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# The relationship between risk, capital and efficiency in South African banks

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# The Relationship Between Risk, Capital and Efficiency in South African Banks

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UNIVERSITY OF THE WITWATERSRAND

## DECLARATION

I, Blazius Kasungula Kwakwala, declare that this dissertation is my own work. I have duly indicated and acknowledged any reference to the work of other authors. I undertook this research work in partial fulfilment of the requirements for the Master of Management in Finance and Investment Management degree at the University of the Witwatersrand, Johannesburg. I also declare that the thesis has not, either in whole or in part, been submitted for a degree or diploma to any other institution or university for a similar qualification. Lastly, I declare that I did obtain all approvals to undertake the research.

*Electronically signed* 31th March, 2015

Signature of Candidate Date

_____ _____

Signature of Supervisor Date

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## ABSTRACT

This research project analyzed the relationship between bank risk taking, capital and operating efficiency in South African banks. The relationship between bank risk taking, capital and operating efficiency is one of the central topics in banking studies because of regulators' and researchers' quest to understand the determinants of bank risk taking. The research used a panel data set of top 4 South African banks for the period 2004 to 2013. The period under study includes the credit crisis which therefore introduces parameter instability with a known structural break or change point into the regression parameters. The research data was collected from financial statements of the sampled the banks to construct standard accounting measures of bank risk taking, capital adequacy and operating efficiency all of which were regressed using simultaneous equations in EViews. The regression results do not provide evidence of any relationship between risk taking and capital. The only statistically significant relationship is the inverse relationship between risk taking and efficiency. The finding that efficiency is negatively related to bank risk taking supports earlier research findings that bank risk taking is more pronounced in inefficient banks compared to efficient ones. It also supports the moral hazard hypothesis which posits that banks undertake more risk taking when faced with greater inefficiencies; and the "bad management" hypothesis which states declines in efficiency lead to increased risk taking. The regression results also do not provide evidence of a relationship between capital and efficiency: implying that capital and efficiency are not simultaneously determined. The results in this study oblige management and regulators to pay much attention to operating efficiency as a driver of bank risk taking.

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Mwakoma nonse. How great you are.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background

South Africa has a well developed and regulated banking system that compares favourably with many industrialised countries. The banking sector is viewed as world class, with adequate capital, technology, infrastructure and a strong regulatory and supervisory environment. According to the 2012/13 World Economic Forum Competitive Survey, South African banks were rated 2nd out of 144 countries for soundness, while the country was rated 3rd for financial sector development (South African Reserve Bank, (SARB) 2013).

The attractive economic features, legislation, regulation, technology, products and the number of participants have induced stiff competition in the banking industry. Currently, the South African banking industry consists of 17 registered banks, 3 mutual banks, 14 local branches of foreign banks, 43 foreign banks with approved local representative offices while other foreign banks acquired stakes in major banks. Of the nominal value of the total South African banking sector's shares in issue at the end of 2013, foreign shareholders held about 47.7%, domestic shareholding represented 24.3% and minority shareholders (those with a shareholding less than 1% shareholding) represented about 28.0% (SARB, 2013).

As a result of this heightened competition, there has been a tremendous emphasis on improved operating efficiency in the banking industry. All banks are forced to operate closer to the best practice or efficient production function in order to safeguard or gain more market share. This increase in competition and, ultimately, greater operating efficiency, has the potential to lead to incentives for excessive bank risk taking behaviour due to the fact that competition reduces the market power of banks. For example, increased competition may conspire to oblige managers to employ an expansionary strategy which may end up being excessively risky (Gorton & Rosen

(1995)). Regulators have tried to counterbalance these possible incentives for greater bank risk taking by giving capital adequacy a more prominent role in the banking regulatory process. In this sense, due to both regulatory and market pressures, most South African banks have been under pressure to boost their capitalisation.

Against this background, regulators and researchers have focused on understanding and analyzing the determinants of bank risk taking, and more specifically, examining the impact of capital and operating efficiency on bank risk taking. However, knowledge about the relationship between bank capital, operating efficiency and risk taking is still very limited and mixed.

## 1.2 Purpose Of The Research

This research sought to analyze the relationship between bank risk taking (on one hand) and capital adequacy and operating efficiency (on the other hand) as drivers of bank risk taking behaviour in South Africa.

## 1.3 Research Question

The main research question is: how does a South African bank's capital adequacy and operating efficiency influence the bank's risk-taking behaviour (that is, how do less capitalized and less efficient banks compare with well-capitalized and efficient banks in terms of risk taking in South Africa)?

## 1.4 Problem Statement

Studies that have been conducted before on the relationship between bank risk taking, capital and operating efficiency have mainly focussed on the United States (for example Chernobai, Jorion and Yu (2011); Jeitschko and Jeung (2005); Hughes and Mester (1998); Kwan and Eisenbeis (1997); Berger and De Young (1997); Jacques and Nigro (1997); Shrieves and Dahl (1992)); on Europe (for example Eken and Kale (2013); Fiordelisi, Marques-Ibanez and Molyneux (2011); Altunbas, Carbo, Gardener and Molyneux (2007); Iannotta, Nocera and Sironi (2007); Williams (2004); Rime (2001)); and on Asia (for example Lee and Hsieh (2013); Tan and Floros (2013); Deelchanda

and Padgett (2009); Agusman, Monroe, Gasbarro and Zumwalt (2008); Konishi and Yasuda (2004)). However, there has hardly been a comprehensive study of this relationship in the banking industry in South Africa such that current knowledge and research about this relationship in South African banks is scanty. Given this context, empirical analysis is the only solution for determining the relationship in South Africa. To a greater extent, this study is informed by the previous studies stated above. This study stretches these previous studies to the banking industry in South Africa. The significance of this study lies in the fact that there are substantial differences between capital markets in emerging market economies of which the South African banking industry is one and capital markets in developed market economies. Godlewiski (2004) extended studies of this relationship to emerging market economies from three major geographic areas of central and eastern Europe, Asia and South America. Rojas-Suarez (2000) puts forward the main emerging markets' problem concerning capital regulation efficiency: lack of data and accounting standards and rules, bad reporting systems, and inefficient financial markets.

## 1.5 Outline Of The Paper

Chapter 1 presents the background and outline of the research paper, the research purpose, research question and problem statement. Chapter 2 presents the theoretical framework underpinning financial intermediation, bank risks, and the hypotheses as well as existing empirical findings. Chapter 3 presents the research methodology that was used to conduct the research: the research design, sampling, the dependent and independent variables and the econometric models. Chapter 4 presents and analyses the research findings. Chapter 5 presents the limitations as well as recommendations of the study and summarizes the study.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

This chapter presents the theoretical framework underpinning financial intermediation, bank risks, and the hypotheses as well as existing empirical findings on the relationship between bank risk, capital adequacy and operating efficiency.

## 2.2 Financial Intermediation

According to Mishkin and Eakins (2012), banks are financial intermediaries that channel funds from households and institutions with surplus funds (that is, surplus spending units or suppliers of funds) to deficit spending units or users of funds (those with shortages of funds). In this intermediation process, banks carry out four basic services:

### 2.2.1 Liquidity Management

As financial intermediaries, banks have two main sources of funds other than owners' equity: deposits and borrowed funds. Both these sources make up over 75% of banks' assets (Saunders & Cornett, 2014). This stylized fact, high leverage, implies that a bank needs enough ready cash to pay its depositors when they demand payment or make withdrawals (Mishkin & Eakins, 2012). Liquidity management is the process of acquiring and retaining liquid assets sufficient enough to satisfy such cash demands by depositors or other customer obligations (Saunders & Cornett, 2014).

### 2.2.2 Asset Management

According to Mishkin and Eakins (2012), in a general sense, banking involves selling liabilities with various size, liquidity, risk and return combination/characteristics and transforming the proceeds into lower risk assets in order to make profits. Like any other production function, this process is called asset transformation: banks borrow liabilities to fund trading assets. In this regard, Mishkin and Eakins (2012) define asset management as the process of acquiring lower risk but high return assets (loans and other trading securities) which are diversified enough to minimize risk losses; and

managing the liquidity of the said assets to ensure that the bank can satisfy its immediate cash outflows and regulatory capital reserves at no or minimal cost. The four principle earning asset areas for banks are business loans; real estate loans; individual/consumer loans; and investment securities (Saunders & Cornett, 2014).

### 2.2.3 Liability Management

Liability management is the process of acquiring low cost funds to meet the bank's asset acquisition function (Mishkin & Eakins, 2012). Just like any other player in any market, banks compete against each other in the acquisition of liabilities. The issue is to acquire such funds at low cost so that when transforming the liabilities into assets the bank can manage to mark up the cost of the funds at an economical price to the borrower so that the bank can make profitable sales. For example, presented with an attractive security trading, a bank can acquire the precedent liabilities by either borrowing from other banks or selling fixed deposits both of which entail different funding costs.

### 2.2.4 Capital Adequacy Management

Like any commercial entity, banks need capital to operate and survive. However, in the banking industry, capital plays a much more distinctive role compared to all other industries because banks are highly leveraged institutions. Regulatory authorities therefore require banks to keep minimum amounts of capital to ensure that at any particular point in time, banks are able to pay their creditors/depositors and to absorb any unanticipated risk losses with enough flexibility to continue operating as a going concern. Failure to do this would mean bank failure or insolvency. Besides, in the event of actual failure, capital also protects depositors who are non equity liability holders against losses. Therefore, capital adequacy management is the determination and acquisition of the minimum capital reserves which the bank needs to operate smoothly (Mishkin & Eakins, 2012).

## 2.3 Risks Of Financial Institutions

Born of the nature of intermediation, banks face various risks: interest rate risk, credit risk, market risk, liquidity risk, operational risk, off-balance sheet risk, foreign exchange risk, sovereign risk and insolvency risk.

### 2.3.1 Interest Rate Risk

The source of interest rate risk is the asset transformation function of banks (Saunders & Cornett, 2014). The assets purchased by banks do not always match the maturity or duration of the liabilities the bank sells. Interest rate risk therefore arises when interest rates fluctuate in the interval. When a bank holds longer term assets relative to liabilities, and interest rates rise, the bank incurs an increase in funding costs when it raises new liabilities at the higher interest rates in order to fund the longer term assets. This increased cost of funding, relative to the returns being earned on the asset investments (which were originally purchased at lower interest rates), is called refinancing risk. On the other hand, when a bank holds longer term liabilities relative to assets, and interest rates fall, the bank faces reinvesting risk: the diminished returns which the bank would earn from funds reinvested at the prevailing low interest rates relative to the cost of funds (higher interest rates) which subsisted at the time the assets were originally purchased (Saunders & Cornett, 2014).

### 2.3.2 Credit Risk

According to Saunders and Cornett (2014), credit risk arises when a borrower fails to honour in full or partially honours loan repayments (Saunders and Cornett, 2014). When banks lend money, the maximum return arises when the loans pay off interest payments on the promised dates and principal on maturity in full. In this case, credit risk arises if the promised principal/interest cash flows do not materialize in full or do not materialize at all resulting in the mean return on the investment being less than the maximum possible. In this sense, loan holdings in a bank's banking book have a constant and high probability upside return (interest/principal repayments) and a large but smaller probability downside risk (credit risk loss) (Saunders & Cornett, 2014).

The potential for credit risk requires banks to critically assess its borrowers pre-lending and to do post lending tracking of the borrowers to assure themselves that their borrowers are still credit worthy. Banks can also manage credit risk by spreading it in multiple credit portfolios instead of concentrating it in one credit portfolio (Saunders & Cornett, 2014).

### 2.3.3 Market Risk

According to Hull (2012), market risk relates to the possibility that investments in the bank's trading book will decline in value. Hull (2012) defines a bank's trading book as the portfolio of liquid and marketable assets and liabilities (such as bonds, commodities, foreign exchange, equities and derivatives) which is different from a banking book which contains relatively illiquid and longer duration assets and liabilities held for hedging, funding or investment purposes (Mishkin & Eakins, 2012). Market risk arises when a bank adopts an active trading strategy especially an unhedged or open position and, due to volatility on the markets, prices take an unfavourable direction contrary to trader forecasts or expectations (Hull, 2012).

### 2.3.4 Liquidity Risk

Hull (2012) defines liquidity as a bank's ability to pay its liability holders (such as depositors) or trading counter parties (such as corporate claimants of off balance sheet credit lines) when the financial claims they hold with the bank become due for payment. Hull (2012) distinguishes two aspects of liquidity risk: liquidity trading risk and liquidity funding risk.

According to Hull (2012), a liquid position in a trading asset is one that can be unwound at short notice. As the market for an asset becomes less liquid, traders face the risk of losses because they face bigger bid-offer spreads. According to Hull (2012) the price at which an asset can be sold depends on the asset's mid-market price or value estimate; the quantity to be sold; the desired turnaround time; and economic dynamics. Liquidity trading risk arises in that when one bank decides for whatever reason to unwind a trading position, other banks with similar positions decide to do the same thing; yielding

a “liquidity black hole” phenomenon whereby the liquidity normally present in the whole financial market or banking industry evaporates (Hull, 2012).

According to Saunders and Cornett (2014), liquidity funding risk is a bank’s ability to meet its cash needs as they arise. Banks can generally predict and manage to cope with day to day withdrawals by liability holders. However, other cash needs are less predictable: for example when liability holders demand enormous withdrawals, or when off balance sheet counter parties draw down on credit lines that the bank has granted. Such circumstances expose the bank to liquidity funding risk. The main sources of liquidity for a bank are cash holdings and cash convertible securities; and the ability to liquidate trading book positions, borrow money in the wholesale market or from the central bank, attract retail deposits and/or securitize assets (like loans) at short notice (Hull, 2012).

As in a “liquidity black hole”, when banks find themselves less liquid for some reason, deleveraging emerges: the banking industry becomes more reluctant to lend money. This yields an increase in credit spreads. Demand for both trading assets diminishes and asset prices decrease. The value of the collateral supporting loans decreases and banks reduce lending further. This leads to asset sales being necessary, which leads to further reduction in asset prices and a repeat of the cycle: leading to reduced liquidity throughout the economy (Hull, 2012).

### 2.3.5 Operational Risk

According to Chernobai, et al., (2011), operational risk arises from unforeseen circumstances triggered by failure or inadequacy of systems, people, internal processes or arrival of unexpected external shocks. There are various sources of operational risk: namely, fraud; violations of employment, health or safety standards which result in workers compensation payments; trading malpractices; loss from natural disasters; or information technology failures such as transactional processing failures (Hull, 2012).

Chernobai, et al., (2011) distinguish operational risk from all the other risks in that while the other risks arise as a risk and return trade-off, operational risk is the residual and random risk that remains in the normal course of doing business unrelated to managers' risk taking appetite (almost verging on unexpected shocks).

### 2.3.6 Off-Balance Sheet Risk

Off-balance sheet risk arises from financial firms' off-balance sheet activities, that is, contingent assets and liabilities like credit guarantees which do not appear on the bank's current balance sheet. However, they have the potential to appear on the balance sheet in future if the contingent asset holder defaults on its obligations. Such an eventuality results in off balance sheet risk. The eventuality serves to actualize the contingent liability (Saunders & Cornett, 2014).

### 2.3.7 Foreign Exchange Risk

Foreign exchange risk arises when a bank finds itself in a situation where it has to liquidate its net foreign currency denominated assets and liabilities at an unfavourable exchange rate compared to the one which was applied at the time the bank traded in the foreign asset-liability position (Eun, Resnick and Sabherwal, 2012). For purposes of illustration, suppose a South African bank makes a loan to a Kenyan corporate in Kenyan Shillings. If the Kenyan Shilling depreciates against the South African Rand, the loan repayments to the South African lending bank would be devalued in South African Rand terms. Over the investment period, if the Kenyan Shilling depreciates too low, when the South African lender converts the loan repayment cash flows from Kenyan Shillings back into South African Rands, the overall return could be negative and indeed worthless or valueless.

### 2.3.8 Country or Sovereign Risk

According to Eun, et al., (2012), for banks which operate foreign franchises or subsidiaries, adverse political developments in the host countries pose country or sovereign risk which falls in two categories: transfer risk or control risk. Transfer risk arises when a host country for a franchise/subsidiary or trading partner prohibits flows of

capital, payments or know how across its borders. This incapacitates subsidiaries or trading partners from making or receiving in- or out-bound cash flows even if they want to. Control risk arises when a country enacts policy or statutory restrictions on ownership and control of local corporates. Examples include mandatory transfer of ownership in local firms from foreign to domestic investors or restrictions on foreign shareholding in local firms (Eun, et al., 2012).

### 2.3.9 Insolvency Risk

According to Hull (2012), solvency refers to a firm having more assets than liabilities, so that the value of its equity is positive. According to Mishkin and Eakins (2012), insolvency risk arises when one or more of the above mentioned risks losses drive a bank's owners' capital or equity to, or near to, zero. For example, because banks have higher financial leverage compared to owners' equity, credit risk losses can easily throw a bank into insolvency. In this sense, to remain solvent, a bank needs more owners' equity, that is, lower financial leverage (Mishkin & Eakins, 2012). Capital provides the bank with a cushion under such risk exposures.

## 2.4 Bank Risk Taking: Hypotheses Explanations

Before introducing findings from previous studies regarding the relationship between risk taking, capital and operating efficiency, it is important to highlight the hypotheses which purport to explain the relationship between bank risk taking, capital and operating efficiency namely: bad management hypothesis, moral hazard hypothesis, cost skimping hypothesis, regulatory hypothesis and bad luck hypothesis.

According to Berger and De Young (1997) and Williams (2004) the "bad management" hypothesis states that banks operating with low levels of efficiency have higher costs largely due to inadequate credit monitoring and inefficient control of operating expenses (which is reflected in lower cost efficiency almost immediately). Thus, declines in cost (and revenue) efficiency will temporally lead to increases in banks' risk due to credit, operational, market and reputational problems.

The moral hazard hypothesis was suggested by Gorton and Rosen (1995) who stated that in an unhealthy banking industry, entrenched managers will tend to take on more risk rather than less risk; and that, under actual or expected increased competition, well informed managers who normally have better information on the quality of the portfolio might employ an expansionary strategy, which may end up being excessively risky.

A closely related proposition to the moral hazard hypothesis is advanced by Jeitschko and Jeung (2005) who state that bank managers have incentives to take on more risk either when banks have lower levels of capital or the banks are less efficient and bank managers believe that state agencies will get involved to protect the institution and its creditors in case of any failure or when the risks are borne entirely by the shareholders. Thus, moral hazard arises from informational friction and the existence of agency problems.

The “cost skimping” hypothesis assumes that there is a trade-off between short-term efficiency and future risk-taking. Berger and De Young (1997) posit that in the short term a bank may appear to be more efficient or profitable as it devotes fewer resources to risk management. As a result, bank risks remain unaffected in the short run. In the medium term however, banks reach higher risk levels as they have to purchase the additional inputs necessary to mitigate future higher risks (Berger & De Young, 1997). In other words, if a bank prefers not to spend sufficient resources to mitigate risks in the short term the bank would appear as efficient and a positive relationship between risk and efficiency would then occur which ultimately result in higher future risks.

Ford and Sundmacher (2007) corroborate “bad management” and “cost skimping” hypotheses. According to them, the cost-to-income ratio of a bank may be a potential leading indicator of unexpected operational risk losses. This ratio is an efficiency index, given its measurement of the cost incurred in generating each Rand of income. While a reduction in this ratio is generally considered favourable – a sign of lower cost per Rand of income and hence greater efficiency – Ford and Sundmacher (2007) posit that there must be some critical threshold at which the relationship between costs and income as

embodied in the ratio, cannot be sustained without the bank incurring an escalation in operational risk. For example, from the perspective of costs, an obsession with achieving a lower cost-to-income ratio each reporting period can result in a bank reducing discretionary expenditures in audit, personnel and monitoring systems – all of which may impact directly and adversely on risk management. According to Schildbach (2013), comparison of efficiency ratios is generally most meaningful among banks within the same model and the definition of a “high” or “low” ratio should be made within this context. Nonetheless, Schildbach (2013) states that 50% is generally regarded as the maximum optimal ratio.

An important factor contributing to a positive relationship between capital and risk relates to the actions of regulators and supervisors (Altunabs, et al., 2007). According to this regulatory hypothesis, regulators encourage banks to increase their capital commensurably with the amount of risk taken. This increase in capital, when the amount of risk rises, could also partly be due to efficient market monitoring from markets when capital positions are deemed inadequate. Tan and Floros (2013) also state that banks are forced by regulators to hold higher levels of capital when bank risk taking increases; this is due to the fact that the cost of issuing fresh equity at short notice can be avoided by holding additional capital above the minimum regulatory requirement. On the other hand, the requirement to hold higher levels of capital from regulatory authorities can be responded by banks through increasing portfolio risk.

According to Berger and De Young (1997) the “bad luck” hypothesis posits that loan losses can arise from adverse economic circumstances, causing banks to spend more to recover the loans (Berger & De Young, 1997). In other words, external exogenous events (e.g., unexpected shocks) can precipitate increases in problem loans for the bank unrelated to managers’ skills or their risk taking appetite. These increases in risk result in additional costs and managerial effort. Thus, under this hypothesis, increases in bank risk can precede falls in cost and revenue efficiency.

## 2.4 Bank Risk Taking Behavior: Background Literature

This section presents an overview of findings on the relationship between bank risk taking, operational efficiency and capitalization. Kwan and Eisenbeis (1997) and Berger and De Young (1997) blazed the trail of studies on the relationship between bank risk taking, capital and operating efficiency. Their seminal studies revealed that efficiency and capital are significant drivers of bank risk-taking.

Kwan and Eisenbeis (1997) used a simultaneous equation framework to test hypotheses about the interrelationships among bank interest rate and credit risk-taking, capitalization and operating efficiency. They found a positive effect of inefficiency on risk-taking which purported that poor performers are more vulnerable to risk-taking than high performance banking organizations. Kwan and Eisenbeis (1997) also found a positive effect of inefficiency on the level of capital: firms with more capital were found to operate more efficiently than less well-capitalized banking organizations.

Kwan and Eisenbeis (1997) also stated that operating efficiency may be dependent on bank risk. Risks may be costly to manage, in the sense that a high risk firm may require additional capital and labor inputs to produce the same level of outputs. For example, it may be more costly to monitor a high-risk loan portfolio, or to run a highly mismatched maturity gap. If it is more costly to run a risky firm, bank risk is expected to have a negative effect on operating efficiency (Kwan and Eisenbeis, 1997). This will lead to a positive effect of bank risk on operating efficiency.

Berger and De Young (1997) employed Granger-causality techniques to test four hypotheses regarding the relationships among loan quality, cost efficiency, and bank capital. The findings suggest that problem loans precede reductions in measured cost efficiency; declines in cost efficiency precede increases in problem loans; and reductions in capital at thinly capitalized banks precede increases in problem loans. Hence, cost efficiency may be an important indicator of future problem loans and problem banks.

These findings by Berger and De Young (1997) yielded the cost skimping hypothesis: that maximissation of short-term profits by reducing funds devoted to allocating and monitoring loans, other things being equal, would boost both efficiency and risk measures, producing (in the short term) a positive relationship between risk and efficiency.

In other related studies, Rime (2001) and Jacques and Nigro (1997) found (respectively) a positive and negative association between changes in risk and capital. Hughes and Mester (1998, 2009) also corroborate that capital and risk are likely to be influenced by the level of efficiency of the bank. From a regulatory perspective, and other things being equal, regulators may allow an efficient firm with better management probably more flexibility in terms of their capital levels (more leverage) and risk profile. On the other hand, from a moral hazard point of view, a less efficient firm may be tempted to take on higher risk to compensate for the lost returns.

Williams (2004) and Altunbas, et al., (2007) replicated both Kwan and Eisenbeis (1997) and Berger and De Young (1997) papers in a European banking setting. Similar to Berger and De Young (1997), Williams (2004) used Granger-causality techniques to assess the inter-temporal relationships among problem loans, cost efficiency, and financial capital. Williams (2004) found that poorly managed banks (banks with lower efficiency) tended to make poorer quality loans.

A negative relationship between capital and risk is also obtained in UK banks and building societies according to Alfon, Argimon, and Bascuñana-Ambrós (2004). They argue that the possible explanations for keeping substantially high capital positions are: distance from minimum capital requirement, internal risk assessments by bank managers and their skills in managing risk, the level deemed appropriate by rating agencies and depositors and the costs of raising extra capital.

Like Kwan and Eisenbeis (1997), Altunbas, et al., (2007) used a static simultaneous equation framework to investigate the relationship between capital, loan provisions and

cost efficiency for a sample of European banks over the period 1992-2000. In stark contrast to Williams (2004), and in contrast to the established US evidence, Altunbas, et al., (2007) did not find a positive relationship between inefficiency and bank risk-taking. They report that banks with higher efficiency tend to take on higher levels of risk while less efficient banks seem to have higher capital levels and lower levels of credit risk. Their study found a positive relationship between risk on the level of capital (and liquidity), possibly indicating regulators' preference for capital as a mean of restricting risk-taking activities.

Altunbas, et al., (2007) also found evidence that the financial strength of the corporate sector has a positive influence in reducing bank risk-taking and capital levels. They found no major differences in the relationships between capital, risk and efficiency for commercial and savings banks although there are for co-operative banks. In the case of co-operative banks they did find that capital levels are inversely related to risks and that inefficient banks hold lower levels of capital. Some of these relationships also vary depending on whether banks are among the most or least efficient operators.

Iannotta, et al., (2007) found a positive relationship between capital and risk, meaning regulators encourage banks to increase their capital commensurably with the amount of risk taken, which supports the 'regulatory hypothesis'. Iannota, et al., (2007) attributed the relationship between capital and risk to the fact that a different asset risk can be compensated by a different level of capitalization. Agusman, et al., (2008) found that equity-to-total-assets are negatively related to risk.

Fiordelisi, et al., (2011) used Granger-Causality techniques to assess the relationship between capital, efficiency and risk for a sample of European commercial banks over the period 1995 – 2007. The results indicate that inefficient banks typically have higher risk levels and higher capital levels increase bank efficiency.

Analysing risk taking at Japanese commercial banks Konishi and Yasuda (2004) found that risk taking behavior goes down at commercial banks when capital adequacy

requirements are introduced. On the other hand, Deelchand and Padgett (2009), examining the relationship between risk, capital and efficiency at Japanese cooperative banks, found that portfolio risk and regulatory capital are positively related. More capital tends to absorb adverse shocks and thus reduces the likelihood of failure (Deelchand & Padgett, 2009). Banks raise capital when portfolio risk goes up in order to keep up their capital buffer: as such, changes in risk and capital outlook by bank management are simultaneously determined (Deelchand & Padgett, 2009). Banks aim at holding more capital than required (i.e., maintaining regulatory capital above the regulatory minimum) as insurance against breach of the regulatory minimum capital requirement. These two Japanese studies indicate that the results for Japan differ to some extent.

Lee and Hsieh (2013) applied the Generalized Method of Moments technique for dynamic panels using bank-level data for 42 Asian countries over the period 1994 to 2008 to investigate the impacts of bank capital on profitability and risk. Their study found a negative relationship between capital and risk through the whole Asian banking sample, thus supporting the moral hazard hypotheses.

Tan and Floros (2013) assess the relationship between bank efficiency, risk and capital for a sample of Chinese commercial banks employing three efficiency indexes and four risk indicators under a three stage least square method in a panel data framework. The empirical evidence suggests that there is a positive and significant positive relationship between risk (loan-loss provision as a fraction to total loans) and efficiency in Chinese banking industry, while the relationship between risk and level of capitalization is negative and significant.

## 2.6 Summary

Banks are financial intermediaries that channel funds from surplus spending units to those who need the funds but do not have them. In this intermediation process, banks have to manage the liabilities, the assets, the bank's own capital position and the transformation of the liabilities into assets. Born of the nature of intermediation, banks

face operational risk, interest rate risk, off-balance sheet risk, credit risk, foreign exchange risk, market risk, sovereign risk, liquidity risk and insolvency risk.

The relationship between bank risk taking behaviour, capital and efficiency is one of central topics in banking studies. As evidenced by the findings from previous studies reviewed above, existing studies yield contradictory findings. Some studies find positive relationships while others find negative relationships between bank risk taking behavior, capital adequacy and operating efficiency. Still other studies find simultaneous causality relationships between capital and efficiency.

Existing studies (which focussed on the United States, Europe and Asia) yield contradictory findings. Some studies find positive relationships while others find negative relationships between bank risk taking behavior, capital adequacy and operating efficiency. Still other studies find simultaneous causality relationships between capital and efficiency.

# CHAPTER 3

# RESEARCH METHODOLOGY

## 3.1 Introduction

The purpose of this research was to analyse the relationship between bank risk taking (on the one hand) and capital adequacy and operating efficiency (on the other hand) as determinants of bank risk taking behaviour in South African banks. The main research question is: how does a South African bank's capital adequacy and operating efficiency influence the bank's risk-taking behaviour (that is, how does the risk taking behaviour of a less capitalized and less efficient bank in South Africa differ from the risk taking behaviour of a well-capitalized and efficient bank)? This chapter presents the research design, sampling, the dependent and independent variables and the econometric models that were used to conduct the research.

## 3.2 Research Design

A research design is an outline of how a research project will be conducted (Babbie & Mouton, 2001). In this study, the quantitative correlational research design was chosen and used because this study explores relationships between variables which the researcher cannot control (bank risk taking, operating efficiency and capitalisation). A correlation is a relationship between variables (Cresswell, 2009). The whole purpose of correlational research is to figure out if or which variables are connected; if or which variables interact with each other, so that when one variable changes, an indication arises of how the other will change. Correlational designs often entail variables that the researcher can not control but which the researcher simply measures or analyses to see whether they are related (Creswell, 2009).

## 3.3 Sampling

The study used a panel data set of top 4 South African banks for the period 2004 to 2013. The banking industry in South Africa has 17 registered banks of which Standard, Absa, First Rand and Nedbank make the top four with up to 75% of total banking sector

assets and liabilities. These major banks also operate franchises in several countries across Africa (SARB, 2013). Data was collected from the banks' balance sheets and income statements to construct standard accounting measures of bank risk taking, capital adequacy and operating efficiency which were regressed in EViews using simultaneous equations. The frequency of the data was annual, as in annual reports. Secondary data was also collected from South African Reserve Bank publications.

## 3.4 Dependent/Explained Variables

This section introduces the dependent/explained variables (bank risk taking, capital adequacy and operating efficiency) which the study employed.

### 3.4.1 Bank Risk Taking

Credit risk was chosen and used to represent bank risk taking in this study. As positioned by Godlewski (2004), the rationale is that credit risk is the biggest risk that banks face, by virtue of the very nature of their business as financial intermediaries. The predominance of credit risk is even reflected in the composition of economic capital, which banks are required to keep aside for protection against various risks. Godlewski estimates that credit risk takes about 70% of economic capital while the remaining 30% is shared between the other two primary risks, namely market risk and operational risk.

The second reason why credit risk was chosen and used to represent bank risk taking in this study is that although the bank risks are described independently, in reality, they are interrelated. Specifically, according to Chernobai, et al., (2011), credit risk is positively related to all the other risks. For example, borrowers fail to maintain promised debt repayments when interest rates rise. Thus, interest rate risk leads to credit risk. Besides, in many cases loan repayments are critical ingredients for a bank's liquidity position. As such, customers' inability to honour promised loan repayments can adversely affect the bank's liquidity. Thus, interest rate risk and credit risk are also positively correlated with liquidity risk (Saunders & Cornett, 2014). The interaction of these risks with credit risk means that attempts to affect credit risk impact on other risks.

That is, the mitigation of some risks may be achieved as a by-product of the mitigation of credit risk.

Deelchand and Padgett (2009) identify a number of accounting measures for credit risk: all of which employ balance sheet ratios. They are, in no order, the credit loss ratio (which Deelchand and Padgett (2009) define as total credit losses as a percentage of gross loans and advances); loan loss provisions which Deelchand and Padgett (2009) define as credit loss reserves as a percentage of gross assets; and the non-performing loans ratio (which Deelchand and Padgett (2009) define as all non-performing loans as a percentage of gross loans and advances. According to Godlewski (2004) a loan is categorized as non-performing if the debtor has not honoured in part or in full scheduled payments for at least 90 days in which case, it is considered unlikely that the loan will be repaid in full.

This study used credit loss ratios as a measure for bank risk taking. In line with Godlewiski (2004), the rationale is that (i) loan loss provisions are provisional figures within a specified period whereas credit losses are actual (realized) losses that have been incurred within the specified period; (ii) non-performing loans are not static: they can start performing if the debtor starts making payments again, even if all unpaid balances are not honoured. As a measure of bank risk taking, a higher level of credit risk losses (a higher level of credit loss ratio) is therefore suggestive of greater bank risk taking and vice versa. Hence, the decision to use credit risk losses as a measure of credit risk for this study.

### 3.4.2 Capital Adequacy

According to Hull (2012), bank capital has two components: Tier I capital and Tier II capital. Tier I Capital consists of items such as equity and noncumulative perpetual preferred stock net of goodwill (Hull, 2012). It reflects core capital contribution of the bank's stockholders (Hull, 2012). Tier II Capital, also referred to as supplementary capital, refers to all secondary capital sources such as cumulative perpetual preferred

stock and subordinated debt (debt subordinated to depositors) with an original life of five years (Hull, 2012).

According to Saunders and Cornett (2014), capital adequacy protects bank depositors and promotes the stability and efficiency of a financial system as a whole. A bank's Tier I Capital is the ordinary capital of the bank which can absorb bank losses without the bank having to suspend trading. Tier II Capital is the bank's capital which can absorb losses if the bank has to shut down and so provides some degree of protection to depositors (Saunders and Cornett, 2014).

This study used the capital adequacy ratio to measure bank capital adequacy. Expressed as a formula, the capital adequacy ratio equals the sum of the bank's Tier I Capital plus Tier II Capital, divided by its risk weighted assets which are calculated by looking at the bank's loans and evaluating their riskiness; each loan is assigned a percentage number (Saunders & Cornett, 2014). The capital adequacy ratio is a more rigorous measure of capital adequacy because it takes into account stockholders' core contribution as well as all other supplementary capital options available (Hull, 2012). Currently the minimum acceptable ratio is 10% (Saunders and Cornett, 2014).

### 3.4.3 Operating Efficiency

Efficiency represents the effectiveness of a firm's management of its resources and activities. Fiordelisi, et al. (2011), Lee & Hsieh (2013), or Tan & Floros (2013) classify efficiency measures as market based and accounting based. Market based approaches measure efficiency using industry best practice as a yardstick. Banks then assess their efficiency levels in terms of how farther away they lie from the best industry efficiency frontier. There are two market based efficiency measurement tools: data envelopment analysis and stochastic frontier analysis.

The most common accounting based efficiency index is the cost-to-income ratio which measures the cost incurred in generating each Rand of income. While the formula varies across disciplines, the most common formula is as a percentage of operating

expenses/costs to revenue/total income. A low ratio reflects greater efficiency, that is, lower cost per Rand of income, which is a favourable performance indicator. A high ratio reflects lower efficiency, that is, higher cost per Rand of income, which signals risk to continuing profitability (Ford and Sundmacher, 2007). According to Schildbach (2013), efficiency ratios are best compared across firms within the same industry such that what constitutes a "high" or "low" ratio is best defined in relation to that specific industry. Nonetheless, Schildbach (2013) regards 50% as the maximum optimal ratio. This study used cost-to-income ratios as provided in banks' balance sheets and income statements to measure operating efficiency.

### 3.5 Econometric models

Based on the relationships theorized in the literature review as well the proposed measures of bank risk taking, capital adequacy and operating efficiency, the study proposed the following simultaneous equations to assess the relationship between bank risk taking, capital adequacy and operating efficiency:

$$RISK_{i,t} = \alpha_0 + \alpha_1 CAR_{i,t} + \alpha_2 EFF_{i,t} + \alpha_3 SIZE_{i,t} + \alpha_4 NLTA_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$CAR_{i,t} = \beta_0 + \beta_1 RISK_{i,t} + \beta_2 EFF_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 ROA_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$EFF_{i,t} = \gamma_0 + \gamma_1 CAR_{i,t} + \gamma_2 RISK_{i,t} + \gamma_3 SIZE_{i,t} + \gamma_4 LTD_{i,t} + \varepsilon_{i,t} \quad (3)$$

Where:
$i$ is the bank dimension,
$t$ denotes the time dimension and
$\varepsilon_{i,t}$ is the random error term
$RISK_{i,t}$ denotes risk as measured by credit loss ratio for bank $_i$ at time $_t$
$CAR_{i,t}$ denotes capital as measured by total capital adequacy ratio for bank $_i$ at time $_t$
$EFF_{i,t}$ denotes efficiency as measured by cost-to-income ratio for bank $_i$ at time $_t$
$SIZE_{i,t}$ denotes total assets for bank $_i$ at time $_t$
$NLTA_{i,t}$ denotes net loans to total assets for bank $_i$ at time $_t$
$ROA_{i,t}$ denotes return on assets for bank $_i$ at time $_t$
$LTD_{i,}$ denotes loans to deposits ratio for bank $_i$ at time $_t$

### 3.6 Independent/Explained Variables

This section explains the independent bank-specific variables that the study theorizes pertaining bank risk taking, capital and efficiency. These are total assets (SIZE), return

on assets (ROA), net loans to total assets (NLTA) and loans to deposits ratio (LTD). The subscript $_i$ is the bank dimension whereas the subscript $_t$ is the time dimension.

In general, for each one of the three econometric models, it is theorized that the size of banks has a significant bearing on the association between bank risk taking, capital and efficiency. Because big banks have easier access to borrowings and can easily command deposits, they can manage to operate with minimal capital levels (Deelchand & Padgett, 2009).

Each econometric equation includes a random error (disturbance) term, denoted by $\varepsilon_{i,t}$ to account for the fact that models cannot perfectly fit the data. Statistically, a model without a disturbance term ($y = \alpha + \beta x$) is an exact one: it assumes a perfect fit with the data. Under such an assumption, it is almost always possible to estimate with certainty the value of the explained variable $y$, if, given a value of $x$, the values of $\alpha$ and $\beta$ can be calculated. Practically, this assumption is not realistic. Firstly, it is almost always impossible to include all determinants of $y$ in a model. This could be because some determinants of $y$ are not observable or measurable; or because the determinants are too many to include in a single model. Still more, there could be inherent random outside influences or errors in the way $y$ is measured which cannot be captured in a model nor forecast reliably (Brooks, 2008).

### 3.6.1 Bank Risk Taking Model

Equation (1) explains risk taking ($RISK_{i,t}$) as the dependent variable. It tests if capital adequacy and operating efficiency changes precede variations in bank risk taking.

$$RISK_{i,t} = \alpha_0 + \alpha_1 CAR_{i,t} + \alpha_2 EFF_{i,t} + \alpha_3 SIZE_{i,t} + \alpha_4 NLTA_{i,t} + \varepsilon_{i,t} \quad (1)$$

Apart from $SIZE_{i,t}$, which is explained above, the equation includes net loans to total assets ($NLTA_{i,t}$) as an additional independent variable. Loan growth in the banking industry has equivalent importance as revenue growth in the industrial sector. NLTA captures net lending of the bank. In general, excessive growth of a bank's loan book increases bank risk taking and negatively capital and operating efficiency.

### 3.6.2 Capital Adequacy Model

In Equation (2) bank capital adequacy ($CAR_{i,t}$) is the dependent variable. The equation considers whether risk and efficiency precede variations in bank capital.

$$CAR_{i,t} = \beta_0 + \beta_1 RISK_{i,t} + \beta_2 EFF_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 ROA_{i,t} + \varepsilon_{i,t} \quad (2)$$

The model also controls for the profitability of banks because a bank's capitalization to some extent is dependent on its performance. Thus, apart from $SIZE_{i,t}$, explained above, the research includes return on assets (ROA) to explain capital. Return on assets is an asset transformation measure: it measures the revenue generated by each unit of capital/asset (Deelchand & Padgett, 2009). Given the fact that many firms, banks included, use retained earnings to boost their capital positions, and retained earnings are a product of profitability, capitalization must be positively related to profitability.

The rationale for choosing ROA and not ROE to control for the sampled banks' profitability is that although ROE accurately and consistently reveals a firm's true profitability, its computation disregards financial risk. In a bank, financial risk arises from high leverage which gives managers incentives to become aggressive in chasing profitability in order to pay off the bank's liability costs. Since the formula for ROE does not factor in leverage, ROE does not identify any risk from financial leverage whereas ROA does.

### 3.6.3 Operating Efficiency Model

Equation (3) examines the determinants of bank efficiency, the dependent variable. The equation examines whether levels of capital together with bank risk reflect the changes in bank operating efficiency.

$$EFF_{i,t} = \gamma_0 + \gamma_1 CAR_{i,t} + \gamma_2 RISK_{i,t} + \gamma_3 SIZE_{i,t} + \gamma_4 LTD_{i,t} + \varepsilon_{i,t} \quad (3)$$

Loans to deposits ration ($LTD_{i,t}$) is the independent variable in the Efficiency equation apart from $SIZE_{i,t}$ which is already explained above. LTD addresses the proportion of liabilities which have been transformed into assets. The outcome has a direct bearing on liquidity risk, capital adequacy and operating efficiency. If the ratio is greater than 1,

the bank funded its assets with more borrowings than deposits. If the ratio is too high, in the event of any unforeseen funding requirements or economic crises, the bank might face liquidity risks. If the ratio is lower than 1, the bank funded its assets using deposits as compared to borrowings. Too low a ratio means that the bank is underutilizing its liability holdings thereby underachieving in terms of returns (Mishkin & Eakins, 2012).

## 3.7 Summary

This chapter presented the methodology behind the research. Specifically, it presented research design, sampling, the dependent and independent variables and the econometric models that are theorized to explain the relationship between bank risk taking, capital adequacy and operating efficiency. There are two angles to bank risk taking, capital adequacy and operating efficiency. One treats risk, capital and efficiency as exogenous factors in order to analyze their determinants, the independent variables. The other treats risk, capital and efficiency as endogenous factors in order to analyze their contributions/interplay with each other. The relationship between risk, capital and efficiency is modeled in a simultaneous equation framework because of the two-way interplay amongst the variables.

# CHAPTER 4

# ANALYSIS OF RESEARCH RESULTS

## 4.1 Introduction

This chapter presents and analyses the research findings.

## 4.2 Descriptive Statistics

Table 1.1 tabulates the mean, standard deviation, skewness, kurtosis, and Jarque-Bera statistics for bank risk taking (RISK) as measured by credit loss ratio in %); for capital adequacy (CAR) as measured by total capital adequacy ratio in %); for efficiency (EFF) as measured by cost-to-income ratio in %); for total assets (SIZE) in Rm; for net loans to total assets ratio (NLTA) in %; for return on assets (ROA) in %; and for loans to deposits ratio (LTD) in %) for the sample data for the period under study.

| | RISK | CAR | EFF | SIZE | ROA | NLTA | LTD |
|---|---|---|---|---|---|---|---|
| Mean | 1.045500 | 14.10675 | 56.05500 | 787038.4 | 1.566250 | 61.94750 | 88.92750 |
| Std. Dev. | 0.497336 | 1.418188 | 5.824614 | 347571.5 | 0.559719 | 14.93178 | 9.326856 |
| Skewness | 0.333051 | 0.122480 | 1.065323 | 1.052122 | 0.669017 | -0.273438 | -1.309573 |
| Kurtosis | 2.084693 | 2.300855 | 5.278135 | 3.410600 | 3.270664 | 2.065988 | 4.340128 |
| Jarque-Bera | 2.135797 | 0.914682 | 16.21592 | 7.660726 | 3.105987 | 1.952417 | 14.42646 |

**Table 1.1:** Descriptive Statistics

In the descriptive statistics above, risk, capital adequacy, efficiency, size and return on assets report positive skewness that is long right tailed distributions. Net loans to total assets and loans to deposits ratio report negative skewness, that is, long left tailed distribution. Kurtosis for efficiency, size, return on assets and loans to deposits ratio as exceeds 3 which means peaked distributions relative to the normal. Kurtosis for risk, capital adequacy, net loans to total assets ratio is less than 3 which means flat distribution relative to the normal. The above findings coupled indicate that the sample data is not matching a normal distribution. The sample data points more to a *t*-distribution of the variables with fatter tails and smaller peaks at the mean.

In the pages that follow, the descriptive statistics are presented graphically for each sampled bank for the period under study (2004 – 2013). In addition, secondary data on the same variables collected from South African Reserve Bank publications for the sampled banks is also presented for the years 2012 - 2013.

### 4.2.1. Capital Adequacy

Figure 1.1 shows the trend for capital adequacy ratio (in %) for the sampled banks for the period under study.

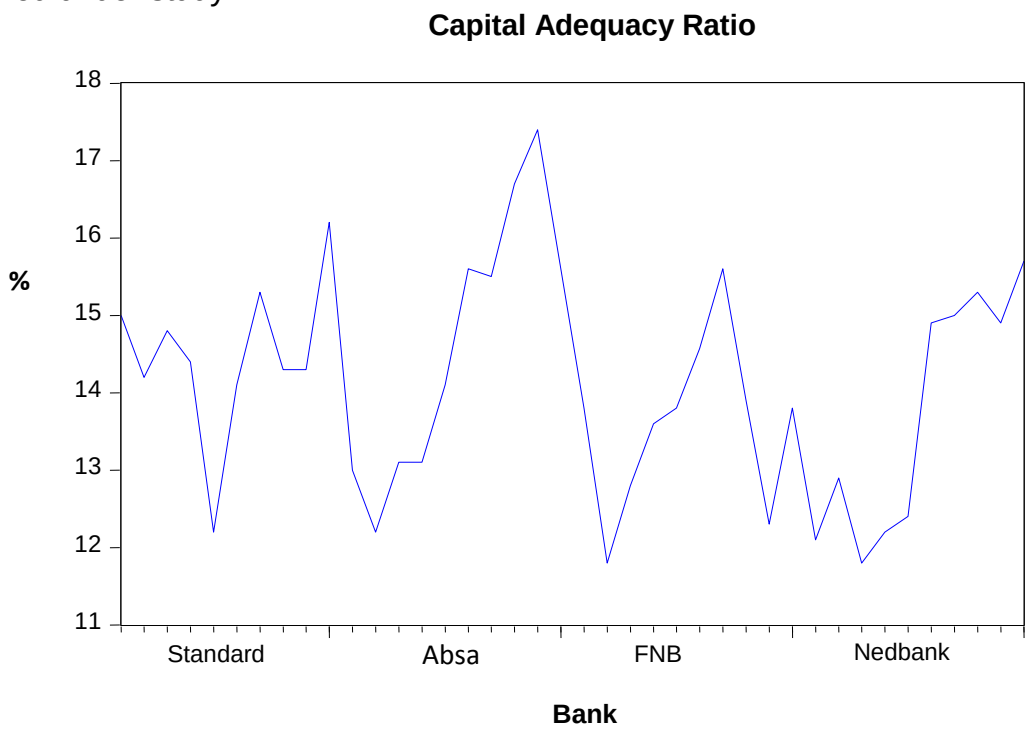



**Figure 1.1: Capital Adequacy Ratio (in %)**

In addition, secondary data as reported by the SARB (2013) indicates that as of December 2013, despite implementation of Basel III higher capital requirements from January 2013, the banking sector continued to be adequately capitalized at 15.6%. The sector achieved 11.8% for Tier I capital adequacy as at 31 December 2013, with common equity capital and reserves on average accounting for 75.2% of total regulatory capital and reserves. The financial leverage multiple of the banking sector declined marginally during 2013, amounting to 13.2 times as at 31 December 2013 compared with 13.3 times as at 31 December 2012.

### 4.2.2 Assets

Figure 1.2 shows the trend for assets in million South African Rands for the sampled banks for the period under study.

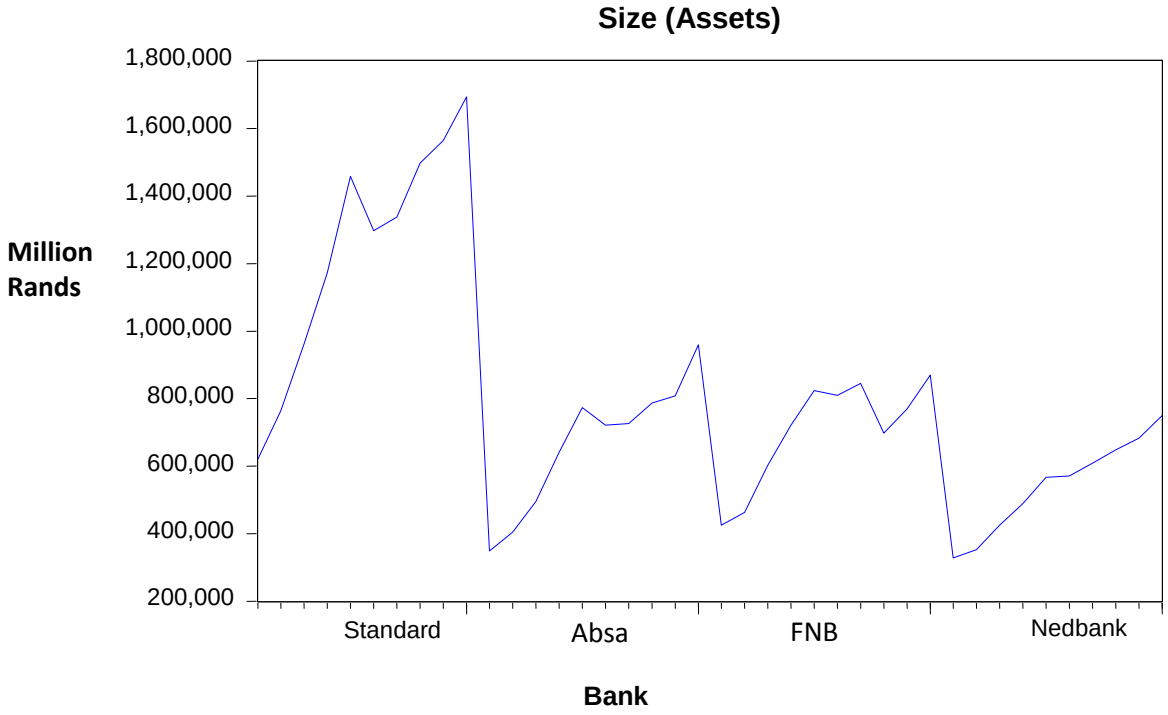



**Figure 1.2: Assets**

In addition, secondary data as reported by the SARB (2013) indicates that as of December 2013, assets in the entire banking industry totaled R3.8 trillion representing an increase of 5.2% from R3.7 trillion in December 2012. Total banking sector assets rose by 4.3% from about R3.8 trillion in December 2013 to R4.0 trillion in July 2014. Like the year before, as of mid 2014, home loans constituted a lion's share of gross loans and advances at 27.2%, followed by term loans at 20.1%; lease and installment creditors at 10.9% and commercial mortgages at 8.8%.

According to SARB (2013), 76.6% of the whole banking industry assets constituted of gross loans and advances, which, as of December 2013, amounted to R2.9 trillion, an increase of almost 8% from R2.7 trillion in December 2012. The increase originated mainly from increases in lease and installment debtors, foreign currency-denominated loans and specialized lending. Off-balance-sheet items increased from R1 trillion mid 2013 to R1.1 mid 2014 whereas impaired advances in general declined by 2.7% to

R108.3 billion as at end December 2013. Specific impairments rose to 45.7% in December 2013 from 40.3% in December 2012.

Figure 1.3 shows the average credit loss ratio for the sampled banks for the period under study.

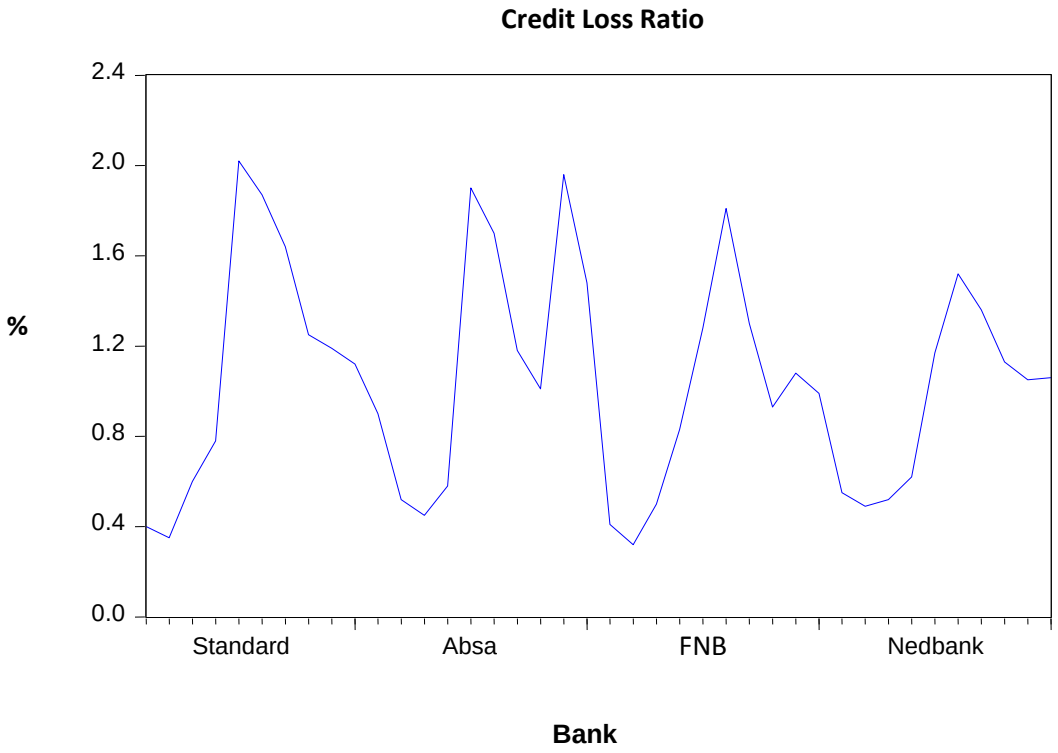



**Figure 1.3: Credit Loss Ratio (in %)**

### 4.2.3 Total Liabilities

Secondary data as reported by the SARB (2013) indicates that as of December 2013, deposits in the entire banking industry constituted 87.6% of liabilities slightly higher from 85.5% in 2012. The liabilities were made up as follows: 29.7% of time deposits, 20.4% in current account deposits, 17.2% in call deposits, 12% in negotiable certificates and other deposits constituted 12.4%.

In terms of customer segmentation, corporate and retail customers accounted for the most deposits at 45.2% and 22.6% respectively; deposits from banks averaged 9.8%; security firms deposits averaged 7.3%, public sector deposits averaged 6.8%, and sovereign deposits averaged 5.0% of total deposits in the entire banking industry.

Figure 1.4 shows the trend for total liabilities in million South African Rands for the sampled banks for the period under study.

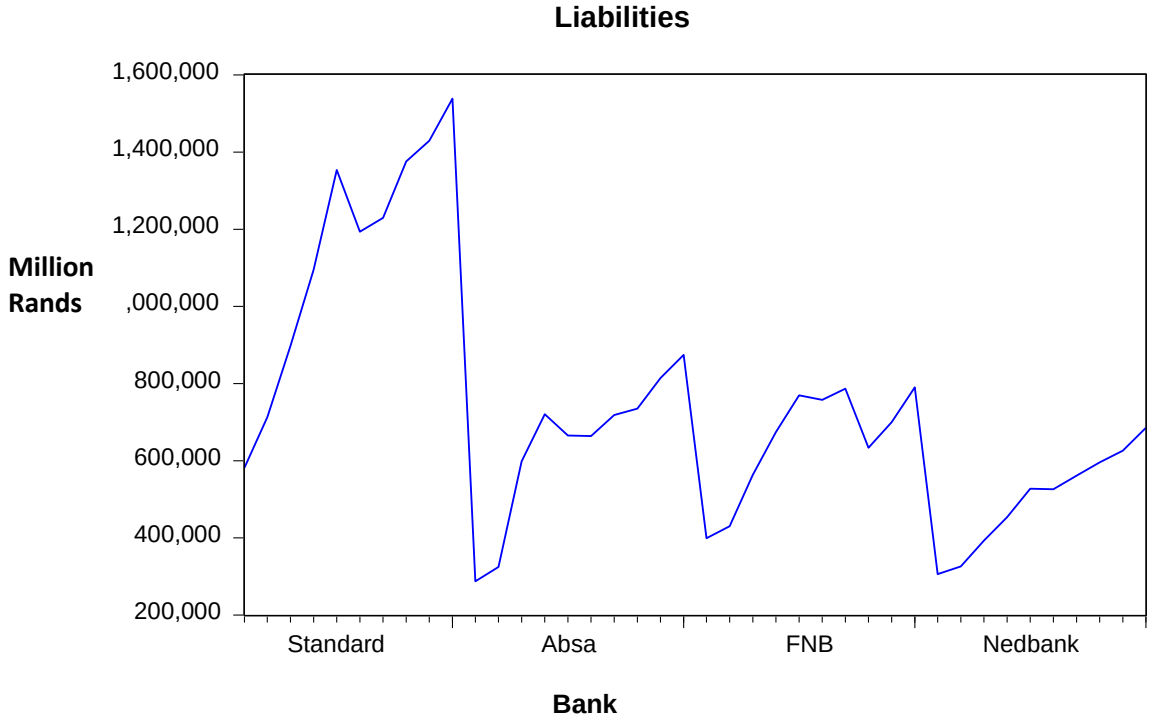



**Figure 1.4: Total Liabilities (in million South African Rands)**

Figure 1.5 shows the trend for loans to deposits ratio (in %) for the sampled banks for the period under study.

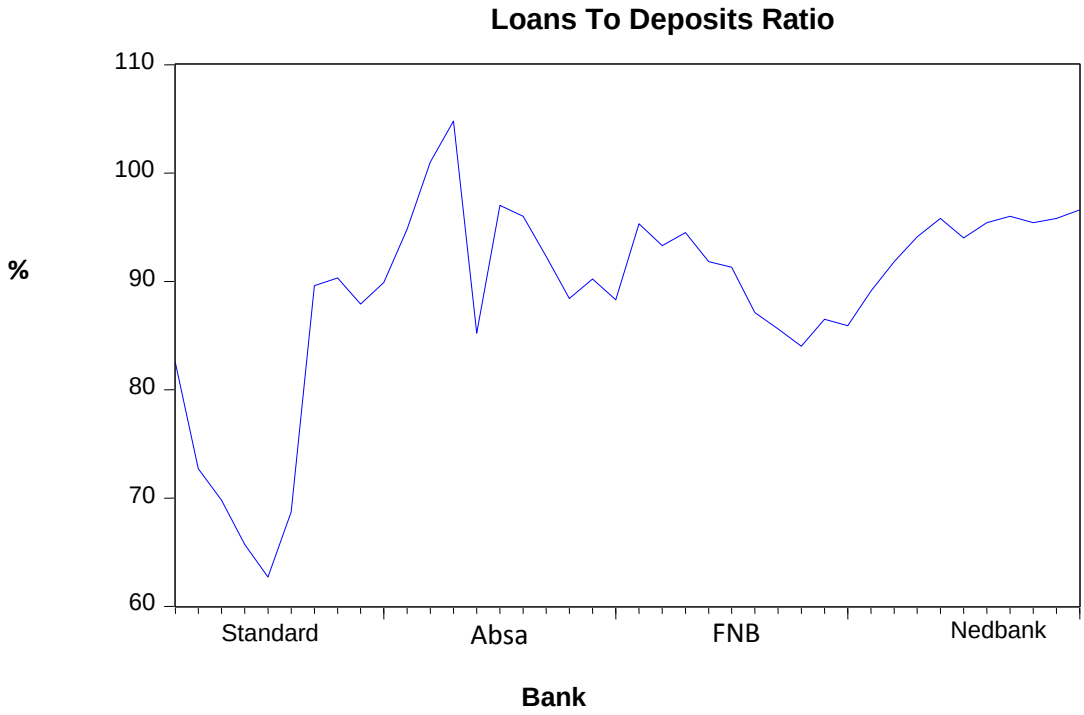



**Figure 1.5: Loans To Deposits Ratio (in %)**

Figure 1.6 shows the trend for loans to deposits ratio (in %) for the sampled banks for the period under study.

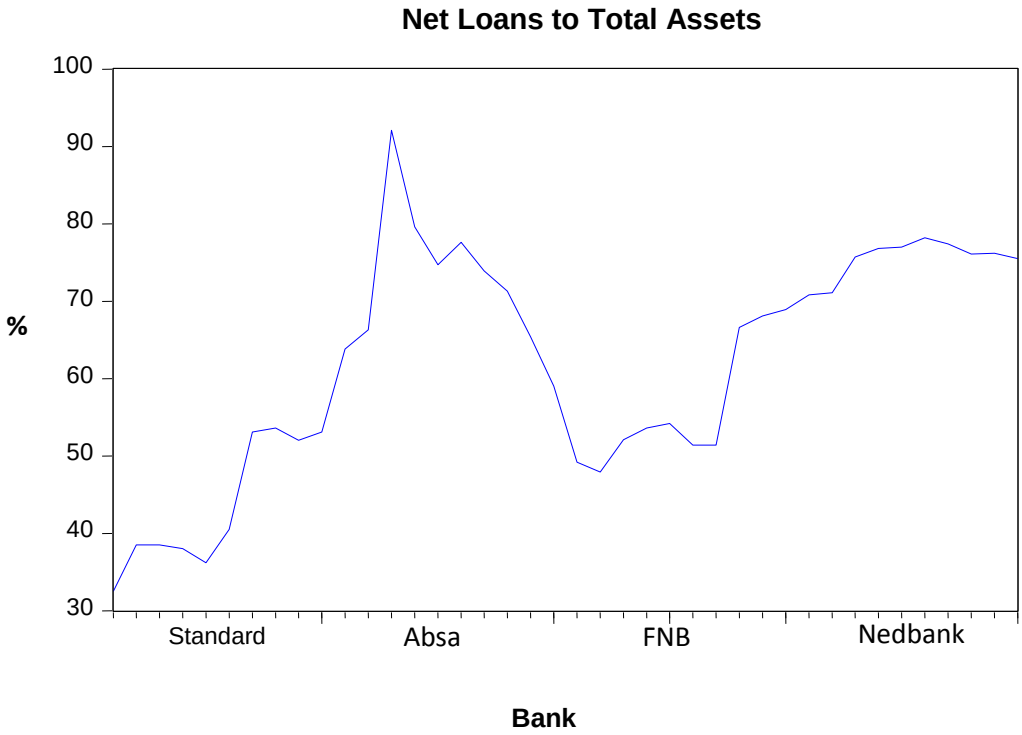



**Figure 1.6: Net Loans to Total Assets (in %)**

### 4.2.4 Profitability

Secondary data as reported by the SARB (2013) indicates that efficiency in the whole banking industry went down as the cost-to-income ratio rose from 52.22% mid 2013 to 54.94% mid 2014. This arose from increases in operating expenses from 106.62% mid 2013 to 120.29% mid 2014. Secondary data as reported by the SARB (2013) indicates that return on assets went down from 1.22% mid 2013 to 0.97% mid 2014. Likewise, return on equity went down from 16.41% mid 2013 to 13.06% mid 2014.

Figure 1.7 shows the trend for cost to income ratio (in %) for the sampled banks for the period under study.

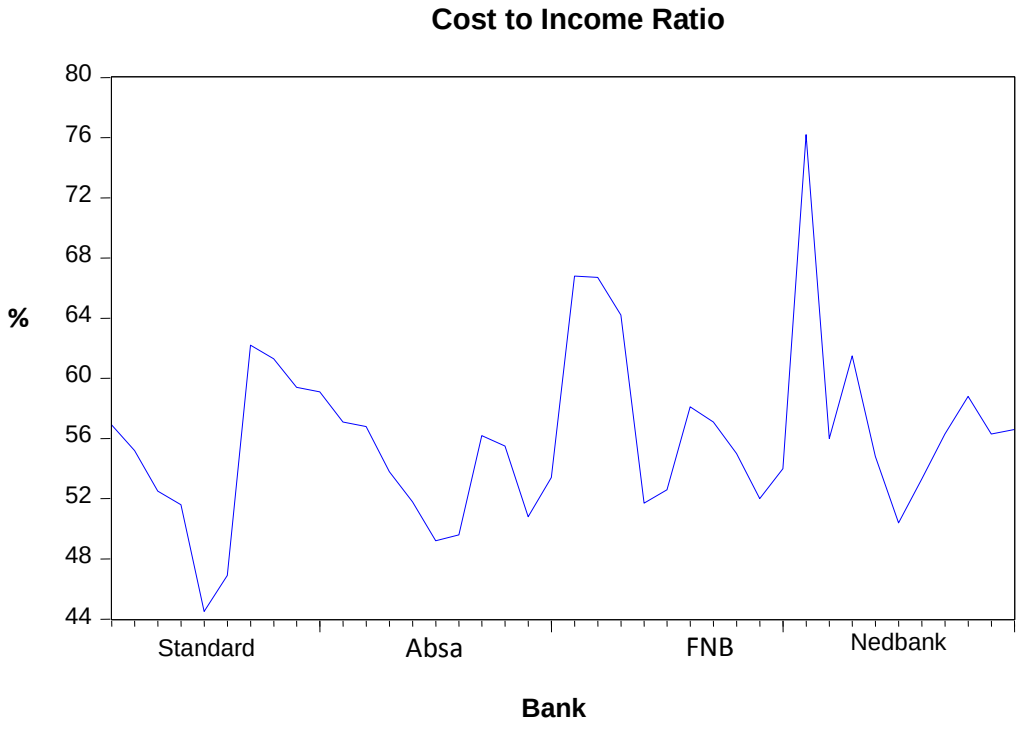



**Figure 1.7: Cost To Income (%)**

Figure 1.8 below shows the trend for return on assets for the sampled banks for the period under study.

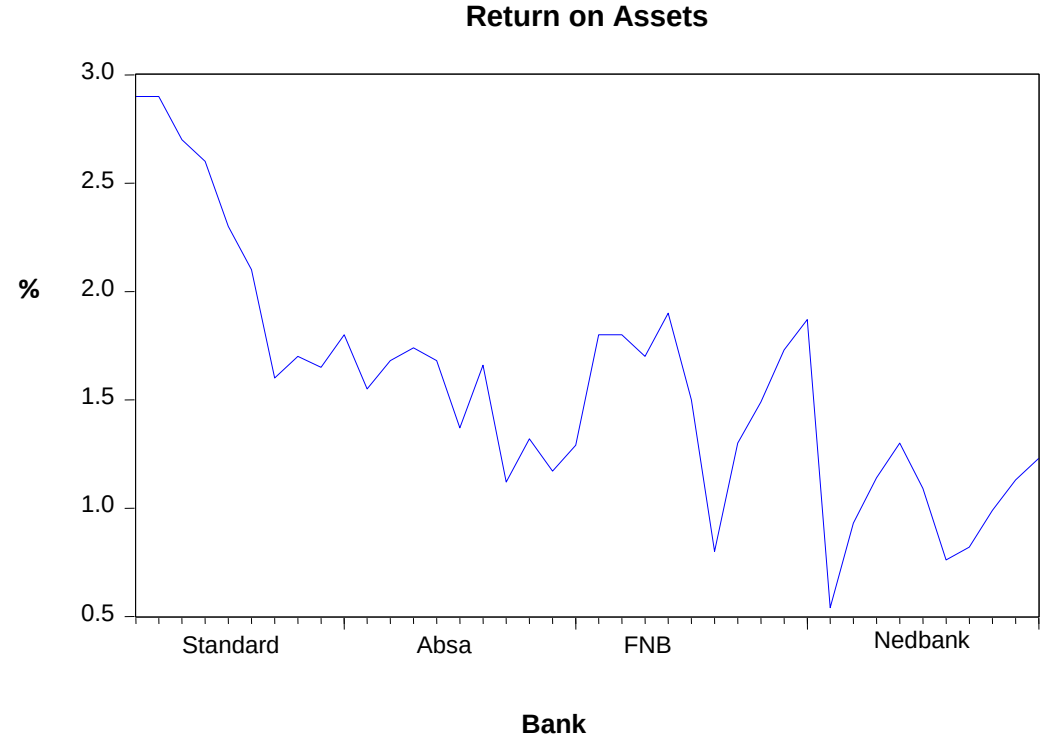



**Figure 1.8: Return On Assets (%)**

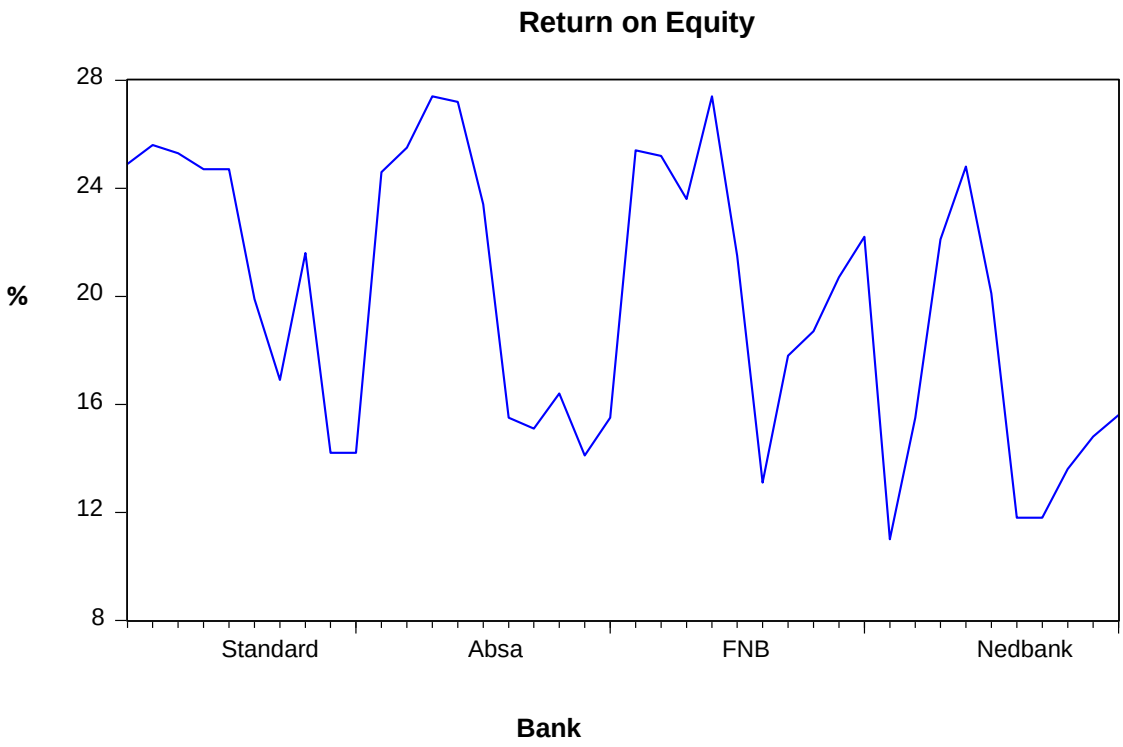



**Figure 1.9: Return On Equity (%)**

### 4.2.5 Correlation Matrix

According to Brooks (2009), correlation between two variables refers to linear association (not causality) between them. Variables which are correlated with each other move in a completely symmetrical way in relation to each other. The association is given by the correlation coefficient where + and – mean positive and negative linear correlations. Below is the correlation matrix for the variables under study.

| | CAR | EFF | LTD | NLTA | RISK | ROA | ROE | SIZE |
|---|---|---|---|---|---|---|---|---|
| CAR | 1.000000 | -0.176337 | -0.039882 | -0.047923 | 0.457747 | -0.050258 | -0.525685 | 0.378267 |
| EFF | -0.176337 | 1.000000 | 0.341928 | -0.012410 | -0.484109 | -0.277223 | -0.192400 | -0.253106 |
| LTD | -0.039882 | 0.341928 | 1.000000 | 0.725465 | -0.144585 | -0.626130 | -0.196091 | -0.516304 |
| NLTA | -0.047923 | -0.012410 | 0.725465 | 1.000000 | 0.003172 | -0.704763 | -0.300471 | -0.491238 |
| RISK | 0.457747 | -0.484109 | -0.144585 | 0.003172 | 1.000000 | -0.263189 | -0.479532 | 0.507788 |
| ROA | -0.050258 | -0.277223 | -0.626130 | -0.704763 | -0.263189 | 1.000000 | 0.687353 | 0.353388 |
| ROE | -0.525685 | -0.192400 | -0.196091 | -0.300471 | -0.479532 | 0.687353 | 1.000000 | -0.131928 |
| SIZE | 0.378267 | -0.253106 | -0.516304 | -0.491238 | 0.507788 | 0.353388 | -0.131928 | 1.000000 |

**Table 1.2:** Correlation Matrix

The correlation matrix depicts semi strong linear associations between risk taking, capital and operating efficiency as well as between capital and operating efficiency. The matrix does not therefore improve the study's ability to predict the relationship between bank risk taking, capital and operating efficiency. As indicated in the matrix, efficiency is weakly negatively related to capital, risk as well as return on assets. This means that as capital, risk and return on assets increase, efficiency decreases. There is semi strong positive correlation between risk and capital. This means that as capital increases so does bank risk taking. Return on assets is weakly negatively related to capital and risk. Size is semi strongly positively related to capital and risk. Size is also negatively related semi strongly to efficiency. Net loans to total assets ratio is weakly positively related to risk. It is also weakly negatively related to capital and efficiency. Loans to deposits ratio is weakly negatively related to risk, capital and semi strongly positively related to efficiency.

### 4.3 Regression Output

This section presents the regression output in respect of the relationship between bank risk taking, capital adequacy and operating efficiency.

The $R^2$ statistic in each regression output measures how well the proposed regression model (containing the explanatory variables) actually fits the data or how well it actually explains variations in the dependent variable. The standard error indicates sampling variability of the regression (Brooks, 2008). While the *t*-test tests single hypotheses involving only one coefficient, the F statistic tests more than one coefficient simultaneously. The significance of the F statistic produced by the regression indicates that there is a relationship between the dependent and the set of independent variables. The *p*-value attached to the test statistic dictates whether this null hypothesis should be rejected or not (Koop, 2009).

#### 4.3.1 Bank Risk Taking Model

Table 1.3 summarizes the regression results for the risk equation. The output shows an $R^2$ of 0.35 meaning the model fits the data marginally. The standard deviation at 37.97

indicates marginal precision of the regression parameters. The F statistic at 4.56 rejects the null hypothesis that all of the coefficients except the intercept coefficient are zero. At the 0.001 significance, p-value also significantly dictates the null hypothesis rejection.

$$RISK_{i,t} = \alpha_0 + \alpha_1 CAR_{i,t} + \alpha_2 EFF_{i,t} + \alpha_3 SIZE_{i,t} + \alpha_4 NLTA_{i,t} + \varepsilon_{i,t} \quad (1)$$

| Variable | Coefficient | Standard Error | t-test Statistic | Probability |
|---|---|---|---|---|
| Constant | 2.875308 | 6.216900 | 0.462499 | 0.6467 |
| CAR | 0.637753 | 0.733140 | 0.869893 | 0.3905 |
| EFF | -1.458624 | 0.579367 | -2.517617 | 0.0167 |
| SIZE | 0.312717 | 0.211536 | 1.478314 | 0.1485 |
| NLTA | 0.288150 | 0.600890 | -0.479540 | 0.6346 |
| $R^2$ | 0.349822 | | | |
| Standard Error | 37.95546 | | | |
| F statistic | 4.573333 | | | |

**Table 1.3:** Bank Risk Taking as the dependent variable

The results show a weak positive relationship between capital adequacy and risk: that is, no evidence of the 'regulatory hypothesis' that regulators' actions drive banks to hold capital based on the levels of risk that the bank is underwriting. The only statistically significant relationship is the inverse relationship between efficiency and risk, that is, decreases in efficiency lead to increases in bank risk taking behavior.

The finding that efficiency is negatively related to bank risk taking agrees with the hypothesis that bank risk taking is more pronounced in inefficient banks compared to efficient ones. In line with Kwan and Eisenbeis (1997), Berger and De Young (1997), Williams (2004) and Fiordelisi, et al., (2011), these results support the moral hazard hypothesis: that bank managers engage in more risk taking when banks are less efficient. The results also support the "bad management" hypothesis: that declines in efficiency lead to increases in banks' risk due to the chain effect of inefficiency on the bank's risk management functions.

### 4.3.2 Capital Adequacy Model

Table 1.4 reports the results for Equation (2) where the dependent variable is capital. The output shows an $R^2$ of 0.22 meaning the model fits the data only marginally. The standard deviation at 8.82 indicates high precision of the regression parameters. The F statistic at 2.42 rejects the null hypothesis that all of the coefficients except the intercept coefficient are zero meaning that there the independent and dependent variables are related. At the 0.001 significance, p-value also significantly dictates the null hypothesis rejection.

$$CAR_{i,t} = \beta_0 + \beta_1 RISK_{i,t} + \beta_2 EFF_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 ROA_{i,t} + \varepsilon_{i,t} \quad (2)$$

| Variable | Coefficient | Standard Error | t-test Statistic | Probability |
|---|---|---|---|---|
| Constant | 0.023933 | 1.419213 | 0.016863 | 0.9866 |
| RISK | 0.048358 | 0.053445 | 0.904806 | 0.3719 |
| EFF | 0.179252 | 0.207656 | 0.863219 | 0.3941 |
| SIZE | 0.103568 | 0.051340 | 2.017318 | 0.0516 |
| ROA | 0.034433 | 0.077392 | 0.444911 | 0.6592 |
| $R^2$ | 0.222284 | | | |
| Standard Error | 8.825378 | | | |
| F statistic | 2.429442 | | | |

**Table 1.4:** Capital Adequacy as the dependent variable

The regression results show weak relationships between capital on the one hand and risk taking and operating efficiency on the other hand. The results do not therefore provide evidence of the existence of a relationship between capital and bank risk taking and operating efficiency. The regression results also show a weak positive relationship between size and capital; and return on assets and capital.

### 4.3.3 Operating Efficiency Model

Table 1.5 reports the results for the efficiency equation (Equation (3)) where efficiency is the dependent variable. The output shows an $R^2$ of 0.34 meaning the model fits the data marginally. The standard deviation at 9.96 indicates high precision of the regression parameters. The F statistic at 4.38 rejects the null hypothesis that all of the coefficients

except the intercept coefficient are zero. At the 0.001 significance, p-value also significantly dictates the null hypothesis rejection.

$$EFF_{i,t} = \gamma_0 + \gamma_1 CAR_{i,t} + \gamma_2 RISK_{i,t} + \gamma_3 SIZE_{i,t} + \gamma_4 LTD_{i,t} + \varepsilon_{i,t} \quad (3)$$

| Variable | Coefficient | Standard Error | t-test Statistic | Probability |
|---|---|---|---|---|
| Constant | 0.104908 | 1.600929 | 0.065529 | 0.9481 |
| CAR | 0.062775 | 0.199505 | 0.314656 | 0.7549 |
| RISK | -0.104414 | 0.041253 | -2.531067 | 0.0162 |
| SIZE | -0.053255 | 0.058161 | -0.915662 | 0.3663 |
| LTD | 0.397946 | 0.246727 | 1.612903 | 0.1160 |
| $R^2$ | 0.340341 | | | |
| Standard Error | 9.958762 | | | |
| F statistic | 4.385437 | | | |

**Table 1.5:** Operating Efficiency as the dependent variable

The regression results show that bank risk taking is negatively and significantly related to efficiency: that is, decreases in efficiency lead to increases in bank risk taking behavior. This agrees with the hypothesis that inefficient banks underwrite more risk compared to efficient ones. In line with Kwan and Eisenbeis (1997), Berger and De Young (1997), Williams (2004) and Fiordelisi, et al., (2011), these results support the moral hazard hypothesis and the "bad management" hypothesis.

In addition, they show that size is negatively related to efficiency; meaning that big banks achieve lower efficiencies compared to small banks. This could be attributed to core rigidities (for instance in implementing much stricter policies) or higher operational costs or inefficiencies that accompany big organizations as opposed to lean and nimble organizations.

The results show a weak positive between the loans to deposit ratio and efficiency which means that conversion of deposits into loans speaks into greater efficiency in transforming assets into liabilities. In other words, too low a ratio means that the bank is underutilizing its liability holdings thereby underachieving in terms of returns (Mishkin & Eakins, 2012).

## 4.4 Summary

This chapter presented and analyzed the research results. The research used a panel data set of top 4 South African banks for the period 2004 to 2013. Data was collected from the banks' balance sheets and income statements to construct standard accounting measures of bank risk taking, capital adequacy and operating efficiency which were regressed using simultaneous equations in EViews. Taking into account both the correlation matrix and the regression output, the results show no evidence of relationships between bank risk taking and capital. The only significant relationship is the inverse relationship between risk taking and efficiency which support the moral hazard and the "bad management" hypotheses and is consistent with previous studies.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Introduction

This chapter summarises the research report and presents both the recommendations and limitations of the study.

## 5.2 Summary Of The Research Report

This research studied the relationship between risk, capital and efficiency in South African banks between 2004 and 2013. It adopted a simultaneous equation model in which risk, capital and efficiency are modelled as dependent variables. The R2 statistic for all the econometric models shows that the models marginally fit the data.

The regression results do not provide evidence of any relationship between risk taking and capital. The only significant relationship is the inverse relationship between risk taking and efficiency. This supports the view that compared to efficient banks, inefficient ones underwrite more risk taking. These results support the moral hazard hypothesis which posits that faced with greater inefficiencies, banks undertake more risk taking; and the “bad management” hypothesis which states declines in efficiency lead to increased risk taking.

The regression results also do not provide evidence of a relationship between capital and efficiency: implying that capital and efficiency are not simultaneously determined. However, this sharply counters the correlation matrix result that efficiency is weakly negatively related to capital, as well as the regression result that size is negatively related to efficiency; suggesting that bigger banks tend to be less efficient. This could be attributed to core rigidities (for instance in organizational capability) or higher operational costs that accompany large banks as opposed to lean and nimble banks.

## 5.3 Recommendations

Banks face risk losses and business challenges such as lower demand in credit, increased funding costs and lower income fees among others. Improving capital adequacy and operating efficiency by investing in technology, leveraging on digital channels and market development are opportunities which banks can grab to mitigate the risks and business challenges. The results in this study oblige management and regulators to pay much attention to operating efficiency as a driver of bank risk taking.

## 5.4 Limitations Of The Study

In discussing limitations of a research work, the measuring instrument that was used in a study is the first point of reflection (Brooks, 2008). Previous studies on the relationship between risk, capital and operating efficiency measure operating efficiency in terms of industry best practice. Banks then assess their efficiency levels in terms of how farther away they lie from the best industry efficiency frontier. This study used cost-to-income ratios as provided in banks' balance sheets and income statements. While the cost-to-income ratios are valid and reliable, the data envelopment analysis and stochastic frontier analysis are more sophisticated and statistical techniques.

The second limitation of the study is that the study sampled 4 of the 17 registered banks in South Africa. The sampled banks operate franchises across emerging markets in Africa. The results presented in their annual reports therefore are group operations results not South African operations results. This means that the findings are more amenable to emerging markets in general than specific to South Africa.

The third limitation of the study is that the study used credit loss ratios as a proxy for bank risks. A more extensive measure of banks risks incorporating several major bank risks (market risk, credit risk and operational risk) would enhance the generalizability of the findings.

The final limitation is that the period under study includes the 2008 credit crunch when financial markets experienced abnormal credit risk losses. The credit crisis therefore

introduces parameter instability into the study: the credit crisis itself being the structural break or change point. According to Hansen (1992), parameter stability is necessary for prediction and econometric inferences. Where variables, parameters or models change over a sample period, it becomes difficult to interpret regression results. The study did not run any tests of parameter stability to detect instability in the regression.

Any further studies should consider and build upon these limitations.

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