The relationship between interest rates, credit risk and profitability of commercial banks in South Africa.

By

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Abstract

This research investigates the relationship between interest rates, credit risk, and profitability of commercial banks in South Africa over a 20-year period from 2002 to 2022. The study focuses on seven listed commercial banks, utilising secondary data and employing panel data analysis with Feasible Generalised Least Squares (FGLS) regression to correct for heteroskedasticity and autocorrelation. The objectives were to examine the effects of interest rates on credit risk and profitability, as well as the effect of credit risk on profitability. The findings reveal a non-linear relationship between interest rates and credit risk, with regression analysis showing an insignificant relationship. This suggests that interest rate changes may not significantly influence credit risk. Bank-specific factors such as size and capital adequacy were found to strongly influence credit risk. Regarding interest rates' effect on profitability, a weak positive linear relationship was observed, but regression analysis indicated an insignificant relationship. Credit risk was found to have a significant positive impact on profitability at the 1% significance level, highlighting its importance for bank profitability.

Overall, the study concludes that bank-specific factors play a pivotal role in credit risk and profitability, emphasising the need for banks to focus on these factors for effective risk management and profitability enhancement. The positive correlation between profitability and economic growth suggests that South African banks are more profitable under favourable economic conditions. The study's contribution lies in providing empirical evidence and insights to aid banks in developing strategies to navigate interest rate environments and enhance financial stability, as well as assisting policymakers, including the South African Reserve Bank, in monetary policy execution.

Keywords: Interest Rates, Credit Risk, Profitability, South African Banks, South African Reserve Bank, FGLS Regression

DECLARATION

I, …Thembelihle…Nyeleti…Lulu…Shabangu., declare that the research work reported in this dissertation is my own, except where otherwise indicated and acknowledged. It is submitted for the degree of Master of Management in Finance and Investment at the University of the Witwatersrand, Johannesburg. This thesis has not, either in whole or in part, been submitted for a degree or diploma to any other universities.

Signature:…  ……...……

Date: …29…February…2024……..

DEDICATION

I dedicate this research to my son, Mukonazwothe Zwivhuya Emmanuel Magalela, whose unwavering love and inspiration kept me motivated throughout this journey. To my mother, Mrs Hlamalani Shabangu, for her endless support, encouragement and belief in my abilities. I also dedicate this work to my family, friends and colleagues who have been pillars of strength and support in my life. Special thanks to my supervisor, Dr Chengete Chakamera, for his guidance, patience, and invaluable mentorship. This research is dedicated to everyone who has played a significant role in my life.

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Chapter One: Introduction

1.1 Introduction

Banks play a crucial role in the development and stability of the economy (Demirgüç-Kunt & Huizinga,1999). They serve as intermediaries, allowing savers to deposit their money and earn interest for deferring consumption, while borrowers can access funds at a certain cost (the lending interest rate) for immediate consumption (Kana, 2017). However, due to certain underlying factors such as inflation, monetary policy and unemployment, interest rates are subject to changes that can affect the credit risk and profitability of banks. Interest rates may affect the profitability of banks by influencing the cost of borrowing and the ability of borrowers to repay their loans.

Kutum (2017) highlighted a report by The Basel Committee on Banking Supervision in 2016, indicating that banks operating in economies with macroeconomic issues are more vulnerable to high credit risk. This underscores the importance of studying the relationship between interest rates, credit risk and profitability of commercial banks. This study will focus on the context of South Africa.

1.2 Background of the Research

Over the past four years, South Africa has undergone significant interest rate fluctuations since the global financial crisis, primarily due to macroeconomic challenges such as high inflation, which have adversely impacted the economy. Since the implementation of inflation targeting in February 2000, the repo rate reached its lowest point of 3,5% in July 2020 to alleviate the harsh conditions caused by the Covid-19 pandemic. Currently, it stands at its highest level of 8,25% since the end of the financial crisis in 2009 (Refer to Figure 1).

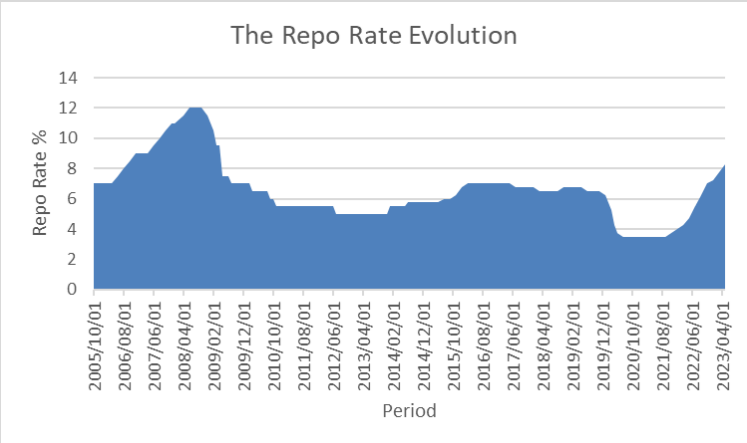

Figure 1: The Repo Rate Evolution (Source: SARB)

Interest rate, as defined by Faure (2014), is the compensation paid by a borrower to a lender for the use of money over a specified period, which is also referred to as the price of money. In South Africa, interest rates are influenced by the monetary policy tool of the South African Reserve Bank (SARB), known as the repo rate. The repo rate is the interest rate at which banks borrow funds from the Reserve Bank (Greenwood-Nimmo, Steenkamp, & van Jaarsveld, 2022). The Monetary Policy Committee (MPC) convenes six times a year to determine the repo rate based on the level of inflation in the economy, aiming to manage the value of the rand and ensure financial stability in the country. This process is called inflation targeting.

Inflation, defined as an increase in the general price of goods and services in the economy (Ibrahim, 2019), is interconnected with interest rates (Wambui, 2013). When the monetary policy is implemented by increasing the repo rate, banks adjust the interest rates at which they receive deposits and lend money to borrowers (SARB, 2015).

This presents a significant challenge for borrowers with variable interest rate contracts, including home loans, instalment-sale financing, overdrafts, deposits and government bonds, which are subject to fluctuations in interest rates (SARB, 2015). Such fluctuations impact borrowers' affordability and increase the cost of borrowing (Vong & Chan, 2006; Tanasković & Jandrić, 2015; Munangi, 2020). When borrowers’ ability to repay their loans reduces due to an increase in the cost of borrowing caused by high interest rates, this can cause borrowers to default on their loan repayments, subsequently leading to an increase in credit risk for banks. Credit risk is a problem and a cost for commercial banks, as it results from non-performing loans, which are a cost for banks and therefore reduce their profitability (Khemraj & Pasha, 2013). Given the volatility of interest rates in South Africa over the past four years, there is a critical need to explore the relationship between interest rates and credit risk for banks in this context.

South Africa has the largest banking industry in Africa (Galal, 2023), which occupies 35% of the financial sector in the country (International Monetary Fund, 2022). However, banking operations inherently entail various risks, including market risk, credit risk, liquidity risk, operational risk, concentration risk and earnings risk (Sbârcea, 2017; Kutum, 2017). Among these, credit risk is of particular concern, given that banks derive a significant portion of their income from lending activities (Kutum, 2017), making them vulnerable if borrowers default on loan repayments (Munangi, 2020). Credit risk is the likelihood that a borrower will fail to fulfil their financial obligations in accordance with the agreed terms (Smit, 2003). One of the most popular methods for measuring credit risk is using the non-performing loan ratio (NPLR).

According to the SARB (2023a) financial stability review report, the banking sector's non-performing loan ratio has been increasing (Refer to Figure 2). It rose from 4,49% in April 2022 to 4,98% in April 2023, and impaired advances increased from 218,99 (Rbn) to 265,67 (Rbn) within the same period, respectively (SARB, 2023b). While it may be argued that credit risk in South African banks is relatively low and banks continue to be profitable, these trends pose long-term stability risks (Mogagabe, 2020).

The SARB (2023a) also stated that banks are granting loans at a faster rate than the gross domestic product (GDP) rate. This is another concern given the current state of the economy in South Africa, which includes slow economic growth, high interest rates, high unemployment, high inflation, and the energy crisis. If this increase in credit risk is not properly managed, it can lead to serious financial repercussions in the future that may be harmful to the financial stability of South African banks.

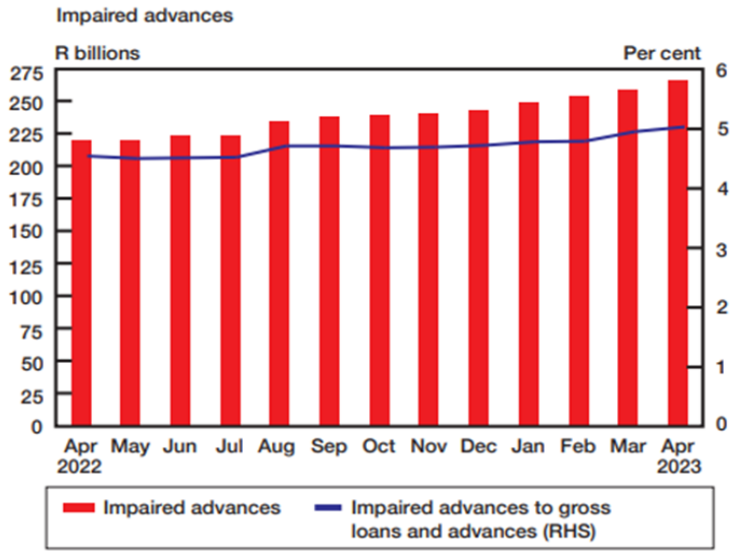

Figure 2: Impaired Advances and NPLR for the South African Banking Sector (Source: SARB, 2023)

The banking sector is a major contributor to the economy, and therefore, its success and stability contribute to the well-being and economic growth of the country (Simbanegavi, Greenberg, & Gwatidzo, 2012). For banks to ensure success and survival, they must operate efficiently by generating profits, creating wealth for their shareholders, managing risk properly, and developing strategies to protect them from the negative impacts of macroeconomic factors (Amsi, Ngare, Imo, & Gachie, 2017; Ally, 2013).

1.3 Research Problem

From the aforementioned context, it is evident that there is a compelling need to investigate the relationship between interest rates, credit risk and profitability of commercial banks in South Africa. While several studies have explored the relationship between credit risk and financial performance (Munangi, 2020), the determinants of non-performing loans and their effects on profitability (Mogagabe, 2020; Khumalo, Ferreira-Schenk, van Rensburg, & Mokatsanyane, 2021), and factors influencing bank profitability in the South African banking sector (Kana, 2017; Booyens, Nayagar, & Le Roux, 2018), there is a lack of literature investigating these three variables comprehensively, particularly within the South African context. As noted by Munangi (2020), "Exploration of the relation between interest rates and credit risk is new, however, and empirical evidence is lacking". Therefore, this study aims to address this research gap by analysing the potential interplay between interest rates, credit risk and profitability.

1.4 Motivation of the Study

The purpose of this study is to analyse the relationship between interest rates, credit risk and profitability of commercial banks in South Africa. The research aims to encourage banks to develop strategies to protect their financial stability in a highly influenced interest rate environment, where their future profits and stability are threatened by interest rate hikes and a continuous increase in credit risk, amidst an economy experiencing macroeconomic issues. Furthermore, the study will assist the SARB and other policymakers in the execution of monetary policy. Lastly, the findings of this study will help fill the research gap and contribute empirical evidence to the existing literature.

1.5 Main Research Question and Sub-Questions

Main Research Question

- What is the relationship between interest rates, credit risk and profitability of commercial banks in South Africa?

Research Sub-Questions

- What is the effect of interest rates on credit risk of banks in South Africa?
- What is the effect of interest rates on profitability of banks in South Africa?
- What is the effect of credit risk on profitability of banks in South Africa?

1.6 Research Purpose and Objectives

Research Purpose

- To determine the relationship between interest rates, credit risk and profitability of commercial banks in South Africa.

Research Objectives

- To investigate the effect of interest rates on credit risk of banks in South Africa.
- To investigate the effect of interest rates on profitability of banks in South Africa.
- To examine the effect of credit risk on profitability of banks in South Africa.

Chapter Two: Literature Review

The chapter covers the literature review conducted on the relationship between interest rates, credit risk and profitability of commercial banks. It reviews the empirical evidence from previous studies and the relevant theoretical framework for this study.

It is important to note that some of the literature refers to the influence of interest rates by central banks as monetary policy. Therefore, 'monetary policy' and 'interest rates' are used interchangeably in this section. The same applies to 'credit risk', 'default ratio', 'nonperforming loan (NPL)', 'non-performing loans (NPLs)' and 'non-performing loan ratio (NPLR)', as NPL, NPLs and NPLR are used as measures of credit risk. Additionally, literature on interest rates is categorised into high and low interest rates due to limited empirical evidence. Most previous studies focused on either a high or low interest rate environment when conducting their research.

2.1 Theoretical Framework

Inflation Targeting Framework Theory

Since its first implementation in December 1989 by the Bank of New Zealand (Sarwat, n.d.), inflation targeting has been adopted by many countries worldwide as a monetary policy framework to ensure price stability and encourage economic growth (Hammond, 2011). South Africa is among the nations that began implementing inflation targeting in February 2000 after encountering difficulties managing exchange rates (SARB, 2020). The SARB found inflation targeting to be a superior monetary policy framework compared to exchange rate targeting and money supply targeting, helping to establish accountability and transparency between policymakers and the public.

Inflation targeting is a monetary policy framework where central banks use interest rates to manage and control inflation within a specific target range (Green, 1996). In South Africa, inflation targeting has gained significance due to its history of high inflation rates and economic instability. This is supported by previous research indicating that the inflation targeting framework is often adopted by countries facing economic challenges (Romdhane, Chakroun, & Mensi, 2023).

When an economy experiences inflation above the target range, central banks may significantly increase interest rates to elevate the cost of borrowing, thereby reducing overall demand and spending (Matheson, 2019). Conversely, when inflation is below the target, central banks can stimulate economic activity by lowering the interest rate to encourage borrowing and spending. This means that changes in interest rates influenced by the inflation

targeting framework affect the cost of borrowing in the economy. According to the Canadian Investment Regulatory Organisation (CIRO), high interest rates increase the cost of borrowing, affecting borrowers' ability to repay their loans, which can lead to defaults and an increase in credit risk (Tanasković & Jandrić, 2015; Ogundipe, Akintola, & Olaoye, 2020). However, low interest rates also encourage banks' risk tolerance behaviour, potentially leading to an increase in credit risk (González-Aguado & Suarez, 2015).

Changes in interest rates driven by the inflation targeting framework can also impact bank profitability. Commercial banks serve as intermediaries between lenders and borrowers in the economy (Kana, 2017). Therefore, their primary income source comes from the difference between the interest they earn on loans and the interest they pay on deposits, known as net interest income (Mogagabe, 2020). Commercial banks' lending interest rates are influenced by the repo rate, which is the interest rate at which banks borrow reserves from the SARB (Greenwood-Nimmo et al., 2022). When interest rates increase, banks raise their lending interest rates, subsequently affecting their profits. The effect of interest rates on bank profitability can be positive or negative. It is positive if banks increase their lending rates in response to the tightening of monetary policy, and borrowers can still repay their loans, thereby allowing banks to increase their profitability (Vong & Chan, 2006). However, if the increase significantly affects borrowers' affordability to repay their loans, this can lead to defaults and subsequently reduce bank profits (Vallcorba & Delgado, 2007).

2.2 Empirical Literature Review

Credit Risk

Credit risk is a major concern within the banking industry, capable of determining a bank's sustainability and profitability when managed effectively or precipitating its failure or bankruptcy when overlooked (Munangi, 2020). It played a significant role in the 2007-2009 global financial crisis (Charles & Kenneth, 2013). Credit risk can be assessed through various measures, including non-performing loans to total loans and advances, impaired loans to gross loans, net charge-offs to total loans and advances, pre-provision profit to total loans and advances, and risk-weighted assets to total assets (Saeed & Zahid, 2016). For this study, the non-performing loans ratio will be utilised as a measure of credit risk. According to Kutum (2017), non-performing loans often constitute the primary cause of bank failures, underscoring the critical importance of effective credit risk management for both bank stability and overall economic health.

There are several determinants that influence non-performing loans, including macroeconomic factors such as interest rates, economic growth, unemployment, and inflation,

as well as bank-specific factors such as capital adequacy, return on assets, loans, and deposits (Gila-Gourgoura et al., 2017; Mogagabe, 2020). However, this study will specifically focus on the effect of interest rates on credit risk.

Profitability

Ensuring robust revenue generation, effective cost management, and favourable profit margins from loan portfolios is vital for bank profitability (Munangi, 2020). According to Ally (2013), banks that are well managed are more likely to be profitable than those that are not. There are three common ways in which bank profitability can be measured: return on assets (ROA), return on equity (ROE), and net margins (Dorsey, 2004). This study will primarily utilise return of assets (ROA) as a profitability measure, given its widespread use (Kohlscheen, Murcia, & Contreras, 2018).

ROA, expressed as a ratio or percentage of net income to total assets, is influenced by both internal and external determinants, also known as bank-specific and macroeconomic determinants respectively (Khan & Sattar, 2014). Internal determinants pertain to factors within the bank's control, while external determinants encompass macroeconomic variables beyond the bank's influence.

Macroeconomic determinants include, but are not limited to GDP growth rates, inflation, and interest rates, while bank-specific determinants encompass, but are not limited to non-performing loans, capital adequacy, bank size, loan-to-deposit ratios, cost-to-income ratios, and non-interest income ratios (Mogagabe, 2020).

The Effect of Interest Rates on Credit Risk of Banks.

Interest Rates

<u>High Interest Rates</u>

The SARB states that when the repo rate is used as a monetary policy tool, it influences the borrowing costs of the financial industry and the overall economy. During the global financial crisis from 2007 to 2009, the South African economy was severely affected by interest rate hikes. The repo rate reached an all-time high of 12% since the introduction of inflation targeting. Munyai (2010) states that even after the introduction of the National Credit Act during the recession in South Africa, the biggest problem is high interest rates, which leads to over-indebtedness for borrowers (Munangi, 2020). Over-indebtedness reduces the borrower’s ability to repay their loans, thereby increasing credit risk. However, empirical results regarding the relationship between high interest rates and credit risk are mixed.

A study by Solarin, Yusoff, & Dahalan (2011) explored the relationship between interest rates and non-performing loans in the Malaysian Islamic banking sector. Their findings revealed a positive relationship between interest rates and non-performing loans (NPLs). Ćurak, Pepur, & Poposki (2017) investigated the determinants of NPLs in the Southeastern European banking systems. Their research also identified a positive association between higher interest rates and elevated non-performing loan (NPL) levels. Vallcorba & Delgado (2007) conducted a study emphasising the long-term effect. They observed that lower wages and higher interest rates contribute to increased default ratios over time. Independently, both Wambui (2013) and Njoki (2014) explored the relationship between interest rates and mortgage default rates in Kenya. Their studies consistently demonstrated a positive link between rising interest rates and an increase in NPLs.

In a study by Ogundipe et al. (2020), it was established that there is a significant positive relationship between interest rates and NPLR, indicating that higher interest rates are associated with higher NPLR.

Mahrous & Samak (2020) conducted a study focusing on countries in the MENA region, exploring the impact of monetary policy on credit risk. Their findings revealed a positive relationship between monetary policy and credit risk, with an interesting twist. The relationship was significant up to a threshold of 6.3. Beyond this threshold, an increase in the lending interest rate was associated with a rise in credit risk within the banking sector. This phenomenon was attributed to the increased burden placed on borrowers as interest rates rise, which increases the likelihood of bad loans and NPLs. Intriguingly, below the 6.3 threshold, the relationship became negative and significant.

Low Interest Rates

While high interest rates pose challenges to the economy, low interest rates also have significant implications. Research indicates that low interest rates incentivise banks to take on more risk (Özşuca & Akbostancı, 2012), which can lead to long-term risks. Additionally, low interest rates elevate banks' risk tolerance, prompting relaxed lending standards and increased loan volumes, thereby exacerbating credit risk (González-Aguado & Suarez, 2015). Conversely, cheaper credit encourages borrowers to take on more debt, stimulating economic activity and potentially leading to a rise in inflation (SARB, 2020). In response, the SARB will need to intervene by raising interest rates to manage inflation, which will consequently lead to borrowers' over-indebtedness and prompt banks to tighten their borrowing standards.

Empirical evidence suggests that low interest rates correlate with increased risk tolerance among banks, leading to a rise in bank risk-taking behaviour. Özşuca & Akbostancı (2012) discovered that when interest rates are low, banks tend to exhibit more risk-tolerant behaviour.

They also found that lower short-term interest rates reduce the risk of outstanding loans. Additionally, it was found that if short-term interest rates fall below a certain theoretical benchmark, it increases the bank's risk-taking behaviour. Similar results were found by Altunbaş, Gambacorta, & Marqués-Ibáñez (2014), who discovered that relatively low interest rates contribute to an increase in bank risk over an extended period.

Maivald & Teplý (2020) investigated the effect of low interest rates on banks' non-performing loans using the annual data of 823 banks from the Eurozone, Sweden, Denmark, Switzerland, and Japan from 2011 to 2017, which included a period of zero and negative rates. They found that after one year of low interest rates, the non-performing loan ratio increases, which can be explained by changes in the economic environment during a low interest rate period.

These findings underscore the importance of maintaining interest rates at an optimal level to mitigate credit risk and ensure financial stability. Policymakers, such as the SARB, must carefully balance interest rates to facilitate borrower repayment while fostering economic growth. This strategy is essential for safeguarding banks from credit risk influenced by monetary policy decisions.

The Effect of Interest Rates on Profitability of Banks.

Previous literature has presented mixed findings regarding the relationship between interest rates and bank profitability. Anbar & Alper (2011) conducted a study on banks in Turkey and found a positive relationship between real interest rates and bank profitability, suggesting that higher real interest rates could lead to increased profitability for banks. Similarly, Kumar, Acharya, & Ho (2020) observed a positive relationship between short-term interest rates and bank profitability, while noting a negative relationship between long-term interest rates and bank profitability. This implies that an increase in long-term interest rates may decrease bank profitability.

Khan & Sattar (2014) examined the banking sector of Pakistan and identified a strong, positive relationship between interest rates and bank profitability. Minny & Görmüş (2017) conducted a study in Turkey, revealing a significant positive relationship between changes in interest rates and bank profitability. Booyens et al. (2018) investigated South Africa's four largest banks from 2006 to 2015 and found a positive relationship between real interest rates and bank profitability.

In contrast, Genay & Podjasek (2014) studied the impact of low interest rates on bank profitability, finding that a low interest rate environment tends to decrease bank profitability. However, they noted that this effect is relatively small and may be offset by profits generated from low interest rates stimulating economic activity. Additionally, a study conducted on 109

large international banks across 14 advanced economies revealed that low interest rates and a flat-term structure can reduce bank profitability over (Borio, Gambacorta, & Hofmann, 2015).

The Effect of Credit Risk on Profitability of Banks.

Researchers have presented varying findings regarding the relationship between credit risk and bank profitability. Some studies have identified a significant positive relationship between the two variables, while others have observed a weak positive relationship. Conversely, certain researchers have reported a negative relationship between credit risk and profitability.

Kadioglu, Telceken, & Ocal (2017) investigated the impact of non-performing loans on bank profitability across 55 banks in Turkey. Their study revealed a significant negative relationship between non-performing loans and bank profitability when both return on equity and return on asset were employed as measures. Consequently, an increase in non-performing loans was found to reduce asset quality, resulting in diminished return on assets and equity.

Similar conclusions were drawn by Topak & Talu (2017), who found a negative relationship between non-performing loans ratio and bank profitability. Bapat (2018) conducted a study on Indian banks, uncovering a negative impact of non-performing loans on bank profitability. Similarly, Kumar et al. (2020) observed a negative relationship between the non-performing loans ratio and bank profitability among New Zealand banks.

In contrast, Kutum (2017) examined the influence of credit risk on the profitability of listed banks on the Palestine Exchange, utilising the non-performing loans ratio as a measure of credit risk. Their study revealed a weak but positive relationship between credit risk and profitability, as measured by the return on assets. They suggested that banks may enhance profitability by factoring credit risk into loan costs, potentially explaining this result. Saeed & Zahid (2016) also reported similar findings, identifying a positive relationship between credit risk and profitability.

Considering the empirical evidence, it is reasonable to expect a negative relationship between credit risk and bank profitability. Non-performing loans represent a cost to banks, thereby reducing their income and profitability. However, a positive relationship between credit risk and profitability prompt further exploration. Banks must assess whether such relationships stem from effective credit risk management strategies (Munangi, 2020) or the ability to incorporate credit risk into costs. Moreover, banks should consider the macroeconomic environment in which they operate. While a positive relationship may be feasible in rapidly growing developed economies, it may pose long-term risks in emerging markets experiencing economic challenges, such as South Africa's slow economic growth, high unemployment, and inflation.

Model Specifications – Advantages and Disadvantages

The exploration of the relationships between interest rates, credit risk and bank profitability within the banking sector has been a focal point of extensive empirical research. Researchers have employed a variety of model specifications to analyse these interactions, each offering unique insights and limitations (Kana, 2017; Munangi, 2020; Ifeacho & Ngalawa, 2014; Solarin et al., 2011). This section will review common models used in prior research, namely Pooled Ordinary Least Squares (OLS), Fixed Effects (FE), Random Effects (RE), Generalised Method of Moments (GMM), System-Generalised Method of Moments (System-GMM), Feasible Generalised Least Squares (FGLS), and Auto-Regressive Distributed Lag (ARDL).

Pooled OLS Model

The Pooled OLS model applies the Ordinary Least Squares (OLS) approach to panel data, assuming that all entities in the dataset possess identical underlying attributes by disregarding entity-specific effects (Vossen, n.d.). Its primary advantage lies in its simplicity and efficiency (Gujarati, 2009). According to the Gauss-Markov theorem, the OLS estimator is considered the best linear unbiased estimator (BLUE) since it has the lowest variance within the category of linear unbiased estimators (Taboga, 2021). Moreover, Gujarati (2009) also emphasises its straightforward implementation, making it more accessible compared to more complex models like fixed or random effects.

However, pooled OLS ignores the panel data structure, potentially leading to biased and inconsistent estimates due to correlations across time and entities (Albright, Zappe, & Winston, 2011). Furthermore, it is highly sensitive to outliers and often violates the assumption of uncorrelated error terms over time, which undermines its efficiency and reliability (Munangi, 2020; Baltagi, 2005).

Fixed Effects Model

According to Torres-Reyna (2007), the Fixed Effects Model (FEM), also known as the Least Squares Dummy Variable model, is an econometric model used to examine the relationship between predictor and outcome variables within an entity, such as an individual, company, or country. It is particularly useful when the main interest of the study is to analyse the effects of variables that vary over time. This approach controls for all time-invariant differences between entities, thereby reducing bias from omitted variables that are constant over time (Kohler & Kreuter, 2009).

However, the FEM suffers from several drawbacks. It reduces degrees of freedom by using dummy variables for each entity, which can be problematic in small samples (Hsiao, 2006). Additionally, it cannot estimate the effects of time-invariant variables and may exhibit

multicollinearity when the number of cross-sectional units is large (Williams, 2018; Chin'anga, 2015).

Random Effects Model

The Random Effects Model (REM) regards the variation among entities as stochastic and uncorrelated, with the predictor variables incorporated into the model (Torres-Reyna, 2007). This model includes time-invariant variables in the analysis, offering a more comprehensive understanding of the data (Torres-Reyna, 2007; Williams, 2018). It is more efficient than fixed effects models when its assumptions are met, utilising both within and between variations and requiring fewer parameters (Mustafa, 2023). However, the REM assumes that entity-specific effects are uncorrelated with explanatory variables, which, if violated, leads to biased and inconsistent estimates (Torres-Reyna, 2007). Moreover, it captures unobserved heterogeneity but does not allow for detailed interpretation of entity-specific effects, focusing instead on average effects across entities (Mustafa, 2023).

GMM Model

The Generalised Method of Moments (GMM) model is an estimation technique that integrates observed economic data with the information derived from population moment conditions to generate estimates for the unknown parameters of the economic model (Zsohar, 2012). It provides robust estimates in the presence of heteroscedasticity and autocorrelation (Wintoki, Linck, & Netter, 2012). GMM can overcome many issues associated with pooled OLS (Ifeacho & Ngalawa, 2014). However, the use of lagged regressors as instruments in first-differenced GMM can result in weak instruments, posing challenges for reliable estimation (Han & Phillips, 2010; Arellano & Honore, 2001).

System-GMM Model

System-GMM model is an extension of the GMM approach that uses both levels and first differences of variables as instruments, enhancing efficiency and better addressing endogeneity issues (Ifeacho & Ngalawa, 2014). While it effectively handles endogeneity and is efficient with limited time dimensions, it assumes homogeneous slope coefficients across panel members and ignores cross-sectional dependence, which can limit its applicability in certain contexts (Karaduman, 2021).

FGLS Model

Feasible Generalized Least Squares (FGLS) corrects for heteroscedasticity and autocorrelation in error terms by estimating the error structure (Yap, 2011). This makes FGLS more efficient than OLS under conditions of heteroscedasticity or autocorrelation (Bai, Choi,

& Liao, 2020). Nevertheless, its finite sample properties are typically unknown, which can complicate its practical application (Kuan, 2004).

ARDL Model

The Auto-Regressive Distributed Lag (ARDL) model, as outlined by Oxera (2010), views the focal variable as dependent on its past values (auto-regressive) and the present and previous values of other variables (distributed lag), offering flexibility in accommodating various lag structures. This flexibility is one of its main strengths. However, ARDL models can face challenges in identifying correct relationships in data with unit roots, risking spurious correlations. Additionally, these models may approximate stochastic trends rather than capturing genuine dynamics, particularly in datasets with limited time-series observations.

The choice of model specification in the analysis of interest rates, credit risk and bank profitability is crucial and should be guided by the specific characteristics of the data and the research questions at hand. Each model offers distinct advantages and limitations that need to be carefully considered to draw robust and meaningful conclusions.

2.3 Research Gaps and Demarcation of the Study

The literature review highlights the limited research on the relationship between interest rates, credit risk and bank profitability in South Africa and globally. Furthermore, there is a lack of empirical evidence examining the interplay between these three variables, as well as empirical evidence utilising the FGLS model to analyse these relationships. Studies on high interest rates generally support a positive relationship with credit risk, while findings on low interest rates remain mixed. Similarly, the relationship between interest rates and profitability, as well as between credit risk and profitability, lacks consensus.

Chapter Three: Methodology

This chapter explains how the research objectives and questions were approached. The methodology section discussed the statistical tools, data characteristics, variables used in the models, diagnostic tests, and the econometric software utilised in the study.

3.1 Data

For this study, only the secondary data of seven listed commercial banks was used due to data constraints. Data for unlisted banks was unavailable, and only the seven listed banks had complete data covering the study period. The selected commercial banks include Standard Bank Group, ABSA Group, FirstRand Group, Nedbank Group, Capitec Group, Investec Limited Group, and Sasfin Holdings. The data of all the variables included in this study were collected from the Audited Annual Financial Statements of the banks, Equity RT, and Bloomberg.

The data covers a period from 2002 to 2022. This period was selected for several reasons: Firstly, the study period aligns with the inflation-targeting period from 2000 to the current year. Secondly, this timeframe was chosen because Capitec bank was established on the 1st of March 2001, and their financial data was only available from 2002 onwards. Lastly, the period was chosen to encompass at least two cyclical periods of interest rate hikes that occurred since the introduction of inflation targeting.

The monetary policy rate (repo rate) was utilised as a proxy for interest rates, with data collected from Equity RT. Credit risk was assessed using the non-performing loans ratio (Kohlscheen et al., 2018). This ratio was calculated as net charge-off (impairments) to total loans and advances (Saeed & Zahid, 2016). The non-performing loans ratio was chosen as a proxy for credit risk due to its widespread use in the literature. Lastly, return on assets (ROA) was selected as the measure of profitability (Dorsey, 2004).

3.2 Research Approach, Design and Econometric Models

The objective of this study is to analyse the relationship between interest rates, credit risk, and profitability of banks by exploring the interplay of these three variables. A quantitative research approach will be employed to analyse the data and interpret the findings.

Research Approach

Quantitative research involves gathering and examining numerical data, which can be utilised to identify trends, create forecasts, examine cause-and-effect connections, and apply findings

to broader groups (Bhandari, 2022). This research approach is appropriate for this study for several reasons:

1. The study used secondary numerical data and STATA statistical software to analyse the data (Remler & Van Ryzin, 2011).
2. Quantitative research allows for the examination of relationships between variables (Salkind, 2012). This is crucial for defining the objective of this study by analysing the relationship between interest rates, credit risk, and profitability of commercial banks in South Africa.

The benefits of the quantitative research approach include its time efficiency in analysing larger samples of data using statistical software (Connolly, 2007). It can utilise larger data samples compared to qualitative research (Rahman, 2016), and it can standardise the collection of data, enabling the drawing of general conclusions from the results (Bhandari, 2023). However, a limitation of the quantitative research approach is its inability to ascertain deeper underlying meanings and explanations (Rahman, 2016).

Research Design

This study employed panel data analysis as the dataset includes both cross-sectional and time series data. Panel data is a combination of observations from the same entities across different time periods (Baltagi, 2005; Kennedy, 2008). Panel data offers several advantages:

1. Panel data provides more information, greater variability, reduced collinearity among variables, expanded degrees of freedom, and enhanced efficiency compared to other types of data (Baltagi, 2001).
2. It can account for individual-specific effects, addressing individual differences and allowing researchers to isolate the effects of changing factors over time while controlling for consistent individual traits (Ghosal, n.d.).

Combining time series and cross-sectional data enhances the quality and quantity of data that would have been difficult to attain using only one of these datasets (Gujarati, 2003; Baltagi, 1995).

Econometric Models

To determine the relationship between interest rates, credit risk and profitability of commercial banks in South Africa, three models were estimated. The models are specified as follows according to the three objectives.

To investigate the effect of interest rates on credit risk of banks (Objective 1), the following empirical model is estimated:

$$NPLR_{i,t} = \alpha_i + INT_{i,t}\beta_1 + SIZE_{i,t}\beta_2 + CAR_{i,t}\beta_3 + INF_{i,t}\beta_4 + EGR_{i,t}\beta_5 + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots 1$$

Where:

- ***NPLR:*** Represents credit risk, proxied by the non-performing loan ratio.
- ***INT:*** Represents the interest rate, proxied by the repo rate.
- ***SIZE:*** Represents bank size, measured by the logarithm of the asset value.
- ***CAR:*** Represents capital adequacy ratio, calculated as the ratio of equity to total assets.
- ***INF:*** Represents inflation, measured by the consumer price index (CPI).
- ***EGR:*** Represents economic growth, measured by the GDP growth rate.
- α is the constant, ε is the error term, and β is the coefficient.

The indices *i* and *t* denote the bank and time period respectively.

To investigate the effect of interest rates on profitability of banks (Objective 2), the following empirical model is estimated:

$$ROA_{i,t} = \alpha_i + INT_{i,t}\beta_1 + SIZE_{i,t}\beta_2 + CAR_{i,t}\beta_3 + INF_{i,t}\beta_4 + EGR_{i,t}\beta_5 + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots 2$$

Where:

The rest of the variables and parameters are as defined in the previous equation.

To examine the effect of credit risk on profitability of banks (Objective 3), the following empirical model is estimated:

$$ROA_{i,t} = \alpha_i + NPLR_{i,t}\beta_1 + SIZE_{i,t}\beta_2 + INF_{i,t}\beta_3 + EGR_{i,t}\beta_4 + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

Where:

- ***ROA:*** Represents profitability, measured by the return on assets.

The rest of the variables and parameters are as defined in the previous equations.

Control Variables

The control variables in this study were selected to capture both macroeconomic and bank-specific factors influencing credit risk and profitability. For this study, bank size, capital adequacy, inflation, and economic growth are included as control variables of credit risk and profitability of banks. Many empirical studies, including those by Ngalawa (2014), Munangi (2020), Booyens et al. (2018), Gila-Gourgoura & Nikolaidou (2017), and Mogagabe (2020), have utilised and controlled for similar variables due to their potential impact on the results.

These variables were chosen due to their consistent inclusion in prior research, demonstrating their relevance and impact on the analysis.

Additionally, these variables were selected because reliable data were available, allowing for robust analysis. Importantly, these variables passed the multicollinearity test, ensuring they did not distort the regression results. Consequently, leverage was eliminated due to multicollinearity issues, and capital adequacy was removed from model 3 because it exhibited a correlation above 0.8 with credit risk (the independent variable) in model 2.

In summary, the final models (1, 2, and 3) include control variables that were carefully selected based on their proven relevance in the literature, data availability, and the need to avoid multicollinearity, ensuring accurate and meaningful results.

3.3 Analytical Method

This study employed Feasible Generalised Least Squares (FGLS) regression analysis as an econometric framework to correct for heteroskedasticity and autocorrelation in the estimated models (Yap, 2011). FGLS is an econometric technique extended from the Ordinary Least Squares (OLS) regression method, offering a reliable approach for regression analysis in the presence of varying variances and related error terms (Eric, 2024).

The FGLS model was chosen for this study for several reasons:

1. To address autocorrelation and heteroskedasticity problems in the estimation models to avoid biased estimations of standard errors (Yap, 2011).
2. Studies, including one by Bai, Choi, & Liao (2020), have shown that in the presence of heteroskedasticity and autocorrelations, the FGLS technique is a better estimator than OLS.
3. The FGLS estimator was chosen because the panel data consisted of more time periods than cross-sectional units (Hoechle, 2007).

The application of the FGLS model has been discussed and applied in previous studies (Yap, 2011; Hoechle, 2007; Ongore & Kusa, 2013; Bai et al., 2020).

Diagnostic Tests

This study conducted three diagnostic tests, namely the multicollinearity test, autocorrelation test and heteroskedasticity test, to ensure that the results of regression models are reliable, efficient, unbiased and robust (Baltagi, 2008).

Multicollinearity Test

Multicollinearity is a data problem where there is a linear relationship between two or more predictors in the linear regression model (Alin, 2005), leading to incorrect results (Kim, 2019). This study employed the correlation coefficient approach to test for multicollinearity issues between the predictors (Kuhn & Johnson, 2016). According to Gujarati (2003), a model suffers from significant multicollinearity when the correlations between the variables exceed 0.8. Control variables exhibiting multicollinearity were removed from the regression model.

Autocorrelation

Autocorrelation, also referred to as serial correlation, is a statistical measurement that illustrates the connection between a variable and its lagged values over different time periods (Banton, 2021). It occurs when the error in one period is correlated with errors from other periods. Failing to account for autocorrelation leads to reliable but inefficient estimates of the regression coefficients and distorted standard errors (Baltagi, 2005). In this study, the Wooldridge serial correlation test was used to detect autocorrelation in the models. Models with autocorrelation issues were corrected using FGLS regression (Yap, 2011).

Heteroskedasticity

Heteroskedasticity, as defined by Ali & Giaccotto (1984), is the presence of non-normally distributed errors in a linear model. Testing for heteroskedasticity enhances a model's reliability and robustness. For this study, the presence of heteroskedasticity was tested in all models. Any model showing heteroskedasticity issues was corrected using FGLS regression to achieve reliable, robust, efficient and unbiased results (Yap, 2011; Baltagi, 2005).

Chapter Four: Results and Analysis

4.1 Introduction

This chapter presents and discusses the results of the study. As discussed in the previous chapter, the results are derived from a quantitative analysis. Descriptive statistics, Correlation analysis, and Feasible Generalised Least Squares (FGLS) regression analysis were used to answer the three objectives of the study. The statistical software used to analyse the data is Stata. The chapter is outlined as follows: Section 4.1 presents the introduction, Section 4.2 presents the preliminary analysis, Section 4.3 presents the findings and discussion of the regression analysis, and Section 4.4 presents the conclusion of the findings of the study.

4.2 Preliminary Analyses

4.2.1 Descriptive Statistics

Table 4.1 illustrates the descriptive statistics of all variables included in the study. The mean, standard deviation, minimum value and maximum value are represented for each variable. On average, the banks included in the study had a return on assets (ROA) of 2.13% and a standard deviation of 2.11% over a 20-year period starting from 2002 to 2022. This means that during the 20 years, South African banks included in the sample obtained an average profitability of 2.13%. The least profitable bank had an ROA of minus 0.51%, while the most profitable bank had an ROA of 11.74%.

Table 4.1: Descriptive Statistics of Variables: 2002–2022

Descriptive Statistics						
Variable		**Mean**	**Standard Deviation**	**Minimum**	**Maximum**	**Observations**
Dependent	ROA	0,0213	0,0211	-0,0051	0,1174	147
Independent	NPLR	0,0244	0,0446	-0,0071	0,2209	147
Control	INT	0,0708	0,0241	0,0350	0,1350	147
	SIZE	5,7604	1,0344	3,0700	8,2503	147
	CAR	0,1353	0,1402	0,0453	0,9569	147
	INF	0,0553	0,0202	0,0139	0,1102	147
	EGR	0,0225	0,0257	-0,0596	0,0560	147

The average non-performing loan ratio (NPLR) was 0.0244, indicating that on average banks 2.44% of loans issued were not collected. The standard deviation for NPLR was 0.0446, while the minimum and maximum NPLR was minus 0.0071 and 0.2209 respectively. The average

interest rate was 7.08% over 20 years, with a standard deviation of 2.41%. The minimum interest rate was 3.5%, while the maximum interest rate was 13.5% during that period.

Bank size had an average logarithmic value of 5,76 and a standard deviation of 1,03 during the 20-year period. The minimum bank size logarithmic value was 3,07 and the maximum bank size logarithmic value was 8,25. The average capital adequacy ratio (CAR) was 0.1353, with a minimum and maximum CAR of 0.0452 and 0.9569 respectively. The standard deviation of the CAR was 0.1402. The average inflation rate during the 20 years was 5.53%, with a standard deviation of 2.02%. During this period, the lowest inflation rate was 1.39% and the highest inflation rate was 11.02%. The average economic growth rate was 2.24%, with the minimum growth rate at minus 5.96% and the maximum growth rate at 5.6%. The standard deviation was 2.57%.

4.2.2 Correlation Analysis

Table 4.2 shows that there is a strong positive correlation between credit risk and profitability of 0,8017, and the strength of the relationship between the two variables is significant at 1% level of significance. This strong positive relationship implies that high levels of credit risk are associated with high profitability.

Table 4.2: Correlation Matrix

	ROA	NPLR	INT	SIZE	CAR	INF	EGR
ROA	1,0000						
NPLR	0,8017***	1,0000					
INT	0,2004**	0,0624	1,0000				
SIZE	0,0592	0,3734***	-0,2018**	1,0000			
CAR	0,8703***	0,8422***	0,1422*	-0,0345	1,0000		
INF	0,0728	0,0121	0,6363***	-0,0314	0,0321	1,0000	
EGR	0,1606*	0,0239	0,4269***	-0,1753**	0,1067	0,0671	1,0000

(*), (**) and (***) represents the (10%), (5%) and (1%) level of significance respectively.

Interest rates and profitability have a weak positive correlation of 0,2004. This correlation is significant at 5% level of significance, suggesting that when interest rates increase, profitability also increases.

There is a positive but statistically insignificant correlation between bank size and profitability of 0,0592. This indicates that there is no linear relationship between bank size and bank profitability.

Capital adequacy has a strong positive correlation with profitability of 0,8703. The correlation between capital adequacy and profitability is statistically significant at 1% level of significance. This suggests that high levels of capital adequacy are associated with higher profitability.

Inflation is positively correlated to profitability at 0,0728. However, this correlation is statistically insignificant, indicating that there is no linear relationship between the two variables.

Economic growth has a weak positive correlation of 0,1606. The relationship is statistically significant at 5% level of significance. This means that the profitability of banks in South Africa is associated with the growth of the economy.

4.3 Regression Analysis

4.3.1 Diagnostics Tests

Unit Root Test

Before performing the regression analyses, it is essential to first test the stationarity of the variables. This evaluation is vital as it allows for an examination of how the stochastic process generating the series behaves over time, thereby mitigating the risk of obtaining spurious results from the models (Baltagi, 2008). This study implemented the Levin-Lin-Chu unit root test to check for stationarity in the panel data.

The Levin-Lin-Chu test is a unit root test used to assess stationarity in time series variables by detecting unit roots. This unit root test is appropriate for this study as it can test for unit roots in panel data (Levin, Lin, & Chu, 2002), and this study employs panel data analysis.

Levin-Lin-Chu Unit Root Test Hypothesis

$\boldsymbol{H_0}$**:** *Panels contain unit roots.*
$\boldsymbol{H_a}$**:** *Panels are stationary.*

Table 4.3 below shows that all variables included in the study obtained a p-value of less than 5% level of significance. This indicates that the data for these variables do not contain any unit root and are stationary.

Table 4.3: Levin-Lin-Chu Unit Root Test

Levin-Lin-Chu Unit Root Test			
Variable	**P-Value**	**Significant**	**Reject or Accept Null Hypothesis**
Profitability (ROA)	0.0000	Yes	Reject
Credit Risk (NPLR)	0.0022	Yes	Reject
Interest Rate (INT)	0.0033	Yes	Reject
Bank Size (SIZE)	0.0000	Yes	Reject
Capital Adequacy (CAR)	0.0002	Yes	Reject
Inflation (INF)	0.0000	Yes	Reject
Economic Growth (EGR)	0.0010	Yes	Reject

Multicollinearity Test

Tables 4.4, 4.5 and 4.6 illustrate the multicollinearity test performed on the independent variables and control variables for Models 1, 2 and 3. Gujarati (2003) states that a model experiences significant multicollinearity when the correlations between the variables are greater than 0,8. The tables illustrated below show that there are no multicollinearity problems among the variables, as all the correlations between the variables are less than 0,8. Therefore, all three models of this study pass the multicollinearity test.

It is important to note that capital adequacy was excluded from model 3 as a control variable, due to a strong positive correlation of 0,8422 with credit risk, which was causing multicollinearity problems in the model. The credit risk variable was not removed as it is the key focus independent variable in the model.

Table 4.4: Multicollinearity Test for Model 1 with Credit Risk as the Dependent Variable.

	INT	**SIZE**	**CAR**	**INF**	**EGR**
INT	1,0000				
SIZE	-0.2018	1,0000			
CAR	0.1422	-0.0345	1,0000		
INF	0.6363	-0.0314	0.0321	1,0000	
EGR	0.4269	-0.1753	0.1067	0.0671	1,0000

Table 4.5: Multicollinearity Test for Model 2 with Profitability as the Dependent Variable.

	INT	**SIZE**	**CAR**	**INF**	**EGR**
INT	1,0000				
SIZE	-0.2018	1,0000			
CAR	0.1422	-0.0345	1,0000		
INF	0.6363	-0.0314	0.0321	1,0000	
EGR	0.4269	-0.1753	0.1067	0.0671	1,0000

Table 4.6: Multicollinearity Test for Model 3 with Profitability as the Dependent Variable.

	NPLR	SIZE	INF	EGR
NPLR	1,0000			
SIZE	0.3734	1,0000		
INF	0.0121	-0.0314	1,0000	
EGR	0.0239	-0.1753	0.0671	1,0000

Autocorrelation and Heteroskedasticity Test

The Fixed Effect Models and Random Effect Models that were initially deemed suitable for this study according to the Hausman Test, all exhibited signs of autocorrelation and heteroskedasticity. To address these issues, Feasible Generalised Least Squares (FGLS) regression was employed to robustly estimate Models 1, 2 and 3 and correct for autocorrelation and heteroskedasticity. Therefore, these regression models are homoscedastic and free from autocorrelation.

Diagnostics tests were performed to enhance the reliability of the regression results in this study (Baltagi, 2008).

4.3.2 Findings and Discussions

Feasible Generalised Least Squares Regression Results

Objective 1: To investigate the effect of interest rates on credit risk of banks in South Africa.

Table 4.7: Effect of Interest Rates on Credit Risk FGLS Regression Results

Model 1: FGLS Regression			
Dependent Variable: Credit Risk			
Variable Type	**Variable**	**Coefficient**	**P-Value**
Independent Variable	Interest Rates	0,0979	0,2400
Control Variable	Bank Size	0,0177***	0,0000
	Capital Adequacy	0,2708***	0,0000
	Inflation	-0,0775	0,3830
	Economic Growth	-0,0267	0,6510
	Constant	-0,1160***	0,0000

(*), (**) and (***) represents the (10%), (5%) and (1%) level of significance respectively.

Relationship between Credit Risk and Interest Rates

Table 4.7 shows a positive relationship between interest rates and credit risk. However, this relationship is insignificant, suggesting that interest rates are not a significant determinant of credit risk. These results are theoretically unexpected.

According to the SARB (2015), when the repo rate increases, banks factor that cost into their prime lending rate, which then increases the cost of borrowing (Mogagabe, 2020). Once the cost of borrowing increases, it reduces borrowers' ability to repay their loans, especially those with variable contracts (Tanasković & Jandrić, 2015). This can cause them to default and subsequently lead to an increase in credit risk.

Other previous studies, including a study by Solarin et al. (2011) conducted on the Malaysian Islamic banking sector for the period 2007:1 to 2009:12 using the ADRL and Granger Causality test, found a significant positive relationship between credit risk and interest rates in the long run. These results provide support to other previous studies such as Jiménez & Saurina (2006), who found a positive relationship between credit risk and interest rates in the Spanish banking sector.

Therefore, the difference in the significance of the results might be attributed to differences in geographical location, sample size, econometric tools used, time periods and intervals, control variables, or other factors not mentioned.

Relationship between Credit Risk and Bank Size

Table 4.7 illustrates a positive relationship between credit risk and bank size, which is highly significant at 1% level of significance. Therefore, a 1% increase in bank size will lead to a 0,02% increase in credit risk. Abdullah, Khan, & Nazir (2012) found similar results in their study. Interestingly, they discovered that the positive relationship between credit risk and bank size is significant in local banks and insignificant in foreign banks.

These results are supported by previous empirical evidence from a study conducted by Wiryono & Effendi (2018), who also found a significant positive relationship between bank size and credit risk in the Islamic banking system. The larger the bank, the more assets it owns, and therefore the more financing it can provide to clients, which then exposes the bank to more credit risk (Das & Ghosh, 2007; Khemraj & Pasha, 2009; Zribi & Boujelbène, 2011; Tehulu & Olana, 2014; Wiryono & Effendi, 2018).

In contrast, historical studies argue that there should be a negative relationship between credit risk and bank size. This is because larger banks have a competitive advantage over smaller banks, with more access to efficient risk management strategies and their ability to diversify risk in their loan portfolios, which subsequently reduces their credit risk (Tehulu & Olana, 2014). In support of this reasoning, Ćurak et al. (2017) found a negative relationship between credit risk and bank size in their study, which was also in line with the findings of Tehulu & Olana (2014).

Relationship between Credit Risk and Capital Adequacy

Table 4.7 exhibits a significant positive relationship between capital adequacy and credit risk at the 1% level of significance. Therefore, a 1% increase in capital adequacy will increase credit risk by 0,27%. According to Mogagabe (2020), the capital adequacy ratio measures the amount of capital a bank reserves in comparison to its risk exposure. This implies that banks with high credit risk exposure are required to have higher capital adequacy ratios or capital reserves to protect themselves and be better equipped to manage credit risk during difficult economic times (Rehman, Muhammad, Sarwar, & Raz, 2019). Hence, there is a positive relationship between credit risk and capital adequacy. From a South African context, Mogagabe (2020) found that non-performing loans and capital adequacy are positively correlated. The reason for this positive correlation is attributed to poor implementation of corporate governance standards within the banking institutions.

However, it is essential to note that capital adequacy risk management strategy helps minimise credit risk for banks (Mogagabe, 2020), subsequently reducing credit risk. This explains the negative relationship between capital adequacy and credit risk found in other previous studies (Tehulu & Olana, 2014; Hussain & Hassan, 2005).

Relationship between Credit Risk and Inflation

Table 4.7 shows a negative relationship between credit risk and inflation, which is also insignificant. This indicates that inflation is not a significant determinant of credit risk. These results are consistent with the findings of a study by Fofack (2005), which found an insignificant relationship between the two variables, particularly for African Financial Community (CFA) countries. Valahzagharda, Kashefib, Alikhanic, & Hosseinid (2012) similarly found the same results in Iran.

Although the results suggest that inflation cannot significantly influence the credit risk of South African banks, this contradicts the findings of some previous empirical studies. For instance, according to Nkusu (2011), high inflation is associated with low unemployment according to the Philips curve. This means that if fewer people are unemployed and more are employed, more individuals in the economy can afford to repay their loans (Nkusu, 2011). From a South African context, these results are similar to those of Khumalo et al. (2021), who investigated the impact of macroeconomic factors on credit risk for the top five South African banks from 2009 to 2018/9. In their study, they found that credit risk and inflation are negatively correlated. This is also in line with the study by Wiryono et al. (2018) in Islamic banking, which found a negative relationship between inflation and credit risk. Vogiazas & Nikolaidou (2011) also found a negative relationship between credit risk and inflation in the Romanian banking system.

However, from an economic perspective in South Africa, during high inflationary periods, customers' purchasing power reduces as it becomes more expensive to buy goods or services. In such an environment, borrowers with variable contracts encounter difficulties as it becomes expensive for them to service their loans (Munangi, 2020). This then reduces the borrower's ability to repay their loans and therefore increases credit risk (Tanasković & Jandrić, 2015), resulting in a positive relationship between credit risk and inflation. This is supported by a study conducted by Mogagabe (2020), who discovered a positive correlation between credit risk and inflation from a sample of eight South African banks. However, there is still limited research with regards to the relationship between credit risk and inflation from a South African context.

These relationships are both supported by a study conducted by Nkusu (2011), which found that the relationship between inflation and credit risk, as measured by non-performing loans, can either be positive or negative because inflation affects borrowers' debt-servicing capacity differently.

It is therefore plausible to believe that there could be reasons why this study has failed to detect a significant relationship between credit risk and inflation. This could be attributed to different sample sizes, methods, time frames, control variables, or other unmentioned factors.

Relationship between Credit Risk and Economic Growth

Table 4.7 indicates a negative relationship between credit risk and economic growth. However, this relationship is insignificant. This means that economic growth is not a significant determinant of credit risk. From a South African perspective, these results align with the findings of Khumalo et al. (2021), who found an insignificant relationship between the credit risk and economic growth. These results are supported by some previous empirical evidence (Poudel, 2013; Kalirai & Scheicher, 2002; Aver, 2008).

Although the results suggest that economic growth cannot significantly influence the credit risk of South African banks, this contradicts the findings of some previous empirical studies. A study conducted by Louzis, Vouldis, & Metaxas (2010), observed a negative relationship between nonperforming loans (NPLs) and GDP. From an economic standpoint, during an economic expansion when the economy is growing and the GDP growth rate increases, the standard of living improves due to heightened productivity and income growth (Mogagabe, 2020). In such an economic environment, eligible loan applicants can borrow money from banks and repay it, thereby reducing the risk of default and mitigating credit risk (Kana, 2017). Ćurak et al. (2017) similarly found a negative relationship between economic growth and credit risk. They further explained that the economic state of a country determines borrowers' ability to repay their loans. That is, if there is economic growth, credit risk drops due to people's ability

to repay their loans. Conversely, when economic conditions are not favourable, credit risk increases due to borrowers' inability to repay their loans (Ćurak et al., 2017). Wiryono & Effendi (2018) also confirmed a negative relationship between economic growth and credit risk.

It is therefore plausible to believe that there could be reasons why this study has failed to detect a significant relationship between credit risk and economic growth. This could be attributed to different sample sizes, methods, time frames, control variables, or other unmentioned factors.

Objective 2: To investigate the effect of interest rates on profitability of banks in South Africa.

Table 4.8: Effect of Interest Rates on Profitability FGLS Regression Results

Model 2: FGLS Regression			
Dependent Variable: Profitability			
Variable Type	**Variable**	**Coefficient**	**P-Value**
Independent Variable	Interest Rates	0,0732	0,1590
Control Variable	Bank Size	0,0023***	0,0040
	Capital Adequacy	0,1286***	0,0000
	Inflation	-0,0085	0,8780
	Economic Growth	0,0443	0,2310
	Constant	-0,0153***	0,0080

(*), (**) and (***) represents the (10%), (5%) and (1%) level of significance respectively.

Relationship between Profitability and Interest Rates

Table 4.8 shows that there is a positive relationship between bank profitability and interest rates. However, the relationship is insignificant. This suggests that interest rates are not a significant determinant of bank profitability. These results are in line with the findings of Kana (2017), who also found an insignificant relationship between the two variables. These results are supported by previous empirical evidence from a study by Anbar & Alper (2011), who also found an insignificant relationship.

Although the results suggest that interest rates cannot significantly influence the profitability of South African banks, this contradicts the findings of some previous empirical studies. A study conducted by Booyens et al. (2018) found a positive relationship between interest rates and the profitability of banks in South Africa. According to the SARB (2015), when interest rates increase, banks factor in that cost by adjusting their prime lending rates to maintain profitability. Vong & Chan (2006) suggest that banks can increase their profits amid rising interest rates due to the lend-long and borrow-short strategy. They argue that when interest rates rise, banks charge more for issued loans than they offer for savings accounts to remain profitable, even during periods of rising interest rates. As borrowers' ability to repay their loans

reduces and subsequently leads to an increase in credit risk (Vallcorba & Delgado, 2007), banks protect themselves by charging a higher rate to compensate for this credit risk (Vong & Chan, 2006).

It is therefore, cautioned that the reader should interpret the results with the knowledge that the relationship between profitability and interest rates is currently facing conflicting empirical results.

Relationship between Profitability and Bank Size

Table 4.8 shows a positive and significant relationship between profitability and bank size, where profitability is the dependent variable, interest rates is the independent variable, and bank size is the control variable. Therefore, a 1% increase in bank size will significantly increase profitability by 0.002% at the 1% level of significance. These results are also supported by the empirical evidence of Anbar et al. (2011), who also found a positive and significant relationship between bank size and profitability. According to Boahene, Dasah, & Agyei (2012), if large banks are well managed, they are able to perform much better than smaller banks through competitive advantages such as economies of scale, high bargaining power, the ability to invest in research and development, and improved operational efficiency derived from access to advanced technologies. This then leads to lower operational costs and increased profitability. Additionally, the researchers also mentioned that larger banks have higher chances of securing lucrative deals in the banking industry compared to smaller banks.

Relationship between Profitability and Capital Adequacy

Table 4.8 illustrates a positive and significant relationship between capital adequacy and profitability, significant at 1% level of significance. This means that a 1% increase in the capital adequacy ratio will lead to a 0,13% increase in bank profitability. This shows that South African banks included in this study are efficient, financially stable, and able to manage their risk and losses well (Dietrich & Wanzenried, 2011). According to Jasevičienė & Valiulienė (2013), banks that are able to manage their risks well are able to perform better, hence there is a positive relationship between the two variables. In the South African context, these results are in line with the findings of Booyens et al. (2018) who found a positive and significant relationship between capital adequacy and profitability. This relationship is also supported by previous studies (Demirgüç-Kunt & Huizinga, 1999; Pasiouras & Kosmidou, 2007). Anbar & Alper (2011) also found the same results, emphasising that a higher the capital adequacy ratio mitigates the need for external funding, thereby enhancing profitability. Additionally, Gul, Irshad, & Zaman (2011) stated that well-capitalised banks with high capital adequacy ratios can adhere to regulatory capital standards and leverage excess capital to generate more profits.

Objective 3: To examine the effect of credit risk on profitability of banks in South Africa.

Table 4.9: Effect of Credit Risk on Profitability FGLS Regression Results

Model 3: FGLS Regression			
Dependent Variable: Profitability			
Variable Type	**Variable**	**Coefficient**	**P-Value**
Independent Variable	Credit Risk	0,4226***	0,0000
Control Variable	Bank Size	-0,0052***	0,0000
	Inflation	0,0498	0,2740
	Economic Growth	0,0744**	0,0410
	Constant	0,0368***	0,0000

(*), (**) and (***) represents the (10%), (5%) and (1%) level of significance respectively.

Relationship between Profitability and Credit Risk

Table 4.9 shows a significant positive relationship between credit risk and profitability. Therefore, a 1% increase in credit risk will lead to a 0,42% increase in profitability. This unexpected outcome is contrary to the typical expectation, as non-performing loans are a cost to the bank and are expected to reduce the bank's profits (Kana). However, Boahene et al. (2012) also found a positive relationship between the two variables, attributable to non-interest income such as excessively high lending rates, commissions and bank fee charges (Saeed & Zahid, 2016).

There are several factors that could contribute to a positive relationship between credit risk and the profitability of banks in South Africa. According to Mogagabe (2020), South African banks exhibit relatively low credit risk, suggesting that they operate under acceptable levels of credit risk. This may indicate that South African banks are efficient and able to manage their risks effectively. Banks that implement strong credit risk management strategies are often able to perform well and increase profits even when facing rising credit risk (Jasevičienė & Valiulienė, 2013; Boahene et al., 2012; Mirach, 2010). Another reason for this positive relationship could be banks' ability to factor in the costs of credit risk in their loan portfolios by charging higher interest rates, thereby increasing their profits (Kutum, 2017). This supports the potential positive relationship between credit risk and profitability in South African banks.

However, Munangi (2020) found a negative relationship between credit risk and the profitability of South African banks. The difference in the results may be due to the sample size of the banks. For this study, only seven listed banks consisting of the largest banks in South Africa were used due to data constraints, whereas the study conducted by Munangi (2020) included eighteen South African banks. The lack of smaller banks in the sample size of this study could have affected the results, leading to a positive relationship rather than a negative one.

However, Kana (2017) also discovered a negative relationship between credit risk and profitability for nine South African banks, indicating that the difference in the relationship could be due to variations in sample size, time periods, data availability or other unmentioned factors.

Evidence from other research shows that an increase in credit risk results in reduced bank performance (Kaaya & Pastory, 2013). This negative relationship between credit risk and profitability is also supported by previous literature and empirical evidence, including studies by Kadioglu et al. (2017), Topak & Talu (2017), Bapat (2018), and Kumar et al. (2020). They argument that credit risk leads to increased impairments, which is a cost for the bank, and therefore should reduce the bank's profitability.

Relationship between Profitability and Bank Size

Table 4.9 shows a negative relationship between profitability and bank size when profitability is a dependent variable, credit risk is an independent variable, and bank size is a control variable. Therefore, a 1% increase in bank size will reduce profitability by 0,01%, and the relationship is statistically significant at 1% level of significance. According to Munangi (2020), the larger the bank, the more it is exposed to bureaucracy and legislation costs, which reduce its profits.

Previous studies have yielded mixed results regarding the relationship between bank size and profitability. Since the sample used in this study consists of large banks in South Africa due to data constraints, the negative relationship in this case can be explained by bureaucracy costs faced by large banks (Munangi, 2020). These findings highlight the complexities involved in the relationship between bank size and profitability, with factors such as bureaucracy costs playing a significant role in influencing profitability for larger banks.

Relationship between Profitability and Inflation

Table 4.8 and 4.9 both indicate an insignificant relationship between inflation and profitability. This implies that inflation is not a significant determinant of bank profitability. These results align with the findings of Kana (2017), who observed an insignificant relationship between bank profitability and inflation in South Africa. Anbar & Alper (2011) also noted an insignificant relationship between the two variables.

Although the results suggest that inflation cannot significantly influence the profitability of South African banks, this contradicts the findings of some previous empirical studies. A study by Kosmidou, Tanna, & Pasiouras (2005) found a positive relationship between inflation and bank profitability. According to Booyens et al. (2018), a possible explanation for this positive

relationship is the banks' ability to accurately predict inflation and adjust their interest rates accordingly, allowing their income to grow faster than their costs.

On the contrary, some studies have found a negative relationship between the two variables. Sufian & Chong (2008), Sayilgan & Yildirim (2009), and Alexiou & Sofoklis (2009), found a negative relationship between inflation and profitability in the Philippines, Turkish, and Greek banking sectors, respectively. Inflation and profitability can be negatively correlated if banks fail to accurately predict inflation and are unable to adjust interest rates according to the rise in inflation, causing costs to grow faster than income (Vong & Chan, 2006).

It is therefore plausible to believe that there could be reasons why this study has failed to detect a significant relationship between inflation and bank profitability. This could be attributed to different sample sizes, methods, time frames, control variables, or other unmentioned factors.

Relationship between Profitability and Economic Growth

Table 4.8 and Table 4.9 illustrate conflicting results regarding the relationship between economic growth and profitability. Table 4.8 shows an insignificant relationship, while Table 4.9 shows a positive relationship. The positive relationship results are consistent with previous empirical literature that have discovered a positive relationship between economic growth and bank profitability. Therefore, Table 4.9 demonstrates a significant positive relationship between economic growth and bank profitability at 5% level of significance. An increase in GDP growth rate will lead to a 0,07% increase in bank profitability. These results are in line with the findings of Booyens et al. (2018) in their study.

According to Sufian & Chong (2008), the GDP growth rate has a huge impact on the supply and demand of loans and deposits. When the economy expands, the demand for loans increases, which in turn increases profitability for the banks (Dietrich & Wanzenried, 2011). In the context of South Africa, a study by Kana (2017) found a positive correlation between GDP and bank profitability, emphasising that high economic growth increases the demand for interest-bearing and non-interest-bearing financial services, subsequently increasing profits. Similarly, Booyens et al. (2018) found the same relationship between the two variables. Mogagabe (2020) also obtained similar results with the support of Makri, Tsagkanos, & Bellas (2014), that a rise in GDP increases the efficiency of assets and therefore increases the return on assets. The positive relationship between economic growth and profitability is consistent with previous literature and empirical evidence (Demirgüç-Kunt & Huizinga, 1999; Anshu & Gakhar, 2019).

4.4 Conclusion

This research examined the relationship between interest rates, credit risk, and profitability of commercial banks in South Africa over a 20-year period from 2002 to 2022. The study was limited to seven listed commercial banks due to data availability constraints.

The findings revealed that interest rates do not have a significant influence on credit risk and profitability of these banks. Instead, bank-specific factors such as bank size and capital adequacy were found to have a significant influence on credit risk. Similarly, profitability was influenced by factors including credit risk, bank size, capital adequacy, and economic growth.

These results suggest that the credit risk and profitability of South African commercial banks are primarily driven by bank-specific factors rather than macroeconomic factors. This implies that bank management has substantial control over the levels of credit risk and profitability.

The positive correlation between profitability and economic growth suggests that South African banks tend to be more profitable under favourable economic conditions.

In conclusion, bank-specific factors play a pivotal role in the credit risk and profitability of commercial banks in South Africa. Therefore, to effectively manage credit risk and enhance profitability, banks should place greater emphasis on these factors.

Chapter 5: Summary and Conclusions

This chapter provides a comprehensive summary and conclusion based on the results obtained from Chapter 4 and the overall research. It synthesises the key findings and insights derived from the analysis of the relationship between interest rates, credit risk and profitability of commercial banks in South Africa. Additionally, this section offers reflections on the implications of these findings for the banking sector and presents avenues for future research.

5.1 Research Problem and Purpose

According to the SARB (2023a), credit risk, as measured by non-performing loans ratio, has been increasing in South Africa. This upward trend is often attributed to high-interest rates (Munyai,2010), which in turn reduces borrowers' capacity to repay their loans (Tanasković & Jandrić, 2015). This research aimed to determine the relationship between interest rates, credit risk and profitability of commercial banks in South Africa. Three objectives were explored to examine and understand the relationship between interest rates, credit risk and profitability of banks in South Africa. The first objective was to investigate the effect of interest rates on credit risk of banks in South Africa. The second objective was to investigate the effect of interest rates on profitability of banks in South Africa. The final objective was to examine the effect of credit risk on profitability of banks in South Africa.

5.2 Summary of Results

The below provides a comprehensive overview of the key findings obtained from the analysis conducted to explore the relationship between interest rates, credit risk and profitability of commercial banks in South Africa.

The effect of interest rates on credit risk (Objective 1).

The correlation analysis indicated a non-linear relationship between interest rates and credit risk, a finding supported by regression analysis which showed an insignificant relationship between interest rates and credit risk. This suggests that there is no general support for the idea that changes in interest rates significantly influence the credit risk of banks in South Africa. However, the regression analysis revealed that the credit risk of South African banks is strongly influenced by other factors such as bank size and capital adequacy.

The effect of interest rates on profitability (Objective 2).

Correlation analysis suggested a weak positive linear relationship between interest rates and profitability. However, regression analysis indicated a positive but insignificant relationship. This implies that there is no general support for the notion that changes in interest rates

meaningfully influence the profitability of banks in South Africa. Nevertheless, the regression analysis showed that the profitability of South African banks is significantly influenced by other factors such as bank size and capital adequacy.

The effect of credit risk on profitability (Objective 3).

The correlation analysis revealed a very strong positive linear relationship between credit risk and profitability, a finding supported by regression results showing a significant positive relationship between credit risk and profitability at the 1% level of significance. This indicates that credit risk is a significant determinant of bank profitability in South Africa. Additionally, the regression analysis established that the profitability of banks in South Africa is significantly influenced by capital adequacy, bank size, and economic growth.

5.3 Implications and Recommendations

Implications

The positive relationship between bank size, capital adequacy, and credit risk indicates that as banks expand and enhance their capital adequacy, they may also face an increase in credit risk. This might be a result of larger banks engaging in riskier investments or extending more loans to clients. Hence, South African banks need to be cautious when expanding their operations and ensure the implementation of robust risk management strategies to mitigate credit risk.

With regard to credit risk as a primary independent variable, a positive relationship was observed between bank profitability, credit risk, and economic growth, while profitability and bank size had a negative relationship. However, when interest rates were the focus independent variable, bank profitability showed a positive relationship with bank size, capital adequacy, and economic growth. This suggests that investors could potentially earn higher returns from banks that have higher credit risk, are larger, have higher capital adequacy, and operate in an economically growing environment. However, the dual relationship between bank size and profitability implies that there could be an optimal size for banks to maximise profitability.

The lack of interest rates having an impact on credit risk and profitability on the seven listed banks included in the study, indicates that changes in monetary policy may not directly affect credit risk and the profitability of banks. Therefore, regulators may need to explore alternative macroprudential tools to effectively manage the stability of the banking sector.

Recommendations

Enhanced Risk Management

As banks grow and enhance their capital adequacy, they should also strengthen their risk management strategies. This may involve implementing stricter credit assessment procedures and regularly monitoring their risk profiles. This recommendation aligns with Mogagabe's (2020) recommendation. Additionally, consistent monitoring and assessment of key performance indicators, such as interest rates, credit risk and profitability, are vital for identification and management of risks and opportunities.

Investment Strategies

Investors should consider the positive relationship between credit risk and profitability when making investment decisions, as high profits in the banking sector may be associated with high credit risk. They should also be aware of the potential risks that may arise due to high credit risk levels before they invest in banks.

Regulatory Frameworks

Policymakers should take into account the findings of this study when formulating and enforcing regulatory frameworks. They may need to prioritise bank-specific variables over broader macroeconomic indicators such as interest rates. This recommendation is also supported by a study conducted by Kana (2017).

Capital Adequacy Management

It is essential for banks to keep sufficient capital reserves to effectively handle credit risk and maintain profitability (Rehman et al., 2019).

Aligning Economic Policies

Policymakers should coordinate monetary and fiscal policies with the goal of enhancing economic growth, thereby creating a favourable environment for the profitability of the banking sector. A conducive economic environment is beneficial for borrowers as they are better positioned to repay their loans. Such alignment will also contribute to maintaining financial stability in the economy, considering the significant role banks play in the economy. This recommendation is in line with suggestions made by Ćurak et al. (2017).

Investing in Advanced Technology

Investing in advanced technological infrastructure can boost operational efficiency, especially for larger banks, leading to improved profitability (Boahene et al, 2012).

5.4 Limitations and areas for further study

Limitations

Despite the valuable insights gained from this study, there are several limitations that should be noted:

- The study only used Return on Assets (ROA) as a measure of profitability. Future research could consider other measures such as Return on Equity (ROE) and net margins to provide a more comprehensive analysis of profitability.
- The research did not include all potential bank-specific, macroeconomic, and industry-specific factors that could impact credit risk and profitability.
- The research was limited to listed banks due to data constraints, which may limit the applicability of the findings to all banks in South Africa.
- The research did not test for causality among the variables.
- The research was based on data from only seven listed banks over a period from 2002 to 2022, which may not capture all trends or fluctuations.

Areas for further study

The following areas in the context of South Africa could be explored in future research:

- Future research could investigate the relationship between interest rates, credit risk, and profitability using different proxies for these variables.
- Future research could include more bank-specific, macroeconomic, and industry-specific variables to provide a more comprehensive understanding of the factors affecting credit risk and profitability.
- Additional research could be conducted to determine the ideal bank size that optimises profitability while minimising credit risk.
- Future research could investigate the impact of technological innovation, such as fintech developments, on banking sector dynamics and profitability.

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