ANALYSING THE EFFECTS OF INTEREST RATE AND RESERVE REQUIREMENT RATIO ON BANK CREDIT RISK IN NAMIBIA

BY

AILI ANDREAS

9702571

A THESIS

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN ECONOMICS

AT

THE UNIVERSITY OF NAMIBIA

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SUPERVISOR: PROF. J P S SHEEFENI

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DECLARATION

I Aili Andreas declare that the entirety of the work contained therein is my own original work that I am the owner of the copy right thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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ABSTRACT

The study assessed the effect of monetary policy instruments (interest rates and reserve requirements) on banking institutions risk, measured in terms of non-performing loans. The study used quarterly data from Bank of Namibia from 2001Q1 to 2017Q3. The study employed the Autoregressive Distributive Lag (ARDL) lag model to determine the effects. Since the reserve requirements is seldom used in Namibia and ever kept at one percent of the bank's total liabilities to the public, it was considered dormant. Therefore, shocking the reserves requirements up-or down-wards is not plausible in the Namibian economy. The variables considered are non-performing loans (NPL), as a dependent variable and interest rates (I), banks tier I capital (CA), banks' total assets (TA), gross domestic product (GDP), and private credit extension (CR); as the explanatory variables. The results indicate that there is a short run negative effect between interest rates and bank risk, which implies that the low rate would increase the bank's non-performing loans. The negative relationship indicates that low inflation or price stability does not guarantee financial stability in the economy. The Granger causality results indicate non-causality between interest rates and bank risk, but interest rates Granger cause economic growth and private sector credit that have a direct effect to bank risks.

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LIST OF ACRONYMS

ADF	:	Augmented Dickey-Fuller
ARDL	:	Autoregressive Distributive Lag
BID-2	:	Determination on Asset Classification, Suspension of Interest and Provisioning
BoN`	:	Bank of Namibia
CA	:	Tier I capital
CAMELS	:	Capital, Asset Quality, Management Adequacy, Earnings, Liquidity Management and sensitivity to market rates
CR	:	Private Credit Extension
FSR	:	Financial Stability Report
GDP	:	Gross Domestic Product
I	:	Interest Rates
IMF	:	International Monetary Fund
RR	:	Reserve Requirements
SARB	:	South Africa Reserve Bank
SREP	:	Supervisory Review and Evaluation Process
TA	:	Banks' total assets

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CHAPTER ONE: INTRODUCTION

1.1. Background to the study

As stipulated by Matemilola, Bany-Ariffin & Muhttar (2015), after the global crisis, monetary policy is regarded as an effective tool of stabilizing the economy and promotes economic growth in terms of aggregate demand, investment and output. On the contrary, Geng, Grivoyannis, Hang and He (2016) state that low interest rates lead to excessive credit expansion which results in the financial imbalances and economic fluctuations due to excessive credit expansion. Many central banks have adopted a policy of low interest rate to restore the economy from recession after a bust of the dot-com bubble.

Geng et al. (2016) further stated that although it is difficult to state that expansionary monetary policy is the root cause of the 2008 global financial crisis, it has contributed to such effect. Since the global financial crisis, the impact of expansionary monetary policy or low interest rate has become a focal point of debate in theory and practice. Therefore, it is crucial for economists to make a conclusive analysis of the monetary policy effect when drawing up their macro prudential management framework because it affects the level and dispersion of impaired assets and banking profitability (Geng & Zhai, 2015; Gizycki, 2001).

Namibia and most economies usually use interest rate as a standard one-monetary instrument to influence their economic performances. In August 2017, Bank of Namibia (BoN) cut interest rates by 0.25% to 6.75% in order to boost economic growth. During the Monetary Policy Committee announcement, BoN Deputy Governor stated that low interest rates can benefit Namibians when the commercial banks decides to pass-on the benefit to its clients through reduced monthly installments when servicing their loans. The benefit of expansionary monetary

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policy was seconded by Geng and Zhai (2015), who state that, low interest rates and reserve requirements ease economic recession.

The Bank of China made a frequent adjustment on the interest rate (price-based instrument) and reserve requirement ratio (quantitative instrument) simultaneously to achieve its macroeconomic goals and objectives. However, it is still unclear whether the effects of interest rates and reserve requirements are the same on the bank risks (Geng et al, 2016).

Geng and Zhai (2015) state that many central banks preferred the expansionary monetary policy, which is associated with low interest rates and low reserve requirements ratio to ease recession. Conversely, there is a risk of running a consistent expansionary monetary policy because continuous low interest rates can increase the asset price, securitized credit and push financial entities to take more risk.

According to Glocker and Towbin (2011), the emerging economies are mostly reluctant to increase interest rate in order to cease credit booms. This is because high interest rates lead to more capital inflows and appreciation of the currency. In particular, high interest rates make it expensive for the borrowers to access bank credit. High interest rates increase information asymmetry, which drives away the good borrowers from the market and leave risk lovers, which eventually leads to adverse selection and moral hazard problems (Beutler, Bichsel, Bruhin & Danton, 2017).

The reserve requirement ratio is a percentage of banks' deposits that is required by law to be kept with the central bank (Feinman, Descher & Hinkelman, 1993). The flat rate of the reserve requirement is used to control the amount of money that the bank is able to extend for credit. The increases in reserve requirement ratio serves as an implicit tax on the banking sector and widen

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the gap between the deposit and lending rates. Therefore, the high reserve requirements ratio, results in high interest rates and less loanable funds (Glocker & Towbin, 2011).

The central banks of many emerging countries use the interest rate and reserve requirements as monetary policy instruments. The two instruments have different effects on bank risk. For instance, the interest rate can affect the bank risks through the channels of asset valuation, search for yields, asset substitution, constant leverage, central bank communication, asset-liability mismatch and the habit formation while the reserve requirements affect bank risk through liquidity and cost channel (Geng & Zhai, 2015; Alper, Binci, Demiralp, Kara & Ozlu, 2016).

Interest rate can also affect the bank risk through the search of yield. Low interest rates can reduce the bank's revenue, which incentivize banks to invest in risk areas or other financial instruments (International Monetary Fund (IMF), (2017). Therefore, search of yield by commercial banks can lead to a low proportion of safe assets in the banks' portfolio. The commercial banks' objective is to maximize profit and with low interest rate, banks target a constant leverage ratio. The European Central Bank (2017) defines the leverage ratio as a core capital (Tier I capital) over banks' total exposures of both the on-balance and off-balance sheet items. The low interest rate can boost the values of the banks' assets. An increase in the banks' equity due to low interest rate will increase the banks' appetite for risk asset for high returns. This act is very fragile to the banking system as it negatively exposes the system to riskier and asset value shocks (Geng & Zhai, 2015).

Geng and Zhai, (2015) state that the interest rate can affect the bank risk through the central bank communication and habit formation channel. With credible and transparency banking regulations, low interest rates will induce moral hazard effect. The low interest rate signifies a

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loose monetary policy and regulatory environment, which stimulate banks to take on risky projects. The habit formation channel is when the low interest rates induce investors to consume more and invest in high-risk projects or financial instrument, which results in higher bank risk.

The reserve requirements variations affect the bank risk through the liquidity and the cost channel. The low interest rates increase the banks' liquidity and loanable funds while the increase in reserve requirements cause a contraction. The cost effect is when the reserve requirements affect the banking financials through the implicit tax on the financial system. The low reserve requirements imply that there is a low implicit tax on the banking system and banks are having excessive funds to lend the investors (Alper et al, 2016).

1.1.1 Financial industry performance in Namibia

The effect of global financial crisis, which affected the emerging and development economies was also witnessed in Namibia. During the year 2007, Namibia's economic growth slowed down to 3.8% from 4.1% witnessed from the preceding year. The negative economic growth was associated with the negative effect of the US subprime mortgage market that affected the global activities including the Namibian commodity demand. Due to economic slowdown during the period, Namibia experienced persistent inflationary pressure due to high food prices and high fluctuation in oil prices. To curb the situation, the Bank of Namibia responded through monetary policy tightening by raising interest rates by 150 basis points in 2007, which moderated credit extension especially during the second quarter (Bank of Namibia, 2007).

Despite the economic effect from financial crisis, the Namibian financial system remains resilient, sound and profitable. The banking and non-financial institutions remain well capitalized with the non-performing loans (NPL) ratio of 1.5% (Bank of Namibia, 2017).

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Although, the financial system is still facing potential risks that can harm financial stability if left un-monitored. According to the Bank of Namibia (2017), the risks to the Namibian financial system got well absorbed in 2016 compared to year 2015. Furthermore, the increase in US interest rate has a positive effect to the global economy, more specifically to commodity producing countries. The volatility in the global economy is a major concern given the negative development of Namibia downgraded by the credit rating agencies (Bank of Namibia, 2017).

Bank of Namibia is using the combination of an off-site capital adequacy, asset management, management quality, earnings, liquidity adequacy and sensitivity to market risk (CAMELS) assessment and on-site Supervisory Review and Evaluation Process (SREP) risk assessment methodology to analyze and measure the financial performance of the banks. The CAMELS assessment is used to measure banking institutions' financial performance. On the other hand, SREP provides senior management with an effective overall view of the current risk profile of banking groups (IMF, 2018). Ahsan (2016) defined the components of CAMELS as follows:

Capital adequacy

The banking institution need to hold sufficient capital to enable it to understand and absorb the shocks that hit the market. The capital adequacy is measured by the equity over total assets ratio of the bank, which enables the bank to meet financial unexpected condition due to foreign exchange (forex) risk, credit risk, market risk and interest rate risk. The banks are required to hold sufficient capital to protect the depositors' interest.

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Asset Quality

The asset quality dimension is an important aspect for the bank to understand the risk on the debtors' exposure. The asset quality is measured by NPL ratio, which is the total non-performing loans over total loans. The ratio will also help the bank to ensure that they keep sufficient funds to cover bad investment. In Namibia, the Determination on Asset Classification, Suspension of Interest and Provisioning (BID-2) require banks to reserve funds depending on the loans and advances classification category.

The loans and advances are classified into five categories namely: a) Pass (those asset sound and performing according to the contractual terms); b) Special Mention (assets that are fully protected but exhibit potential weaknesses and are overdue by 60 days but less than 90 days); c) Substandard (assets that are overdue by 90 days but less than 180 days); d) Doubtful (assets that are overdue by 180 days but less than 360 days) and; e) Loss (are the assets that overdue by 360 days and are required to be written off within 90 days). BID-2 stipulates the minimum provisioning amounts to be maintained by the bank depending on the asset category as stipulated in Table 1.1.

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Table 1. 1: Asset Classifications

Loans graded category	Provisioning percentage of total loans
Pass	1%
Special mention	2%
Substandard	10%
Doubtful	50%
Loss	100%

Source: BID-2

Management Quality

Management quality is measured by total cost to total income of the bank, which reflects the management soundness of a bank. The quality and skillful of the bank's management can safeguard the operation of the bank in a smooth and decent manner, which result in high banking profit.

Earnings Quality

The earning quality of the bank measures the profitability and productivity that can enable the institutions to be competitive and remain in business. Banks can only maintain adequate capital, paying dividends, providing investment opportunities and maintaining competitive outlook depending to its earning quality. The ratios used to measure the banks' profitability are return on assets (ROA) and return on equity (ROE).

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Liquidity Performance

According to Hazzi and Kilani (2013), the liquidity performance of the bank is measured by the liquidity ratio, that indicating the ability to pay the obligations when they become due. The banks liquid assets are cash and investments, which are easily convertible at a lower cost and failure to maintain adequate liquidity will lead to a bank-run.

1.2. Statement of the problem

The commercial bank risks are posing a big threat to the financial system, due to monetary policy variations, which required a detailed and effective macro prudential management framework. The monetary policy authority (Central Bank) normally uses the interest rate as a monetary policy tool for economic management (Geng et al, 2016). In Namibia, the Central Bank influences short-term interest rate to affect money supply, credit extension to achieve the macroeconomic objectives. Other monetary policy tools like reserve requirements ratio with the same effect is seldom used (Bank of Namibia, 2008). Although, expansionary monetary policy will enhance cheap borrowing and high consumption due to high money multiplier in the economy, low interest rate and reserve requirements, can also be a potential threat to banks' financial performances and hence, bank risks (Wang, 2017). Therefore, this study intends to investigate the impact of interest rate and reserve requirements on bank risk in Namibia.

1.3. Objective of the study

The main objective of the study is to analyze the effect of interest rate and reserve requirements on the banks' risk. The specific objectives are:

- To investigate whether the relationship between bank risk and monetary policy instruments (interest rate and reserve requirements) is of short-run or long-run nature.

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- To investigate whether the relationship between bank risk and monetary policy instruments (interest rate and reserve requirements) is of short-run or long-run nature.

- To determine which of the two variables (interest rate and reserve requirements) significantly affect bank risk.

1.4. Research hypothesis

- H_O: There is no short-run relationship between banks' risk and monetary policy instruments (interest rate and reserve requirements).
- H_I: There is a short-run relationship between banks' risk and monetary policy instruments (interest rate and reserve requirements)
- H_O: There is no long-run relationship between banks' risk and monetary policy instruments (interest rate and reserve requirements).
- H_I: There is a long-run relationship between banks' risk and monetary policy instruments (interest rate and reserve requirements)
- H_O: The monetary policy instruments (interest rate and reserve requirements) do not significantly affect banks' risk.
- H_I: The monetary policy instruments (interest rate and reserve requirements) do significantly affect banks' risk.

1.5. Significant of the study

The study is important as it is hoped that it would provide another perspective of the monetary policy instruments' effect to bank risks other than to the macroeconomic broad goals of price stability (inflation), employment and economic growth. Further, most studies have addressed the effect of interest rate to either economic growth or inflation but studies on reserve requirements and interest rates on bank risks are very limited.

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1.6. Limitation of the study

The study focused on four main commercial banks in Namibia because other banking institutions are still at the infant stage. The inclusion of the small banks in the study would distort the results because they are not comparable.

1.7. Delimitation of the study

The scope of this study covered the effects of interest rate and reserve requirements on the commercial bank risks in Namibia. This study covered the quarterly period from 2000 to 2016, which represent the banking industry in Namibia.

1.8. Chapters outline

This paper consists of six chapters. Chapter 1 provides the background of the study, statement of the problem, objective of the study, research hypothesis, significant of the study, limitation of the study and delimitation of the study. Chapter 2 presents the overview of the macroeconomic variables in relation to banking sector performance in Namibia. Chapter 3 provides the theoretical and empirical literature review. Chapter 4 states the methodology employed in the paper. Chapter 5 provides the findings and chapter 6 summarizes, concludes and provides recommendations.

1.6. Limitation of the study

The study focused on four main commercial banks in Namibia because other banking institutions are still at the infant stage. The inclusion of the small banks in the study would distort the results because they are not comparable.

1.7. Delimitation of the study

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CHAPTER TWO: OVERVIEW OF THE MACROECONOMIC VARIABLES IN RELATION TO BANKING SECTOR PERFORMANCE IN NAMIBIA

2.1. Introduction

The chapter on overview of the macroeconomic variables used in this study provides the behavioral trend analysis over the years of the variables used in the study and the justification of selecting such variables. The purpose was to analyze the effect of the macroeconomic variable to microeconomic variables on the banking sector risk in Namibia.

2.2. Non-Performing Loans

As stated in the previous chapter, non-performing loans are classified as assets overdue for 360 days. The non-performing loans (NPL) can affect the performance of the bank and increase the risk on bank run because the bank is unable to generate income to conduct banking business. The NPL was above N$500 million in the early quarter of 2001 but declined in the third quarter and early quarter of the year 2003. During the year 2007, the non-performing loans in absolute value shoot up to reach the N$1.0 billion in 2009. However, the non-performing loans start to decline from the year 2010 before it start hiking up as from the year 2015 to $2.0 billion in 2017. This is shown in Figure 2.1.

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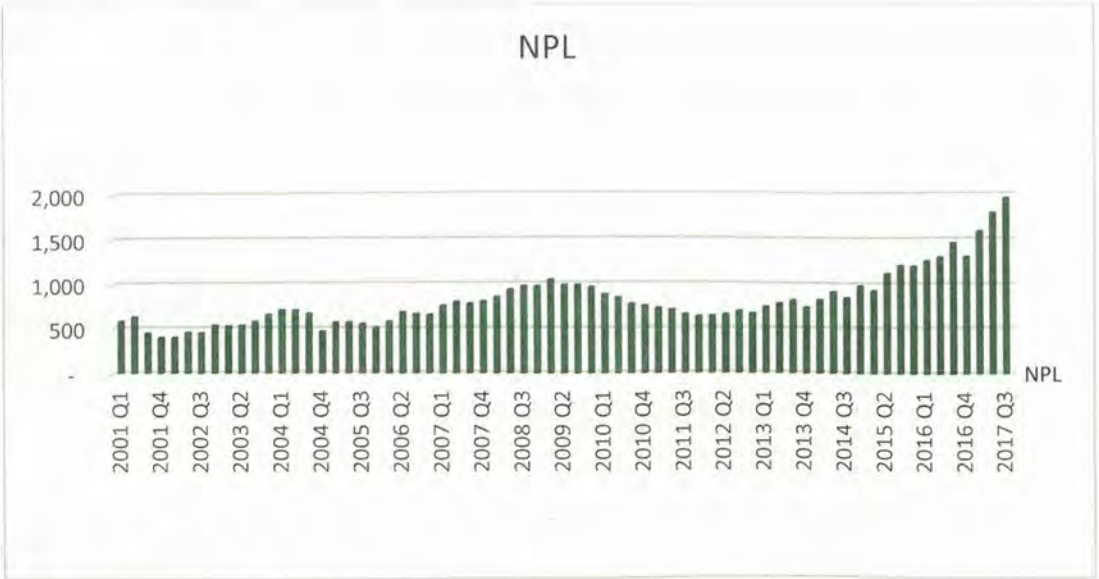
Figure 2. 1 Non-performing loans trend



Source: BoN

2.3. Monetary policy instruments

According to South Africa Reserve Bank (SARB) (2007), interest rates are the prices for loanable funds. The interest rates determine prices of funds to be invested, funds to loan out to borrowers at any specific period. The central bank influences the lending rate of commercial banks through repo rate, which implies that if repo rate increases it will be expensive for the commercial banks to get repo funds. The repo system is the borrowing and repurchasing transaction system, which involves the temporary sale of a financial asset by the bank (borrower) to obtain the needed cash from the lender (central bank). The repo rate is regarded as a benchmark of the short-term interest rate, which implies that if the repo rate increases, the bank will react by increasing the prime rate. As a result, banks will pass the additional cost through to consumers.

As depicted in Figure 2.2, the graph is showing a positive relationship between repo rate and prime rate. However, the reserve requirement is stagnant over the years at 1.0%. This is an

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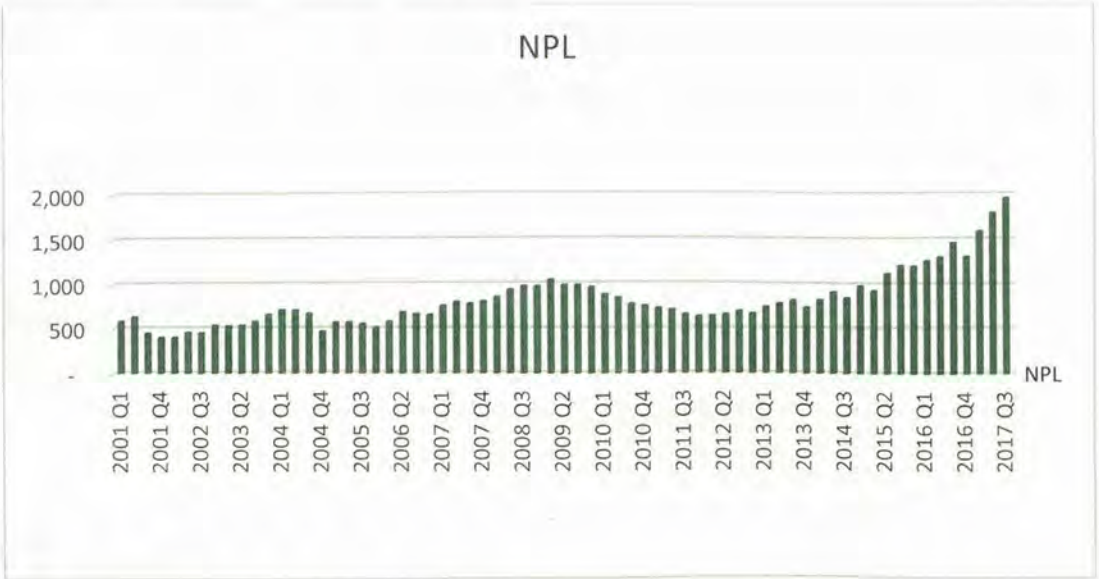

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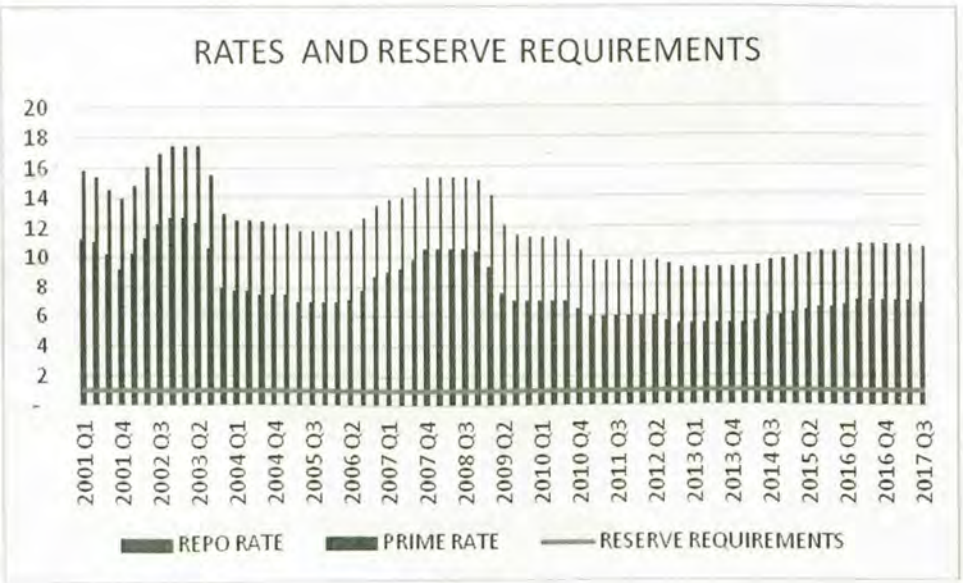
indication that it is seldom used in Namibia. However, comparing the movement between interest rates and NPL, presents an ambiguous result. Interest rates are very low from the year 2011 to 2017 compared to early 2000, but NPL is very high in those years where interest rate seems to be low.

Figure 2. 2: Monetary policy instruments



Source: Author's construct using BoN data

2.4. Total Assets

The total assets component of the banking institution is made up of cash and balances, short-term negotiable securities, loans and advances, trading and investment securities, fixed assets (property, plant and equipment) and other assets. Despite the various assets' components, the loans and advances are the major components in the banking business. Since interest rates determine the price of loanable funds, the trend analysis can be done in relation to interest rate movement. Figure 2.3 indicates an increase in total assets over the years reaching N$100.0 billion as from the first quarter 2016 on-wards. In comparison to the movement of interest rates,

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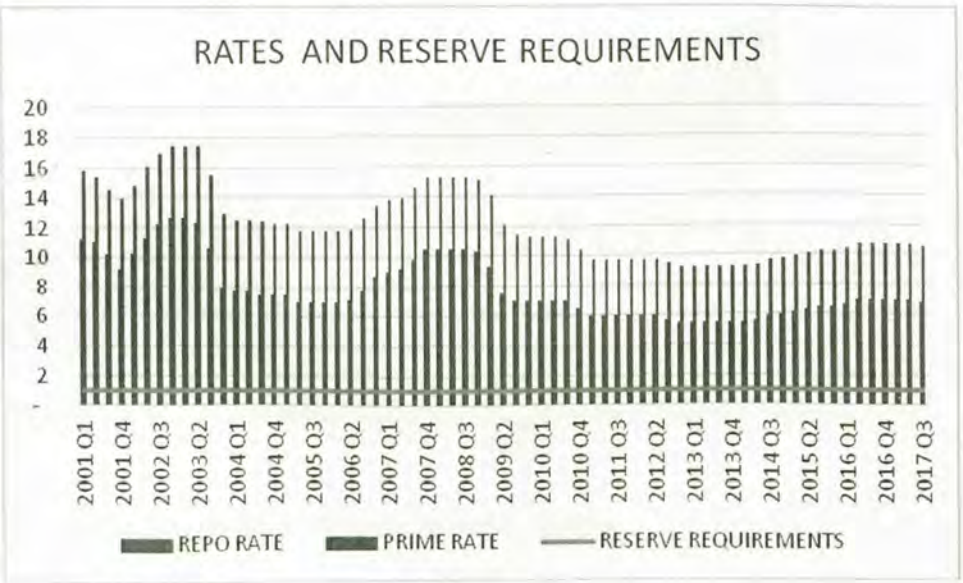

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it shows a negative relationship, which implies that banks tend to lend more when interest rates are low.

Figure 2. 3: Total assets

Source: Author's construct using BoN aggregated industry returns data

2.5. Gross Domestic Product at market prices

The gross domestic product (GDP) is the total expenditures for all final goods and services produced within the country in a specific period of time. Figure 2.4 shows how the GDP of Namibia performed over the years. As other variables, the GDP for Namibia increased gradually to reach N$220.0 billion from the year 2014. However, the picture is not clear as to whether variation in interest rates has an effect on GDP at market prices.

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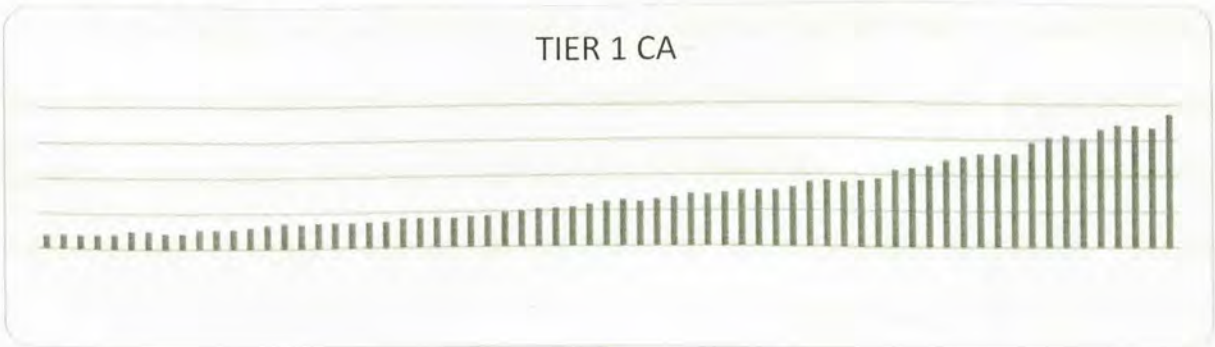
Figure 2. 4: GDP at market prices

Source: Author's construct using data from BoN

2.6. Tier 1 Capital

Tier 1 capital is the core capital that banks use as a cushion to absorb the losses that hits the market. Figure 2.5 shows Tier 1 capital of the banking institutions in Namibia, which increased gradually above N$9.0 billion in 2017. Although the NPL also increased gradually, banking institutions seems to be adequately capitalized to absorb losses.

Figure 2. 5: Tier 1 Capital



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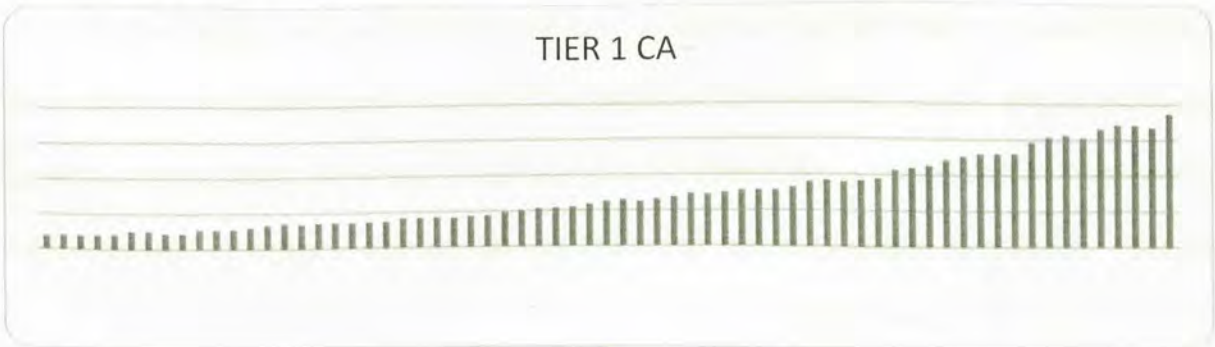

Source: Author's construct using BoN aggregated industry data

2.7. Private Sector Credit

The private sector credit extension is the macroeconomic variable, which includes the credit extension of both banks and non-banks financial institutions. Figure 2.6 is indicating a positive trend.

Figure 2. 6: Private Credit extension

Source: Author's construct using BoN database

2.8. Conclusion

This chapter looked at the trends of the variables of interest using the quarterly data of the period from 2001 to the third quarter of 2017. The trends of the variables' studies depict the positive growth over the years. However, it still not clear whether there is a direct effect between bank risk, measured in terms of non-performing loans and monetary policy instruments. Therefore,

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further analysis is required to study the effects thereof. The next chapter looks at both theoretical and empirical literature on the effect of monetary policy instruments to bank risks.

CHAPTER THREE: LITERATURE REVIEW

3.1. Introduction

This chapter outlines different views of various authors regarding the effect of monetary policy instruments on bank risk. The chapter presents both the theoretical and empirical views by several authors regarding the effect of monetary policy into bank risks as discussed in sections 3.2 and 3.3 respectively.

3.2. Theoretical Literature

According to Dell'Ariccia, Laeen & Saurez (2016), the financial crisis initiates the debate on the effect of interest rate to bank risk taking. The effect of interest rate to bank risks is also known as monetary policy's risk-taking channel that affects the quality and quantity of bank credit. Some authors like Geng et al. (2016) hold views that too low interest rates for a persistent time-period can also be a root cause of financial crises. The persistent soft monetary policy (low interest rate) can spur financial crisis to the economy through asset price boom, spurring banking institutions and other financial intermediaries to increase leverage and excessive or uncalculated risks (Dell'Ariccia et al., 2016). The interest rate movements can expose banks to risks because of the differential maturity mis-match of their assets and liabilities. Beutler, Bichsel, Bruhin & Danton (2017), state that the banks are adversely affected by interest rate movements because on average, their fixed assets are locked in the long-term period compared to their liabilities. Due to assets and liabilities mis-match, the banks experience loss in economic value because assets

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values decrease more than the value of liabilities, which also affect bank lending. The economic value of a bank's assets, liabilities and off-balance sheet instruments is affected by interest rate due to adjustments in the discount rates that affect the present value of the future cash-flow (Beutler et al., 2017).

According to Beutler et al. (2017), the theoretical literature on the transmission of monetary policy states that interest rate risk exposure makes a bank lending more sensitive to changes in nominal interest rates. However, Dell'Ariccia, (2016) state that the monetary theories offer ambiguous relationship of the effect of real interest rates and bank risk. The traditional portfolio models predict that an increase in interest rates will reduce risk taking because higher interest rates on safer assets will cause a reallocation from riskier securities. However, a high risk-free rate may also raise a hurdle rate for investment and make agents to cut projects that have low returns or high risk. Prior to the financial crisis, reserve requirements rates were seldom used as monetary policy instrument to control financial and price stability in both developed and developing countries. However, the magnitude of the size and volatility of capital into the emerging market following the financial crisis that post a financial and macroeconomic stability challenges revive the use of reserve requirement ratio to restore the stability. Due to the financial crisis, the emerging economies experience high volatility in exchange rates and credit growth.

The standard reaction of many developing countries was to keep the policy rates at a lower level needed to avoid excessive appreciation of the domestic currency and tightening macro prudential to curb excessive credit growth (Alper, Binici, Dmiralp, Kara & Ozlu, 2014). Since 2002, the Inflation Targeting regime was commonly used in Peru. The central bank implements the policy

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by setting a reference interbank interest rate and uses open market operation to keep the interbank rate at a reference level, given the reserve requirements rates. However, after the financial crisis, the central bank began to use the reserve requirements rate for both domestic and foreign currency banking liabilities for monetary policy control in order to fight undue credit growth (Pérez-Forero & Vega, 2015). .

The financial crisis intensified the strength of macro prudential policy in mitigating systemic risks. The macro prudential policy can address the evolution and distribution of system-wide risk in the financial sector over a given period during economic down or upswings. Due to economic fluctuations over period, financial sectors can be overexposed to aggregate risk, which requires them to build up capital buffers needed during downturns. During the economic upswings, the banking sectors tend to lend more, experience rapid hike in asset prices, high leverage and maturity mismatch which require them to build up sufficient capital during good times to prevent widespread financial distress. Due to economic upswings, banks are more exposed to agency problem when the macroeconomic policy instruments (interest rates and reserve requirements) are high and their intermediations are more compressed (Dell'Ariccia et al., 2016).

Altunbas, Gambacorta & Marques-Ibanez (2010), state that many central banks lower their interest rates after the crisis to ward off the recession. The reason to lower interest rate was engineered by myth that the end-results will be consistent with the inflation-targeting objectives. Prior the global crisis, the monetary policy implications on financial imbalances and financial stability was underestimated. However, loose monetary policy demonstrated by low interest rates and reserve requirements can create excess liquidity in the market. The excess liquidity can be

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root cause of financial instability as it encourages banks to take excessive risk. The low interest rate can affect bank risk through valuations, incomes and cash flows, which complicates the way banks' methodology of measuring risk. Further, the low rate can lead to low returns in investment such as government securities and low cost of borrowing which agitated both borrowers and investors to take excessive risk.

Masurov, (2012), state that the financial crisis has attracted much attention from the agents of economy like monetary policy authorities, politicians, members of professional communities and media representatives. The crisis brought large scale expenses in all sectors of the economy which necessitate the development of new risk management framework within the financial sectors. The authorities developed the early warning indicators to give signals when the banking institutions performances worsen. The authorities use tools to limit certain effects associated with accumulation of risks and those reducing the incentives for banking institutions to take excessive risks.

According to Janvisloo, Muhammad & Hassan (2013), the development and expansion of financial institutions and the global crisis led to a close linkage between economic conditions and the banks' operations. Due to negative effects erupted from financial crisis, countries or economies start examining the relationship between the macroeconomic variables and banks' behavior and operations. The banking institutions do have a crucial role to play in the transmission of monetary policy, which necessitate the need for the economists to study and understand the relationships. The negative effects from financial crises of 1997 led to financial restructuring in many emerging economies such as Malaysia. Due to negative effects from

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financial crisis, many big firms shifted their funds from banking systems to established stock and bond markets. The movement of big firms' funds to stock and bond market has shaken the banks' profitability. To remain in business, banks begin to attract new customers such as Small and Medium Size Enterprises and household sectors. However, SMEs established by bank loans are very fragile, which exposed the banking sectors to macroeconomic volatility shocks. The macroeconomic shocks can affect the profit of SMEs, which will affect the banks' performance directly or indirectly through default or credit risks.

Altunbas, Gambacorta & Marqués-Ibáñez (2010), state that it is difficult to measure the impact of low interest rate on bank risk-taking. The main challenge is to separate the effects of changes in monetary policy rates on the risk of outstanding loans and the bank's incentive to take on new loans. The reduction on interest rate has varying effects. The positive effect is when low interest rate causes a positive direct effect on lending portfolio or when the default rates decline. However, low interest rate can also have a negative effect especially when they are below the benchmark as it leads to search of yield, which increase the new way of risk taking. The various ways that interest rates influence bank risk-taking are through valuations, income, cash flows and incorrectly measuring of risk. Assets and collateral values increase when monetary policy rates are low which influences banks to incorrectly estimate the probabilities of default, loss given default and asset price volatilities. High asset prices increase the value of equity, which lead to adjustments in bank balance sheets and leverage conditions. The other channel that low interest rates affect bank risk-taking is thorough returns on investments especially government bonds that might increase incentives for financial institutions including banks to take on more risks for behavioral, contractual and institutional reasons. The banks may take excessive risks in search

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of yield and ignore the fact that the interest rate may decline for a short period to compensate for low inflation. Due to search of yield, banks may invest in high risk instruments. Furthermore, the corporate may only invest in a short-time bucket while studying or judging the manager competence. The wholesale funding is very volatile, as the corporate may withdraw their funds instantly upon poor performance, which may cause the banks' liquidity crisis. The other effect of monetary policy on bank risk-taking may be through habit formation. The risk-averse is relaxed during economic expansion since investors' consumption increases relative to normal levels. Therefore, monetary expansion may increase real economic activity in relation to risk-averse. Finally, the central bank communication policies as well as the policy makers' reaction functions may influence investors' and banks' risk-taking. The predictability of central bank monetary policy decision may increase moral hazard. Therefore, the central bank is encouraged to maintain tight monetary policy during good economic conditions to reduce banks' incentive of taking excessive liquidity risk.

3.3. Empirical Literature

To determine the relationship between the bank risks, authors such as Wilson (1997), study the relationship of probability of default of financial institutions with the set of macroeconomic variables under a stressed condition.

To address the issue, Altunbas, Gambacorta & Marques-Ibanez (2010), considered the quarterly change in the monetary policy rate and deviation of interest rate from a benchmark level, using data from Bloomberg during the period of 1998 to 2008, to evaluate the monetary policy stance. They used the country specific benchmark measures of the difference between the actual nominal short-term interest rate and that generated by a 'Taylor rule' with interest rate smoothing (TGAP); the difference between the actual nominal short-term interest rate and that generated by

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a standard "Taylor rule", using equal weights on output and inflation and no interest rate smoothing (TGAP2); and the difference between the real short-term interest rate and the "natural interest rate" (NRGAP), calculated using the Hodrick-Prescott filter. The study found that the effects of changes in the short term monetary policy rate on banks' risk are positive, ceteris paribus. This implied that the overall quality of a loan portfolio increases (banks' EDFs decrease) if interest rates are lowered. The drop in the EDF seems to be reinforced by the reduction in bank funding liquidity cost after a decline in interest rate. Furthermore, the coefficient to TGAP variable were negative and significant consistent with the risk-taking channel that if interest rate is below the benchmark rate, banks tend to take more risks. The study revealed that if the interest rate is 100 basis points below the value given by Taylor rule, the probability for the bank to default increases by 0.6 percent after a quarter in the short run while in the long run is by 8.0 percent (Altunbas et al., 2010).

According to Janvisloo (2013), some authors' studies several credit risk models in various risk factor of several macroeconomic situations. The different indicators such as NPL ratio to total assets was used as a credit risk indicator. The studies that used the NPL indicator are called stress testing as they tend to test the healthy condition of banks with shocked variables on risk. This study is called stress testing because it tests the sensitivity of a shocked variable on risk without any interdependence to other risk factors. The other studies used the scenario analysis, where both macroeconomic and financial variables were used to assess the risk. In these studies, the gross domestic product and interest rate has a negative relationship on NPL ratio. Similarly, the unemployment, consumer price index (CPI) and exchange rate has an effect on loan quality.

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Mazreku & Morina (2016) used the stress testing method to draw out the volatility level of bad loans due to stressed macroeconomic terms in their 10% and 20% level. Further, he analysed the changes in the level of non-performing loans in two different scenarios and do the comparisons. The main hypothetical scenario was based on the deterioration of economic condition in Eurozone that reflected by a decline in immigrant transport and export, which decreased output demand in Kosovo. As a result, economic growth decline, output gap widens and quality of loan portfolio declined. The economic growth was assumed to decline with 2.6% in 2015 while output gap widens with 6.0%. The quality of loans portfolio was estimated by considering a coefficient of elasticity of non-performing loans (NPLs) against output gap of 0.822, which implies an increase of 4.8% of NPL on total loans of the banking sector. The real sector shock assumed a constant lending growth on the following year while credit risk was combined with market risks (interest rate and exchange rate risk). The assets interest rates were assumed to decline by 2.0% while interest rates increased by 1.5% due to interbank competitions. Euro was assumed to depreciate by 20% against other currencies while profit assumed to be impacted by insufficient interest income generation due to a decline in lending growth and increase in NPL growth. The expected profit of banks was taken as current for the first half of 2014 while for the second half was shocked with 40.0% to reflect the effect of reduced lending. The study found the banking sector in Kosovo to be well capitalized in June 2015, with a capital adequacy at 18.5%. The asset quality was also good as the non-performing loans in relation to total loans stood at 7.2%. The loans in Kosovo banking sector was well provisioned. Since the banking sector in Kosovo were highly profitable, credit risk was minimal during the stressed conditions. Expected profit was used to absorb losses when NPL increased by 4.8% during the stressed condition, which resulted in a decline of capital adequacy ratio. The capital adequacy ratio declined to 18.2%,

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which was still above the prudential capital ratio of 12% in Kosovo. In the scenario where capital adequacy ratio of any bank fell below the minimum capital requirements of 12%, 0.15 million euro was required for restoration, which was equivalent to 0.003% of the projected GDP for 2015 in Kosovo. In this scenario, the banking sector' NPL reached 12% while the individual banking institution highest NPL was 14.6%.

Futhermore, Başarır (2016), used stress test technique to measure the banking sector vulnerability against a set of hypothetic scenarios or events. The model of macro stress test of credit risk for the banking sector was used based on three scenario analysis. The macroeconomic credit risk model was based on Wilson's CreditPortfolioView of Turkish Banking Sector between the period 1999Q1-2012Q4. Further, the period from 2013Q1-2014Q4 was forecasted using historical simulation analysis. Firstly, the VAR model was used to determine the relationship between the macro variables used. After, the credit risk satellite models were created to determine the relationship between macro variables and non-performing ratio. The study set a framework to test the non-performing loan ratio against some unexpected situation using model scenarios. The study uses historically observed peak level as shocks between the periods of 1999Q1-2012Q4. The study indicated that banking sector was resistant to the similar shocks of 2001 financial crisis. Given the severity of shocks, the NPL only stood at 13% using the assumption of the crisis, compared to 128% that was realized during 2001 crisis. The paper concludes that Turkish banking sector had a strong financial position and effective management to withstand shocks that hit the market.

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some claim that higher interest rates increase bank risk. However, it was observed that the effect of interest rate was rather low on those banks with high capital compared to the banks with more off-balance business. As a result, banks tend to react heterogeneously to interest rate changes, where banks with high capital adequacy and income diversification efficiently absorb the risks hitting the market. In determining the impact of monetary policy instruments on bank risk taking, most studies especially in developed economies used the Ordinary Least Square to study the relationship between interest rates and bank risk. In China, many researchers study the relationship between reserve requirements and bank risk. However, most study found the negative relationship of interest rate or reserve requirements to bank risk.

Geng & Zhai (2015), study employed an ordinary least square and generalized squares methodology to establish the linear model that determines the impact of monetary policy instruments on bank risk in China using data from the last quarter of 2007 to the third quarter of 2013. The Panel Smoothing Transition Regression (PSTR) approach was employed to analyze the effect of interest rates and reserve requirements in bank risks in China and revealed a non-linear relationship between interest rates and bank risks while reserve requirements had an insignificant effect on bank risk.

Further, Geng et al. (2016), studied the effects of interest rates on bank risk in China. The study uses the annual data from the year 2001 to 2012 for 16 listed Chinese banks whose total asset accounts for 65% of the Chinese banking industry in 2012. The sample was made of five large commercial banks, eight joint-stock commercial banks and three city commercial banks obtained from Almanac of China Finance and Banking and the commercial banks' website. They

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constructed three models to investigate the relationship between changes in interest rates and bank risk. The first model used NPL as a dependent variable to establish three panel data regression. The results from the regression, the effect of real GDP growth rate on bank risk were negative and statistically significant. The negative statistically significant relationship indicates the pace which economic development reduces the bank risk. The bank risk decreases during good economic performance that boost up banking business and revenue. During the economic booms, the banks do not need to take uncalculated risk to achieve high revenue. The bank assets were found to have a positive statistically significant effect to bank risks. The positive relationship of total assets to bank risks indicates that banks with larger size of balance sheet have high appetite to engage in risky activities. The negative statistically significant effect was found between capital adequacy ratio and bank risk because high capital curb excessive expansion of risky assets, protect depositors' interests and those of other creditors as well as ensure that banks are stable and operating normally.

Beutler et. al (2017), analyzed interest rate transmission shock on bank lending through the gains and losses of banks' economic capital. The study analysed the effect using the quarterly data for the period between 2001Q2 and 2013Q3 on bank lending, exposure to interest rate risk, capital, liquidity, and balance sheet size from the periodic surveys conducted by the Swiss National Bank (SNB). The sample of this study represented the ideal laboratory of 67 domestically commercial banks. The analysis results were that the impact of an interest rate shock on bank lending were mainly depend on the bank exposure to interest rate risk and the banks that are highly exposed to interest shocks had a negative effect on their lending. Their estimates indicated that a year after a permanent 1% point upward shock in nominal interest rates, yielded on the average banking in

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Adeleke & Awodumi (2018), employed the Autoregressive Distribution Lag estimation technique to study the short- and long- term effects of bank credit supply determinant in Nigeria. The study used annual time series data from 1970-2015 from the Central Bank of Nigeria Statistical Bulletin, 2014 and World Bank's Development Indicators (WDI, 2015 and 2016-online version). The explanatory variable used in this study to determine the effect of bank's credit supply in Nigeria are GDP, Foreign Liabilities (measured in terms of Debt Outstanding), inflation, exchange rate, money supply, interest rate spread and reserve requirements. The empirical findings revealed that exchange rate, money supply, net foreign liabilities and real GDP have positive long-run impact on Nigerian private sector credit. On the other hand, money supply, net foreign liabilities and reserve requirements found to have a short-term effect on bank credit. The effect of interest rate spread was found to be insignificant.

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The efficient operation of commercial banks is important for economic growth, macroeconomic policy implementation, and macro-economic stability, which became prominent after a global financial crisis of 2008. Most countries, including Namibia actively use interest rate to ensure price stability. However, interest rates and other monetary policy should be used simultaneously to achieve both price and financial stability. Geng et al. (2016), state that monetary policy aiming at price stability may not necessarily lead to financial stability and there may be a trade-off. Despite the monetary policy prominence in restoring economic instability, no study was conducted in the past on the impact of monetary instruments on bank risk in Namibia. Therefore, the study is filling the literature gap on the impact of monetary policy instruments variations on bank risks in Namibia.

3.4. Conclusion

The chapter outlined different views on the effect of monetary policy determinants to bank's performance. After the financial crisis, it became evident that price stability does not necessarily lead to financial stability. However, some authors indicated that holding interest rate too low for a persistent period can be a root cause of financial instability. Due to low interest rates, banks tend to increase leverage and take excessive or uncalculated risk in search of yields. Most of the countries both developed and developing were using interest rate as a policy instrument, while reserve requirements seldom used to control financial stability. However, the magnitude of the

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CHAPTER FOUR: RESEARCH METHODS

4.1. Introduction

This chapter outlines the autoregression distributive lag (ARDL) methodology used in this study to determine the effects of interest rates and reserve requirements on bank risks. The chapter gives a detailed description of both theoretical and empirical model specification, and definition and measurement of the variables employed in the model. It also looks at the estimation technique, data sources and data analysis employed. The study employed the macro- prudential theory that analyses the economic variables variations to the health, soundness and vulnerabilities of a financial system.

4.2. Model specification and Econometric framework

The study involves econometric modelling to determine the impact of interest rates and reserve requirements on bank risk in Namibia. The study makes use of the quarterly data, covering the period from 2001 to the third quarter of 2017. In order to test the relationships among variables, the approach to cointegration within an Autoregressive Distributed Lag (ARDL) framework, developed by Pesaran and Shin (1998) was employed. The same framework was employed by

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Adeleke, et al. (2018), to conduct a bound testing analysis of bank credit supply determinants in Nigeria and Timoty et al. (2017), to study the effect of macroeconomic determinants on non-performing loans in Nigeria.

Most of the time series macroeconomic and financial data variables are non-stationary, which implies that they have a stochastic trend. The variables that are integrated of the first or higher orders can be transformed to stationary variables by differencing the data. The analysis was conducted based on other studies reviewed, that have examined the relationship between banking risks and monetary policy instruments in different jurisdictions such as that of Altunbas et al. (2010). However, few modifications were made to suit the study of monetary policy instruments effect to bank risks in Namibia.

The study used the autoregressive distributive lag modeling approach to predict the current value of the dependent variable based on both the current and lagged value of the dependent variables as depicted below. To achieve the objective of the study, two standard equations were conducted concurrently to determine the effect of interest rate and reserve requirement ratio on bank risks in Namibia.

$$NPL_t = \alpha + \beta_1 i_t + \beta_2 TC_t + \beta_3 TA_t + \beta_4 CR_t + \beta_5 GDP_t + \varepsilon_t \quad (4.1)$$

$$NPL_t = \propto + \partial_1 rr_t + \partial_2 TC_t + \partial_3 TA_t + \partial_4 CR_t + \partial_5 GDP_t + \varepsilon_t \quad (4.2)$$

Where the dependent variable is non-performing loans (NPL), representing the bank risk, α & $\propto$ are intercepts, β_1 & ∂_1 are the slope coefficients while β_2, β_3, β_4, β_5 and ∂_2, ∂_3, ∂_4 ∂_5 represent other equation coefficients, i, is interest rates, rr is reserve requirement ratio, TC is Tier 1 capital,

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TA is the banks' total assets, CR is total private credit extensions, GDP is the gross domestic product, which represents country's economic performance while ε is the error term.

The ARDL look at the similar models studied earlier, except that it includes the lagged dependent variable as one of its explanatory variables as depicted in equation (4.3) below.

$$Y_t = \delta_0 + \sum_{i=1}^{p} \beta i \, Y_{t-1} + \sum_{i=0}^{q} \alpha i X_{t-i} + \varepsilon_t \qquad (4.3)$$

Where Y_t is a vector implies that any variable in the model can be treated as dependent variable, X_t are explanatory variables, α and β are coefficients, δ represent a constant, i = 1,…,n, p and q are optimal lag orders and ε_t is an error term.

4.3. Justification and Measurement of Variables

Non-Performing Loans

Non-performing loans is a dependent variable that measures the bank risks. Banking institutions experienced a challenge in terms of revenue required to meet the counterpart obligations when non-performing loans are high. The nonperforming loans are the root cause of credit risk. The banks' income and profitability is negatively affected by non-performing loans. The non-performing loan ratio (non-performing loans/total loans) is the best proxy of a good health bank's portfolio. The lower the non-performing ratio indicates better commercial banks financial performance (Mulwa, 2015). In this study, the evolution of non-performing loans was used to study the effect.

Interest Rates

Interest rate is a price of loanable funds that used to maintain price stability. However, financial instability can erupt, although inflation is low.

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Reserve Requirement ratio

The reserve requirement ratio although it is dormant in Namibia was used to determine the effect on financial stability. To determine the impact of reserve requirements on bank risks, the hypothetical increase on reserve requirements will be employed. The assumption and hypothetical increase on reserve requirements is in line with the stress tests used to analyze the reliance of banking systems. According to Jakubik and Sutton (2011), there are two approaches that underpin stress tests. These are sensitivity test and macro stress tests (scenario). The sensitivity test applies when the single key variable is shocked to determine the reaction of the banking system. Since the stress event is unlikely to be affected by a single variable, it might lack plausibility. The macro-stress test is therefore having an advantage in examining the impact of changes in a number of key variables against the bank risks. Krznar and Matheson (2017), state that the macro-prudential stress tests should be used to capture the macro-effects of the health of banking institutions, the banking sector and the real economy.

Tier I Capital

Tier I capital is the first cushion that the bank use to off-set any shocks hitting the market. The well capitalized bank can be resilient to shocks. Therefore, the negative relationship between bank risks and capital is expected. The BoN defined Tier 1 capital as core capital which consists of permanent shareholding equity such as issued, and fully paid-up ordinary shares and perpetual non-cumulative preference shares plus disclosed reserves of additional paid in share premium and retained earnings or undistributed profits as well as minority interest in consolidated subsidiaries. According to Mulwa (2015), the strength of banks risk shifting effects depends on its capital.

Reserve Requirement ratio

The reserve requirement ratio although it is dormant in Namibia was used to determine the effect on financial stability. To determine the impact of reserve requirements on bank risks, the hypothetical increase on reserve requirements will be employed. The assumption and hypothetical increase on reserve requirements is in line with the stress tests used to analyze the reliance of banking systems. According to Jakubik and Sutton (2011), there are two approaches that underpin stress tests. These are sensitivity test and macro stress tests (scenario). The sensitivity test applies when the single key variable is shocked to determine the reaction of the banking system. Since the stress event is unlikely to be affected by a single variable, it might lack plausibility. The macro-stress test is therefore having an advantage in examining the impact of changes in a number of key variables against the bank risks. Krznar and Matheson (2017), state that the macro-prudential stress tests should be used to capture the macro-effects of the health of banking institutions, the banking sector and the real economy.

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Total Assets

The banks total loans are mainly made up of loans and advances. It is viewed that when price of loans (interest rates) is low; banks tend to relax credit requirements in search for yield. As a result, non-performing loans increase.

Private Credit Extension

The private credit extension is the macroeconomic variable that represents the total loans and advances granted in the domestic economy as a whole. The reason for private credit extension inclusion in the model is to determine the effect of monetary instruments variations to the whole economy. The highly indebted nation can negatively affect the banks' performances especially if they fail to service their loans on time. According to Mulwa (2015), there will be high demand of credit during economic booms compared to times of recession.

Gross Domestic Product (GDP)

GDP represents economic growth of the country. Banks tend to generate sufficient income during economic booms. Therefore, the negative relationship is expected between GDP and bank risks. The high economic growth may strengthen the loan servicing capacity, hence low credit risk (Mulwa, 2015)

Error Term

The error term in the model represents those variables which affect the bank risks but excluded from the model.

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4.4. Data Analysis Methods

To study the effect of monetary policy instruments in relation to bank risks, the Autoregressive Distributive Lag Modelling (ARDL) was employed, to study both the long- and short-term relationships between variables. Nkoro and Uko (2016) stated that although theoretical economic analysis suggests the long run relationship between variables, most econometricians ignored the inherent features of time series variables, by assuming variables were stationary or at least stationary around the deterministic trend that exhibited a long run relationship. At the time the econometric model was formulated assuming that the means and variances were constant and not depending on time. Currently, econometric model reveals that the most time series are not stationary as initially thought. The ARDL was employed due to its inherent advantages that necessitated it to be applied in the underlying variables with a mixture of integration order of either I(0) or I(1) or a combination of both. Further, the bound cointegration testing procedure does not require the pre-testing of the variables included in the model for unit roots and is robust when there is a single long run relationship between the underlying variables.

The ARDL error correction representation is also more efficient, in establishing the single long run relationships and in any sample data size (small or finite). Therefore, the Granger (1981) and, Engle and Granger (1987), Autoregressive Distributed Lag (ARDL) cointegration technique or bound test of cointegration (Pesaran & Shin 1999; Pesaran et al., 2001; Johansen & Juselius, 1990)) cointegration have become eminent in providing solutions to the long run relationship between time series that are non-stationary. Based on the above advantages, the ARDL approach was employed in this study to analyze the underlying effects of monetary policy instruments to bank risks.

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For data consistency and easy interpretation, the seasonal factors were eliminated through adjustment of the series and stabilization of its variances, which led to equation 4.1 and 4.2 expressed in natural logarithms as depicted below.

$$LNNPL_t = \propto + \beta_1 lni_t + \beta_2 lnTC_t + \beta_3 lnTA_t + \beta_4 lnCR_t + \beta_5 lnGDP_t + \varepsilon_t \quad (4.4)$$

$$LNNPL_t = \propto + \partial_1 lnrr_t + \partial_2 lnTC_t + \partial_3 \ln TA_t + \partial_4 lnCR_t + \partial_5 lnGDP_t + \varepsilon_t \quad (4.5)$$

4.4.1. Correlation coefficient

A correlation coefficient test is used to determine whether there is a relationship between dependent variable (non-performing loans) and the explanatory variables used in the study. The purpose and objective of correlation coefficient analysis is to predict the future value of one or more variables from the current value of one variable.

4.4.2. Unit root

Initially before continuing with the bound test, it is necessary to study the properties of the time series to determine whether they are stationary. Series are tested to determine whether the variables are integrated of order n = 0, 1, 2 to avoid spurious results. If the series are I(2), the F-statistic and W-statistic are not valid because the bound test assumes that the variables are either integrated of order n = 0 or 1. Therefore, in case there is evidence suggesting the presence of unit roots, Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979), Phillips-Perron (PP) (1988) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (1992) tests are considered to ensure results are valid and can be relied upon. The null hypothesis for these tests in exception of KPSS suggest that there is a presence of unit roots ($H_0: \delta_1=0$) or non-stationary, whereas, the alternative hypothesis depicts that there is no presence of unit roots ($H_A: \delta_1 \neq 0$) or stationary of series.

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4.4.3. Bound Cointegration test

After testing for unit roots, the first approach of ARDL is to conduct the bound test for cointegration. The bound test of cointegration is testing the long-term relationship between the underlying variables within a dynamic specification framework. According to Nkoro and Uko (2016), cointegration tests how non-stationary time series move away from equilibrium can be paired for the equilibrium forces to ensure they do not drift too far apart. It uses the F-statistic, to test the significance of the lagged levels of variables in the error correction form of the ARDL model. Since the study used the quarterly data to analyze the effects of bank risks in Namibia, the maximum lagged observation was therefore 4 including the trend. The tested null hypothesis states a no cointegration, whilst the alternative hypothesis depicts a cointegration. The presence of cointegration suggests both long-run and short-run coefficients, expressed as follows:

$$\Delta LNNPLt = \propto_0 + \sum_{i=1}^{k} \partial_1 \Delta lni_{t-1} + \sum_{i=0}^{k} \partial_2 \Delta lnTC_{t-i} + \sum_{i=0}^{k} \partial_3 \Delta lnTA_{t-i} + \sum_{i=0}^{k} \partial_4 \Delta lnCR_{t-i} + \sum_{i=0}^{k} \partial_5 \Delta lnGDP_{t-i} + \beta_1 lnI_{t-1} + \beta_2 lnTC_{t-1} + \beta_3 lnTA_{t-1} + \beta_4 lnCR_{t-1} + \beta_5 lnGDP_{t-1} + \gamma ECM_{t-1} + \varepsilon_t \quad (4.6)$$

Where; $\beta_1 - \beta_5$ are long-run coefficients and $\partial_1 - \partial_5$ are short-run dynamic coefficients, α is the intercept term, while ε_t are error term which is serially uncorrelated residuals with zero mean. The variable ECM_{t-1} represent error correction term represents the residuals of the long-term model lagged one period, which captures the long-term relationship. The F-statistic is carried out to test the existence of the long-term relationship of the variables. The two critical values to be compared with the computed F-statistic assume that the variables in the model are I(1), whilst the other set assumes variables to be I(0). In case the F-statistic exceeds the upper bound, the null hypothesis which states that there is no long-term relationship could be rejected without any need of conducting variables order of integration. Further, if the computed F-statistic is below the

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lower bound, then the assumption of no long-term relationship cannot be rejected. However, if the computed F-statistic fall between these two bounds, the result is inconclusive and depends on whether the variables are I(0) or I(1), and so the unit root tests on the variables may be carried out.

Practically, the null hypothesis of the no long-run relationship is tested under condition: H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ against the alternative H_A:$\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$. The decision is arrived at by comparing the computed with the two bound critical values.

4.4.4. Long Run Estimates of the ARDL Model or Appropriate Lag Length for the ARDL Model

The following step is conducted to find the appropriate lag length for each of the underlying variables in the ARDL model. Finding the appropriate lag length is essential to get standard normal errors terms that do not suffer from non-normality, autocorrelation, heteroscedasticity etc. (Gaussian error term). The study determines the optimum lag length by using proper model selection criteria of Akaike Information Criterion (AIC), Swartz Bayesian Criterion (SBC) or Hannan-Quinn Criterion (HQC). The step is crucial to avoid spurious regression if there is a long-run relationship between the underlying variables.

4.4.5. Reparameterization of ARDL Model into Error Correction Model (ECM)

To avoid spurious results by regressing non-stationary variables, data was differenced in order to achieve stationary variables. The ECM specification enabled the researcher to obtain both the short- and long– run relationship between variables. In the presence of disequilibrium, the adjustment of speed is non-zero which measures the distance of system variation from the equilibrium point at time t. The speed of adjustment is expected to be negative in order to force

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dependent variable back to its long run path. Therefore, the Engle-Granger on the cointegration framework is to test the long-run equation and state whether variables are cointegrated while on the second stage it caters for short-run model including residual from the cointegration equation.

4.4.6. Granger Causality Test

The study uses the linear and non-linear Granger causality to study the effects of bank risk by considering both banking and macroeconomic variables. The Granger causality captures the ability of the current and lagged variable to predict or cause other variables of interest. The objective for conducting Granger causality is to provide further evidence for causal relationships between variables of interest. The Granger causality can determine whether there is a causal directional (unidirectional, bidirectional or non-directional) relationship between two variables.

4.5 Conclusion

The methodology chapter introduced the ARDL econometric model employed in the study to examine the effect of bank risks in relation to the banking and macroeconomic variables. The chapter gives a basic overview of variables employed in the study and the expected sign or effect based to the macroeconomic theory and past studies. Further, the chapter discussed the ARDL methodology steps employed to achieve the study objectives. The next chapter provides the empirical results of the study.

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CHAPTER FIVE: EMPIRICAL ANALYSIS AND INTERPRETATION

The chapter provides the results analysis and interpretations of the effect of interest rates on bank risk. The chapter will provide the statistical properties of data, the correlation coefficient test, the stationary test, the appropriate lag length, bound test approach, the long run and short run estimates results of the model. Furthermore, the chapter provides the diagnostic test and the Granger causality test results.

5.1. Statistical Properties of Data

To determine the effect of monetary policy instrument on bank risk, data was analyzed to determine the trend before empirical studies. On first level, the time series were non-stationary, which might lead to a spurious correlation. The spurious correlation shows significant results

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between the dependent and independent variable, which cannot be relied upon. Therefore, the unrelated series might therefore provide significant results, which implies that Ordinary Least Squares (OLS) methodology leads to inconsistent and biased results if it is applied. To ensure that the data are stationary, they were integrated to order n=1 or I(1) because at levels or I(0) series are non-stationary.

5.3. Correlation Coefficient Test

The present study conducted a correlation coefficient test to determine whether there is a relationship between dependent non-performing loans (LNNPL), the explanatory variable of interest rate (LNI) and other control explanatory variable of Gross Domestic Product (LNGDP), banks' core capital (LNCA), private sector credit (LNCR) and banks' total assets (LNTA). The Pearson Correlation test was used and results are displayed in Table 5.1. The results closer to 1 indicate the strong positive correlation between variables while the closer to -1 indicate the strong negative relationships. However, the closer to zero indicate weak correlation between variables. The results show that there is a strong positive correlation between LNNPL and control explanatory variable of capital, LNGDP, LNCR and LNTA indicated by strong positive correlation coefficients in the range of 0.7 to 0.82. However, the results also displayed a weak negative relationship between non-performing loans (LNNPL) and interest rates (LNI) indicated by a coefficient of -0.41.

Table 5. 1: Correlation between variables

Variables	LNNPL	LNCA	LNGDP	LNI	LNCR	LNTA
LNNPL	1	0.821233	0.784724	-0.41485	0.815742	0.813191
LNCA	0.821233	1	0.976707	-0.7907	0.9923	0.99528
LNGDP	0.784724	0.976707	1	-0.78321	0.977947	0.980383
LNI	-0.41485	-0.7907	-0.78321	1	-0.77917	-0.78337
LNCR	0.815742	0.9923	0.977947	-0.77917	1	0.997826

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LNTA	0.813191	0.99528	0.980383	-0.78337	0.997826	1

5.4. Stationary tests

After the graphical presentation of the trend in data, the study took a formal test of stationary using an Augemented Dickey Fuller (ADF) test. The most important reason for testing for unit roots in time series data is to ensure that the results are not spurious. The ADF test was conducted both in levels and first difference and the results are displayed in Table 5.2.

Table 5. 2: Unit Root (ADF) Test Results

Variables	**Test Statistic**	**1% critical values**	**5% critical values**	**10% critical values**	**Results**
LNCA	-0.473842	-3.533204	-2.906210	-2.590628	Non-stationary
DLNCA	-9.624773	-3.536587	-2.907660	-2.591396	Stationary
LNGDP	-1.442916	-3.538362	-2.908420	-2.591799	Non-stationary
DLNGDP	-12.21639	-3.538362	-2.908420	-2.591799	Stationary
LNNPL	0.186581	-3.533204	-2.906210	-2.590628	Non-

LNTA	0.813191	0.99528	0.980383	-0.78337	0.997826	1

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LNNPL	0.186581	-3.533204	-2.906210	-2.590628	Non-

					stationary
DLNNPL	-8.317452	-3.534868	-2.906923	-2.591006	Stationary
LNI	-1.529359	-3.538362	-2.908420	-2.591799	Non-stationary
DLNI	-3.943769	-3.534868	-2.906923	-2.591006	Stationary
LNCR	-2.556002	-3.533204	-2.906210	-2.590628	Non-stationary
DLNCR	-9.689100	-3.534868	-2.906923	-2.591006	Stationary
LNTA	-2.626191	-3.536587	-2.907660	-2.591396	Non-stationary
DLNTA	-11.71081	-3.534868	-2.906923	-2.591006	Stationary
RR					

According to the ADF test results displayed in Table 5.1, the calculated t-statistics obtained from the variables in the levels are non-stationary as the values in absolute terms are lower than the correspondent critical t-statistic values at 99%, 95% and 90% level of significant. For example, when the comparison is made of the computed t-statistic of the first variable LNCA computed statistic -0.474, which is lower than the critical t-statistics of -3.53, -2.91 and -2.59 at 99%, 95% and 90% respectively. Since the absolute computed t-statistic value is lower than the critical t-statistic value, then null hypothesis ($H_0: \delta_1 = 0$) cannot not rejected, which implies the presence of the unit root or non-stationary. However, on the first differences all variables became stationary. For example, on the first difference of DLNCA, then the computed t-statistic is -9.62,

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LNCR	-2.556002	-3.533204	-2.906210	-2.590628	Non-stationary
DLNCR	-9.689100	-3.534868	-2.906923	-2.591006	Stationary
LNTA	-2.626191	-3.536587	-2.907660	-2.591396	Non-stationary
DLNTA	-11.71081	-3.534868	-2.906923	-2.591006	Stationary
RR					

According to the ADF test results displayed in Table 5.1, the calculated t-statistics obtained from the variables in the levels are non-stationary as the values in absolute terms are lower than the correspondent critical t-statistic values at 99%, 95% and 90% level of significant. For example, when the comparison is made of the computed t-statistic of the first variable LNCA computed statistic -0.474, which is lower than the critical t-statistics of -3.53, -2.91 and -2.59 at 99%, 95% and 90% respectively. Since the absolute computed t-statistic value is lower than the critical t-statistic value, then null hypothesis ($H_0: \delta_1 = 0$) cannot not rejected, which implies the presence of the unit root or non-stationary. However, on the first differences all variables became stationary. For example, on the first difference of DLNCA, then the computed t-statistic is -9.62,

which is high then the critical t-statistic of -3.54, -2.91 and -2.59 at 99%, 95% and 90% level of significance respectively. This implies that all variables are integrated I (1).

5.5. Choosing the Appropriate Lag Length for the ARDL Model

After establishing the order of integration, the study establishes the optimal lag length for the model. The lag length criterion of Sequential modified LR test statistic (LR), Final prediction error (FPE), Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SC) and Hannan-Quinn Criterion (HQ) was employed. This study opted to use LR, FPE and AIC because of their powerfulness and consistency in lag order selection (see results in Table 5.3).

Table 5. 3 Lag order Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	345.3588	NA	8.44e-13	-10.77330	-10.56919	-10.69302
1	702.5582	635.0212	3.16e-17	-20.97010	**-19.54135***	-20.40817
2	762.7768	95.58507	1.51e-17	-21.73895	-19.08554	-20.69535
3	815.3769	73.47318	9.67e-18	-22.26593	-18.38788	**-20.74068***
4	863.6758	**58.26526***	**7.69e-18***	**-22.65637***	-17.55367	-20.64946

* indicates lag order selected by the criterion

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5.6. Bound test approach to cointegration

The bound test approach to cointegration confirms the existence of the long-run equilibrium to which variables converges with time. The bound test approach to cointegration was used to determine whether there is a long-run relationship between variables. Table 5.4 reveals that the computed F-statistic of 5.5 is higher than the critical bound values of 4.68 at 1% significant value. Therefore, the null hypothesis stating that there is no long-run relationship exists between variables can be rejected in favour of the alternative hypothesis that the long-run relationships between variables exist.

Table 5. 4: Bound test results

Test Statistic	Value	k
F-statistic	5.522253	5

Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Since the results indicate a long-run relationship between non-performing loans and explanatory variables in the model, the study continued estimating the long-run ARDL Error Correction equation.

5.7. Long Run Estimates of the Selected ARDL Model

Results 5.5, indicates the long-run relationships results between the dependent variable (NPL) and explanatory variables. The results indicate that there is a positive long-run relationship between the non-performing loans and interest rates as well as private sector credit, indicated by

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a statistical significant t-statistics above 2. The positive and significant relationship between interest rates and non-performing loans indicates that increase in interest rates would lead to an increase in non-performing loans due to affordability. With high interest rates, credit becomes expensive, which results in high default rate. The positive and significant relationship between non-performing loans indicates that excessive private sector credit expansion will lead to high non-performing loans in the long-run. This is because during good times banks tend to relax their stringent terms and condition that allows less creditworthy clients to access loan facilities. The GDP was found to be negatively related to non-performing loans at 10% significant level, which is in line with Mulwa's (2015) study, that higher economic growth strengthens loan-servicing capacity. Other explanatory variables of capital (CA) and banks' total assets (TA) were found to be statistically insignificant.

Table 5. 5: Estimated Long Run Coefficient

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	-0.963540	0.538623	-1.788896	0.0796
LNCA	0.516197	0.444365	1.161653	0.2508
LNI	1.642966	0.206258	7.965572	0.0000
LNCR	1.630756	0.598452	2.724959	0.0088
LNTA	-0.897610	0.736718	-1.218390	0.2287
C	0.467651	3.818098	0.122483	0.9030

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5.8. Short Run Estimates of the Selected ARDL Model

Table 5.6 displays the short-run coefficients from the ARDL. Unlike the long run estimates, short-run estimates indicate three variables (capital, interest rate and private sector credit) that came out statistically significant in the model. Since the diagnostic test shows no evidence of serial correlation between variables as indicated in Table 5.7, it provides comfort that the results are relied upon.

Table 5. 6: Short Run Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP)	-0.464885	0.255877	-1.816827	0.0751
D(LNCA)	0.488842	0.239960	2.037181	0.0468
D(LNCA(-1))	-0.891977	0.303037	-2.943456	0.0049
D(LNCA(-2))	0.307651	0.230132	1.336843	0.1872
D(LNI)	0.425991	0.335617	1.269278	0.2101
D(LNI(-1))	0.654506	0.642520	1.018654	0.3132
D(LNI(-2))	-0.841942	0.370284	-2.273772	0.0272
D(LNCR)	0.786801	0.300819	2.615526	0.0117
D(LNTA)	-0.433075	0.367240	-1.179271	0.2438
CointEq(-1)	-0.482476	0.099043	-4.871382	0.0000

Cointeq = LNNPL - (-0.9635*LNGDP + 0.5162*LNCA + 1.6430*LNI + 1.6308*LNCR -0.8976*LNTA + 0.4677)

According to the short run estimates, capital, capital (-1) and interest rates (-2) came out statistical at 5% significant level. The estimates show a direct positive relationship between capital and non-performing loans. The bank's capital is a financial wealth of the bank that can be used to start and maintain the business operations. In economics, capital is also referred to as a factor of production together with labour and land. The differenced banks' capital (D(LNCA)) is positive and statistical significant, indicates that banks with high capital tend to have high risk

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appetite and engage in risky activities. The study also shows a direct positive relationship between private sector credit and non-performing loans. In economics, the private sector credit refers to financial resources in form of loans and advances, purchases of non-equity securities, trade credits and other accounts receivable to private sector with a claim to make a repayment of the principal amount plus interest as per their contractual terms. The differenced banks' private credit extension D(LNCR) is positively and significant related to non-performing loans, indicates that expansion of private sector credit will lead to high non-performing loans. The private sector credit was found to be positively related at 5% significant level to non-performing loans that confirms that the highly indebted nation will affect the banks performances, which forces banks to engage in risk lending in search of yields. The short run equation displayed a negative error correction term, which explains the extent of disequilibrium to be eliminated at each period. The coefficient of speed of adjustment between short run dynamics and long run equilibrium values was negatively statistical significant. The size of coefficient of error correction term of -0.48 is statistical significant 5 percent in the model, which indicated the speed of adjustment between the short-run and long run disequilibrium value.

As Jakubik and Sutton (2011) rightful put it, shocking a single variable for sensitivity test is easy to implement but may lack plausibility. The study did not shock reserve requirements to determine the impact since it has been constant at 1% of the banks' total liability to the public since inception. Therefore, shocking the reserve requirements up- or down-ward is therefore not plausible in the Namibian economy. In this regard, the interest rate was considered as one of most monetary policy instruments used to stimulate the economy, hence the effect to bank risks was investigated in this study.

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5.9. Diagnostic Test

Normality test

The study uses normality test to determine whether the sample data was drawn from a normal population. The study uses the Jarque-Bera test to determine the normality of the sample data. The null hypothesis states that the sample data are not significantly different than a normal population whereas the alternative hypothesis states that the sample data are significantly different than a normal population. To test for normality, the decision rule is determined by the probabilities values whether the data are normal distributed or not. In this regard, when the probabilities > 0.05, then the data are normal whereas when the probabilities < 0.05 the data are not normal.

Table 5. 7 : Normality test

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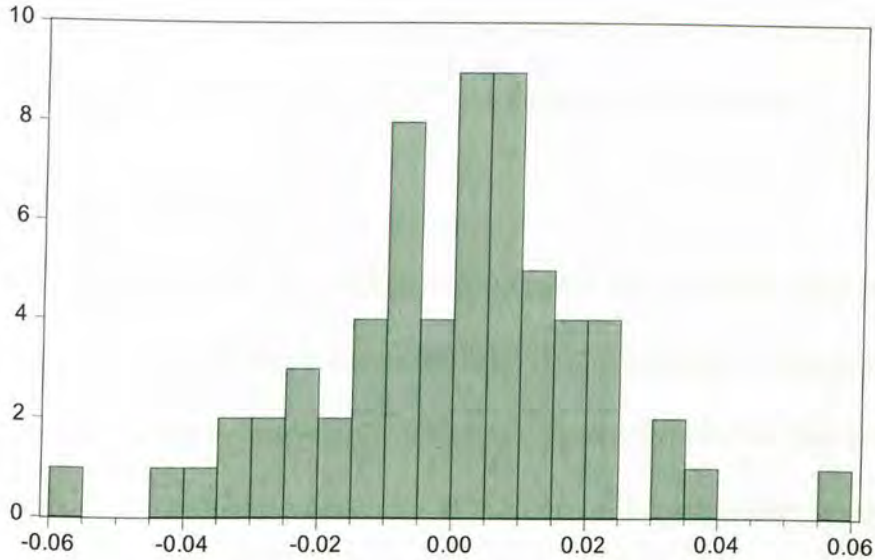


The probability of the diagnostic normality test is 0.39, which is greater than 0.05. Therefore, we do not reject the null hypothesis, which implies that the data are normal.

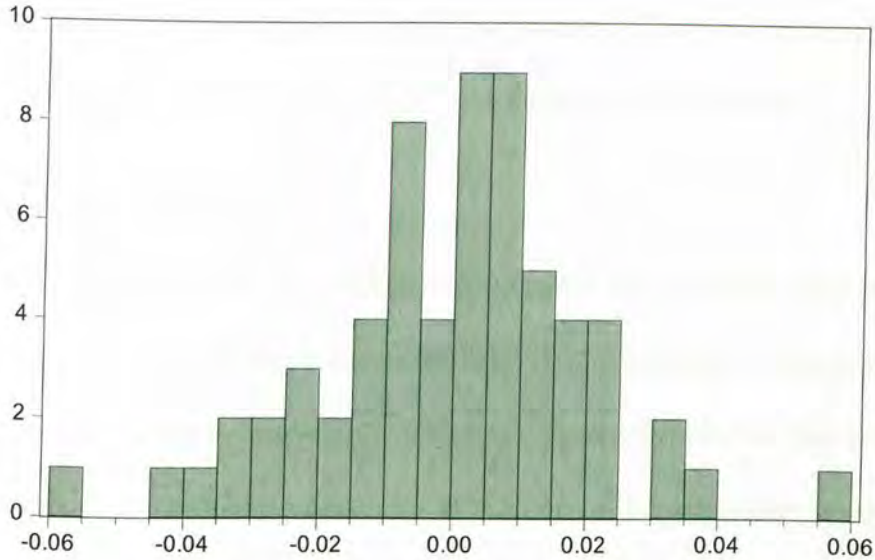
Autocorrelation

The study used the Breusch-Godfrey Serial Correlation LM test to test for autocolleration in the error terms. The null hypothesis for testing the error term states that there is no serial correlation against the alternative hypothesis there is a presence of serial correlation among the error terms. The decision rule, the null hypothesis would be rejected if the p-value for the observed R-square is less than 5% significance value.

Table 5. 8: Serial correlation LM Test

F-statistic	0.197823	Prob. F(2,49)	0.8212
Obs*R-squared	0.512624	Prob. Chi-Square(2)	0.7739

According to Table 5.7, the serial test results coefficients are all insignificant indicated by the p-value of 0.82 and the observed R-square of 0.51 percent. Since the probability is greater than



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0.05, we do not reject the null hypothesis in favour of the alternative hypothesis. The data presents the absence of autocorrelation among the error terms.

Heteroscedasticity

Hetroscedasticity occurs when the variances of the error term keep changing across observations. The study used Breusch-Pagan-Godfrey Heteroscedasticity test to examine the variation of the error term across observations. The null hypothesis indicates that the variances of the error term are constant or homoscedasticity in relation to the alternative hypothesis of heterescedasticity. The null hypothesis can be rejected if the test statistic p-value is less than the threshold of 0.05 whereas when the p-value is greater than 0.05 it implies that the variances of the error term is homoscedasticity. The results of heteroscedasticity test: Breusch-Pagan-Godfrey are presented in Table 5.9.

Table 5. 9: Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.430373	Prob. F(21,41)	0.1606
Obs*R-squared	26.63909	Prob. Chi-Square(21)	0.1831
Scaled explained SS	12.44920	Prob. Chi-Square(21)	0.9267

The heteroscedasticity test results indicate that the variances of the error terms are homoscedasticity indicated by a p-value of the Chi-Square of 0.1831, which is greater than threshold p-value of 0.05.

5.10. Pairwise Granger Causality Test Results

The study conducted the Granger causality test to determine the causal direction between bank risks and explanatory variables considered in the model. The Granger causality is applied to evaluate the dynamic linkage among economic variables of interest. The objective of Granger

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5.10. Pairwise Granger Causality Test Results

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causality is to find causal directional (unidirectional, bidirectional or non-directional) relationships between two variables. The results of the Pairwise Granger Causality test are presented in Table 5.10.

Table 5. 10: Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
LNI does not Granger Cause LNNPL	65	0.83263	0.4399
LNNPL does not Granger Cause LNI		1.13981	0.3267
LNGDP does not Granger Cause LNNPL	65	2.47857	0.0924
LNNPL does not Granger Cause LNGDP		0.90781	0.4089
LNCA does not Granger Cause LNNPL	65	3.86671	0.0263
LNNPL does not Granger Cause LNCA		0.46287	0.6317
LNCR does not Granger Cause LNNPL	65	3.44349	0.0384
LNNPL does not Granger Cause LNCR		3.07191	0.0537
LNTA does not Granger Cause LNNPL	65	3.13251	0.0508
LNNPL does not Granger Cause LNTA		1.61418	0.2076
LNGDP does not Granger Cause LNI	65	4.53828	0.0146
LNI does not Granger Cause LNGDP		2.64009	0.0796
LNCA does not Granger Cause LNI	65	3.93516	0.0248
LNI does not Granger Cause LNCA		0.06786	0.9345
LNCR does not Granger Cause LNI	65	2.93383	0.0609
LNI does not Granger Cause LNCR		4.00700	0.0233
LNTA does not Granger Cause LNI	65	3.56322	0.0345
LNI does not Granger Cause LNTA		4.38128	0.0167
LNCA does not Granger Cause LNGDP	65	14.7100	6.E-06
LNGDP does not Granger Cause LNCA		6.02026	0.0041
LNCR does not Granger Cause LNGDP	65	17.7159	9.E-07
LNGDP does not Granger Cause LNCR		4.17739	0.0200
LNTA does not Granger Cause LNGDP	65	19.8288	2.E-07
LNGDP does not Granger Cause LNTA		2.39692	0.0997
LNCR does not Granger Cause LNCA	65	2.97054	0.0589

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LNCA does not Granger Cause LNCR		4.15655	0.0204
LNTA does not Granger Cause LNCA	65	4.35749	0.0171
LNCA does not Granger Cause LNTA		0.98373	0.3799
LNTA does not Granger Cause LNCR	65	5.95717	0.0044
LNCR does not Granger Cause LNTA		0.05169	0.9497

The results indicate that interest rates do not Granger cause bank risks and bank risk does not Granger cause interest rate. However, the data shows a unidirectional causality at 10 percent significance value, running from economic growth to bank risks (NPL). Further, there is a unidirectional causality that runs from the banks' Tier I capital (CA) to bank risks. The unidirectional causality at 10 percent significance value was again found running from the banking institutions' total assets (TA) to bank risk. However, the bi-directional causality was found between private sector credit extension and bank risk. Although the results show that the interest rate does not Granger cause bank risks, it influences other variables that Granger cause bank risks such as GDP and private sector credit. The results show a bi-directional causality between interest rates and GDP as well as between interest rates and private sector credit.

5.11. Conclusion

The chapter presented the model results that indicate a positive long-run relationship between the non-performing loans and interest rates as well as private sector credit. The GDP was found to be negatively related to non-performing loans. The short run-estimates results indicate a negative relationship between interest rates and non-performing loans, which confirms that price stability does not guarantee financial stability. The next chapter is presenting the conclusion, policy recommendation and area for future research.

LNCA does not Granger Cause LNCR		4.15655	0.0204
LNTA does not Granger Cause LNCA	65	4.35749	0.0171
LNCA does not Granger Cause LNTA		0.98373	0.3799
LNTA does not Granger Cause LNCR	65	5.95717	0.0044
LNCR does not Granger Cause LNTA		0.05169	0.9497

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CHAPTER SIX: CONCLUSION, POLICY RECOMMENDATION AND AREA FOR FUTURE RESEARCH

6.1. Introduction

Following the regression outcomes and analysis of the results outlined in the preceding chapter, this chapter presents the conclusion of the study. As Geng and Zhai (2015) state, emerging countries use interest rates and reserve requirements as monetary policy instruments to effect bank risk. The interest rate influence bank risks through asset valuation channel, search for yields, asset substitution, constant leverage, central bank communication, asset-liability mismatch and the habit formation. On the other hand, the reserve requirements affect bank risk through the liquidity and the cost channel. Since the reserve requirements have been constant at 1% of the bank's liabilities to the public, it was good as dormant and shocking it, lacks plausibility. In this regard, the study uses interest rate as monetary policy instrument to study the effect to bank risk in Namibia. The study used the quarterly data obtain from Bank of Namibia website as from 2001Q1 to 2017Q3 and the variables of interest were NPL, I, TA, TC, CR and GDP, used ARDL econometric modelling to analyses the effect.

6.2. Research conclusion

To test the reliance of data, the study conducted a stationarity test and all variables were found stationary at I(1). The optimal lag length for the study was (-4) attested by LR, FPE and AIC powerfulness and consistency in lag order selection. The bound test approach to cointegration confirmed the existence of the long-run equilibrium to which variables converges with time. Therefore, the study went further to conduct a long-run relationship estimates between the dependent variable (NPL) and explanatory variables. The results indicate that there is a positive

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long-run relationship between the non-performing loans (NPL) and interest rates (I) as well as private sector credit (CR). However, the GDP found to be negatively related to non-performing loans at 10% significant level, which indicates that higher economic growth strengthens loan servicing capacity.

The short-run estimates, found capital, capital (-1) and interest rates (-2) to be statistical significant at 5% level. The results show a positive relationship between capital and non-performing loans, while the capital in the first lag period found to be negatively related to non-performing loans. The negative relationship between capital and non-performing loans was expected since well capitalized banks are resilient and able to absorb shocks in the market. The negative relationship between interest rates and non-performing loans indicates that price stability does not guarantee financial stability. Therefore, the results show that low interest rate increase bank risks. The private sector credit was found to be positively related at 10% significant level to non-performing loans, an indication that highly indebted nation will affect the banks performances that forces banks to engage in risk lending in searching of yields.

Further, the study found a unidirectional causality at 5% significance value, running from economic growth to bank risks (NPL), from the banks' Tier I capital (CA) to bank risks as well as from the banking institutions' total assets (TA) to bank risk. However, the bi-directional causality was found between private sector credit extension and bank risk. Although the results show that the interest rate does not Granger cause bank risks, it influences other variables that Granger cause bank risks such as GDP and private sector credit. The results show a bi-directional causality between interest rates and GDP as well as between interest rates and private sector credit.

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6.3. Policy Recommendations

Cognizance should be exercised when Bank of Namibia uses the monetary policy instruments to stimulate the economic growth. The variation in interest rates has an indirect effect to bank risks through economic growth and private sector credit extensions. The results show that there is a long-run relationship between interest rate and non-performing loans. This implies that an increase in interest rates would affect the bank risks in the long-run as attested by the Granger causality results. Although the results show the non-directional causality between interest rates and bank risk, there is a bi-directional causality between interest rates and GDP as well as credit extension. Low interest rates lead to economic expansion and excessive credit expansion which results in the financial imbalances and economic fluctuations. However, the high interest rate is also not good for the economy as it results in economic and private credit contractions. This is evidence that regulating price stability through the variation of interest rates is not sufficient and it does not guarantee financial stability. The policy makers should ensure that changing interest rates have an adverse effect on the economic growth and price stability. The variation in interest rate can cause economic and price fluctuations. However, the price stability does not necessarily cause financial stability. Therefore, policy makers should consider using monetary policy instruments together with other macro-prudential instruments to complement price and financial stability.

6.4. Area of Future Research

The study was limited on the effect of interest rates into bank risk, in terms of non-performing loans, which represent the banks' credit risk. The future researchers are recommended to expand the study into the effects of interest rates on banks' profitability, measured in terms of return on assets (ROA and ROE). Further, future study should be extended to investigate the effect of

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