2 Regression Results Estimate

5.2.1 Liquidity Risk Results Estimates

The variables that are significantly influencing liquidity risk management in banks will be sorted out from appendix B in the appendix section. As can be seen from the table, bank size influences liquidity risk positively and have a significant relation at 0.088 level of significance which can be supported with the findings of (khizer, Muhammad, and sadaqat 2011) that larger banks benefits from larger returns. Capital adequacy ratio plays a significant role in liquidity risk of banks but negatively affect it with respect to this study. That is, capital adequacy decreases by approximately 25% for every 1% increase in cash. Net working capital is highly significant at 0.02 and has a high positive association with liquidity risk with approximately 48% influenced as suggested by (Isshaq and bokpin 2009) that net working capital have a positive relationship with liquidity risk.

5.2.2 Credit Risk Results Estimates

The factors affecting bank credit risk can be investigated using appendix C. Here, we realized a significant and positive relationship between bank size and credit risk. This finding can be supported from the researchers (Akhtar, Ali, and Sadaqat 2011) .banks should keep their gearing ratio at a reasonably level when considering debt financing. The gearing ratio in this study is found to have a significant relationship and positively influencing credit risk supported by (Sensarma & Jayadev 2009). Operating efficiency ratio which is regarded as a measure for the management to make use of minimum utilization of resources to generate maximum returns tends to be positively and insignificantly related to bank credit risk. Also, cash is also a factor significantly influencing credit risk and positively associated for a 22.3% increase in cash for any 1% increase in credit loan.

5.2.3 Capital Risk Results Estimates

The variables influencing capital risk management in banks based on this study will be derived from appendix A. Cash is said to be a significant factor on capital risk but negatively related to it. This may result from the fact that banks with bigger cash with respect to their assets have greater liquidity, less risk and less need for capital. Loan loss reserves is found to have a significant relationship with capital risk at 0% level of significance and positively influencing banks financial risk at approximately 78%.this can be justified by the fact that a higher loan loss reserves results in a greater credit risk and a possibly greater need for capital. Also, bank size is significantly and positively impacting capital risk level due to its access to equity and possibly investment

opportunities taken by the bank from the capital market justifiable from the fact that larger banks tend to hold less capital than smaller banks.

Chapter 6

CONCLUSIONS AND POLICY RECOMMENDATION

This study examines financial risk management in South African banks employing 12 banks consisting of locally and foreign controlled banks. The study covered the period of 2006 – 2011 data obtained from the bank scope. Descriptive statistics, correlation and regression analysis was used to analyze the results. The financial risk is measured with the liquidity, capital and credit worthiness of the banks. This study have successfully identified variables that significantly affects financial risk in South African banks. The results show fitness of both liquidity, capital and credit risk model with probability of F-statistics at 0% level of significance respectively indicating the three models are best fit.

We found out that ownership structure of the banks do not influence financial risks in South African banks. This study point out that bank size is the major factor significantly and positively affecting our three financial risks used in this study. Hence we can conclude that bank size of South African banks is a factor influencing financial risk management in South Africa. Independent variables that have positive and insignificant relationship with financial risks are return on asset and operating efficiency ratio. This study reveals a partial image of financial risk management in South African banks as this study does not establish the effect of other financial risks that is faced by the banking industry. I recommend the South African banking industry to improve their

consideration of financial risk management by introducing Basel II rules in to their system that ensured that banks become strong enough to welcome shocks from operation.

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APPENDICES

Appendix A: Capital Risk Model

```
. xtreg cpr bks roa cash oper aqr11r wns, re vce(cluster n)
```

Random-effects GLS regression	Number of obs	=	70
Group variable: n	Number of groups	=	12
R-sq: within = 0.1516	Obs per group: min	=	5
between = 0.4853	avg	=	5.8
overall = 0.3925	max	=	6
	wald chi2(6)	=	32.10
corr(u_i, X) = 0 (assumed)	Prob > chi2	=	0.0000

(Std. Err. adjusted for 12 clusters in n)

cpr	Robust		z	P> z	[95% Conf. Interval]	
	Coef.	Std. Err.				
bks	-1.165723	.3503757	-3.33	0.001	-1.852446	-.478999
roa	-.0994501	.3339966	-0.30	0.766	-.7540715	.5551712
cash	-21.80903	8.476452	-2.57	0.010	-38.42257	-5.195485
oper	-.0133273	.0606784	-0.22	0.826	-.1322548	.1056001
aqr11r	.7786375	.163079	4.77	0.000	.4590086	1.098266
wns	-6.321346	4.022364	-1.57	0.116	-14.20504	1.562343
_cons	24.80462	6.363788	3.90	0.000	12.33183	37.27742
sigma_u	3.1278595					
sigma_e	2.7101707					
rho	.57118181 (fraction of variance due to u_i)					

Appendix B: Liquidity Risk Model

```
. xtreg lqr cpr bks roe roa nwc wns, re vce(cluster n)

Random-effects GLS regression           Number of obs   =    70
Group variable: n                       Number of groups =    12

R-sq:  within = 0.2464                   Obs per group:  min =    5
      between = 0.5994                               avg =    5.8
      overall  = 0.5832                               max =    6

corr(u_i, X) = 0 (assumed)                Wald chi2(6)    =   80.45
                                           Prob > chi2     =   0.0000

                                           (Std. Err. adjusted for 12 clusters in n)
```

lqr	Robust					
	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
cpr	-2.2513642	.108208	-2.32	0.020	-.463448	-.0392804
bks	2.017828	1.182268	1.71	0.088	-.2993756	4.335032
roe	-.2103292	.126205	-1.67	0.096	-.4576864	.0370281
roa	1.098276	.8235694	1.33	0.182	-.5158901	2.712442
nwc	48.63053	15.53877	3.13	0.002	18.17509	79.08596
wns	-2.909648	5.618243	-0.52	0.605	-13.9212	8.101906
_cons	55.95724	10.95302	5.11	0.000	34.48971	77.42477
sigma_u	8.3065434					
sigma_e	4.2836643					
rho	.78992436	(fraction of variance due to u_i)				

Appendix C: Credit Risk Model

```
. xtreg cdr bks cash oper ger aqrllr wns, re vce(cluster n)
```

```
Random-effects GLS regression      Number of obs   =    72
Group variable: n                  Number of groups =    12
```

```
R-sq: within = 0.3073              Obs per group: min =     6
      between = 0.6068                  avg =    6.0
      overall = 0.5723                  max =     6
```

```
corr(u_i, X) = 0 (assumed)          Wald chi2(6)    =   42.41
                                       Prob > chi2     =   0.0000
```

(Std. Err. adjusted for 12 clusters in n)

cdr	Robust					[95% Conf. Interval]	
	Coef.	Std. Err.	z	P> z			
bks	.0113022	.0052097	2.17	0.030	.0010915	.021513	
cash	.2235848	.1050871	2.13	0.033	.0176178	.4295518	
oper	.0013488	.0019514	0.69	0.489	-.0024759	.0051735	
ger	.0046889	.0021553	2.18	0.030	.0004645	.0089132	
aqrllr	-.0035503	.0026741	-1.33	0.184	-.0087915	.0016909	
wns	.0343867	.0372895	0.92	0.356	-.0386993	.1074727	
_cons	.6976321	.0661938	10.54	0.000	.5678946	.8273696	
sigma_u	.03799895						
sigma_e	.0211794						
rho	.76297487	(fraction of variance due to u_i)					