The Relationship between Capital Adequacy and Profitability under Basel III in the Namibian Banking Sector

By

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PLAGIARISM DECLARATION

I Esther Kaulinawa Pomuti, know the meaning of plagiarism and declare that all the work in the dissertation is my own, except where otherwise indicated and acknowledged by means of complete references. This thesis has not been submitted to other Universities, Technikons or Colleges for degree purposes. Errors and omissions noted in this work are attributed to my own imperfection.

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Abstract

Globally, capital adequacy is one of the most central topics for both regulatory authorities and banks. It promotes stability and intends to reduce bank insolvency. It also represents the most important element of banks' profitability (Profits are the first line of defense against losses from credit loss in a bank). After the collapse of Bretton Woods in 1973, many banks incurred large foreign currency losses, with Banks outside Germany having taken heavy losses on their unsettled trades with Herstatt Bank in Cologne, West Germany, when it collapsed in June 1974. This study empirically tests the relationship between changes in the capital adequacy ratio under Basel III and return on equity (ROE) of the Namibian banking sector and whether such relationships exist in the short run or long run. The study used panel quarterly data for a sample of three Namibian commercial banks from the year 1999 to 2019.It employed one panel unit root tests namely: Im, Pesaran and Shin W-stat (IPS). To test the existence of a long-run relationship (equilibrium) or effect between the dependent and independent variables, the study employed the Panel Co-integration methods using Pedroni and Kao (Engle-Granger based) tests. The study carried out the Hausman test to determine the best approach for analysis and determined the PMG approach to be the preferable model for analysis. Various diagnostic tests such as multicollinearity through the correlation analysis, autocorrelation, and heteroscedasticity and cross-sectional dependence tests were carried out to determine if the data set is well-modelled and if the results can be taken seriously. The study's results under the PMG model showed that ROE and CAR have a positive significant relationship in the short run. A dummy variable to capture the connection between ROE and CAR before and after BASEL III shows that the relationship is positive and significant indicating that ROE increases more when there is capital regulation than when there is no capital regulation. The study also concluded that there is no long run relationship between CAR and ROE. Finally, the interaction effect between the dummy variable and CAR is negative but significant and thus indicating that the positive relationship does not persist post Basel III.

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LIST OF ABBREVIATIONS

ADF-Augmented Dickey Fuller

BCBS-Basel Committee on Banking Supervision

BIS- Bank for International Settlements

BoN-Bank of Namibia

BWK-Bank Windhoek

FNB-First National Bank Namibia

CET1-Common Equity Tier 1

CVA-cover Credit Value, the adjustment

CCR-Counterparty Credit Risk

DFE – Dynamic Fixed Estimator

ECM -Error correction model

FEM-Fixed Effect Model

GDP-Gross Domestic Product

HPI-Housing Price Index

JB-Jargue Berra

LCR-Liquidity Coverage Ratio

LLC-Levin, Li and Chu

IPS- Im, Pesaran and Shin

ROE-Return on Equity

ROA- return on assets

CAR-Capital Adequacy Ratios

LTCM-Long-Term Capital Management

MG-Mean Group

MM-Modigliani-Miller Theory

NSFR-Net Stable Funding Ratio

NAMFISA-Namibia Financial Institutions Supervisory Authority

NFSR-Namibian Financial Stability Report

NBK-Nedbank Namibia

NPL-Non-Performing Loans

NSX-Namibia Stock Exchange

NSA-Namibia Statistics Agency

OLS-ordinary Least Squares

PMG- Pooled Mean Group

REM-Random Effect Model

SBN-Standard Bank Namibia

VECM-Vector Error Correction Model

RIR-Real Interest Rate

TL/TA- Total Loan/Total Asset

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Chapter 1 : Introduction

1.1 INTRODUCTION AND BACKGROUND

Globally, the significance of the banking sector is undeniable in any country across the world. This sector is considered to be the lifeblood of the economy of a country (Mohiuddin, 2019). Corrigan (1982 and 2000) discusses what makes banks special are: (1) they offer transaction accounts, (2) they are sources of liquidity for all other institutions and (3) they are a transmission belt for monetary policy. This validates the regulations imposed upon banks as a result of their unique roles in economies. The way in which the banking sector is regulated has a great impact on the lending patterns and holds relevance in determining the growth potential of the economy.

Profitability of a bank is influenced by higher capital requirement and thus hovering concern on the relationship between financial performance (profitability) and minimum capital requirement of bank (Christian et al., 2008). The profitability of banks has three measures namely: Return on Equity (ROE) is a very important measure of bank performance as any other operating business, banks need to earn financial returns on its employed capital and this is the key interest for investors. ROE shows how well a company uses investment funds to generate earnings growth. ROEs between 15% and 20% are generally considered good. ROE is more than a measure of profit; it's a measure of efficiency (Alman, 2018). The riskier banks have proven to be more profit efficient as the return on equity is adjusted to the risk associated with the bank. Hence, banks with higher return on equity (ROE) ratio is appreciable as it is the primary indicator of bank's profitability and functional efficiency.

Minimum capital adequacy ratios are critical regulations that ensure that banks have enough cushions to absorb a reasonable number of losses before they become insolvent and consequently lose depositors' funds (Brian, 2018). It promotes stability and intends to reduce bank insolvency. It also represents the most important element of bank's ability to absorb shocks to the financial markets. Understanding the relationship between capital adequacy and bank profitability especially in an uncertain environment is therefore crucially important. Bank profitability is a very essential indicator of bank performance, it represents the rate of return a bank has been able to generate from using the resources at its command to produce and sell services. Seemingly, a constructive capital adequacy position safeguards the banks from losses as well as risks associated with the financial system and promotes bank financial stability. Without profits, no firm can survive and attract outside capital to meet its investment target in a competitive environment (Olukekan and Adeyinka, 2013).

After the collapse of Bretton Woods in 1973, many banks incurred large foreign currency losses, with Banks outside Germany having taken heavy losses on their unsettled trades with Herstatt Bank in Cologne, West Germany, when it collapsed in June 1974. These disruptions in the international financial markets and the failure of Bank Herstatt motivated the central bank governors of the G10 countries to establish a Committee on Banking Regulations and Supervisory Practices at the end of 1974 (BIS, 2014). This committee was later renamed the Basel Committee on Banking Supervision after it came to an end at the end of 1974 (BIS, 2018a). It was designed as a forum for regular cooperation between its member countries on banking supervisory matters.

Since 1983, the Basel committee has worked on introducing appropriate measures of adequacy to ensure stability in the global financial system and the most prominent of these measures was capital adequacy of banks. The BCBS developed guidelines namely: Basel I, Basel II and Basel III. The primary focus of these guidelines has been to ensure that banks are required to hold enough capital to mitigate the risks that arise from their businesses. Basel III as the area of interest for this study, was agreed upon by the members of the Basel Committee on Banking Supervision (Jones and Zeitz, 2017), is intended to provide a regulatory framework on capital adequacy and market risk that strengthens bank capital requirements to increase liquidity and reduce leverage.

In Namibia, the common suppliers of funds for supporting domestic economic activities are commercial banks, development banks and micro-finance institutions. However, other financial institutions such as pension funds, unit trusts, and insurance companies also play a role in providing funds for domestic investment purposes, in that they also create a platform for raising domestic savings. Plaatjie (2019) argues that in Namibia, the banking sector raised concerns regarding the cost of regulatory projects on the profitability of banks. The great concern lies in the cost of implementation of the banks due to the compulsory nature of compliance from the Bank of Namibia. With the current global economic distress experienced in Namibia, this sets a lot of pressure on the financial performance of banks in the country.

The Bank of Namibia is entrusted with the function of supervising commercial banks in the country. Over the past years, the bank has raised concerns over the increasing household debt that is mainly dominated by instalment credit, overdrafts and credit facilities, which are mostly used to finance unproductive luxury imported vehicles (BON, 2014). Most Namibian households have trouble honouring their outstanding loans, debts and/or credit. This threatens the economic and financial stability of the country especially in the current situation where house prices are very high and implies higher mortgages (Nuugulu, 2019). Overally, this has drastic effects on commercial banks performance and generally economic performance due to possible consumer defaults.

The Namibian banking sector remained profitable despite the prevailing recessionary conditions mainly attributed by increases in both the net interest income and operating income. Bank Profitability as measured by the Return on Equity (ROE) as well as the Return on Assets (ROA) ratios, indicate that the banking sector profitability has improved since 2018. The ROE increased from 18.5 percent in 2018 to 20.0 percent in 2019 (Figure 14). ROA increased marginally from 2.1 percent in 2018 to 2.2 percent in 2019 (NFSR, 2020).

In Namibia, during 2019, the banking sector remained adequately capitalised and maintained a capital position well above the prudential requirement. All the capital ratios recorded ratios above the minimum regulatory requirements, specifically, 6.0 percent for Common Equity Tier 1 (CET 1), 8.5 percent for Tier 1 capital and 11.0 percent for total risk-weighted capital (NFSR, 2020). Moreover, the capital conservation buffer requirement made-up 1.0 percent of the total risk-weighted capital ratio requirement12. Total qualifying capital declined from N$16.8 billion in 2018 to N$15.7 billion in 2019, owing to an increase in dividend pay-outs as well as the switch to Tier 2 instruments.

In 2019, The Bank of Namibia relaxed the capital conservation buffer and reduced it to zero percent for about 24 months in order to support banking institutions to supply credit to the economy as a policy relief measure during the pandemic. Furthermore, the robust capital buffers, are nonetheless, expected to cushion most of the NBFIs sector from the shocks in the interim, while the long-term impact remains uncertain due to the changing dynamics of the pandemic (NFSR, 2020). This critically highlights the importance of a capital adequacy ratio in the banking system.

Namibia is one of the countries that are part-taking in the implementation of Basel III. As part of Basel III monitoring, Namibia has to submit data on a bi-annual basis to the Bank of International Settlements. Currently, all G20 countries are in a transition phase to the full implementation of the Basel III framework. In Namibia, the Basel III Capital Framework (BID-5A) was issued in July 2018 and all the commercial banks had to follow, this is because all the commercial banks are subsidiaries and it is required by the South African Reserve Bank (SARB) that the subsidiaries of South African Banks are also required to report on Basel III to the parent company.

One of the main lessons that banking regulators took from the September 2008 financial crisis was that the banking system held insufficient capital and that post crisis regulatory frameworks should increase the minimum capital requirements (Majcher, 2015). This statement is supported by various other researchers such as Van Der Weide and Zhang (2019), Siljeström (2013). The overall direct impact of the 2007/2008 global financial crisis on the domestic financial system of Namibia has been relatively low, because in part to limited exposure to sub-prime related investments by financial intermediaries which was made possible by existing exchange control regime (NFSS, 2013). This is illustration of how society cannot afford the risk associated with financial instability as well as bailing out failed financial institutions.

In Namibia, the only other studies carried out on the Basel III implementation to the knowledge of the researcher is by Plaatje (2019) who assessed the impact of Basel III implementation on the profitability of Namibian banks. However, Plaatjie (2019) did not touch on capital adequacy requirement as a focus. This is a very crucial matter because without a strong capital adequacy in place, financial systems are vulnerable to any stress encountered. There was no further study beyond that and thus, this study focuses on the relationship between capital adequacy and profitability of banks in Namibia.

1.2 PROBLEM STATEMENT

The 2007/2008 financial crises have tested the strength and resilience of many economies around the globe. Because of the experience of the financial crisis in 2008, it was clear that the Basel II Accord needed some modification to prevent the same kind of crises from occurring (Raman, 2015). It was also clear that the relationship between capital adequacy requirement and bank profitability needed to be critically understood.

The capital buffer theory suggests that the excessive increase in capital than required decreases the risk of the bank (Jokipii and Milne, 2011). This theory suggests that capital buffer may increase the performance of banks due to reducing the interest rate, which increases the demand for bank loans.

However, the results of the literature on the impact on bank profitability are mixed. Stovrag (2017) investigated the relation of changes in capital requirements on the profitability of Swedish banks. He found that capital requirement ratios seem to have a negative and statistically significant correlation with the Return on Equity (ROE) for both large banks and niche banks. Goddard et al. (2010) who investigated eight member countries in the European Union in 1992 to 2007, their results concluded that capital ratio negatively affects profitability. Furthermore, Kiragu (2010) investigated the relationship between profitability and capital adequacy of commercial banks in Kenya and found that capital requirement ratios seem to have a negative but statistically insignificant correlation with the Return on Equity (ROE).

The following is a review of various studies and debates around the subject of capital adequacy requirement and bank profitability that have been carried out internationally and regionally but not on a domestic level. Various researchers focused on the relationship between capital adequacy ratio and bank profitability/performance (Vyas et al, 2008, Ranga 2012, Gabriel, 2016, Strovag 2017, Karigu, 2010, Goddard et al, 2010, Nyoka, 2017, Udom and Onyekah, 2018).

Ranga (2012) and Vyas et al., (2008) where the two studies assessed the impact of capital requirements on bank performance that found a positive relationship. Ranga (2012) found opposing results to Strovag (2017) in analysing the impact of minimum capital requirements on commercial banks performance in Zimbabwe. Vyas et al., (2008) investigated the impact of the capital adequacy requirement on performance of scheduled commercial banks of India. Their study found that the factors: bank level factors like, capital to risk weighted assets ratio, non-interest income and net interest margin have a positive and significant impact on profitability. On the other hand, Gabriel (2016), Nyoka (2017), Udom and Onekah (2018) found a direct influence of capital ratio on bank profitability.

Various studies have focused on the impact of capital adequacy on the performance of banking system; however, these have been limited to other countries, to the knowledge of the author there is only one study done on the relationship between the two aspects mentioned above on the Namibian context. This study is by Plaatjie (2019) Secondly, the Namibian banking system continues to experience several social and economic challenges which set pressure on the financial performance of banks. Thirdly, it serves as important to understand how the changes in the capital adequacy ratio under Basel III influences return on equity (ROE) of a bank. Lastly, this paper provides a broader view of the bank performance during pre-covid 19 crises. This creates a gap as no study has been done to analyze the relationship between capital adequacy and the profitability of banks under Basel III in Namibia.

The introduction of Basel III has raised questions around the impact of capital adequacy requirements on profitability for the banking sector. Balin (2008) was one of the researchers that pointed out that both Basel I & Basel II ignored the effect of this implementation on the emerging markets. Namibia being an emerging economy, the primary focus of this study is to investigate the relationship between capital adequacy requirement and bank profitability under Basel III, focused on Namibia. This is critical as a country could face dire consequences with regards to its prospects of economic growth if the banking sectors has challenges that can hinder its capital adequacy and performance in its financial sector especially that of the financial intermediation sector and thus this warranted an investigation.

1.3 SIGNIFICANCE OF THE STUDY

The main problem for internationally operating banks implementing Basel III is the potential impact on profitability while meeting the minimum capital requirements (Weber, 2014). In an unpredictable and volatile environment, there are differing conclusions regarding the state of the relationship between capital adequacy requirement and the profitability of a bank. Weber (2014) argues that it will be harder to reach high values in the key ratios such capital adequacy. The outcome of this problem results in putting more capital aside in a hope of reaching better capital ratios, as the ratios represent the capital adequacy of banks under Basel III.

In contrast to Weber's opinion, Otcker-Robe and PazarbaSıoğlu (2010) argue that most banks worldwide would have no problem meeting the new minimum capital requirements under Basel III in 2013 (7%) and 2014 (8%), but more banks close to 2019 were predicted that to start failing one after another as the Tier 1 capital will be increased bringing the minimum requirement to 10.5%. This in essence affects the level of their profit. This is the interest that drives this study's investigation.

Namibian banks face key risks to the sector such as higher NPL's (Non-performing loans) stemming from embattled sectors and various exposures to banking variables e.g., mortgage loans. Other risks come from the links between banks and sizable, but relatively less regulated, non- bank financial institutions.

Considering that there are limited studies done in Namibia when it comes to the relationship between capital adequacy and profitability in the banking sector it serves a need to investigate this issue. Although at the moment Namibian commercial banks are above the new minimum capital requirements under Basel III, the bank sector has historically experienced various challenges such as slowing deposit growth, increasingly expensive marginal funding costs and low liquidity which directly affects the performance of banks and their capability of reaching or exceeding the minimum capital requirement under Basel III.

According to Deloitte (2019), excess liquidity levels that have fallen to the point where commercial banks have been converting fewer liquid assets on their balance sheets into short-term liquidity through the repurchase window at the central bank. This means that the Namibian banks have had low liquid assets in excess of their regulatory minimum requirements. It is also of concern given the current economic downturn experienced in Namibia, which already puts weight on the financial performance of commercial banks.

Namibia also has low financial literacy levels, irrespective of their economic status, and tend to lack a sound grasp of the way financial systems operate and how they should choose financial service providers and products and services. This study would help in understanding the important aspects when it comes to banking operations and realization of investment. On the other hand, financial performance demonstrates the ability of the bank to make high profits and face the systemic shocks (Aymen, 2013). The paper seeks to help the management of banks, policymakers, and economists to realize the significance of this relationship. This is a very important study especially now with the global pandemic (COVID-19), the findings will also assist to assess the strength of Namibia's banks and to provide solutions on the how banks will recover from the losses they are likely to incur.

Capital adequacy ratio is an important component especially when it comes to attracting investment, a bank with a high capital adequacy ratio is considered safe and likely to meet its financial obligations and performance well in recessions. Capital is viewed as the foundation of any business and no business or industry can survive without capital (Basel Committee on Banking Supervision, 1988). The banking industry noticeably has a huge effect on a country's macroeconomic wellbeing, and especially on its capital markets.

Furthermore, Sheefeni (2015) is in support that bank profitability is an important source of retained earnings. This is because bank profitability is significant component of bank capitalization, which provides a margin of protection during recessionary periods, and enables the banks to be more resilient against external shocks. In conclusion, capital ratio helps in maintaining confidence of the public in the financial system. It assures the public that depositors' funds are safe, that the bank can accommodate the credit needs of the community. It also serves as a means of assessing the strength of a bank, assuring the regulatory bodies that the financial system is not threatened or weakened by any crisis in a single bank or group of banks (Udom and Onyekach, 2018).

1.4 OBJECTIVE

The objectives of the research are:

- To empirically test the relationship between changes in the capital adequacy ratio under Basel III and return on equity (ROE) of the Namibian banking sector.
- To empirically test whether such a relationship between changes in the capital adequacy ratio under Basel III and the return on equity (ROE) of the Namibian banking sector exists in the short run or long run.

The study uses a panel data mode and a random-effects technique which estimates effects for time invariant variables, this same model was used by Olukekan and Adeyinka (2013).

1.5 HYPOTHESES

1.5.1. Hypothesis One

H_0: There is a relationship between Capital adequacy Ratio and Bank Profitability in Namibia

H_1: There is no relationship between Capital adequacy Ratio and Bank Profitability in Namibia

1.5.2. Hypothesis Two

H_0: The relationship between ROE and CAR is significantly stable post Basel III implementation in Namibia's commercial banks

H_1: The relationship between ROE and CAR is not stable post Basel III implementation in Namibia's commercial banks

1.6 STRUCTURE OF THE THESIS

The thesis is structured as follows: Chapter 2 briefly discusses the banking regulation and implementation of Basel III in Namibia, while Chapter 3 gives an overview of the existing empirical literature and theoretical literature, Chapter 4 explains the methodology used, Chapter 5 presents, interprets and discusses the results obtained, Chapter 6 summarizing the findings and concluding the study, Chapter 7 outlines the references and Chapter 8 outlines the appendix.

Chapter 2 : The Namibian Banking Sector and Regulation, The Implementation Basel III

2.1 THE DEVELOPMENT OF BASEL ACCORDS

2.1.1 Basel I

In 1988, Basel I was originally designed for banks that operate internationally, it was established with the need for a multinational accord to strengthen the stability of the international banking system and to remove a source of competitive inequality arising from differences in national capital requirements. This accord was more focused on credit risk and later market risk. It called for a minimum capital ratio of capital to risk-weighted assets of 8% to be implemented by the end of 1992. By the late 1990s, Basel I had come to be a blunt instrument that was ‘useless for regulators and costly for banks’ (quoted in Wood, 2005: 129). The Asian financial crisis demonstrated that the risks facing banks had become more complex and that the existing capital framework had failed to keep up with the pace of financial innovation (Lall, 2012)

Basel 1 Capital Ratio = **Tier 1 capital** + **Tier 2 capital Risk weighted assets** $\geq 8\%$

2.1.2 Basel II

Despite these measures international financial markets experienced several further episodes of distress in the 1990’s. These major financial crises were now from diverse regions, and included Mexico in December 1994, the Asia crisis beginning in July 1997, Russia in August 1998, the complete collapse of the U.S. hedge fund Long-Term Capital Management (LTCM) in September 1998, and Brazil towards the end of 1998 and early 1999 (Dungey *et al.,* 2002).

In June 1999, the Committee issued a proposal for a new capital adequacy framework to replace the 1988 Accord, which is generally known as Basel II. This accord was introduced with three pillars to help fulfill its purpose. The three pillars stipulated were: minimum capital requirements, supervisory review and market discipline. The purpose was to improve banking sector risk by mostly focusing on Credit Risk and Operational Risk as Market Risk was already addressed in Basel I.

The conditions prevailing in the negotiations for Basel II strongly favored an outcome of regulatory capture by large international banks. As the best informed about the Basel Committee’s agenda, these banks are expected to gain first-mover advantage in the regulatory process, exercising undue influence over the specifications of Basel II. Latecomers, regional and developing country banks, are predicted to have negligible impact on the accord, impeded both by lack of information about the regulatory agenda and a limited institutional context (Lall, 2012). These were one of the reasons that led to the failure of Basel II accord.

Cornford (2009) argued that the experience of the 2007/2008 financial crisis has led to the conviction that important parts of the Basel II agreement needed rethinking and revision, in particular those concerning the scale and quality of banks' overall capital levels and the allocation of capital to exposures whose riskiness was inadequately assessed prior to the crisis.

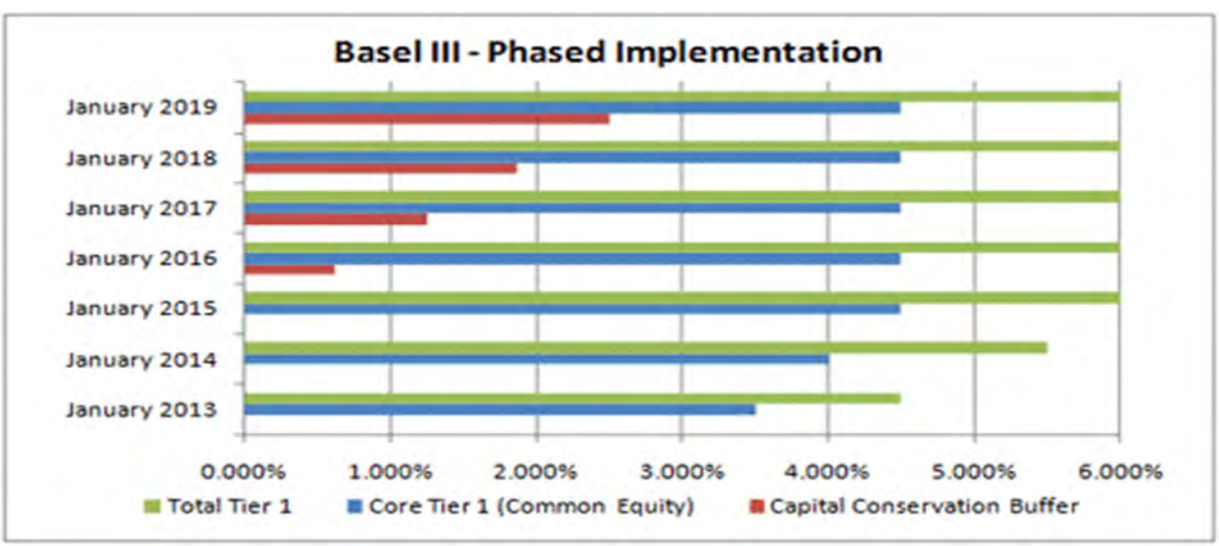
Basel 2 Capital Ratio = **Tier 1 capital** + **Tier 2 capital** + **Tier 3 capital Credit risk** + **Market risk** + **Operational risk** > 8%

2.1.3 Basel III

After the experience of the 2008 financial crises, it was clear that the Basel II Accord required some modification to prevent the same problem from reappearing (Raman, 2015). Basel I and II held capital ratios that were too low to sustain confidence in banks, through stress testing. Basel III was then introduced in 2010 by the members of the Basel Committee on Banking Supervision. Walter (2011) highlighted the objectives of Basel III as to impose higher standards for banking sector's ability to absorb the shocks from the economic and financial sectors. In addition, Gaul (2011), emphasized that two main objectives are pursued. Firstly, the institutions have to possess a higher level of their equity in order to deal with potential losses. Secondly, these institutions should operate at lower risk levels.

The Basel III Phased Implementation

Figure 2-1 The Basel III Phased Implementation



***Source*: http://financialmarketsjournal.co.za/**

Basel II focused on the *asset* side of the balance sheet, Basel III mostly addresses the *liabilities,* i.e., capital and liquidity. In 2013 the Basel Committee on Banking Supervision within then Bank for International Settlements (BIS) began to phase-in Basel III's liquidity and capital requirements in order to: (i) improve the banking sector's ability to absorb shocks arising from financial and economic stress, whatever the source; (ii) improve risk management and governance; and (iii) strengthen banks' transparency and disclosures (BIS, 2016). The motive of the implementation was to improve the general ability to cover and thereby withstand potential shocks, which might occur from economic or financial market stress.

Basel III introduced new capital and liquidity standards to strengthen the regulation, supervision, and risk management of the banking sector. The global capital framework and capital buffers require financial institutions to hold more capital. The leverage ratio introduced a non-risk-based measure to supplement the risk-based minimum capital requirements. The liquidity ratios ensure that adequate funding is maintained in case of severe crisis (IBM, 2014).

2.2 NAMIBIAN BANKING SECTOR AND REGULATION

Namibia has the second largest financial system in southern Africa that well-established financial system which is controlled by legislation and state agencies working through the bank of Namibia. The banking regulation in Namibia is governed by a legal instrument now known as the Banking Institutions Act, 2010, (Act No. 14 of 2010) which seeks to achieve credibility, stability, and economic growth in the banking sector.

The Banking Institutions Act, 1988, (Act No.2 of 1988) was the first act which was amended in 2010 to Banking Institutions Act, 2010, (Act No. 14 of 2010). The act was amended to provide for certain definitions; to provide for consolidated supervision; to provide for the registration of controlling companies and cancellation thereof; to regulate investment by controlling companies and the restructuring within group of companies; to authorise foreign banking institutions to open branches in Namibia; to prohibit banking institutions from converting to branches of foreign banking institutions; to authorise the Bank to determine minimum capital funds in respect of banking institution or banking group (*Please refer to the Government Gazzate 5 November 2010*). The Namibia Financial Institutions Supervisory Authority (NAMFISA) being another regulatory body apart from the Bank of Namibia (BoN) for the financial sector, it is an independent institution established by virtue of Act No. 3 of 2001 that regulate and supervise financial institutions in the financial services industry in the public interest, and fully funded by levies imposed on this industry.

The banking sector comprises of eleven banking institutions. These can be grouped as follows: four commercial banks (First National Bank Namibia, Standard Bank Namibia, Bank Windhoek, and Nedbank Namibia); a small-medium enterprise bank; an E-bank; two microfinance banking institutions; a small branch of a foreign banking institution; and a representative office (Nkabila, 2017). Among this eleven banks, the four commercial banks are the only applicable to the capital framework. The financial sector is dominated by the commercial banks, and the financial intermediation process is dependent upon these commercial banks. The banking system is characterized by an oligopolistic market structure in which a few institutions dominate the industry (Andongo and Stork, 2005). According to IMF (2007) the close ties that Namibia has with South Africa have significantly benefited its financial institutions. All the commercial banks are subsidiaries of South Africa banks, except for Bank Windhoek. All the commercial banks are listed on the Namibian Stock Exchange with except Nedbank Namibia.

In 2019, the Namibian banking sector was adequately capitalised and maintained a healthy capital position. According to NFSR (2020), the total qualifying capital declined from N$16.8 billion in 2018 to N$15.7 billion in 2019. All the measured capital ratios were above the minimum regulatory requirements (i.e., above 6.0% for Common Equity Tier 1 (CET 1), 8.5% for Tier 1 capital and 11.0% for total risk-weighted capital). However, both the total risk weighted capital ratio (RWCR) as well as the Tier 1 risk weighted capital, ratio declined in 2019 when compared to 2018. The total RWCR declined from 16.7% in 2018 to 15.3% in 2019. This was because the Bank of Namibia (BON) as a policy relief measure relaxed the required capital conservation buffer (which allows banking institutions to use the capital they have built up during good times during times of distress) and reduced it to zero percent for at least 24 months in order to support banking institutions to supply increased credit to the economy. This measure was intended to boost the already distressed economy by lending to the most vulnerable sectors (NFSR, 2020).

The IJG (2020) recorded that of the big four commercial banks FNB Namibia remains the best-capitalised, reporting a capital adequacy ratio of 18.8%, while SBN Holding reported the lowest capital adequacy ratio of 14.1% as of 31 December 2019. These ratios are well above the regulatory minimum of 10%. In a difficult environment the performance of the Namibian banking sector has remained resilient and showed improvement. Bank profitability as measured by the Return on Equity (ROE) as well as the Return on Assets (ROA) ratios. The ROE increased from 18.5% in 2018 to 20.0% in 2019 and the ROA increased marginally from 2.1% in 2018 to 2.2% in 2019 (NFSR, 2020). BON (2019) recorded that in 2019 all capital ratios stood well above the minimum regulatory requirements. The Common Equity Tier 1(CET1), Tier 1 and total eligible capital ratios stood well above their minimum regulatory requirements of 6.0%, 8.5% and 11.0%, respectively. The Tier 1 leverage ratio was also well above the regulatory limit of 6.0%, indicating that banking institutions are already managing the risk of excessive leveraging in a prudent manner.

The Basel III implementation deadlines below proposed by the BCBS.

Figure 2-2 Basel III Implementation deadlines

***Source*: Bank for International Settlements (2019)**

2.3 THE IMPLEMENTATION OF BASEL III IN NAMIBIA

A constructive capital adequacy position safeguards the banks from losses as well as risks associated with the banking business and promotes bank profitability. The Basel III capital adequacy standards applicable to banks was intended to be phased in in Namibia over a period of 5 years starting in 2018 (Basel III Capital Framework (BID-5A) was issued in July 2018), but however due to the horrendous corona virus it has been postponed. Namibia's banks would therefore remain under the Basel II regulations until 2022. Considering the Covid-19 pandemic, the implementation date of the Basel III standards has been deferred by one year to 1 January 2023 (BIS, 2020). The BON has issued a timetable of annual deliverables of minimum requirements to be met by the participating banks as they progress to Basel III and it will be assessing the feasibility, impact, and readiness of the country to meet the Basel III framework.

The Namibian Basel III implementation plan phases

Figure 2-3. The Namibian Basel III Implementation Plan Phases

Phased in Arrangement					
Year	2018	2019	2020	2021	2022
Minimum common equity capital ratio	6.0	6.0	6.0	6.0	6.0
Additional tier 1 capital (maximum)	1.5	1.5	1.5	1.5	1.5
Common equity tier 1 capital	7.5	7.5	7.5	7.5	7.5
Capital conservation buffer	0.5	1.0	1.5	2.0	2.5
Total minimum tier 1 capital ratio	8.0	8.5	9.0	9.5	10.0
Tier 2 capital	2.5	2.5	2.5	2.5	2.5
Total risk-weighted capital ratio	10.5	11.0	1.5	12.0	12.5
Leverage ratio	6.0	6.0	6.0	6.0	6.0

***Source*: Bank of Namibia**

Chapter 3 : Literature Review

3.1 THEORETICAL LITERATURE

3.1.1 Introduction

This chapter discusses the theoretical and empirical theories relevant to the study. It follows various scholarly works and theories.

This section contains review of theories relevant to the study. The literature is based on the buffer theory of capital adequacy, economies of scale theory, Modigliani-miller (MM) theory, the pecking order theory, and the moral hazard theory.

3.1.2 The Buffer theory of Capital Adequacy

The Capital Buffer Theory was introduced by Calem and Rob (1996). The buffer theory predicts that banks will maintain a level of capital above the required minimum (a buffer of capital). When a bank reaches the minimum regulatory capital ratio it may have an incentive to raise more capital to minimize the risk of any regulatory costs triggered by the failure to meet the stipulated capital requirements. Jokipii and Milne (2011) strongly supports the capital buffer theory, which suggests that an excess increase in capital than required by the regulator, decreases the risk of the bank, and supports the linkages between capital adequacy regulation and profitability of commercial banks.

Heid et al (2004) tested the capital buffer theory; their results agree with the notion of Jokipii and Milne (2011). They found that the coordination of capital and risk adjustments depends on the amount of capital the bank holds more than the regulatory minimum capital. Diamond (1984), proposed that some banks avoid insolvency through a variety of means, including holding a capital buffer of sufficient size, holding enough liquid assets, and engaging in risk management.

The costs of falling below the minimum required level of capital are both explicit and implicit. Buser et al, (1981) argue that implicit costs of regulation may arise from regulatory interference designed to control excess demand for insurance (e.g., expanding risk taking). Explicit costs relate to penalties and/or restrictions imposed by the supervisor triggered by a breach of the regulation, possibly even leading to bank closure.

This study is premised on the buffer theory of capital adequacy, poorly capitalized banks may encourage taking additional risk in the hope that higher expected returns will help to increase their capital.

3.1.3 Economies of Scale Theory

The Economies of Scale Theory states that larger size banks can enjoy economies of scale and produce services at lower cost per unit and can produce their outputs or services more cheaply and efficiently than can the small banks. Indeed, financial institutions that have a bigger size may benefit from economies of scale, reducing the cost of processing and gathering information. The amount of total assets can be used to determine the size of a bank. As a result, large banks will earn a higher profit than small banks. It is expected, therefore, that bank size is positively related to bank profitability.

Aladwan (2015) was among the researchers to investigate the connection between the bank size and bank profitability. He investigated the effect of bank size on its profitability for Jordanian listed commercial banks within different size bank categories and found that a significance difference in the profitability of these different sized banks. Gabriel (2016) disagrees that size of the bank may also be a determinant of the performance. Post-crises, the costs associated with ‘too-big-to-fail’ bailouts have heightened the policy debate concerning the role and benefits of bank size and the influence of public safety net subsidies that accrue with both size and complexity (Schmid and Walter, 2009).

Boyd and Heitz (2016) supports that that systemic risk increases when the larger players in the financial sector have a larger share of output, he adds that the potential benefits to economies of scale are unlikely to ever exceed the potential costs due to increased risk of a banking crisis. It can be defined as a description of a bank whose collapse would cause catastrophic damage to the economy. This theory will help the study to determine whether banks really are really "Too big to fail" especially when trying to reach the required minimum capital.

3.1.4 Modigliani-Miller (MM) Theory

The Modigliani and Miller (1958) approach deals with the cost of capital structure, also known as the Irrelevance Theory. Gaul (2011) highlighted that the Modigliani-Miller theorem states that, under certain circumstances, the cost of financing a company is independent of its financing structure in terms of capital and debt. In relation to an increased capital requirement for banks, the Modigliani and Miller (MM) theory proposes an independent relationship between the financing structure and the cost of financing, viz. a change in one does not force a change in the other. This theory was tested by Kostrovska et al., (2017) on the Macedonian Banking System. Based on this theory, some economists and regulators argue that there should not be any cost of financing reason for the financial institutions to be against the higher proportion of equity capital required by the Basel III Accord (Berger *et al*., 1995). While others like Aboura and Lépinette (2015) support the view that the Modigliani-Miller theorem cannot be applied to banks, because they do not share the same characteristics as non- financial institutions. The MM theory is relevant to the study as the minimum capital requirement is associated with the cost of capital. BIC (2019) assumes that the lower the MM offset, the larger the effects of higher capital requirements on bank funding cost.

3.1.5 Pecking Order Theory

The Pecking order theory was first suggested by Donaldson in 1961 and it was modified by Stewart C. Myers and Nicolas Majluf in 1984. The theory states that companies prioritize their sources of financing (first in their internal financing then to external financing) according to the cost of financing, preferring to raise equity as a financing means of last resort. Internal funds are used first, and when that is depleted, debt is issued, and when it is not sensible to issue any more debt, equity is issued. According to the theory, if the pecking order holds, we expect a higher probability in issuing instruments with more information asymmetries (i.e., capital) for those banks that the markets know, such as listed banks. This indeed ties to the objectives of this study as it focuses on listed banks and raising capital to adhere to the capital adequacy requirement.

This pecking order theory of a business's financial structure is also an alternative to the Modigliani-Miller model in the long term, but it is especially relevant now when a business is forced to turn to the markets to raise new capital when it has experienced a negative shock to its equity or the value of its collateral (Gaul, 2011).

Llorens and Martin-Oliver (2017) analysed the determinants of banks financing choices under capital regulation in Spanish banks. They used the logic of the pecking order theory to examine whether the banks' choices of financial instruments are related to adverse selection costs. Their analyses found that banks issue financial instruments to cover liquidity needs and growth opportunities during the sample period. The choices among the available instruments respond to a combination of capital regulation and the costs of asymmetric information. Indeed, the sample banks' preferred choice to finance growth is debt, in line with the pecking order. In addition, they found that banks finance their exponential growth with debt instruments and covered the additional regulatory capital requirements from higher risk-weighted assets with the issuance of hybrid instruments.

3.1.6 Moral Hazard Theory

The more stringent Basel III requirements can cause the problem of moral hazard in the banking industry, banks may become more profitable but also riskier. The Moral Hazard Theory predicts that when capital requirements under Basel III framework forces banks to increase their capital, they will react by also increasing the risk level. Sharpe (1978) indicates that risk-based capital requirement can eliminate moral hazard, and this makes it very relevant to the study.

Green (1984) gives an example in his study that bank depositors (clients) do not have any incentive to monitor banks' behaviour; it follows that managers would have more opportunity to increase asset riskiness and exploit moral hazard arising from the deposit to increase asset riskiness and exploit moral hazard arising from the deposit insurance subsidy.

Adding to the literature, Aggarwal, and Jacques (2001) who developed and estimated a 3SLS model to examine the simultaneous impact of PCA on both bank capital and credit risk in the US and Rime (2001) who empirically investigated the capital requirements and bank behaviour in Switzerland both tested the moral hazard theory. They found a positive relationship between capital and risk adjustments, indicating that banks that have built up capital have, at the same time, also increased risk. This discovery supports the moral hazard theory.

3.1.7 ANALYSIS OF THEORITICAL REVIEW

The literature on capital adequacy and bank profitability is mixed as some found a negative relationship while some found positive relationship. The literature also points to a series of model on how one can analyze the relation between CAR and ROE. Similarly, to the paper of Heid et al (2004) who assessed how German savings banks adjust capital and risk under capital regulation with a focus on the capital buffer theory. This study will explore the capital buffer theory which will express the relationship between capital adequacy and bank profitability. Heid et al (2004), in their study find evidence that the coordination of capital and risk adjustments depends on the amount of capital the bank holds more than the regulatory minimum also called capital buffer.

3.2 EMPIRICAL REVIEW

3.2.1 Introduction

This section contains review of various studies done regarding the relationship between capital adequacy and bank profitability in different countries. However, the results of the literature on the relationship between capital adequacy and bank profitability are mixed.

3.2.2 The Relationship between Capital Adequacy and Bank profitability

Capital is a very important determinant of profitability in the banking system. The main problem for internationally operating banks implementing Basel III is the potential impact on profitability while meeting the minimum capital requirements (Weber, 2014). Bank profitability is a very essential indicator of bank performance. The increased capital requirement in some banks is more profitable because holding more capital against their assets will reduce the size of the bank's balance sheets.

The connection between capital adequacy and bank profitability has been widely debated (i.e Vyas et al. 2008, Karigu, 2012, Ranga 2012, Ezike and Oke, 2013, Nyoka, 2017, Datta and Mahmud, 2018 and Agbeja, Adelakun et al. 2019). However, the way that the capital adequacy and the bank profitability influence one another appears to be mixed, there are more supported views of a positive relationship between capital and bank profitability than a negative relationship.

On the one hand studies have shown that capital adequacy relates to a positive effect on bank profitability (Gabriel, 2016; Lee and Hsien, 2013 and Ranga, 2012). Gabriel (2016) examined the relationship between an increased capital ratio and the profitability of a bank. He conducted an empirical study of a sample of European banks after implementation of Basel III and concluded that the impact on profitability was much more nuanced. He also found that a financial institution which holds a higher level of capital seems to generate more profitability; banks which are well-capitalized are considered as being less risky and can have access to funds at better conditions. Moreover, banks which have a higher capital ratio have a more efficient behaviour because their operating income increases more than their operating expenses. It can also be added that well-capitalized banks make stronger monitoring efforts and make better lending decisions.

Commonly, this confirms a significant relationship that was found in his study. In the same strain, Ranga (2012) analysed the impact of minimum capital requirements on commercial banks performance in Zimbabwe. The findings reveal a significant and positive relationship between commercial banks capitalization and its performance. The study recommends that the basis for capital to be held by bank should be in line with the risk a bank is exposed to, hence the higher the risk profile of a bank, the higher the capital should be. Lee and Hsieh (2013), examined the influence that capital has on financial performance of banks in Asia, provide evidence that capital affects net interest margin and net interest revenue over average assets of banks positively.

In addition, Ezike and Oke (2013) likewise investigated the impact of the adoption of the capital adequacy standards on the performance of Nigerian banks and found that capital adequacy standards exert a major influence on bank performance. Udom and Onyekah (2018) and Agbeja, Adelakun et al (2019) also found that capital adequacy impacts positively on the financial performance of commercial banks in Nigeria. Against the backdrop of these findings, it is a clear indication of how a change in capital adequacy would cause a change in the bank's performance levels. Vyas et al., (2008) investigated the impact of bank level factors like, capital to risk weighted assets Ratio, non-interest income and net interest margin on bank performance measured through return on assets of scheduled commercial banks in India in a panel data study over the period 1997-2007.Their study found a positive and significant impact of the mentioned bank level factors on profitability of the scheduled commercial banks in India. Datta and Mahmud (2018) explored the effect capital adequacy on the profitability of listed commercial banks operating in Bangladash. Their results showed that capital adequacy is positively related to the profitability of a bank. This study also found that the regulatory capital held by banks is greater than the minimum capital requirement guided under Basel II accord.

Furthermore, Nyoka (2017) tested the hypothesis that there is a positive and statistically significant relationship between bank capital and profitability. He provides evidence of a positive relationship between capital ratios (CAR), return on equity (ROE) and return on assets (ROA) in his study for South African commercial banks, supporting the generally held notion that there is a positive relationship between bank capital and profitability. Berger (1995) in establishing the relationship between capital and earnings for the US banks used a simple two variable empirical model by assuming that Capital Asset Ratio (CAR) and Return on Equity (ROE) form a simple two variable system without the necessity of controlling for other factors. A similar two variable model was used to establish the relationship between CAR and ROA. His results of the model showed that for USA banks in the 1980s there was a strong positive relationship between capital and bank earnings.

In contrast there are authors who found an opposing relationship between capital and bank profitability. Stovrag (2017) investigated the relation of changes in capital requirements on the profitability of Swedish banks. He used a mixed model approach of both qualitative and quantitative during 1999 to 2015. The results from the quantitative analysis are in line with the findings from the qualitative interviews. He found that on one hand, capital requirement ratios seem to have a negative and statistically significant correlation with the Return on Equity (ROE) for both large banks and niche banks. On the other hand, capital requirement ratios seem to have a positive and statistically significant correlation with the Net Interest Margin for niche banks. The other paper is by Goddard et al. (2010) who investigated eight member countries in the European Union in 1992 to 2007; their results concluded that capital ratio negatively affects profitability. This indicates that highly capitalized banks have low-risk level, and in so doing in turn are likely to experience less return.

Kiragu (2010) investigated the relationship between profitability and capital adequacy of commercial banks in Kenya and found that capital requirement ratios seem to have a negative but statistically insignificant correlation with the Return on Equity (ROE). Olukekan and Adeyinka (2013) found mixed results for their study, when they examined the effect of capital adequacy on profitability of deposit- taking banks in Nigeria. For the primary data, the results of their analysis were not significant, but the secondary data analysis presented a positive and significant relationship between capital adequacy and bank profitability.

There are also researchers that researched Basel III specifically with a focus on bank performance. Ndedi and Katemu (2015) examined the impact of the Basel III principles of (capital requirement, leverage ratio, and liquidity requirements) as indicators for commercial bank performance in Europe. Their results using three scenarios, the findings were as follows: Increase in capital does not necessary result to increase in financing cost. A higher leverage will obtain a higher tax advantage and therefore a lower capital is preferred. Basel III capital ratios will prevent over-leveraging and such tax advantage would be reduced, and finally the new requirements do have a significant impact on the net income and credit portfolio allocation.

Albert et al (2011) published a study that concentrated their efforts on the performance of the Chinese banks, even though the Asian banks were not seriously affected by the global financial crisis 2008. They evaluated the Basel III principles to the Chinese banking and how it has impacts to the financial sector. They discovered that, they have been following the norms of the Basel III even before the advent and possible implementation of it.

Lastly, on a Namibian perspective Plaatjie (2019) assessed of the impact of Basel III implementation on the profitability of Namibian banks.

3.2.3 ANALYSIS OF EMPERICAL LITERITURE

From the above discussion, it is concluded that the empirical literature on the relationship between the capital adequacy and bank profitability locally is limited although internationally is vast. As observed in the empirical evidence above locally and internationally, the findings from all these studies have some common features but remained inconclusive. On a Namibian perspective it has proven to be especially limited. Therefore, the motive of this study is to further test the relationship between capital adequacy and bank profitability and from the perspective of a developing country such as Namibia.

Chapter 4 : Research Methodology

4.1 INTRODUCTION

This chapter presents the framework used by the study for the analysis of the relationship between capital adequacy and bank profitability under Basel III in Namibia. This study employs a quantitative research method and uses panel data regression models. The section describes the research paradigm, model specification, econometric techniques utilized in the analysis, definition of variables and a priori expectations, data description and sources and diagnostic tests.

4.2 RESEARCH PARADIGM

Research paradigm is the conceptual lens through which the researcher examines the methodological aspects of their research project to determine the research methods that will be used and how the data will be analysed (Kivunja and Kuyini, 2017). The paradigm defines a researcher's philosophical orientation, and this has significant implications for every decision made in the research process, including choice of methodology and methods (Kivunja and Kuyini, 2017). This speaks directly to trying to understand the relationships the research is looking to explain between capital adequacy and bank profitability. This section discusses the assumptions underpinning this research study.

There are three major philosophical paradigm assumptions namely interpretivism/constructivist, critical theory paradigm and positivism paradigm (Kivunja and Kuyini, 2017). For this study, a post-positivist research paradigm will be adopted. The choice for the post-positivist research paradigm is supported by the principle underlying this study, which is the relationship between bank profitability and capital adequacy requirement. The positivist paradigm is based on the rational idea of Auguste Comte ((1798 – 1857) to test a priori hypotheses that are often stated quantitatively, where functional relationships can be derived between causal and explanatory factors (independent variables) and outcomes (dependent variables). Burns (2000), states that the post-positivist paradigm is usually validated by applying four criteria namely, internal validity, external validity, reliability, and objectivity. It aims to provide explanations and to make predictions based on measurable outcomes (Kivunja and Kuyini, 2017).

In conclusion, assessable data must be collected, and hypotheses tested using statistical analysis. In this analysis, a panel data model is employed to provide logical analysis and predictions based on measurable outcomes and conclusions. Therefore, this study follows the post- positivist paradigm as stated above.

4.3 DATA COLLECTION AND DATA SOURCE

This research was a desktop study, and, for that, it used secondary data. The study used disaggregated Namibia banking data through a quarterly period of 20 years (1999 to 2019) and is confined to the three Namibian commercial banks listed on the Namibian Stock Exchange (NSX) namely: First National Bank Namibia-FNB, Standard bank Namibia-SBN and Bank Windhoek/ Capricon-BWK.The annual data is acquired from secondary sources namely: Namibian Statistics Agency (NSA), Bloomberg data terminal, selected commercial bank's annual integrated reports and the Bank of Namibia (BON) annual reports. The analysis of the data was done using Stata software.

Table 4-1 Sources of data

BANK NAME	VARIABLE	SOURCE OF DATA
CPG	ROE	Bloomberg
	CAR, TL/TA, TA, TN, NPL	CGP Financial Statements
FNB	ROE	Bloomberg
	CAR, TL/TA, TA, TN, NPL	FNB Financial Statements
SBK	ROE	Bloomberg
	CAR, TL/TA, TA, TN, NPL	SBK Financial Statement
	Macroeconomic: GDP - RIR	Namibia Statistics Agency - Bank of Namibia

Source: Author's construction

4.4. THEORETICAL FRAMEWORK

The theoretical underpinning of this study is explained by the pecking order theory (POT). This is because it is in relation to how banks perform financially. The POT depends on the notion that companies prioritize their sources of financing (first in their internal financing then to external financing) according to the cost of financing, preferring to raise equity as a financing means of last resort. Internal funds are used first, and when that is depleted, debt is issued, and when it is not sensible to issue any more debt, equity is issued. Essentially, banks' capital ability is dependent on the expectation that a higher probability is in issuing instruments with more information asymmetries (i.e., capital) for those banks that the markets know, such as listed banks. This indeed ties to the objectives of this study as it focuses on listed banks and raising capital to adhere to the capital adequacy requirement.

4.5. ESTIMATION PROCEDURE

4.5.1. Specified Economic Model

To investigate the relationship between capital adequacy and bank profitability on the Namibian banking system, this study will follow the work of Datta and Mahmud (2018) who feature the impact of Basel II accord in the financial area of Bangladesh through the examination of benefit (profitability) determinants estimated by capital ampleness proportion (capital adequacy ratio), working productivity proportion (operating efficiency), complete bank resources (total bank assets), absolute credits to add up to resource (total loans to total asset) and obligation to add up to resource proportion (debt to total asset ratio). However, adjustments are made to the Datta and Mahmud empirical model to test under Basel III framework and suit the Namibian banking system.

The basis to the adjustments done for the study’s model compared to Datta and Mahmud (2018):

This study is adjusted to ROE only as the reaction variable as compared to Datta and Mahmud who used both ROE and ROA. The study opted for ROE only because Mbekomize and Mapharing (2017) suggested that ROE is the best proxy of the bank’s profitability. This study was not only limited to capital adequacy ratios as explanatory variable, but the model is also controlling for other variables that affect bank profitability such as total capital adequacy ratio (CAR), Non-performing Loans (NPL), total bank assets (TA), total bank loan (TL) and Loan Asset Ratio (TLTA).

Moreover, the study rules out operating efficiency ratio, debt to total asset as opposed to Datta and Mahmud who included them. Additionally, the study allows for macroeconomic variables such as real interest rate, housing price index and gross domestic product. This is done because for example interest rate is crucial for the commercial banks to determine credit extended to businesses and individuals, it also forms part of revenues generating process for the banks in the form of interest income. The housing price is important for inclusion as banks also tend to generate assets through mortgage bonds. Finally, GDP is needed as when banks are aware of the state of the economy, they based their activities such lending on them. In essence, the choice of macroeconomic and the selected independent variables are guided by theoretical factors that might influence the banks’ capital adequacy and profitability level. The adopted financial model follows as:

$$ROE = f(RCRWA, OVRDTA, LNTA, TLOTA, DBTA) \ldots\ldots\ldots\ldots \textbf{(4.1)}$$

And the modified model which is the empirical model is as follows:

$ROE = f(CAR, TA, TL, TLTA, NPL, GDP, HPI, RIR)$........... **(4.2)**

Thus, equation 4.2 shows that ROE is return on equity, CAR is total capital adequacy ratio for bank j at time t, NPL is Non-performing Loan, TA is total bank assets, TL is total bank loan, TLTA is Loan Asset Ratio, GDP is gross domestic product, HPI is house price index, and RIR refers to Real interest rate.

Mbekomize and Mapharing (2017) suggest in their study that ROE is the best proxy of the bank's profitability followed by ROA and the last measure being NIM (Net Interest Margin).

4.5.2. Specified Estimation (Econometric model)

The adopted econometric model as per Datta and Mahmud (2018) is shown as:

$$\mathbf{ROE_{it}=a_0+b_1RCRWA_{it}+b_2OVRDTA_{it}+b_3LNTA_{it}+b_4TLOTA_{it}+b_5DBTA_{it}+E_i} \text{ .....(4.3)}$$

With the modified model showed as:

$$\mathbf{ROE_{j,t} = \beta_0 + \beta_1\, CAR_{j,t} + \beta_2\, LNTA_{j,t} + \beta_3\, LNTL_{j,t} + \beta_4\, TLTA_{j,t} + \beta_5\, LNPLj,t + \beta_6\, GDP_{j,t}}$$

$$\mathbf{+\ \beta_7\, HPI_{j,t} + \beta_8 RIR_{j,t} + A_0 BASEL03j,t + \beta_{10} BASEL04_{j,t} + \varepsilon_{j,t}} \text{ ....(4.4)}$$

Equation 4.4 shows that ROE is return on equity, CAR is total capital adequacy ratio, NPL is Non-performing Loan, TA is total bank assets, TL is total bank loan which measures the banking industry's liquidity, TLTA is Loan Asset Ratio which measures the aggregate sum of obligation comparative with resources claimed by an organization (bank), GDP is gross domestic product growth, HPI is house price index, and RIR refers to Real interest rate.

The study has applied logarithm to the model's variables such as TA, TL, and NPL. Log linear models are known to provide more control over the interaction of the variables. It is thus, significant to note that from equation 4.4 the study does not take the natural logs of all the variables that are expressed as a percentage. However, the rest of the variables expressed as natural logs because they are indices.

The parameter A_0 catches changes on the whole ROE changes by banks in the year's pre (1999 to 2012) BASEL III and the years post (2013 to 2019) BASEL III implementation. BASEL03 represents a dummy variable, which captures the relationship among the variables, ROE and CAR. It represents one for the year BASEL III was implemented to the current year in question (2013 to 2019) and zero otherwise. *"j"* and *"t"* represent banks and period in quarters, respectively. BASEL04 is the interaction term and it indicates joint effect between BASEL03 and CAR. Thus, captures (compares) the changes between the ROE and CAR in the era of Basel III and the one without Basel III. Finally, ε is the error term which contains "the combined effect of the omitted variables" (Freedman, 2005) and assumed to have zero Conditional Expectation with the explanatory variables.

Therefore, β_0 represents the intercept, that is, the value of the dependent variable ROE, when the explanatory variables CAR, LNTA, LNTL, TLTA, LNPL, GDP, HPI, RIR, BASEL03, and BASEL04 assume a value of zero. β_1…… βn= coefficient of the explanatory variables or the slope, that is, the rate at which a change in the explanatory variable affects the behavior of the dependent variable and **μ** is the error term (Udom and Onyekachi, 2018).

Table 4-2 Dependent, Independent and Control Variables Used in the Study

Variable	Measure	Explanation	Notation	Expected nature of a relationship
Dependent Variabl	Profitability	Return on Equity (Net profit/Total	ROE	
Independent Varia	Bank size	Natural Logarithm of Total assets	LNTA	Positive
	Total Loan	Natural Logarithm of Total loans	LNTA	Positive
	Total Capital Adequacy	Tier 1 Capital + Tier 2 Capital) / Ris	CAR	Positive
	Loan Asset Ratio	Total Loan/Total Asset	TL/TA	Negative
	Non-Performing Loans	Non-Performing loans/Total loans	NPL	Negative
Control Variable	Growth Domestic Product	GDP growth rate	GDP	Positive
	House Price Index	HPI	HPI	Positive
	Real Interest Rate	Nominal interest rate minus the Ir	RER	Positive
Dummy Variables		Dummy term for CAR	DBasel03	Positive
		Interaction term for CAR	DBasel04	Positive

Source: Author's construction

4.5.3 Definition of Variables

The dependent variable is the measure of bank profitability.

4.5.3.1 Depended Variable.

4.5.3.1.1 Return on Equity

The return on equity (ROE), which is the most common measure of bank profitability, is an indication of the profit generated by the bank with the money invested by the shareholders. ROE is important for banks as it specifies the market value of banks, and it helps to compare a bank to its competitors and the overall market.

4.5.3.2 Independent Variables

The following bank variables are, according to the theory, expected to impact on bank performance in the way described namely: Bank size, Total Capital Adequacy, Loan Asset Ratio and Non-Performing Loans.

4.5.3.2.1 Bank Size

Bank size is the ratio that represents the ownership of assets by banks. Bank asset is generally found to relate to positively to bank profitability (Kosmidou, 2008). Large banks tend to maintain high level of liquidity against failure probabilities or liquidity shortages to overcome any insolvency problems, on the contrary small banks tend to invest all its available liquidity to increase returns for growth purposes (Aladwan, 2015).

High asset ownership enables banks to offer more financial services at low cost, thereby increasing bank profitability by allowing banks to realize economies of scale. Similarly, Ellul and Pagano (2006) in this study, the total asset is utilizing as the bank size and because the bank size is very bigger than other variables, this study uses a logarithm of total asset.

H1: Bank size has a positive and statistically significant effect on bank profitability.

4.5.3.2.2. Total Capital Adequacy

The capital adequacy ratio is the percentage of a bank's capital to its risk-weighted assets. The weights are defined by risk-sensitivity ratios whose calculation is dictated under the Basel Accord. It is measured by equity to total asset ratio. Under Basel III, the minimum tier 1 capital ratio is 10.5%, which is calculated by dividing the bank's tier 1 capital by its total risk-based assets. It is assumed that an increase in capital causes a decline in ROE ratio, this study hypothesizes a direct relationship between total capital adequacy and return on equity.

H2: capital adequacy ratio has a positive and statistically significant effect on bank profitability.

4.5.3.2.3. Loan-to-Asset Ratio

The study uses the loans assets ratio to measure the total loans outstanding as a percentage of total assets of the banking industry. Loan asset ratio is used to measure the ability of banks in the meet the demand for credit through the guarantee of several assets owned (Abdullah, 2003). The higher this ratio indicates a bank is loaned up and its liquidity is low. The higher the ratio, the exposed a bank may be to higher defaults. The higher this ratio is, the lower bank's liquidity. A higher loan to asset ratio measures the liquidity of a bank and exposes it to insolvency if the risk of NPL's increase. Loan to asset is a comparison of how big credit which is given to banks compared to the total assets owned by banks. For instance, deposits which are liabilities to banks and assets to individuals. If the bank increases its ratio of illiquid assets, it faces the risk of not fulfilling its short-term obligations (withdrawals of deposits), this can create a run-on and exposes the bank to bankruptcy. The study predicts a negative relationship between ROE and the loan Asset ratio.

4.5.3.2.4. Non-Performing Loans (NPL)

NPL is the ratio of the amount of nonperforming loans in a bank's loan portfolio to the total amount of outstanding loans the bank holds. The NPL ratio measures the effectiveness of a bank in receiving repayments on its loans. This study will use the NPL ratio to measure credit risk of the bank and how it affects profitability, cost of capital and financial stability. Non-performing loans to total loans is a proxy for measuring non-performing loans. Olawale (2014) mentioned that banks profitability could be affected inversely by the levels of non-performing loans and advances, thus affecting greatly the overall bank's liquidity. The high level of non-performing loans in the Bank's balance sheet reduces the bank's profitability and affects the performance of it (Ekinci and Poyraz, 2019). This study predicts a negative relationship between bank non-performing loans and ROE.

4.5.3.3. Macroeconomic Control Variables

To avoid a potential omitted variables problem, the bank profitability regressions contain a broad set of control variables X, which includes proxies for GDP growth, House Price Index and Real Interest Rate.

4.5.3.3.1. Gross Domestic Product Growth (GDP)

The GDP is the monetary value of all finished goods and services made within a country during a specific period. Economic output is mainly affected by an increase in bank lending spreads as banks pass a rise in bank funding costs, due to higher capital requirements, to their customers (Slovik and Cournède, 2011). This study uses GDP as a measure for economic growth.

4.5.3.3.2. House Price Index (HPI)

A house price index measures the price changes of residential housing as a percentage change from some specific start date. This study uses HPI as a macroeconomic variable to investigate its impact on the banking system performance and level of capital adequacy and a positive relationship is predicted. According to Youngkyung *et al* (2019) housing prices affect bank profitability in three ways: first, fluctuations in housing prices affect the bank's lending decisions. If housing prices rise, banks tend to increase the volume of loans. Second, fluctuations in housing prices affect the quality of assets owned by banks. Banks' asset soundness will improve in the case of a rise in housing prices. Third, fluctuations in housing prices have a greater impact on bank profitability when the real estate market goes bust.

The reason for including HPI is because property prices in Namibia have increased exponentially over the years and these increases have contributed to increased household borrowing and debt over the years. This indicates the importance of controlling for it which is one of the Bank of Namibia objectives in supporting the health of the financial sector and real economy.

4.5.3.3.3. Real Interest Rate (RIR)

A real interest rate is an interest rate that has been adjusted to remove the effects of inflation to reflect the real cost of funds to the borrower and the real yield to the lender. Bank profitability increases when interest rates are higher, banks make more money, by taking advantage of the difference between the interest banks pay to customers and the interest the bank can earn by investing. When inflation raises interest rates also raises and increase in interest rates provide greater opportunity for banks to increase their profits (Jeevitha et al, 2019). Peng *et al*, (2003) investigated the Impact of Interest Rate Shocks on the Performance of the Hong Kong Banking Sector. Their results showed that a decrease in interest rate leads to an increase in the net profit margin, which was used as a proxy for bank profitability while increase in interest rate has only a small impact on profit margin. Anbar and Alper (2011) found that among macroeconomic variables of GDP growth and inflation, only real interest rate was found to be significantly affecting ROE at 5% level of significance in Turkey. Higher real interest rates can lead to higher bank profitability due to higher rates of return from assets such as loan.

As such, for estimations, equation 4.4 is transformed into in a Heterogenous Dynamic Panel, Panel Autoregressive Distributed Lag (PARDL) Technique represented by equation 4.5. The structure of the data entails heterogeneity as T is greater than N, that is, the years are greater than the number of firms (banks), group. As highlighted in section 4.3 that the study uses 20 years quarterly data for three Namibian commercial banks, T is indeed above N. This makes the sample considerably small and necessitate the need for the method as one of its primary purposes (Dritsaki, 2018 and Saysombath & Kyophilavong, 2013). It was identified by Pesaran and Shin (1999) and has capability to integrate a combination of variables without unit root in levels I (0) together with the ones that appear stationary after being differenced I (1) (Dritsaki, 2018 and Saysombath & Kyophilavong, 2013). It is shown as:

$$\Delta \boldsymbol{ROE}_{j,t} = \varrho_j[\boldsymbol{ROE}_{t-1} - \boldsymbol{\vartheta}_j'\boldsymbol{X}_{j,t}] + \sum_{k=1}^{p-1} \boldsymbol{\tau}_{j,k}\Delta \boldsymbol{ROE}_{j,t-k} + \sum_{k=0}^{q-1} \boldsymbol{\beta}_{jk}' \Delta \boldsymbol{X}_{j,t-k} + \boldsymbol{\varphi}_j + \boldsymbol{\mu}_{jt} \text{………………} \quad \textbf{(4.5)}$$

In equation 4.5, $\Delta \boldsymbol{X}_{j,t-k}$ is the regressors (including CAR, LNTA, LNTL, TLTA, LNPL, GDP, HPI, RIR, BASEL03, and BASEL04) which are differenced for banks $\boldsymbol{j}$ at time $\boldsymbol{t}$. ϱ_j**= -(1-**$\boldsymbol{\hbar}_j$**)** shows the " group-specific speed of adjustment coefficient" which is from the expectation that ϱ_j is less than zero

$\boldsymbol{\vartheta}_j'$ expresses the long run associations' vector.

$[\boldsymbol{ROE}_{t-1} - \boldsymbol{\vartheta}_j'\boldsymbol{X}_{j,t}]$, is the error correction term

$\boldsymbol{\tau}_{j,k}$, $\boldsymbol{\beta}_{jk}'$ are the dynamic coefficients in the short run.

Essentially, $\boldsymbol{\tau}_{j,k}$ is a kx1 vector that are allowed to be purely I(0) or I(1) or cointegrated; ϱ_j is the coefficient of the lagged ROE usually called scalars; $\boldsymbol{\beta}_{jk}$ are kx1 coefficient vectors; $\boldsymbol{\varphi}_j$ is the bank specific fixed effecrs; j=1,…,N; t=1,2,…,T; p, q represent optimal lags; $\boldsymbol{\mu}_{jt}$ is the error term.

The ARDL method was proposed by Pesaran and Smith (1995) Pesaran and Pesaran (1997), Pesaran and Shin (1999) and Pesaran et al. (2001) and it is modelled through the following three estimators:

<u>The Mean Group (MG) Estimator by Pesaran and Smith (1995)</u>

The MG midpoints the information, gauges N separate modellings, looks at the circulation of the assessed coefficients across gatherings, produces reliable evaluations of the normal of the parameters, and parameters are unreservedly free across the gatherings (CrunchEconometrix, 2018).

The Common Correlated Effects or Dynamic Fixed impacts (DFE) assessor by Pesaran (2006)

According to CrunchEconometrix, through this assessor the intercepts contrast across gatherings, the coefficients' slope and mistake differences are indistinguishable. This permits the unique (dynamic) detail (eg. The quantity of slacks included to vary across gatherings).

The Pooled Mean Group (PMG) assessor by Pesaran et al. (1999)

Pesaran, Shin and Smith (199) proposed intermediate estimator which integrates both the MG and DFE. This is called pooled mean group (PMG). It permits the models' intercepts, coefficients in the short-run, and mistake changes (error variance) to vary unreservedly across gatherings. This produces reliable evaluations of the mean of short-run coefficients to taking the basic normal of separate component coefficients.

4.5.4. Estimation Techniques

4.5.4.1. Descriptive statistics

It is necessary that a demonstration and explanation regarding every model's variable's characteristic and whether they connect to every group in the model to allow engagement for a comparative analysis is done (CrunchEconometrix, 2018).

4.5.4.2. Panel Unit Root

To avoid the problem of spurious regression, this paper performed one panel unit root test for the variables, namely: Im, Pesaran and Shin W-stat (IPS). The unit root test is first conducted to establish the stationary properties of the time series data sets. Stationary entails long run mean reversion and determining a series stationary property avoids spurious regression relations. It occurs when series having unit roots are regressed into one another.

Since panel data involves times series which are likely to suffer from non-stationarity and may render problematic results because of spurious regressions (Gujarati, 2011). Panel data are stable (stationary), if their moments are stationary, that is their mean and variance is constant over time, there are no trends, and time varying variances.

Therefore, the study uses the Im, Pesaran and Shin W-stat (IPS) test proposed by Im, Peseran and Shin (2003). The IPS test is vital as it is used to examine the existence of unit root of panel data when powerful tests are needed for the small set of observations (Şen *et al.*, 2014), which is the case of this study.

$$\Delta yt = \beta 1 + \beta 2t + \delta yt\text{-}1 + \sum \delta i \Delta yt - i + u_t \ldots\ldots (4.6)$$

Where ut is a white noise error term and where **Δyt-1 = (yt-1 – yt-2), Δyt-2 = (yt-2 – yt-3),**

The null hypothesis implies that time series contain unit root and the alternative hypothesis states that time series are stationary; the panel unit root tests used the hypothesis below:

***H_0*: θ=0**

H_1: θ<0

θ=0 indicates that beta minus 1 is equal to zero, which means beta is equal to one, which means unit root, and therefore nonstationary.

θ**<0** indicates that beta is different from zero and hence stationary

4.5.4.3 Optimal lag for the model

Since the quantity of slacks influences the ARDL strategy, the quantity of slacks was resolved. Hence, there are five measures used to choose the quantity of slacks, and they as follow: Akaike Information Criterion (AIC), Final Prediction Error (FPE), Hannan-Quinn (HQ) and Schwarz Information Criterion (SC). The criterion with the lowest figure is the preferred on for optimal lags selection.

4.5.4.4 Cointegration

Co-integration is defined as a concept that finds the existence of a long run relationship among the variables of interest (Johansen, 1991). Hence, two series are said to be co-integrated when there is a linear combination of the two series that is stationary or when there is a long run equilibrium relationship between the variables. Furthermore, as Johansen (1995) noted that if there are two or more variables in a model, there is always a likelihood of having more co-integrated vector. Practically, the co-integration test is useful in several ways, depending on the nature of the equation that is tested. Thus, if it is a single equation, the Engle Granger test is used, however, if it is a multivariate system, then the Johansen Approach is executed to determine the existence of the long run equilibrium relationship among variables. For this purpose, the Johansen Co-integration test is used in this study.

To test the existence of a long-run (equilibrium) relationship between capital adequacy and bank profitability, the study will follow the work of Udom and Onyekachi (2018) with modification to the model of some in-depended and macroeconomic variables. The Panel Co-integration methods of Pedroni Cointegration Test and Kao Cointegration Test (Engle-Granger based) are used. Both the Pedroni and The

Kao test specify cross-section specific intercepts and homogeneous coefficients on the first-stage repressors.

Gujarati (2003) states that a linear combination of two or more non-stationary series may be stationary. If such a stationary, or I (0), linear combination exists, the non-stationary (with a unit root), time series are said to be co-integrated. Therefore, testing the stationarity of the residual term makes test for the presence of co-integration. If the variables are nonstationary at level, they are said to be integrated.

If the variables are found to be cointegrated, then the next step is to estimate the cointegrating vector normalized with respect to the in-depended variables. The short-run effects of Return on Equity movements are incorporated into the long-run equation by estimating the VECM.

4.5.4.4.1 Kao (Engle-Granger based)

The Kao test follows the same basic approach as the Pedroni test; however, it specifies cross-section specific intercepts and homogeneous coefficients on the first stage regressors. According to Tatoğlu (2012), this test presents a cointegration test for panel data analysis using Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) tests. The null hypothesis states that there is no cointegration between the series and the alternative hypothesis is that it is cointegration between the series.

4.5.4.5 The Hausman Test

To decide which of the PARDL assessors is the better assessor for the whole model, the Hausman Test is conducted among the three assessors as follows:

MG and PMG: The Hausman test is carried put with the null hypothesis that estimates fail to be significantly different and the alternative hypothesis opposing the null hypothesis. The decision of rejecting the null hypothesis is made upon the event that the probability value is less than the significance level of 5 percent; with decision not to reject the null hypothesis being when the probability value is above the 5 percent level of significance is accepting that the PMG is more efficient than the MG.

MG or DFE: The Hausman test is carried put with the null hypothesis that estimates fail to be significantly different and the alternative hypothesis opposing the null hypothesis. The decision of rejecting the null hypothesis (accepting that MG is the better assessor) is made upon the event that the probability value is less than the significance level of 5 percent; with decision not to reject the null hypothesis being when the probability value is above the 5 percent level of significance is accepting that the DFE is more efficient than the MG

DFE or PMG: The Hausman test is carried put with the null hypothesis that estimates between DFE and PMG fail to be significantly different and the alternative hypothesis opposing the null hypothesis. The decision of rejecting the null hypothesis is made upon the event that the probability value is less than the significance level of 5 percent; with decision not to reject the null hypothesis being when the probability value is above the 5 percent level of significance is accepting that the PMG is more efficient than the DFE.

4.5.4.6. Panel VECM (Vector Error Correction Model) for causal association,

The vector error correction (VECM) model is an unrestricted VAR designed for use with non-stationary series that are known to be co-integrated. It captures the speed at which the dependent variable, the return on equity, adjusts towards long-run equilibrium. The study uses the vector error correction model (VECM) specification, this method corrects for autocorrelation and endogeneity parametrically (Johansen, 1988; 1995).

However, due to the existence of cointegration, the PVECM model was used. If there is cointegration among the variables, correct statistical inference will be obtained by means of analysing causality using the error correction model (Granger, 1969). PVECM is used to check for short run and long run causality between variables. It adds more correction features to the VAR framework. The VECM within the VAR framework is estimated as:

$$\Delta ROE_{jt} = Q_0 + \sum_{j=1}^{r-1} Q_1 \Delta ROE_{j,t-k} + \sum_{j=1}^{r-1} Q_{2k} \Delta X_{j,t-k} + vECT_{j,t-1} + \mu_{jt} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{(4.7)}$$

ΔROE_{jt} is the differenced return on equity for banks, j at time t losing one lag, k. $\Delta X_{j,t-k}$ is the differenced regressors (including CAR, LNTA, LNTL, TLTA, LNPL, GDP, HPI, RIR, BASEL03, and BASEL04) for banks, j at time t losing one lag, k.

r-1 is the lag length decrease by the value of one. While Q_1 and Q_2 represent short-run dynamic coefficients of the model adjustment long-run equilibrium. **v** Represents speed of adjustment parameters it is expected to have a negative sign. $ECT_{j,t-1}$ Is addressing the mistake amendment term is the slacked estimation of the residuals got from the co-reconciliation relapse of the reliant variable on the regressors. Which contains future data obtained from the long-run co-integration relationship.

And $\boldsymbol{\mu_{jt}}$ is residuals (stochastic blunder terms regularly called driving forces, or advancements or stuns.

4.5.4.7. Diagnostic tests

4.5.4.7.1. Multicollinearity

For the study to be taken seriously, the study's model had to be tested for multicollinearity. According to Black et al. (as cited in Mundilo, 2021), "in multiple regression analysis, explanatory variables may become strongly correlated and result in large estimated standard errors and insignificant estimated coefficients. The explanatory variables become largely linearly dependent. This condition is known as multicollinearity."

As indicated by Black et al. (as cited in Mundilo, 2021), in various relapse examination, logical factors may turn out to be firmly correlated and bring about huge assessed standard errors and inconsequential assessed coefficients. The illustrative factors become to a great extent straight reliant. This condition is known as multicollinearity. Multicollinearity exists whenever an independent variable is highly correlated with one or more of the other independent variables in a multiple regression equation. Thus, it is an issue as it may under look the significance of an independent variable, statistically (Allen, 1997).

The condition involves a straight connection between at least two free factors portrays the idea of multicollinearity where standard blunders (errors) are incredibly higher subsequently assessments are wrong (Bassi, 2018). The assessor prompts loose point appraises somewhat, because of the variance inflation factor brought about by multicollinearity. Hsiao (2003) highlighted that Panel data normally give the specialist numerous information focuses, expanding the level of opportunity and decreasing the collinearity among logical factors, henceforth improving the proficiency of econometrics gauges.

Furthermore, when cross-sectional statistics are pooled together at various periods as expected, the populace may have various dispersions. Thus, to account for the issue of multicollinearity, the variance inflation factor was conducted to account for multicollinearity. Wooldridge (2013, p. 98) outlines that the most common of the tests to be carried out is the variance inflation factor (VIF). In this condition, one or more explanatory factors is found to be not correlated with rest of the explanatory variables in the model. To determine that multicollinearity is present the VIF value must be above 10 and hence it will be a problem to estimate the model if the VIF is greater than 10.

4.5.4.7.2. Cross-sectional Dependence or Autocorrelation (serial correlation)

Panel data can be dependent upon unavoidable cross-sectional reliance, whereby all units in a similar cross-area are associated. This is normally ascribed with the impact of some unseen basic variables, basic to all units and influencing every one of them, albeit perhaps in an unexpected way (Tugcu, 2018). If the basic elements, which are excluded from the model, are associated with the regressors, which is generally the situation, both the standard homogeneous assessors for panel data (PMG, DFE) as well as the heterogeneous MG assessor are conflicting.

Cross-sectional reliance is quite possibly the main diagnostic test that an analyst ought to research prior to playing out a panel data. In this unique circumstance, the Breusch and Pagan (1980) LM test, Pesaran (2004) scaled LM test, Pesaran (2004) CD test, and Baltagi et al. (2012) inclination revised scaled LM test are used. The null hypothesis in the test postulates that there is no cross-sections dependence in residuals. Therefore, when the three tests' probability results or one of them, especially, the Pesaran CD (P-CD) test is below than 5 percent significance level, the null hypothesis is rejected, and the researcher can conclude there is cross sectional dependence and vice versa (Tugcu, 2018 as cited in Mundilo 2021, p.44). Essentially, when T is greater than N, the P-CD test results are used for inference of serial correlation.

4.5.4.7.3. Testing for Heterosedasticity

Pedace (2013) highlights that a basic suspicion of the classical linear regression model (CLRM) is homoscedasticity — that the change of the mistake term is steady (constant) over different upsides of the autonomous factors. Be that as it may, this presumption may not generally hold. At the point when it does not occur, the researcher is featured with heteroscedasticity. The latter is the point at which the difference (variance) of the blunder term changes because of a change in the value(s) of the autonomous variable(s).

It is normally communicated as $\text{Variance}(e_t|x_t) \neq \sigma^2$ if the mistake term is heteroscedastic, the scattering of the blunder changes after some time. This abuses the fourth CLRM supposition. At the point when a supposition of the CLRM is disregarded, the OLS assessors may fail to be BLUE ("best linear unbiased estimators") (Pedace, 2013).

The Breusch-Pagan (BP) test is perhaps the most widely recognised tests for heteroscedasticity. It starts by permitting the heteroscedasticity cycle to be a component of at least one of your free (explanatory) factors, and it is generally applied by accepting that heteroscedasticity might be a straight capacity (linear function) of the relative multitude of autonomous factors found in the equation. This suspicion can be communicated as $e^2 = d_0 + d1\&_{t1} + \ldots + d_r\&_{tr} + e_t$. This should lead the mistakes (errors) to be contemporaneously homoscedastic (Wooldridge, 2018).

4.6. CONCLUSION

In this chapter, the researcher attempted to establish the methodology to undertaking the study. Concepts such as research paradigm, method and design were discussed. The chapter also outlined the sources of the data, theoretical framework, and the estimation procedure (data analysis).

Chapter 5 : Empirical Findings and Discussions

5.1. DESCRIPTIVE STATISTICS

Table 5-1 Descriptive Statistics

		ROE	CAR	LNTA	LNTL	TL_TA	BASEL03	BASEL04	NPL	HPI	RIR	GDP
Mean		5.413	3.58	5.00	4.75	14.66	0.33	1.31	0.86	13.6	1.2	0.83
Maximum		9.27	4.27	5.75	5.49	22.67	1	4.27	1.84	25.9	2.8	1.76
Minimum		3.125	2.56	3.49	3.54	9.31	0	0	0.15	4.28	-0.9	-0.3
Std. Dev.		1.32	0.44	0.67	0.61	4.37	0.47	1.87	0.42	7.8	0.85	0.59
Observations	N	212	204	212	212	212	252	252	164	252	252	252
	n	3	3	3	3	3	3	3	3	3	3	3
	T	71	68	71	71	71	84	84	55	84	84	84

Table construction source: Author; Data source: Stata15.1SE estimations

The descriptive statistics of the variables are shown in the table above. The mean values for all the variables are in the range of 0.33 to 15. The maximum values for the variables are indicated to be in the ranges of 1 and 26 with minimum values not exceeding 10. The standard deviations of the variable are in the ranges 0 and 8. As such the standard deviations adequately high, for instance the variable of interest is 1.32 which is high enough to provide explanations of the variations in the data.

5.2. PANEL UNIT ROOT

Table 5-2 Panel Unit Test

Variable	Model specification	Im, Pesaran, and Shin (IPS)		Integration Order
		Levels	First Difference	
ROE	***Intercept and 1 lag***	0.1054(0.5420)	-8.2852(0.0000) ***	I (1)
	Trend& Intercept	-0.33(0.36)		
CAR	***Intercept and 1 lag***	-1.3723(0.09) *		I (0)
	Trend & Intercept	-1.78(0.0374) ***		I (0)
BASEL03	***Intercept***	1.68(0.9537)	-9.68(0.0000) ***	I (1)
	Trend & Intercept	0.3268(0.62)		
BASEL04	***Intercept***	1.58(094)	-9.66(0.0000) ***	I (1)
	Trend & Intercept	0.22(0.59)		
TL/TA	***Intercept***	1.827(0.966)	-8.85(0.0000) ****	1(1)
	Trend & Intercept	-0.90(0.18)		
LNTA	***Intercept***	-0.22795(0.3899)	-11.3136(0.0000) ***	I (1)
	Trend & Intercept	0.6682(0.75)		
LNTL	***Intercept***	-0.1346(0.4465)	-11.7708(0.0000) ****	I (1)
	Trend & Intercept	0.98(0.83)		
NPL	***Intercept and 1 lag***	0.36(0.64)	-6.9935(0.0000) ***	I (1)
	Trend & Intercept	-0.086(0.46)		
HPI	***Intercept***	2.94(0.9984)	-12.466(0.0000) ***	I (1)
	Trend & Intercept	-1.1057(0.13)		
RIR	***Intercept***	-2.225(0.013) ***		I (0)
	Trend & Intercept			
GDP	***Intercept***	-0.62(0.26)	-9.4867(0.0000) ***	I (1)

	Trend & Intercept	0.2787(0.61)		

Table construction source: Author; Data source: Stata estimations

It is depicted that *** contains significance at 5 percent level; ** contains significance at 1 percent level; and * contains significance at 10 percent level. The brackets () represent critical values.

The variable of ROE is significant at 5 percent level of significance in the IPS after first difference at individual intercept hence clearing it off the problem of unit root. The variable of CAR is significant at 10 percent level of significance at levels in both individual intercept and trend and intercept in the IPS, and thus it is stationary after first difference. The dummy variable, BASEL03 is shown to be significance at 5 percent level after difference in individual intercept in the test of IPS and thus outlining that the null hypothesis of BASEL03 has unit root is rejected. Similarly, the interaction term, BASEL04 is significant at 5 percent level after first difference in the test used at individual intercepts and thus indicating that it is free of unit root. The variables of TL/TA, LNTA, LNTL, NPL, HPI, and GDP are stationary at individual intercept in the test but after first difference. Essentially, the variables are significant at 5 percent level and thus making the researcher reject the null hypotheses of unit root existence in each respective variable. For RIR, the IPS results show that the variable is stationary in level at individual intercept. It is significant at 5 percent level at individual intercept. Hence, the researcher rejects the null hypothesis of RIR has unit root.

Overall, the variables are free of unit root at two different orders of integration, level and first difference in the test of IPS. Since the data used in the study is not strongly balanced, that is, it is unbalanced panel, the supplementary test of LLC was not allowed. The subsequent tests to be carried out is the optimal lag selection.

5.3. OPTIMAL LAG SELECTION

Table 5-3 Optimal Lag Selection

Lag	LogL	sequential modified LR test statistic (each test at 5% level) (LR)	Final prediction error (FPE)	Akaike information criterion (AIC)	Schwarz information criterion (SC)	Hannan-Quinn information criterion (HQ)
0	-933.0154	NA	9.62e-09	12.75697	12.97973	12.84747
1	1058.461	3660.010	1.02e-19*	**-12.51974***	-9.846549*	-11.43363*
2	1087.366	48.82666	3.62e-19	-11.27522	-6.151603	-9.193504

3	1143.538	86.53552	9.25e-19	10.39916	-2.825128	-7.321851
4	1357.602	297.9532*	2.99e-19	-11.65678	-1.632318	-7.583863

Table construction source: Author; Data source: Stata estimations

* Indicates lag order selected by the criterion

The optimal lag selection was conducted, and it is shown that the AIC has the lowest figure among all the tests at -12.520 and hence making the study to select to be optimal lags of 3.

5.4. COINTEGRATION TEST

Table 5-4 Pedroni Test of Cointegration and Kao Test of Cointegration

Pedroni Test for Cointegration			**Kao test for Cointegration**		
Test	**Statistics**	**Probability**	**Test**	**Statistics**	**Probability**
Modified Phillips-Perron t	0.8075	0.2097	Modified Dickey-Fuller	0.4669	0.3203
Phillips-Perron t	-6.7978	0.0000***	Dickey-Fuller	-0.1742	0.4309
Augmented Dickey-Fuller t	-1.9894	0.2233	Augmented Modified Dickey-Fuller t	-0.0479	0.4809
			Unadjusted Modified Dickey-Fuller	-3.5598	0.0002***
			Unadjusted Dickey-Fuller	-2.7274	0.0032***

Table construction source: Author; Data source: Stata15.1 estimations

It is depicted that *** contains significance at 5 percent level.

The cointegration test was carried out and is shown in the table above using the Pedroni and Kao tests of cointegration. It is shown that the probability is less than 5 percent level (significant at 5 percent level) in the Phillips-Perron of the Pedroni test; Unadjusted Modified Dickey-Fuller and Unadjusted Dickey-Fuller of the Kao test and hence the null hypotheses of no cointegration in both tests are rejected indicating the existence of a long run relationship between the variables of the study. However, two tests, Modified Phillips-Perron t, and Augmented Dickey-Fuller t in the Pedroni test of Cointegration failed to be significant outlining 67 percent of the insignificant tests. Also, three tests (Modified Dickey-Fuller, Dickey-Fuller and Augmented Modified Dickey-Fuller t) in the Kao test of Cointegration failed to be significant representing

60 percent of the tests whose results are not significant. Therefore, it is concluded, in overall terms that there is no cointegration between the variables. Therefore, the PMG estimation is shown next.

5.5. PANEL ARDL

5.5.1. Short Run Coefficients

Table 5-5 Short Run Coefficients Estimates

	Mean Group		Pooled Mean Group		DFE	
Variables	Coefficient	Trace statistics (brackets: probability figures	Coefficient	Z statistics (brackets: probability figures	Coefficient	Z statistics (brackets: probability figures
CAR	0.48	0.48(0.633)	0.803	0.73(0.005) ***	0.85	0.65(0.52)
BASEL03	2.744	1.27(0.218)	4.24	1.75(0.079) *	3.63	0.56(0.57)
BASEL04	-0.757	-1.23(0.218)	-1.17	-1.72(0.085) *	-1.03	-0.60(0.55)
ECT			-0.10	-0.46(0.646)		

Source: Author's construction with Stata15.1 estimation output

It is depicted that *** contains significance at 5 percent level and * contains significance at 10 percent level. The brackets () represent critical values.

In the short run estimates, the MG shows that all the variables are not significant. Interestingly, however, the variables' coefficients are positive as expected.

The PMG's results indicate that the coefficient of CAR is positive as expected at 0.84. It shows that a further 100 BPs increase in CAR is likely to increase ROE by 80.3 percent in every quarter. This outlines a significant positive relationship. This positive relationship finding is like that of Udom and Onyekah (2018) and Agbeja, Adelakun et al (2019) who found that capital adequacy impacts positively on the financial performance of commercial banks in Nigeria. Moreover, the finding is similar to Nyoka (2017) and Datta and Mahmud (2018) who showed that capital adequacy is positively related to the profitability of a bank. The researcher thus failed to reject hypothesis two and concludes that CAR has a significant positive influence on ROE. Meanwhile, Basel03 and Basel04 are significant at 10 percent significance level. Basel03's coefficient is positive as per expectation. This shows that, ceteris paribus, banks can increase profitability by 424 percent in the environment of regulation than in the environment without regulation. In essence, a hundred banks under Basel III are anticipated to yield N$424 million more in profits than a hundred comparable banks in the absence of Basel III. On the relationship basis, the latter is a positive one. Therefore, this should mean that the Namibian banks have an advantage to raise more funds as they can easily meet the Basel III capital requirement through an ability to raise ROE. This is in line with the Capital Buffer Theory which outlines that when a bank reaches the minimum regulatory capital ratio it may have an incentive to raise more capital to minimize the risk of any regulatory costs triggered by the failure to meet the stipulated capital requirements (Calen & Rob, 1996). Empirically, the result is in line with Ndedi and Katemu (2015) who highlight that Basel III capital ratios will prevent over-leveraging and such tax advantage would be reduced.

The interaction term, Basel04 being against the expectation and significant reveals that the return to CAR (the effect on ROE) in 1999Q1-2012Q4 is anticipated to be 80.3 percent and the return to CAR in 2013Q1-2019Q4 is by anticipation 117 percent lower. Thus, the relationship between ROE and CAR has failed to be stable over time, after Basel III introduction. That is, the relationship was positive in the periods without Basel III but negative in periods with Basel III. This instability can be well explained through the sluggish country's economic performance which started three years after the capital regulation was implemented by BoN which may have resulted in high NPLs (as result of borrowers' inability to service their loans) among the banks to affect interest income and persisted through to 2019.

In the DFE, the coefficients of all the variables, CAR, BASEL03 and BASEL04 are positive as expected but are not significant.

Finally, like in the Pedroni test of cointegration and Kao Cointegration test, the error correction term as represented by ECT in the table confirms that there is no cointegration as it is not significant.

5.5.2. Long Run Estimates

Table 5-6 Long Run Coefficients Estimates

	Mean Group		Pooled Mean Group		Pooled or DFE	
Variables	Coefficient	Z statistics (brackets: probability figures	Coefficient	Trace statistics (brackets: probability figures	Coefficient	Trace statistics (brackets: probability figures
CAR	4.28	2.47(0.013) *	1.065	0.43(0.67)	1.12	0.46(0.646)
BASEL03	39.56	1.45(0.147)	2.93	0.10(0.92)	2.88	0.09(0.927)
BASEL04	-10.77	-1.58(0.115)	-1.039	-0.13(0.98)	-1.06	-0.13(0.893)

Source: Author's construction with Stata15.2 estimation output

It is depicted that *** contains significance at 5 percent level; ** contains significance at 1 percent level; and * contains significance at 10 percent level. The brackets () represent critical values.

In the long run estimates, the MG shows that all the variables but CAR are not significant. Essentially, the coefficient of CAR is positive at 4.28 and significant at 10 percent significance level. This reveals that a further 100 BPs increase in CAR is likely to increase the ROE by 428 percent (N$428 million) in every quarter. This outlines a positive relationship and is similar to that of Udom and Onyekah (2018) and Agbeja, Adelakun et al (2019) who found that capital adequacy impacts positively on the financial performance of commercial banks in Nigeria. Moreover, the finding is like Nyoka (2017) and Datta and Mahmud (2018) who showed that capital adequacy is positively related to the profitability of a bank. The researcher thus failed to reject hypothesis two and concludes that CAR has a significant positive influence on ROE.

Meanwhile, the PMG's results indicate that the coefficients of CAR and BASEL03 are positive as expected at 1.65 and 2.93, respectively. They have failed to be significant, however. For CAR, it is inferred that a further 100 BPs surge in CAR is likely to raise the banks' ROE by 165 percent in every quarter. This outlines a positive insignificant relationship. Meanwhile, Basel03's results show that, ceteris paribus, banks can increase profitability by 293 percent (equivalent to N$293 million) in the environment of BASEL III regulation than in the environment without Basel III regulation. In essence, a hundred banks under Basel III are anticipated to yield N$294 million more in profits than a hundred comparable banks in the absence of Basel III. This reveals an insignificant positive relationship. With this insignificant positive connection, it may mean that as per Pecking Order Theory internal funds (retained earnings) as the first source of funding for the banks may be used to meet the Capital Buffer Theory and just turn to leverage and equity to raise capital. The coefficient of BASEL04 is negative which is not as expected. Moreover, it has failed to be significant. This brings to light that the return to CAR, ROE in 1999Q1-2012Q4 is anticipated to be 428 percent; the return to CAR in 2013Q1-2019Q4 is by anticipation 103.9 percent lower. Thus, the relationship between ROE and CAR has failed to be stable over time. This instability can explained in too much leverage banks tend to have in the long run which makes them only focus on meeting the capital requirements. In addition, the instability could be because of inadequate incentives contained in Basel III to allow banks finance their operations.

Finally, the DFE's results reveal that all variables' coefficients' signs but BASEL04 are as expected. It is, further, revealed that all the variables are not significant. CAR's coefficient shows that a one hundred BPs rise in CAR will result in a 112 percent increase in the banks' profits per financial reporting period of the bank. Thus, an insignificant positive connection is shown. The coefficient of BASEL03 is positive at 2.88. Therefore, ceteris paribus, banks can increase profitability by 288 percent (equivalent to N$288 million) in the environment of BASEL III regulation than in the environment without Basel III regulation. Quintessentially, a hundred banks under Basel III are anticipated to yield N$288 million more in profits than a hundred comparable banks in the absence of Basel III. This reveals an insignificant positive relationship. This could have happened as even if banks are highly leveraged in the long run (under Basel III) which may raise their susceptibility to insolvency/illiquidity, they will still borrow from those unregulated (without Basel III) banks to finance their activities and the unregulated banks may be using their depositors' funds to lend to the regulated ones without their consent. Therefore, by implication, this could be moral hard posed by Basel III on the Namibian commercial banks. The coefficient of BASEL04 is negative and is not as expected. Evidently, the return to CAR, ROE in 1999Q1-2012Q4 is anticipated to be 112 percent; the return to CAR in 2013Q1-2019Q4 is by anticipation 106 percent lower. Thus, the relationship between ROE and CAR has similarly failed to be stable over time. Therefore, Basel III may disincentivise Namibian commercial banks in terms of profitability, particularly, in the long run.

5.6. THE HAUSMAN TEST

To ensure which of the above approaches' results are best for the study's empirical analysis, the Hausman Test was carried out to determine which the three tests, MG, PMG or DFE was best. The results are shown in the table below.

Table 5-7 The Hausman Test

MG and PMG	MG and DFE	DFE and PMG

Effects Test	Chi^2 Statistics	Prob values	Effects Test	Chi^2 Statistics	Prob values	Effects Test	Chi^2 Statistics	Prob. values
Cross-section Chi^2	3.232	0.46	Cross-section Chi^2	5.33	0.2549	Cross-section Chi^2	2.4	0.8

Source: Author's construction with Stata estimation output results

From the test of the Hausman test the Chi-square test shown in the table above, the probability values are insignificant and hence the null hypothesis of MG is the best approach is not rejected. Thus, the researcher concludes that the PMG is the preferred approach in the study and hence this prompted for the further test of Hausman to further determine whether the MG or DFE is the best assessing approach. This allowed the researcher to settle on the estimator to be tested against PMG as the ideal estimator in the first Hausman test. As such, in the table below, the Hausman test results reveal that the probability value between the MG and DFE is greater than the 5 percent level of significance and hence the null hypothesis is not rejected and as a result the study accept that the DFE is the preferred estimator. Next, the Hausman test is further conducted between the DFE and PMG. The results show that the probability value is above the 5 percent significance level. For this reason, the null hypothesis is not rejected, and the researcher concludes that the PMG is the number one assessor for the study's final empirical analysis.

5.7. DIAGNOSTIC TESTS

5.7.1. Multicollinearity through the Correlation Analysis

Table 5-8 Multicollinearity through the Correlation Analysis

	ROE	CAR	TL_TA	LNTA	LNTL	NPL	HPI	RIR	GDP	BASEL03	BASEL04
ROE	1.000										
CAR	-0.22	1.000									
TL_TA	0.890	0.86	1.000								
LNTA	0.960	0.86	0.84	1.000							
LNTL	0.855	0.86	0.873	0.98	1.000						
NPL	0.87	0.83	0.831	0.20	0.16	1.000					
HPI	0.81	0.93	0.866	0.985	0.08	-0.16	1.000				
RIR	0.91	0.82	0.922	0.910	-0.16	0.23	0.837	1.000			
GDP	0.84	0.91	0.916	0.808	0.04	-0.15	0.81	0.871	1.000		
BASEL03	-0.34	0.64	0.061	0.913	-0.02	-0.27	0.900	0.86	0.952	1.000	
BASEL04	-0.34	0.67	0.55	0.88	0.02	-0.26	0.900	-0.17	0.89	0.089	1.000

Source: Author's construction with Stata estimation output results

The table above shows that the variables of ROR, CAR, BASEL03, and BASEL04 correlation figures are below the correlation statistics of 0.80. Thus, the study's model passes the multicollinearity test on these variables. However, the remaining variables' correlation statistics exceed 0.80 and thus make them linearly correlated to make the model suffer from multicollinearity. That is, the variables on macroeconomics, NPL, HPI, LNTA, LNTL, and TA_TL were linearly correlated rendering the study's model to suffer from multicollinearity.

5.7.2. Weak Cross-Sectional Dependence

Table 5-9 Cross Sectional Dependence Test

	CD Test statistics (CD-TS)	p-value
	3.797	0.0000***

Source: Author's construction with Stata estimation output results

It is depicted that *** contains significance at 5 percent level

As shown in the table above the result produced displays 3.797 as CD-TS as well as a probability figure of less than 5 percent level of significance. Consequently, the null hypothesis of feeble cross-sectional dependence is rejected and settle that there is no cross-sectional dependence.

5.7.3. Serial Correlation

Table 5-10 Autocorrelation Test Results

Variable	Q(p) test on variables		LM(k)-test on Variables	
Ue_residuals	Q(p)-stat	p-value	LM (k)-stat	p-value
	3.00	1.000	3.00	1.000

Source: Author's construction with Stata estimation output results

In the table above it is shown that the probability results of both the Q(p) and LM(k) tests on variables are greater than 5 percent level of significance level, insignificant. The researcher thus failed to reject the null hypothesis on "No Serial correlation order k" and a result render the study's model to be free of autocorrelation.

5.7.4. Heteroscedasticity

Table 5-11 Heteroscedasticity Test Results

Breusch-Pagan/Cook-Weisberg (B-P:C-W) test for heteroscedasticity	
Chi^2	Prob. figure
2.05	0.1522

Source: Author's construction with Stata estimation output results

The test of B-P:C-W in the table above displays that the probability figure of 0.1522 is greater than 0.05 percent level of significance and the Chi^2 is greater than 2. The researcher therefore fails to reject the null hypothesis of constant variance, that is homoscedasticity and thus free the model off heteroscedasticity.

5.8. CONCLUSION

In this chapter empirical findings were showed and analysed. Results of panel unit root exhibited different orders of integration, I(0) and I(1) necessitating the need for a Panel ARDL analysis. The results of Panel cointegration using Pedroni and Kao test found no cointegration between the variables. The ideal assessor, PMG also confirms the absence of cointegration through the insignificant error correction. Multicollinearity was identified in macroeconomic variables, TL, TA, TL_TA, HPI, and NPL. Finally, the study's empirical findings can be relied on as cross-sectional dependence, serial correlation and heteroscedasticity were not found.

Chapter 6 : Conclusion and Recommendations

6.1. INTRODUCTION

This Chapter dwells on the conclusion of the study. It commences with the study's conclusions which gives emphasis on what the study focused on, the literature related to the study, the methodology and the results analysis. It then makes recommendations and finally highlights possible areas or focus for long run study on the topic.

6.2. CONCLUSIONS

The study empirically tests the relationship between changes in the capital adequacy ratio under Basel III and return on equity (ROE) of the Namibian banking system and whether such relationship exists in the short run or long run. It employed one panel unit root test namely: Im, Pesaran and Shin W-stat (IPS) and discovered different orders of integration, I(0) and I(1). In essence, the test of unit root results showed that all variables but CAR and RIR are stationary after first difference. The optimal lags were selected to be 1. Next, a test on the existence of a long-run relationship (equilibrium) or effect between the dependent and independent variables was carried Panel Co-integration methods of Pedroni and Kao (Engle-Granger based) tests of cointegration. As such, the test of cointegration through the Pedroni and Kao approaches showed that there is no long run relationship between variables.

Subsequently, the Panel ARDL was conducted for the three estimators of MG, PMG, and DFE. However, only one estimator can be used for the empirical analysis and henceforth, the Hausman test was executed to determine the best estimating approach between MG, PMG, and DFE for analysis. The results of the Hausman test indicated that the PMG assessor is the ideal assessor for the study's model as the probability value is greater than the 5 percent significance level prompting the researcher to fail rejecting the null hypothesis of PMG is the ideal assessor. Thus, the researcher settled on the PMG as the best technique to empirically analyze the study.

In the short run, the PMG's results indicated that the relationship between CAR and ROE is significant and positive in the short run. This is finding is similar to that found in literature such as that of Udom and Onyekah (2018) and Agbeja, Adelakun et al (2019) who found that capital adequacy impacts positively on the financial performance of commercial banks in Nigeria. Moreover, the finding is similar to Nyoka (2017) and Datta and Mahmud (2018) who showed that capital adequacy is positively related to the profitability of a bank. The researcher thus rejected the null hypothesis of the second hypothesis. Meanwhile, Basel03 and Basel04 were significant. Basel03's coefficient is positive as per expectation. This shows that, when all the things are held constant, banks can increase profitability in the environment of regulation than in the environment without regulation. On the relationship basis, the latter is a positive one. This is in line with the Capital Buffer Theory which outlines that when a bank reaches the minimum regulatory capital ratio it may have an incentive to raise more capital to minimize the risk of any regulatory costs triggered by the failure to meet the stipulated capital requirements (Calen & Rob, 1996). Empirically, the result is in line with Ndedi and Katemu (2015) who highlight that Basel III capital ratios will prevent over-leveraging and such tax advantage would be reduced.

The interaction term, Basel04 being against the expectation and significant reveals that the return to CAR is anticipated to be higher in periods when there is no capital regulation and lower in regulatory periods. Thus, the relationship between ROE and CAR has failed to be stable over time, after Basel III introduction. That is, the relationship was positive in the periods without Basel III but negative in periods with Basel III. This instability can be well explained through the sluggish country's economic performance which started three years after the capital regulation was implemented by BoN which may have resulted in high NPLs (as result of borrowers' inability to service their loans) among the banks to affect interest income and persisted through to 2019.

Meanwhile, in the long run, the PMG, all variables were found insignificant including the error correction term which confirms the inexistence of the long run connection among the variables

Finally, various diagnostic tests such as multicollinearity through the correlation analysis, cross sectional dependence, serial correlation and heteroscedasticity tests were carried out to determine if the data set is well-modelled and if the results can be taken seriously. Therefore, the study's model was found to be free of multicollinearity, cross-sectional dependence, and heteroscedasticity.

6.3. RECOMMENDATIONS

The positive relationship between CAR and ROE indicates how the Namibian commercial banking sector can thrive when capital adequacy is ensured in the short run. Thus, the researcher recommends that banks management work on integrating numerous factors to help in formulating approaches that will ensure consistent efficiency such as expanded asset base to ensure that their profitability level does not plunge come the long run (when Basel III is in effect). Further, to the central bank, the Basel III accord should be implemented at the pace that is linked and suitable to the features within national lending/banking segment, perhaps, a lengthy and well-directed feasibility study into implementing the regulation is key. Also, the authority could increase the annual deliverables of Basel III to two years instead of 1 year. Finally, the monetary authority should consider ensuring that contractionary monetary policy is placed to drive interest earnings of banks especially with the teaching experience of Covid-19 pandemic.

6.4. LIMITATION AND AREAS FOR FURTHER RESEARCH

The researcher found three main limitations namely: Firstly, the sample was too small because of the available data which caused various problems upon empirical testing. Secondly, there is no research done on capital adequacy requirement or Basel III accord in Namibia, hence there was little to no literature focusing on the Namibian banking system. Lastly, Bank Windhoek data was unavailable from 1999 to 2008. The unit root test of LLC does is not allowed for an unbalanced panel. This was overcome by the researcher through employing a supplementary test of the IPS.

The researcher calls on the future investigations on the topic to ensure that a balanced panel in data is used and more cross sections (commercial banks) are included to increase the sample and allow for more robust checks.

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Chapter 8 : Appendix

1. Descriptive Statistics

Figure 8-1 Descriptive statistics - Stata Output

```
. xtsum roe car tlta ta tl npl hpi rir gdp gdp basel03 basel04

Variable         |      Mean   Std. Dev.       Min        Max |    Observations
-----------------+--------------------------------------------+----------------
roe      overall |  5.412736   1.323526      3.125      9.275 |     N =     212
         between |             .7726804   4.738095   6.230952 |     n =       3
         within  |              1.13505   2.806783   8.456783 | T-bar = 70.6667
                 |                                            |
car      overall |  3.584314   .4482852      2.575      4.275 |     N =     204
         between |             .1077928    3.47125   3.685714 |     n =       3
         within  |              .437759   2.688064   4.388064 | T-bar =      68
                 |                                            |
tlta     overall |  14.66219   4.365832   9.312975   22.67838 |     N =     212
         between |             5.259934   11.05957   21.43084 |     n =       3
         within  |             2.082904   10.30252   18.81477 | T-bar = 70.6667
                 |                                            |
ta       overall |  5.000216   .6790197    3.49745   5.755036 |     N =     212
         between |             .8882551   3.789255   5.420406 |     n =       3
         within  |             .2583231   4.381766   5.406299 | T-bar = 70.6667
                 |                                            |
tl       overall |  4.750375   .6089286   3.454193   5.491327 |     N =     212
         between |             .7507539   3.721787   5.065009 |     n =       3
         within  |             .3012597   4.099615   5.267176 | T-bar = 70.6667
                 |                                            |
npl      overall |  .8689091   .4214856     .15625    1.84605 |     N =     164
         between |              .170342   .6189958   .9351903 |     n =       3
         within  |             .4078945   .1382253   1.828025 | T-bar = 54.6667
                 |                                            |
hpi      overall |  13.45952   7.771006      4.275     25.925 |     N =     252
         between |             2.18e-15   13.45952   13.45952 |     n =       3
         within  |             7.771006      4.275     25.925 |     T =      84
                 |                                            |
rir      overall |  1.238333   .8572299     -.9375     2.8275 |     N =     252
         between |                    0   1.238333   1.238333 |     n =       3
         within  |             .8572299     -.9375     2.8275 |     T =      84
                 |                                            |
gdp      overall |  .8397619   .5954012      -.275     1.7675 |     N =     252
         between |                    0   .8397619   .8397619 |     n =       3
         within  |             .5954012      -.275     1.7675 |     T =      84
                 |                                            |
gdp      overall |  .8397619   .5954012      -.275     1.7675 |     N =     252
         between |                    0   .8397619   .8397619 |     n =       3
         within  |             .5954012      -.275     1.7675 |     T =      84
                 |                                            |
basel03  overall |  .3333333   .4723426          0          1 |     N =     252
         between |                    0   .3333333   .3333333 |     n =       3
         within  |             .4723426          0          1 |     T =      84
                 |                                            |
basel04  overall |  1.313492   1.865683          0      4.275 |     N =     252
         between |             .0583252   1.246429   1.352381 |     n =       3
         within  |             1.865073  -.0388889   4.236111 |     T =      84
```

2. Panel Unit Root

2.1. IPS

2.1.1. Level

Figure 8-2 Panel Unit root: ROE- IPS Level – Stata Output

```
Im-Pesaran-Shin unit-root test for roe
--------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  70.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              0.1054        0.5420
------------------------------------------------------------------------------
```

Figure 8-3 Panel Unit root: CAR- IPS Level – Stata Output

```
. xtunitroot ips car, lags(1)

Im-Pesaran-Shin unit-root test for car
--------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  68.00

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -1.3723        0.0850
------------------------------------------------------------------------------

.
```

Figure 8-4 Panel Unit root: Basel03- IPS Level – Stata Output

```
. xtunitroot ips basel03, lags(1)

Im-Pesaran-Shin unit-root test for basel03
------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              1.6818        0.9537
------------------------------------------------------------------------------
```

Figure 8-5 Panel Unit root: Basel04- IPS Level - Stata Output

```
. xtunitroot ips basel04, lags(1)

Im-Pesaran-Shin unit-root test for basel04
------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              1.5836        0.9434
------------------------------------------------------------------------------
```

Figure 8-6 Panel Unit root: tlta and TA- IPS Level - Stata Output

```
. xtunitroot ips tlta, lags(1)

Im-Pesaran-Shin unit-root test for tlta
---------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  70.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              1.8270        0.9662
------------------------------------------------------------------------------

.
. xtunitroot ips ta, lags(1)

Im-Pesaran-Shin unit-root test for ta
-------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  70.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.2795        0.3899
------------------------------------------------------------------------------
```

Figure 8-7 Panel Unit root: TL and RIR- IPS Level - Stata Output

```
. xtunitroot ips tl, lags(1)

Im-Pesaran-Shin unit-root test for tl
-------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  70.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.1346        0.4465
------------------------------------------------------------------------------

.
. xtunitroot ips rir, lags(1)

Im-Pesaran-Shin unit-root test for rir
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -2.2249        0.0130
------------------------------------------------------------------------------
```

Figure 8-8 Panel Unit root: GDP and HPI- IPS Level - Stata Output

```
. xtunitroot ips gdp, lags(1)

Im-Pesaran-Shin unit-root test for gdp
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.6203        0.2675
------------------------------------------------------------------------------

.
. xtunitroot ips hpi, lags(1)

Im-Pesaran-Shin unit-root test for hpi
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              2.9427        0.9984
------------------------------------------------------------------------------


.
. xtunitroot ips npl, lags(1)

Im-Pesaran-Shin unit-root test for npl
--------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  54.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              0.3633        0.6418
------------------------------------------------------------------------------
```

2.1.2. Level and Trend

Figure 8-9 Panel Unit root: ROE and CAR- IPS Level and Trend Stata Output

```
. xtunitroot ips roe, trend lags(1)

Im-Pesaran-Shin unit-root test for roe
--------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  70.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.3338        0.3693
------------------------------------------------------------------------------

.
. xtunitroot ips car, trend lags(1)

Im-Pesaran-Shin unit-root test for car
--------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  68.00

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -1.7818        0.0374
------------------------------------------------------------------------------

.
```

Figure 8-10 Panel Unit root: Basel03 and Basel04- IPS Level and Trend Stata Output

```
. xtunitroot ips basel03, trend lags(1)

Im-Pesaran-Shin unit-root test for basel03
------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              0.3268        0.6281
------------------------------------------------------------------------------

.
. xtunitroot ips basel04, trend lags(1)

Im-Pesaran-Shin unit-root test for basel04
------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              0.2296        0.5908
------------------------------------------------------------------------------
```

Figure 8-11 Panel Unit root: TLTA and TL- IPS Level and Trend Stata Output

```
. xtunitroot ips tlta, trend lags(1)

Im-Pesaran-Shin unit-root test for tlta
---------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  70.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.9035        0.1831
------------------------------------------------------------------------------

.
. xtunitroot ips ta, trend lags(1)

Im-Pesaran-Shin unit-root test for ta
-------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  70.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              0.6682        0.7480
------------------------------------------------------------------------------

.
```

Figure 8-12 Panel Unit root: TL and RIR- IPS Level and Trend Stata Output

```
. xtunitroot ips tl, trend lags(1)

Im-Pesaran-Shin unit-root test for tl
-------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  70.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              0.9873        0.8383
------------------------------------------------------------------------------

.
. xtunitroot ips rir, trend lags(1)

Im-Pesaran-Shin unit-root test for rir
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -1.1057        0.1344
------------------------------------------------------------------------------

.
```

Figure 8-13 Panel Unit root: GDP and HPI- IPS Level and Trend Stata Output

```
. xtunitroot ips gdp, trend lags(1)

Im-Pesaran-Shin unit-root test for gdp
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              0.2787        0.6097
------------------------------------------------------------------------------

.
. xtunitroot ips hpi, trend lags(1)

Im-Pesaran-Shin unit-root test for hpi
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     84

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              0.6856        0.7535
------------------------------------------------------------------------------

.

. xtunitroot ips npl, trend lags(1)

Im-Pesaran-Shin unit-root test for npl
--------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  54.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -0.0863        0.4656
------------------------------------------------------------------------------

.
```

2.1.3. First Difference

Figure 8-14 Panel Unit root: ROE and Basel03- IPS - First Difference Level and Trend Stata Output

```
. xtunitroot ips d.roe, lags(1)

Im-Pesaran-Shin unit-root test for D.roe
----------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  69.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                      sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -8.2853        0.0000
------------------------------------------------------------------------------

.
. xtunitroot ips d.basel03, lags(1)

Im-Pesaran-Shin unit-root test for D.basel03
--------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     83

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                      sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -9.6800        0.0000
------------------------------------------------------------------------------

.
```

Figure 8-15 Panel Unit root: Basel04 and TLTA- IPS - First Difference Level and Trend Stata Output

```
. xtunitroot ips d.basel04, lags(1)

Im-Pesaran-Shin unit-root test for D.basel04
--------------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     83

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -9.6640        0.0000
------------------------------------------------------------------------------

.
. xtunitroot ips d.tlta, lags(1)

Im-Pesaran-Shin unit-root test for D.tlta
-----------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  69.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                       sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -8.8525        0.0000
------------------------------------------------------------------------------

.
```

Figure 8-16 Panel Unit root: TL, TA and GDP- IPS - First Difference Level and Trend Stata Output

```
. xtunitroot ips d.ta, lags(1)

Im-Pesaran-Shin unit-root test for D.ta
---------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  69.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -11.3186        0.0000
------------------------------------------------------------------------------

.
. xtunitroot ips d.tl, lags(1)

Im-Pesaran-Shin unit-root test for D.tl
---------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  69.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -11.7708        0.0000
------------------------------------------------------------------------------

.
. xtunitroot ips d.gdp, lags(1)

Im-Pesaran-Shin unit-root test for D.gdp
----------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     83

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                        sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -9.4867        0.0000
------------------------------------------------------------------------------

.
```

Figure 8-17 Panel Unit root: HPI and NPL- IPS - First Difference Level and Trend Stata Output

```
. xtunitroot ips d.hpi, lags(1)

Im-Pesaran-Shin unit-root test for D.hpi
----------------------------------------
Ho: All panels contain unit roots           Number of panels  =      3
Ha: Some panels are stationary              Number of periods =     83

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                         sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar            -12.4660        0.0000
------------------------------------------------------------------------------

.
. xtunitroot ips d.npl, lags(1)

Im-Pesaran-Shin unit-root test for D.npl
----------------------------------------
Ho: All panels contain unit roots           Number of panels       =      3
Ha: Some panels are stationary              Avg. number of periods =  53.33

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                         sequentially
Time trend:   Not included

ADF regressions: 1 lag
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar             -6.9935        0.0000
------------------------------------------------------------------------------

.
```

3. Cointegration Tests

Figure 8-18 Kao Test of Cointegration - Stata Output

```
                                            Number of panels       =      3
                                            Avg. number of periods = 53.333
. xtcointtest kao roe car tlta basel03 basel04

Kao test for cointegration
──────────────────────────
Ho: No cointegration                        Number of panels       =      3
Ha: All panels are cointegrated             Avg. number of periods = 15.333

Cointegrating vector: Same
Panel means:          Included              Kernel:           Bartlett
Time trend:           Not included          Lags:             1.67 (Newey-West)
AR parameter:         Same                  Augmented lags:   1
──────────────────────────────────────────────────────────────────────────────
                                            Statistic         p-value
──────────────────────────────────────────────────────────────────────────────
 Modified Dickey-Fuller t                     0.4669          0.3203
 Dickey-Fuller t                             -0.1742          0.4309
 Augmented Dickey-Fuller t                   -0.0479          0.4809
 Unadjusted modified Dickey-Fuller t         -3.5598          0.0002
 Unadjusted Dickey-Fuller t                  -2.7274          0.0032
──────────────────────────────────────────────────────────────────────────────

.
```

Figure 8-19 Pedroni Test of Cointegration - Stata Output

```
                                            Number of panels       =      3
                                            Avg. number of periods = 53.333
. xtcointtest pedroni roe car tlta basel03 basel04

Pedroni test for cointegration
──────────────────────────────
Ho: No cointegration                        Number of panels       =      3
Ha: All panels are cointegrated             Avg. number of periods = 16.333

Cointegrating vector: Panel specific
Panel means:          Included              Kernel:           Bartlett
Time trend:           Not included          Lags:             2.00 (Newey-West)
AR parameter:         Panel specific        Augmented lags:   1
──────────────────────────────────────────────────────────────────────────────
                                            Statistic         p-value
──────────────────────────────────────────────────────────────────────────────
 Modified Phillips-Perron t                   0.8075          0.2097
 Phillips-Perron t                           -6.7978          0.0000
 Augmented Dickey-Fuller t                   -1.9894          0.0233
──────────────────────────────────────────────────────────────────────────────
```

4. Estimations

4.1. Mean Group

Figure 8-20 MG Estimation - Stata Output

```
. xtdcce2 d.roe d.car d.basel03 d.basel04, lr(L.roe car basel03 basel04) nocrosssectional
(Dynamic) Common Correlated Effects Estimator - Mean Group

Panel Variable (i): b_id                         Number of obs     =        200
Time Variable (t): time                          Number of groups  =          3

Degrees of freedom per group:                    Obs per group (T) =         67
 without cross-sectional averages   = 58.666667
 with cross-sectional averages      = 58.666667
Number of                                        F(24, 176)        =       4.29
 cross-sectional lags               none         Prob > F          =       0.00
 variables in mean group regression = 21         R-squared         =       0.63
 variables partialled out           = 3          R-squared (MG)    =       0.29
                                                 Root MSE          =       0.48
                                                 CD Statistic      =       0.95
                                                    p-value        =     0.3419
```

D.roe	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Short Run Est.						
Mean Group:						
D.car	.4802682	1.006803	0.48	0.633	-1.493029	2.453565
D.basel03	2.744338	2.164051	1.27	0.205	-1.497125	6.9858
D.basel04	-.7570471	.6147002	-1.23	0.218	-1.961837	.4477431
Long Run Est.						
Mean Group:						
L.roe	-.0956988	.0605635	-1.58	0.114	-.214401	.0230035
car	4.279399	1.729961	2.47	0.013	.8887365	7.670061
basel03	39.55826	27.2504	1.45	0.147	-13.85155	92.96807
basel04	-10.77177	6.829679	-1.58	0.115	-24.1577	2.614151

```
Mean Group Variables: D.car D.basel03 D.basel04
Long Run Variables:  L.roe car basel03 basel04
Cointegration variable(s): L.roe
Heterogenous constant partialled out.
```

4.2. Pooled (DFE)

Figure 8-21 DFE or Pooled Estimation - Stata Output

```
. xtdcce2 d.roe d.car d.basel03 d.basel04, lr(l.roe car basel03 basel04) pooled(l.roe car basel03 basel04 d.car d.basel03
> d.basel04) nocrosssectional
(Dynamic) Common Correlated Effects Estimator - Pooled

Panel Variable (i): b_id                         Number of obs     =        200
Time Variable (t): time                          Number of groups  =          3

Degrees of freedom per group:                    Obs per group (T) =         67
 without cross-sectional averages   = 58.666667
 with cross-sectional averages      = 58.666667
Number of                                        F(10, 190)        =       2.93
 cross-sectional lags               none         Prob > F          =       0.00
 variables in mean group regression = 7          R-squared         =       0.87
 variables partialled out           = 3          R-squared (P)     =       0.03
                                                 Root MSE          =       0.54
                                                 CD Statistic      =       1.87
                                                    p-value        =     0.0614
-------------------------------------------------------------------------------
         D.roe |     Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+---------------------------------------------------------------
 Short Run Est.|
---------------+---------------------------------------------------------------
   Pooled:     |
         D.car |  .8577489   1.323668    0.65    0.517     -1.736593    3.45209
     D.basel03 |  3.630892    6.46089    0.56    0.574     -9.032221     16.294
     D.basel04 | -1.026391   1.723337   -0.60    0.551      -4.40407   2.351288
---------------+---------------------------------------------------------------
 Long Run Est. |
---------------+---------------------------------------------------------------
   Pooled:     |
         L.roe | -.1346868   .2486152   -0.54    0.588     -.6219636   .3525901
           car |  1.122985    2.44337    0.46    0.646     -3.665932   5.911901
       basel03 |   2.87585   31.48415    0.09    0.927     -58.83196   64.58366
       basel04 | -1.060191   7.900233   -0.13    0.893     -16.54436   14.42398
-------------------------------------------------------------------------------
Pooled Variables:  L.roe car basel03 basel04 D.car D.basel03 D.basel04
Long Run Variables: L.roe car basel03 basel04
Cointegration variable(s): L.roe
Heterogenous constant partialled out.
```

4.3. Pooled Mean Group

Figure 8-22 PMG Estimation - Stata Output

```
. xtdcce2 d.roe d.car d.basel03 d.basel04, lr(L.roe car basel03 basel04) pooled(L.roe car basel03 basel04) nocrosssectiona
> l lr_options(xtpmgnames)
(Dynamic) Common Correlated Effects Estimator - Pooled Mean Group

Panel Variable (i): b_id                        Number of obs     =        200
Time Variable (t): time                         Number of groups  =          3

Degrees of freedom per group:                   Obs per group (T) =         67
 without cross-sectional averages   = 58.666667
 with cross-sectional averages      = 58.666667
Number of                                       F(16, 184)        =       5.90
 cross-sectional lags               none        Prob > F          =       0.00
 variables in mean group regression = 13        R-squared         =       0.66
 variables partialled out           = 3         Adj. R-squared    =       0.63
                                                Root MSE          =       0.48
                                                CD Statistic      =     -3.797
                                                   p-value        =     0.000
--------------------------------------------------------------------------------
         D.roe|      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------+-----------------------------------------------------------------
Short Run Est.|
--------------+-----------------------------------------------------------------
  Mean Group: |
         D.car|   .8036195   1.096643    0.73   0.005     -1.345761    2.953001
     D.basel03|    4.24238   2.418291    1.75   0.079     -.4973829    8.982143
     D.basel04|  -1.171189   .6790379   -1.72   0.085     -2.502078    .1597011
--------------+-----------------------------------------------------------------
Long Run Est. |
--------------+-----------------------------------------------------------------
  Pooled:     |
            ec|  -.1044854   .2278093   -0.46   0.646     -.5509834    .3420126
           car|   1.064671   2.475011    0.43   0.667     -3.786261    5.915603
       basel03|   2.933171   30.68023    0.10   0.924     -57.19898    63.06532
       basel04|  -1.039657   7.711037   -0.13   0.893     -16.15301     14.0737
--------------------------------------------------------------------------------
Pooled Variables:  ec car basel03 basel04
Mean Group Variables: D.car D.basel03 D.basel04
Long Run Variables: ec car basel03 basel04
Cointegration variable(s): L.roe
Heterogenous constant partialled out.
.
```

5. The Hausman Test

Figure 8-23 The Hausman Test- PMG and MG - Stata Output

```
. hausman pmg mg, sigmamore

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |      pmg          mg          Difference          S.E.
-------------+----------------------------------------------------------------
         car |   -.7194245    -.5633141      -.1561104               .
        tlta |    .9398267     .3800229       .5598038        .1809266
     basel03 |   -28.85708     19.73714      -48.59421               .
     basel04 |    .3330378    -1.684266       2.017303               .
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from xtpmg
           B = inconsistent under Ha, efficient under Ho; obtained from xtpmg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        3.232
                Prob>chi2 =       0.456
                (V_b-V_B is not positive definite)
```

Figure 8-24 The Hausman Test - MG and DFE - Stata Output

```
. eststo mg: qui xtdcce2 d.roe d.car d.basel03 d.basel04, lr(L.roe car basel03 basel04) nocrosssectional

.
. eststo pooled: qui xtdcce2 d.roe d.car d.basel03 d.basel04, lr(l.roe car basel03 basel04) pooled(l.roe car basel03 basel
> 04 d.car d.basel03 d.basel04) nocrosssectional

.
. hausman mg pooled, sigmamore

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |      mg          pooled       Difference          S.E.
-------------+----------------------------------------------------------------
         car |
         D1. |   .4802682     .8577489      -.3774807               .
     basel03 |
         D1. |   2.744338     3.630892      -.8865541               .
     basel04 |
         D1. |  -.7570471    -1.026391        .269344               .
         roe |
         L1. |  -.0956988    -.1346868        .038988               .
         car |   4.279399     1.122985       3.156414               .
     basel03 |   39.55826      2.87585       36.68241               .
     basel04 |  -10.77177    -1.060191      -9.711583               .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtdcce2
            B = inconsistent under Ha, efficient under Ho; obtained from xtdcce2

    Test:  Ho:  difference in coefficients not systematic

                  chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        5.33
                Prob>chi2 =      0.2549
                (V_b-V_B is not positive definite)

.
```

Figure 8-25 The Hausman Test - PMG and DFE - Stata Output

```
. eststo pmg: qui xtdcce2 d.roe d.car d.basel03 d.basel04, lr(l.roe car basel03 basel04) pooled(l.roe car basel03 basel04)
>  nocrosssectional

.
. eststo pooled: qui xtdcce2 d.roe d.car d.basel03 d.basel04, lr(l.roe car basel03 basel04) pooled(l.roe car basel03 basel
> 04 d.car d.basel03 d.basel04) nocrosssectional

.
. hausman pmg pooled, sigmamore

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |      pmg         pooled       Difference          S.E.
-------------+----------------------------------------------------------------
         car |
         D1. |   .8036195     .8577489       -.0541294               .
     basel03 |
         D1. |    4.24238     3.630892        .6114881               .
     basel04 |
         D1. |  -1.171189    -1.026391       -.1447974               .
         roe |
         L1. |  -.1044854    -.1346868        .0302013         .0638724
         car |   1.064671     1.122985       -.0583136         1.344317
     basel03 |   2.933171      2.87585        .0573209         14.27604
     basel04 |  -1.039657    -1.060191        .0205341         3.616302
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from xtdcce2
           B = inconsistent under Ha, efficient under Ho; obtained from xtdcce2

    Test:  Ho:  difference in coefficients not systematic

                  chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        2.37
                Prob>chi2 =      0.7964
                (V_b-V_B is not positive definite)

.
.
```

6. Diagnostics

6.1. Cross Sectional Dependence

Figure 8-26 6.1. Cross Sectional Dependence Test - Stata Output

```
. predict xtdcce2_residuals, residuals

.
. xtcd2 xtdcce2_residuals
Pesaran (2015) test for weak cross-sectional dependence.
Unbalanced panel detected, test adjusted.

H0: errors are weakly cross-sectional dependent.
        CD = -3.797
   p-value = 0.000

.
```

6.2. Serial Correlation

Figure 8-27 Seral Correlation Test - Stata Output

```
.  predict residuals_1
(option xb assumed; fitted values)
(48 missing values generated)

. xtistest residuals_1, lags(1)

Inoue and Solo (2006) LM-test on variables residuals_1
Panelvar: b_id
Timevar: time
p (lags): 1
```

Variable	IS-stat	p-value	N	maxT	balance?
residuals_1	3.00	1.000	3	84	unbalanced

```
 residuals_1: N(3) is smaller than the dimension of H0(83), results unreliable. Consider xtqptest.

 Notes: Under H0, LM ~ chi2(p*T-p(p+1)/2)
    H0: No auto-correlation of any order.
    Ha: Auto-correlation up to order 1.
```

Figure 8-28 Seral Correlation Test: Q(p) test and LM (k) test on variables - Stata Output

```
. xtqptest ue_residuals_1, lags(1)

Bias-corrected Born and Breitung (2016) Q(p)-test on variables ue_residuals_1
Panelvar: b_id
Timevar: time
p (lags): 1
```

Variable	Q(p)-stat	p-value	N	maxT	balance?
ue_residuals_1	3.00	1.000	3	84	unbalanced

```
 Notes: Under H0, Q(p) ~ chi2(p)
    H0: No serial correlation up to order p.
    Ha: Some serial correlation up to order p.

.
. xtqptest ue_residuals_1, order(1)

Bias-corrected Born and Breitung (2016) LM(k)-test on variables ue_residuals_1
Panelvar: b_id
Timevar: time
k (order): 1
```

Variable	LM(k)-stat	p-value	N	maxT	balance?
ue_residuals_1	3.00	1.000	3	84	unbalanced

```
 Notes: Under H0, LM(k) ~ N(0,1)
    H0: No serial correlation of order k.
    Ha: Some serial correlation of order k.
```

6.3. Heteroscedasticity

Figure 8-29 Heteroscedasticity Test - Stata Output

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of roe

         chi2(1)      =     2.05
         Prob > chi2  =   0.1522

.
```